

October 2022

# Nutrition Briefs



## IAFNS Science Innovation Showcase - 2022

**Virtual Event, December 13–15, 2021**

Join us to learn about emerging science and connect with innovators developing alternative protein sources (including plant proteins) and other next-gen topics - with a dedicated session for graduate students and post-docs. [Learn more](#)



## Diet Patterns

### **Association Between Dietary Patterns and Depression: An Umbrella Review of Meta-Analyses of Observational Studies and Intervention Trials**

Vincenza Gianfredi, Monica Dinu, Daniele Nucci, Simone J P M Eussen, Andrea Amerio, Miranda T Schram, Nicolaas Schaper, Anna Odone. *Nutr Rev.* 2022 Oct 14. doi: 10.1093/nutrit/nuac058. [Article link](#)

**Significance:** A global review of observational and trial evidence found weak methodological quality and strength of evidence when associating dietary patterns to depression. The evidence was suggestive of an inverse relationship between depression and the Mediterranean Diet and Diet Inflammation Index.

**Context:** Depression is the most common causes of disease burden worldwide (GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet.* 2018;392:1789-1858). **Objective:** An umbrella review has been performed to assess the strength and validity of the available observational and trial evidence for the association between a variety of dietary patterns and depression. **Data Sources:** MEDLINE/PubMed, Scopus, Web of Science, EMBASE, PsycINFO, and Cochrane Database were searched. **Data Extraction:** The Joanna Briggs Institute Umbrella Review Methodology was used. **Data Analysis:** The review included 19 articles, covering a relatively wide range of dietary patterns: healthy dietary patterns (n = 8), Mediterranean diet (MedDiet) (n = 6), Dietary Inflammatory Index (DII) (n = 5), Western diet (n = 4), Dietary Approaches to Stop Hypertension (DASH) (n = 2), vegetarian diets (n = 4), and other dietary interventions (n = 2). The methodological quality of the included meta-analyses was generally low or critically low. The strength of the evidence was generally weak, although convincing or suggestive evidence was found for an inverse relationship between MedDiet/DII and depression. Higher adherence to the MedDiet and



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lower DII score were significantly associated with lower risk of depression. **Conclusion:** Considering the generally high heterogeneity and low quality of the available evidence, further studies adopting more coherent and uniform methodologies are needed.

## Carbohydrates

### Relative Validity of a Glycemic Index Extended Food-Frequency Questionnaire

Janina Goletzke, Katharina S Weber, Theresa Kössler, Oana-Patricia Zaharia, Kálmán Bódis, Karsten Müssig, Julia Szendroedi et. al. *Nutr Metab Cardiovasc Dis.* 2022 Oct;32(10):2310-2320. doi: 10.1016/j.numecd.2022.07.007. [Article link](#)

**Significance:** The Glycemic-Index Extended Food Frequency Questionnaire showed a moderate to good relative validity for parameters of carbohydrate quality compared to 3-day weighted food records.

**Background and Aims:** The dietary glycemic index (GI) and glycemic load (GL) are increasingly recognized as important for the prevention and management of diabetes mellitus. To extend the portfolio of assessment methods for large-scale epidemiological studies, we propose a GI-specific addition to an already established FFQ. **Methods and Results:** The German version of the EPIC-FFQ was extended by GI-specific questions for major carbohydrate sources varying notably in GI (breakfast cereals, bread, pasta, rice, potato etc.). We performed relative validation analyses comparing the GI-extended FFQ to three to four 3-day weighted dietary records (3-d WDR) in 100 middle-aged individuals with diabetes mellitus participating in the German Diabetes Study (GDS). Level of agreement between the two methods was assessed by correlation and cross-classification analyses as well as Bland-Altman-Plots, conducted separately for women and men. Spearman correlation analysis for female participants suggested good agreement between the GI-extended FFQ and 3-d WDRs for energy adjusted dietary GL ( $r = 0.52$ ,  $p = 0.0004$ ). For both women and men, agreement with the estimations of dietary GI, GL (for men) and carbohydrates from low and higher-GI food sources from the GI-extended FFQ was acceptable ( $r: 0.28-0.45$ ). Classification of the dietary GI and GL in the opposite quartile was <10% comparing the GI-extended FFQ and 3-d WDR. Bland-Altman plots suggested a tendency for an overestimation of the dietary GI from the GI-extended FFQ in the lower GI-ranges, particularly for men. **Conclusion:** Compared to the 3-d WDR, the GI-extended FFQ showed a moderate to good relative validity for parameters of carbohydrate quality.

