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Nutrition Briefs



Dietary Patterns

Implementing the 2020–2025 Dietary Guidelines for Americans: Recommendations for a Path Forward

Lisa M Sanders, Jonathan C Allen, Jeanne Blankenship, Eric A Decker, Mary Christ-Erwin, Eric J Hentges, Julie M Jones, et. al. *Current Developments in Nutrition*, Vol. 5, Issue 12, December 2021, nzab136. [Article link](#)

Significance: Approaches to improve public adherence to the US Dietary Guidelines will need to consider several factors: changes in consumer food behavior in the current pandemic environment, and simple, tailored credible messages delivered by respected influencers. Innovation in food technology has improved food quality, safety and food choices, enabling an opportunity to encourage healthier eating patterns especially in the whole grain, fruit and vegetable groupings.

The Dietary Guidelines for Americans (DGA) provide science-based recommendations for healthy dietary patterns to promote health and reduce risk of chronic diseases. Yet, since their inception in 1980 and updates every 5 y, Americans fall short of meeting dietary recommendations and diet-related chronic diseases continue to be a public health concern. In May of 2021, the Institute of Food Technologists and the Department of Food Science at the University of Massachusetts, Amherst, convened a diverse group of thought leaders in health, nutrition, and food science to identify opportunities and approaches to improve consumer adoption of the DGA recommendations. The invited leaders collaborated in roundtable discussions to develop recommendations and strategies to promote adoption of the DGA recommendations after hearing sessions on the latest consumer trends, advances in food science and technology, and effective communications approaches. Participants agreed that changes in consumer behaviors and heightened interest in health due to the novel coronavirus pandemic have created an opportune time to engage consumers about healthy eating. Communications must be simple, tailored to the consumer, and delivered by influencer(s)/spokesperson(s) who are credible sources and share personal values. Innovations in food science and technology have enabled improvements in the safety, health, acceptability, affordability, and availability of foods, but opportunities to provide more options to enhance consumption of desired food groups, such as fruits, vegetables, and whole grains, remain. Moving Americans toward healthier dietary patterns aligned with DGA recommendations will require collaborations within the food sector and beyond to achieve broad-scale amplification and investment.

Protein

Protein- and Calcium-Mediated GLP-1 Secretion: A Narrative Review

Jonathan D Watkins, Françoise Koumanov, Javier T Gonzalez. *Adv Nutr*. 2021 Dec 1;12(6):2540-2552. doi: 10.1093/advances/nmabo78. [Article link](#)

Significance: A narrative review provides the latest perspective on co-ingestion of protein and calcium that could increase GLP-1 release. By specifically targeting both amino acids and Ca – receptors, this could lead to enhancement in gut hormone secretion, providing a potential cost efficient nutritional therapeutic for human intervention.

Glucagon-like peptide 1 (GLP-1) is an incretin hormone produced in the intestine that is secreted in response to nutrient exposure. GLP-1 potentiates glucose-dependent insulin secretion from the pancreatic β cells and promotes satiety. These important actions on glucose metabolism and appetite have led to widespread interest in GLP-1 receptor agonism. Typically,



this involves pharmacological GLP-1 mimetics or targeted inhibition of dipeptidyl peptidase-IV, the enzyme responsible for GLP-1 degradation. However, nutritional strategies provide a widely available, cost-effective alternative to pharmacological strategies for enhancing hormone release. Recent advances in nutritional research have implicated the combined ingestion of protein and calcium with enhanced endogenous GLP-1 release, which is likely due to activation of receptors with high affinity and/or sensitivity for amino acids and calcium. Specifically targeting these receptors could enhance gut hormone secretion, thus providing a new therapeutic option. This narrative review provides an overview of the latest research on protein- and calcium-mediated GLP-1 release with an emphasis on human data, and a perspective on potential mechanisms that link potent GLP-1 release to the co-ingestion of protein and calcium. In light of these recent findings, potential future research directions are also presented.