## Protein

### Relationship Between Dietary Protein Intake and Gut Microbiome Composition in Community-Dwelling Older Men: Findings from the MrOS Study

Samaneh Farsijani 1 2 3, Jane A Cauley 1 3, Shyamal D Peddada 4, Lisa Langsetmo 5, James M Shikany 6, Eric S Orwoll 7, Kristine E Ensrud et. al. [Article link](#)

**Significance:** Protein intake, independent of plant or animal origin, is significantly correlated with gut microbiome diversity in older males. More study is needed to elucidate the connection of microbiome diversity to health.

**Background:** Little is known about the association of specific nutrients, especially proteins, on the age-related gut dysbiosis. **Objectives:** To determine the associations between the quantity and sources (vegetable and animal) of dietary protein intake and gut microbiome composition in community-dwelling older men. **Design:** We performed a cross-sectional analysis on 775 older men from the Osteoporotic Fractures in Men (MrOS) Study (age  $84.2 \pm 4.0$  years) with available dietary information and stool samples at visit 4 (2014-16). Protein intake was estimated from a brief food frequency questionnaire and adjusted to total energy intake. The gut microbiome composition was determined by 16S (v4) sequencing (processed by DADA2 and SILVA). 11,534 amplicon sequence variants (ASVs) were identified and assigned to 21 phyla with dominance of Firmicutes (45%) and Bacteroidetes (43%). We performed  $\alpha$ -diversity,  $\beta$ -diversity, and taxa abundance (by ANCOM-BC) to determine the associations between protein intake and gut microbiome. **Results:** Median protein intake was 0.7 g/(kg body weight · d). Participants with higher energy-adjusted protein intakes had higher Shannon and Chao1  $\alpha$ -diversity indices ( $P < 0.05$ ). For  $\beta$ -diversity analysis, participants with higher protein intakes had a different center in weighted and unweighted UniFrac PCoA vs. those with lower intake ( $P < 0.05$ ), adjusted for age, race, education, clinical center, batch number, fiber and energy intake, weight, height, and medications. Similarly, higher protein consumptions from either animal or vegetable sources were associated with higher gut microbiome diversity. Several genus-level ASVs, including Christensenellaceae, Veillonella, Haemophilus, and Klebsiella were more abundant in participants with higher protein intakes, whereas Clostridiales bacterium DTUo89 and Desulfovibrio were more abundant in participants with lower

protein intake (Bonferroni corrected  $P < 0.05$ ). **Conclusions:** We observed significant associations between protein intake and gut microbiome diversity in community-living older men. Further studies are needed to elucidate the mediation role of gut microbiome on the relationship between protein intake and health outcomes in older adults.

## Low- and No-Calorie Sweeteners

### Association of Sweetened Beverages Consumption with All-Cause Mortality Risk among Dutch Adults: The Lifelines Cohort Study (the SWEET project)

Novita D Naomi, Elske M Brouwer-Brolsma, Marion E C Buso, Sabita S Soedamah-Muthu, Joanne A Harrold, Jason C G Halford, Anne Raben, et. al. *Eur J Nutr.* 2022 Oct 21;1-10. doi: 10.1007/s00394-022-03023-6. [Article link](#)

**Significance:** Study with Dutch Adults found an adverse association between sugar-sweetened beverage (SSB) consumption and all-cause mortality. Replacement of SSB with low- or no-calorie alternatives reduced all-cause mortality in women. An inverse association between fruit juice and all-cause mortality was observed at moderate consumption.



**Purpose:** Examined associations between sugar-sweetened beverages (SSB), low/no-calorie beverages (LNCB), and fruit juice (FJ) consumption and all-cause mortality in Dutch adults. **Methods:** Data of 118,707 adults participating (mean age = 45 years; 60% was women) the Lifelines Cohort Study were prospectively analyzed. Dietary intake was assessed using a validated food-frequency questionnaire. Participants' vital status was followed-up until February 2022 via the National Personal Records Database. Associations between beverages of interest and all-cause mortality risk were investigated using restricted cubic spline and Cox proportional hazard regression analyses, including substitution analyses. Models were adjusted for demographics, lifestyle, and other dietary factors.

**Results:** During follow-up (median = 9.8 years), a total of 2852 (2.4%) deaths were documented.

Median (IQR) of SSB, LNCB, and FJ consumption were 0.1 (0.0-0.6), 0.1 (0.0-0.6), and 0.2 (0.0-0.6) serving/day, respectively. Dose-response analyses showed linear associations between SSB, LNCB, and FJ consumption and mortality risk. For each additional serving of SSB and LNCB, HRs of all-cause mortality risk were 1.09 (95% CI 1.03-1.16) and 1.06 (95% CI 1.00-1.11). Replacing SSB with LNCB showed a nonsignificant association with a lower mortality risk, particularly in women (HR 0.91, 95% CI 0.81-1.01). Finally, an inverse association between FJ and all-cause mortality was observed at moderate consumption with HR of 0.87 (95% CI 0.79-0.95) for > 0-2 servings/week and HR of 0.89 (95% CI 0.81-0.98) for > 2-7 servings/week when compared to no consumption. **Conclusions:** Our study showed adverse associations between SSB consumption and all-cause mortality. Replacing SSB with LNCB might be associated with lower mortality risk, particularly in women. Moderate intake of FJ was associated with lower all-cause mortality risk.

## Cognitive Health

### Mixed Tree Nuts, Cognition and Gut Microbiota: a 4-week, Placebo-Controlled, Randomized Crossover Trial in Healthy Non-Elderly Adults

Crystal F Haskell-Ramsay, Fiona L Dodd, Darren Smith, Lewis Cuthbertson, Andrew Nelson, John K Lodge, Philippa A Jackson. *J Nutr.* 2022 Oct 6;nxac228. doi: 10.1093/jn/nxac228. [Article link](#)

**Significance:** Intake of 30g/day of mixed nut intake for 4 weeks has a positive effect on cognition in healthy adults, as well as an upregulation of a microbial taxa associated with gut health. Future study may need to include individuals with cognitive decline or gut dysbiosis.

**Background:** Beneficial effects of nut supplementation on cognitive function have previously been demonstrated in young and older adults. Alterations to gut microbiota have also been shown following tree nut consumption. However, no data exists on the effects of nuts on cognition and intestinal microbial communities assessed within the same study. **Objectives:** The study aimed to examine the effects of daily consumption of tree nuts for four weeks on cognitive function (primary outcome), mood, metabolomics, and gut microbial species (secondary outcomes) in healthy, non-elderly adults. **Methods:** This randomized, placebo-controlled, double-blind, counterbalanced crossover study assessed the effects of four weeks' supplementation with 30 g/d mixed tree nuts versus placebo on cognition and mood in 79 healthy 18-49-year-old adults. Metabolic responses, gut bacterial community structure and the potential for these to impact cognition were explored using a multi-omic approach. Bacterial community analysis was conducted in QIIME2. **Results:** Mixed model analysis indicated that nut consumption led to significant improvements to accuracy (placebo M = 92.2% vs. NUTS M = 94.5%;  $p = 0.019$ ) and speed of response (placebo M = 788 ms vs. NUTS M = 757 ms;  $p = 0.004$ ) on a picture recognition

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task. No significant changes to bacterial community alpha or beta diversity were observed when comparing nut consumption to the placebo arm. However, an unclassified Lachnospiraceae amplicon sequence variant (ASV) was significantly enriched in participants when supplemented with nuts ( $p = 0.015$ ). No correlations were observed between the changes to picture recognition and the changes to the unclassified Lachnospiraceae ASV. There were no significant changes to the urinary metabolome. **Conclusions:** These findings indicate a positive effect of nut on cognition following only 4-weeks' consumption in a healthy non-elderly sample, as well as upregulation of a microbial taxa associated with gut health. The effects appear to be independent of one another, but further exploration is required in those experiencing cognitive decline and/or gut dysbiosis.