Carbohydrates

Sugars and Gastrointestinal Health

Djésia Arnone, Caroline Chabot, Anne-Charlotte Heba, Tunay Kökten, Bénédicte Caron, Franck Hansmannel, Natacha Dreumont, Ashwin N Ananthakrishnan, Didier Quilliot, Laurent Peyrin-Biroulet. *Clin Gastroenterol Hepatol.* 2021 Dec 10;S1542-3565(21)01305-7. doi: 10.1016/j.cgh.2021.12.011. [Article link](#)

Significance: How different dietary carbohydrates impact intestinal health is examined in this review. In instances of hyperglycemia and excessive sugar intake, the intestinal barrier is disrupted leading to increase gut permeability and microbiota dysbiosis. This results in the mucosal immunity being compromised, increasing susceptibility to infection.

Sugar overconsumption is linked to a rise in the incidence of noncommunicable diseases such as diabetes, cardiovascular diseases and cancer. This increased incidence is becoming a real public health problem that is more severe than infectious diseases, contributing to 35 million deaths annually. Excessive intake of free sugars can cause many of the same health problems as excessive alcohol consumption. Many recent international recommendations have expressed concerns about sugar consumption in Westernized societies, as current consumption levels represent quantities with no precedent during hominin evolution. In both adults and children, the World Health Organization strongly recommends reducing free sugar intake to less than 10% of total energy intake and suggests a further reduction to below 5%. Most studies have focused on the deleterious effects of Western dietary patterns on global health and the intestine. Whereas excessive dietary fat consumption is well studied, the specific impact of sugar is poorly described, while refined sugars represent up to 40% of caloric intake within industrialized countries. However, high sugar intake is associated with multiple tissue and organ dysfunctions. Both hyperglycemia and excessive sugar intake disrupt the intestinal barrier, thus increasing gut permeability and causing profound gut microbiota dysbiosis, which results in a disturbance in mucosal immunity that enhances infection susceptibility. This review aims to highlight the roles of different types of dietary carbohydrates and the consequences of their excessive intake for intestinal homeostasis.

Low- and No-Calorie Sweeteners

Changes in the Presence of Non-Nutritive Sweeteners, Sugar Alcohols and Free Sugars in Australian Foods

Elizabeth K Dunford, Daisy H Coyle, Jimmy Chun Yu Louie, Kieron Rooney, Anneliese Blaxland, Simone Pettigrew, Alexandra Jones. *J Acad Nutr Diet.* 2021 Dec 2; S2212-2672(21)01511-2. doi: 10.1016/j.jand.2021.11.018. [Article link](#)

Significance: Interest in effects of different types of NNS on health outcomes has led to a surveillance study on NNS intakes/exposure in the Australian diet. Between 2015- 2019, an increase in food products containing NNS was reported, supported by an increase in steviol glycosides, decrease in others including sucralose, aspartame and acesulfame K. These findings provide valuable insights for future research and national policies.

Background: In parallel with growing consumer interest in reducing sugar intake, manufacturers have increased availability of food and beverage products containing non-nutritive sweeteners (NNS). However, emerging evidence indicates that specific NNS types have differential effects on cardiometabolic health. **Objective:** This study examined overall changes in the presence of NNS, sugar alcohols and free sugars (FS) in the Australian food supply and the use of specific NNS types. **Participants/setting:** Data for 21,051 products in 2015 and 21,366 products in 2019 were extracted from The George Institute's FoodSwitch database. **Main outcome measures:** The proportion of products containing NNS, sugar alcohols, FS and a combination of these, as well as proportion of products containing specific

NNS types. **Statistical analyses performed:** Changes between 2015 and 2019 were examined using Pearson χ^2 tests. **Results:** Between 2015 and 2019 there was a significant increase in the proportion of food and beverage products containing NNS (3.8% to 4.3%; $p < 0.001$) and a significant decrease in products containing free sugars (62.7% to 59.9%; $p < 0.001$), driven primarily by Non-dairy beverages. There were changes in the use of specific NNS types between 2015 and 2019, with a large increase in the use of steviol glycosides (33.7% to 50.2%) and a large decrease in the use of sucralose (42.4% to 30.5%), aspartame (21.0% to 14.4%) and acesulfame K (57.4% to 27.7%) ($p < 0.05$ for all). **Conclusions:** These findings on the use of different NNS, sugar alcohol and free sugar ingredients and combinations provide important research insights and will be useful in informing government policies that address sugars and other sweeteners in Australian foods.