## Lipids

### Saturated Fat from Dairy Sources is Associated with Lower Cardiometabolic Risk in the Framingham Offspring Study

Mengjie Yuan, Martha R Singer, Richard T Pickering, Lynn L Moore. *Am J Clin Nutr.* 2022 Oct 28;nqac224. doi: 10.1093/ajcn/nqac224. [Article link](#)

**Significance:** A Framingham Offspring study reported lower atherogenic profile in males with higher intakes of dairy-derived saturated dairy fats compared to those with lower intakes of these fats. However, in women, these effects were weaker. Nondairy saturated fats were not associated with these cardiometabolic outcomes.

**Background:** Current dietary guidance recommends limiting intakes of saturated fats, but most fails to consider that saturated fats from different food sources may have different health effects. **Objectives:** We aimed to evaluate the associations of saturated fats from dairy and nondairy sources with measures of body fat, inflammatory biomarkers, lipid concentrations, and lipid particle sizes and concentrations. **Methods:** The Framingham Offspring Study is a prospective cohort study. Participants ( $n = 2391$ )  $\geq 30$  y of age who had dietary records and data on the outcomes of interest were included. **Results:** Among females, those in the highest quintile (compared with the lowest) of dairy-derived saturated fat had lower multivariable-adjusted levels of body fat [BMI (in kg/m<sup>2</sup>): 26.2 compared with 27.8,  $P < 0.01$ ; and percentage fat mass: 36.7% compared with 38.0%,  $P = 0.09$ ] and larger LDL particle sizes. Nondairy saturated fat in females was inversely associated with the triglyceride (TG):HDL ratio ( $P = 0.03$ ). Among males, intakes of dairy-derived saturated fats were inversely associated with C-reactive protein ( $P < 0.01$ ), fibrinogen ( $P < 0.01$ ), TGs ( $P < 0.01$ ), and the TG:HDL ratio ( $P < 0.01$ ). HDL cholesterol was 2.8 mg/dL ( $P = 0.04$ ) higher among males in the highest (compared with the lowest) quintile of saturated fat from dairy sources. Males with the highest intakes of dairy-derived saturated fats had larger HDL and LDL particle sizes ( $P < 0.01$  for both), a higher HDL particle concentration ( $P < 0.01$ ), and a lower VLDL particle concentration ( $P < 0.01$ ). There were no statistically significant adverse effects of saturated fats from nondairy sources on any of these outcomes in either males or females. **Conclusions:** Males with higher intakes of dairy-derived saturated fats had a less atherogenic profile than males with lower intakes of these fats. These effects were weaker in females. Nondairy saturated fats were not associated with these cardiometabolic outcomes.

## Sodium

### A Global Review of National Strategies to Reduce Sodium Concentrations in Packaged Foods

Emalie Rosewarne, Joseph Alvin Santos, Kathy Trieu, Dejen Tekle, Cliona Ni Mhurchu, Alexandra Jones, Nicole Ide, et. al. *Adv Nutr.* 2022 Oct 2;13(5):1820-1833. doi: 10.1093/advances/nmac048. [Article link](#)

**Significance:** An extensive global review of sodium reduction strategies in packaged foods (2014 to 2020) found great heterogeneity in approaches, targets, and implementation processes. The review concluded that there is room to improve most countries' strategies as regional and income-level disparities persist. The WHO global sodium benchmarks would serve an important role in accelerating product reformulation.

Strategies to reduce sodium concentrations in packaged foods are effective and cost-effective approaches to reducing the burden of disease attributable to high sodium intakes. This review aimed to comprehensively describe, and explore characteristics of, national strategies to reduce sodium concentrations in packaged foods, and assess progress toward achieving national goals. A secondary aim was to understand the number, type, and variation of food category sodium targets set by countries compared with WHO global sodium benchmarks. National sodium reduction reformulation strategies were identified from a search of peer-reviewed and gray literature up to December 2019 supplemented by verified information from key contacts and experts up to December 2020. Key characteristics of countries' strategies were extracted, synthesized, and descriptively analyzed, including details of reformulation strategies and evaluation data. Country targets were mapped to the WHO global sodium benchmarks, and the number and variation of country sodium targets by WHO food categories



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(maximum sodium concentration: n = 26; maximum concentration plus relative reduction/average/sales-weighted average: n = 8; relative reduction: n = 7; average: n = 2), number of food category targets (range: n = 1 to 150), and regulatory approach (voluntary: n = 28; mandatory: n = 9; both: n = 6). Eight of 34 countries mapped to the WHO benchmarks had targets for just 1 specified food category (bread products). One-third of all countries were implementing national strategies to reduce sodium concentrations in packaged foods including establishing targets and/or processes for industry engagement. This review determined that there is scope to improve most countries' strategies. There has been limited progress in implementing and evaluating strategies between 2014 and 2019, and regional and income-level disparities persist. The WHO global sodium benchmarks present an important opportunity to accelerate reformulation action globally.

## Gut Microbiome

### **Perspective: Leveraging the Gut Microbiota to Predict Personalized Responses to Dietary, Prebiotic, and Probiotic Interventions**

Sean M Gibbons, Thomas Gurry, Johanna W Lampe, Anirikh Chakrabarti, Veerle Dam, Amandine Everard, Almudena Goas et. al. *Adv Nutr.* 2022 Oct 2;13(5):1450-1461. doi: 10.1093/advances/nmac075. [Article link](#)

**Significance:** This perspective review provides comprehensive information related to advancement in major computational and experimental tools currently applied to critical questions of microbiota-mediated personalized nutrition and health. It includes a future vision of a precision nutrition and healthcare, leveraging gut microbiota for personalized interventions.

Humans often show variable responses to dietary, prebiotic, and probiotic interventions. Emerging evidence indicates that the gut microbiota is a key determinant for this population heterogeneity. Here, we provide an overview of some of the major computational and experimental tools being applied to critical questions of microbiota-mediated personalized nutrition and health. First, we discuss the latest advances in in silico modeling of the microbiota-nutrition-health axis, including the application of statistical, mechanistic, and hybrid artificial intelligence models. Second, we address high-throughput in vitro techniques for assessing interindividual heterogeneity, from ex vivo batch culturing of stool and continuous culturing in anaerobic bioreactors, to more sophisticated organ-on-a-chip models that integrate both host and microbial compartments. Third, we explore in vivo approaches for better understanding of personalized, microbiota-mediated responses to diet, prebiotics, and probiotics, from nonhuman animal models and human observational studies to human feeding trials and crossover interventions. We highlight examples of existing, consumer-facing precision nutrition platforms that are currently leveraging the gut microbiota. Furthermore, we discuss how the integration of a broader set of the tools and techniques described in this piece can generate the data necessary to support a greater diversity of precision nutrition strategies. Finally, we present a vision of a precision nutrition and healthcare future, which leverages the gut microbiota to design effective, individual-specific interventions.

## Emerging Science Areas

### **Emerging Areas: Nutrition**

#### **Flavan-3-ols and Cardiometabolic Health: a Guideline Recommendation by the Academy of Nutrition and Dietetics**

Kristi M Crowe-White, Levi W Evans, Gunter G C Kuhnle, Dragan Milenkovic, Kim Stote, Taylor Wallace, Deepa Handu, Katelyn E Senkus. *Adv Nutr.* 2022 Oct 3. doi: 10.1093/advances/nmac105. [Article link](#)



This work was supported by IAFNS [Bioactives Committee](#).

**Significance:** This guideline for flavan-3-ols for cardiometabolic health was based, not on deficiency, but on beneficial effects observed across a range of disease biomarkers and endpoints. While a comprehensive assessment of available data was undertaken, evidence gaps identified herein can provide guidance for future randomized clinical trials.