Cognitive Health

DASH Diet Adherence and Cognitive Function: Multi-ethnic Study of Atherosclerosis

George D Daniel, Haiying Chen, Alain G Bertoni, Stephen R Rapp, Annette L Fitzpatrick, José A Luchsinger, Alexis C Wood, Timothy M Hughes, Gregory L Burke, Kathleen M Hayden. *Clin Nutr ESPEN*. 2021 Dec;46:223-231. doi: 10.1016/j.clnesp.2021.10.004. [Article link](#)



Significance: Adherence to DASH diet was not associated with cognitive performance or decline for any of the measures according to a multi-ethnic study using the MESA cohort. A difference by race/ethnicity was suggested. Future study should include exploring the interrelationship between racial and ethnic groups and the impact of diet on cognitive function.

Background and aims: The Adherence to the Dietary Approaches to Stop Hypertension (DASH) diet has been associated with better cognitive function in studies of predominantly White participants; few studies have examined this association in diverse cohorts. Our objective was to examine the association between the DASH diet and cognitive function in the diverse Multi-Ethnic Study of Atherosclerosis (MESA) cohort. **Methods:** Among 4169 MESA participants, we evaluated prospectively, the association between DASH diet adherence and cognitive function. Participants completed a food frequency questionnaire at baseline (2000-2002) and cognitive function was assessed using the Cognitive Abilities Screening Instrument (CASI), Digit Symbol Coding (DSC), and Digit Span (DS) at Exam 5 in 2010-2012 and Exam 6 (2016-2019). Regression analyses were used to evaluate the association between quintiles of DASH diet adherence with CASI, DSC, and DS performance and decline, adjusting for potential confounders. Effect modification by hypertension, diabetes, race/ethnicity, acculturation, and exercise were evaluated. **Results:** DASH diet adherence was not associated with cognitive performance or decline for any of the measures. There were no differences by racial/ethnic groups, with the exception that Hispanic participants reporting greater DASH diet adherence, performed worse on DS at Exam 5 ($p = 0.05$). Components of the DASH diet were differentially correlated with test performance: increased consumption of nuts/legumes was associated with better performance on the CASI at Exam 5 ($p = 0.003$) and Exam 6 ($p = 0.007$). Increased consumption of whole grains was associated with better DSC performance at Exam 5 ($p = 0.04$) and better DS performance at Exam 6 ($p = 0.01$). **Conclusions:** DASH diet adherence was nominally associated with cognitive function with a suggestion of differences by race/ethnicity. Future work should examine more closely, the relationships between racial and ethnic groups and the impact of diet on cognitive function.

Lipids

Lipid-Modifying Effects of Lean Fish and Fish-Derived Protein Consumption in Humans: A Systematic Review and Meta-Analysis of Randomized Controlled Trials.

Janet C Tou, Enza Gucciardi, Ian Young. *Nutr Rev*. 2021 Dec 8;80(1):91-112. doi: 10.1093/nutrit/nuab003. [Article link](#)

Significance: Better designed, longer duration and larger crossover RCTs studies are needed to better evaluate the impact of lean fish and fish proteins on the serum/plasma lipid profile. Learnings from these studies would provide practitioners with evidence-based recommendations for patients to meet the AHA guidelines for fish consumption to reduce cardiovascular disease risk.