Guideline recommendation for a plant bioactive such as flavan-3-ols is a departure from previous recommendations as it is not based on deficiencies but rather improvement in health outcomes. Nevertheless, there is a rapidly growing body of clinical data reflecting benefits of flavan-3-ol intake that outweigh potential harms. Thus, the objective of the Expert Panel was to develop an intake recommendation for flavan-3-ols and cardiometabolic outcomes to inform multiple stakeholders including clinicians, policymakers, public health entities, and consumers. Guideline development followed the process set forth by the Academy of Nutrition and Dietetics which includes use of Evidence to Decision Framework. Studies informing

this guideline (157 randomized controlled trials and 15 cohort studies) were previously reviewed in a recently published systematic review and meta-analysis. Quality and strength-of-evidence along with risk-of-bias in reporting was reviewed. In drafting the guideline, data assessments and opinions by authoritative scientific bodies providing guidance on the safety of flavan-3-ols were considered. Moderate evidence supporting cardiometabolic protection resulting from flavan-3-ol intake in the range of 400–600 mg/d was supported in the literature. Further, increasing consumption of dietary flavan-3-ols may help improve blood pressure, cholesterol levels, and blood sugar. Strength of evidence was strongest for some biomarkers (i.e., systolic blood pressure, total cholesterol, HDL-cholesterol, and insulin/glucose dynamics). It should be noted that this is a food-based guideline and not a recommendation for flavan-3-ol supplements. This guideline was based on beneficial effects observed across a range of disease biomarkers and endpoints. While a comprehensive assessment of available data has been reviewed, evidence gaps identified herein can inform scientists whereby guiding future randomized clinical trials.

## Emerging Areas: Nutrition

### Category: Global Dietary Quality

#### Global Dietary Quality in 185 Countries from 1990 to 2018 Show Wide Differences by Nation, Age, Education and Urbanicity

Victoria Miller, Patrick Webb, Frederick Cudhea, Peilin Shi, Jianyi Zhang, Julia Reedy, Josh Erndt-Marino, Jennifer Coates, Dariush Mozaffarian. *Nature Food* volume 3, p694–702 (2022) 19 Sept. 2022. [Article link](#)

**Significance:** Poor diet quality — a leading cause of disease — accounts for an estimated 26% of global preventable mortality. A recent study involving 189 countries found global diet quality — measured by the alternative healthy index scores — improved modestly between 1990–2008 except for South Asia and sub-Saharan Africa regions. Diet quality scores varied by regions, age, gender, and educational level.

Evidence on what people eat globally is limited in scope and rigour, especially as it relates to children and adolescents. This impairs target setting and investment in evidence-based actions to support healthy sustainable diets. Here we quantified global, regional, and national dietary patterns among children and adults, by age group, sex, education and urbanicity, across 185 countries between 1990 and 2018, on the basis of data from the Global Dietary Database project. Our primary measure was the Alternative Healthy Eating Index, a validated score of diet quality; Dietary Approaches to Stop Hypertension and Mediterranean Diet Score patterns were secondarily assessed. Dietary quality is generally modest worldwide. In 2018, the mean global Alternative Healthy Eating Index score was 40.3, ranging from 0 (least healthy) to 100 (most healthy), with regional means ranging from 30.3 in Latin America and the Caribbean to 45.7 in South Asia. Scores among children versus adults were generally similar across regions, except in Central/Eastern Europe and Central Asia, high-income countries, and the Middle East and Northern Africa, where children had lower diet quality. Globally, diet quality scores were higher among women versus men, and more versus less educated individuals. Diet quality increased modestly between 1990 and 2018 globally and in all world regions except in South Asia and Sub-Saharan Africa, where it did not improve.

## Engage with IAFNS

### IAFNS-USDA Beltsville Webinar Series

October 26, 2022 - December 1, 2022

Orlando Florida

- This series is co-organized by IAFNS and researchers with the USDA ARS Beltsville Human Nutrition Research Center. Join current scientists as they share their latest research on nutrition focusing on the following: Dietary Added Sugars, Complex Carbohydrates, Botanicals, and Flavonoids
- Webinar 3: “Botanicals and the Impact of Growing Conditions and Food Preparation on Food Composition”  
November 15, 2:00 – 3:30 ET. Register [here](#).
- Webinar 4: “Learning About Flavonoids, Diet and Health”  
December 1, 2:00 – 3:30 ET. Register [here](#).

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## **Federal And State Efforts to Restrict PFAS: Impact on Food Companies**

November 14, 2022. 1:00 pm - 2:00 pm ET

Virtual, Event

- Federal and State regulatory bodies are increasing their scrutiny of the potential presence of PFAS in food and food packaging. The webinar will highlight EPA's actions under the PFAS Strategic Roadmap and preview expected actions later in 2022 and beyond. Register [here](#).