Context: Consumption of lean fish and fish-derived proteins were effective for improving lipid profiles in published studies; however, evidence remains inconclusive. **Objective:** To evaluate the effectiveness of lean fish or fish-derived protein on serum/plasma lipid and lipoprotein levels by conducting a systematic review of the literature and meta-analysis of available randomized controlled trials (RCTs). **Data sources:** Medline

(Ovid), Scopus, CINAHL, and Food and Nutritional Sciences databases were searched from the start date of each database to September 2019 to identify RCTs determining the effect of lean fish on lipid profile. **Study selection included:** RCTs investigated lean fish and fish-derived proteins intake and determined at least 1 major lipid or lipoprotein measurement. **Data extraction:** Two reviewers independently evaluated 1217 studies against the inclusion and exclusion criteria. Relevant studies were assessed for risks of bias, and random-effects meta-analysis was conducted to generate average estimates of effect. **Results:** A total of 24 studies met the inclusion criteria. Meta-analysis of data from 18 to 21 eligible crossover and parallel-design RCTs with a total of 1392 to 1456 participants found triacylglycerol-lowering effects for lean fish compared with no fish consumption. Lean fish intake showed no significant differences related to total cholesterol or lipoprotein levels. Subanalysis showed that parallel-group RCTs tended to find greater reduction effects on circulating triacylglycerol than did crossover RCTs. **Conclusion:** Additional better-designed, longer, and larger RCTs, particularly crossover RCTs, are needed to clarify the impact of lean fish and fish proteins on the serum/plasma lipid profile. Findings from such studies would enable practitioners to provide their patients evidence-based recommendations to meet the American Heart Association guidelines for fish consumption to reduce cardiovascular disease risk.

Sodium

Reducing Salt Intake: A Systematic Review and Meta-Analysis of Behavior Change Interventions in Adults

Saman Khalesi, Edwina Williams, Christopher Irwin, David W Johnson, Jacqui Webster, Danielle McCartney, Arash Jamshidi, Corneel Vandelanotte. *Nutrition Reviews*, nuab110, <https://doi.org/10.1093/nutrit/nuab110>. 17 December 2021. [Article link](#)

Significance: Applying behavioral change interventions that involve decreasing purchase of salty foods, and using salt substitutes appear helpful in improving salt consumption practices and salt intake by >1 g/d. Methods of behavioral change interventions applied include decreasing salty food purchase and increasing salt substitute usage.

Background: Prolonged high salt (sodium) intake can increase the risk of hypertension and cardiovascular disease. Behavioral interventions may help reduce sodium intake at the population level. **Objective:** The effectiveness of behavior change interventions to reduce sodium intake in adults was investigated in this systematic review and meta-analysis. **Data source:** The PubMed, Cochrane Library, Cumulative Index to Nursing and Allied Health Literature, and EMBASE databases were searched. **Data extraction:** Narrative synthesis and random-effects meta-analyses were used to determine intervention efficacy. A total of 61 trials (46 controlled trials and 15 quasi-experimental studies) were included. **Results:** Behavior change interventions resulted in significant improvements in salt consumption behavior (eg, decrease in purchase of salty foods; increase in use of salt substitutes), leading to reductions in sodium intake as measured by urinary sodium in 32 trials (N = 7840 participants; mean difference, -486.19 mg/d [95%CI, -669.44 to -302.95]; P < 0.001; I² = 92%) and dietary sodium in 19 trials (N = 3750 participants; mean difference -399.86 mg/d [95%CI, -581.51 to -218.20]; P < 0.001; I² = 96%), equivalent to a reduction of >1 g of salt intake daily. Effects were not significantly different based on baseline sodium intakes, blood pressure status, disease status, the use of behavior change theories, or the main method of intervention delivery (ie, online vs face-to-face). **Conclusion:** Behavior change interventions are effective at improving salt consumption practices and appear to reduce salt intake by >1 g/d.

Gut Microbiome

Tree-based Analysis of Dietary Diversity Captures Associations between Fiber Intake and Gut Microbiota Composition in a Healthy U.S. Adult Cohort

Mary E Kable, Elizabeth L Chin, David Storms, Danielle G Lemay, Charles B Stephensen. *The Journal of Nutrition*, 27 Dec 2021. nxab430, <https://doi.org/10.1093/jn/nxab430>. [Article link](#)

Significance: A new approach using tree structure annotated with grams of carbohydrate, offers a robust way for comparing self-reported diet to gut microbial community composition. Using this method, identified fiber from fruit was associated with abundance of pectinolytic bacterial genus, *Lachnospira*, in the gut of healthy adults.

Diet patterns are a significant and modifiable contributing factor to the composition of the human gut microbiota. **Objective:** We set out to identify reproducible relationships between diet and gut microbial community composition in a diverse, healthy U.S. adult cohort. **Methods:** Two to three Automated Self-Administered 24-hour Dietary Recalls (ASA24) were

collected over 10–14 d together with a single stool sample from 343 healthy adults in a cross-sectional phenotyping study (ClinicalTrials.gov Identifier: NCT02367287). This study examined a multi-ethnic cohort balanced for age (18y–65y), sex, and BMI (18.5–45). Dietary data was edited to a tree format according to published methods. The tree structure was annotated with the average total grams of dry weight, fat, protein, carbohydrate, or fiber from each food item reported. The alpha and beta diversity measurements, calculated using the tree structure, were analyzed relative to the microbial community diversity determined by QIIME 2 analysis of the bacterial 16S rRNA V4 region, sequenced from stool samples. K-means clustering was used to form groups of individuals consuming similar diets and gut microbial communities were compared among groups using DESeq2. **Results:** Alpha diversity of diet dry weight was significantly correlated with gut microbial community alpha diversity ($r = 0.171$). The correlation improved when diet was characterized using grams of carbohydrates ($r = 0.186$) or fiber ($r = 0.213$). *Bifidobacterium* was enriched with diets containing higher levels of total carbohydrate from cooked grains. *Lachnospira*, was enriched with diet patterns containing high consumption of fiber from “Fruits excluding berries”. **Conclusion:** The tree structure annotated with grams of carbohydrate, is a robust analysis method for comparing self-reported diet to gut microbial community composition. This method identified consumption of fiber from fruit robustly associated with abundance of pectinolytic bacterial genus, *Lachnospira*, in the gut of healthy adults.

Biomarkers

Biomarker-based Methods and Study Designs to Calibrate Dietary Intake for Assessing Diet-Disease Associations.

Ying Huang, Cheng Zheng, Lesley F Tinker, Marian L Neuhausser, Ross L Prentice. *J Nutr.* 2021 Dec 14;nxab420. doi: 10.1093/jn/nxab420. [Article link](#)

Significance: Calibration for measurement error correction is necessary when using self-reported dietary intake in diet-disease association analysis. In absence of existing objective biomarkers for calibration purpose, controlled feeding studies are an option to develop new biomarkers for use in calibration or can be used to calibrate self-reported dietary intake directly.

Background: Dietary biomarkers measured in biospecimens can play an important role in correcting for random and systematic measurement error in self-reported nutrient intake when assessing diet-disease associations. To date, high quality biomarkers for calibrating self-reported dietary intake have only been developed for a few nutrients. **Objective:** To investigate new study designs and regression calibration approaches for calibrating self-reported nutrient intake for use in disease association analyses. **Methods:** We studied three regression calibration approaches: (I) an existing approach built on a calibration cohort assuming the existence of an objective biomarker, i.e., biomarker with random independent measurement error, (II) a proposed approach utilizing a biomarker development cohort, and (III) a proposed two-stage approach utilizing both cohorts. We conducted simulation studies to compare performance of different study designs/methods for estimating diet-disease associations and applied suitable methods to examine the association of sodium and potassium intake with cardiovascular disease (CVD) risk in Women’s Health Initiative cohorts. **Results:** Simulation studies showed that approach (I) can lead to biased association estimation when the objective biomarker assumption is violated; the proposed approaches (II) and (III) obviate the need for such an objective biomarker. Precision for estimating the association depends critically on sample size of the biomarker development cohort and the strength of the self-reported nutrient intake. Analyses based on approaches (II) and (III) support previously reported significant findings using approach (I) about associations of the ratio of sodium to potassium intake with CVD risk, while providing efficiency gain for some outcomes. **Conclusions:** Self-reported dietary intake needs to be calibrated for measurement error correction in diet-disease association analyses. When there are no existing objective biomarkers that can be used for calibration purpose, controlled feeding studies can be used to develop new biomarkers for use in calibration or can be used to calibrate self-reported dietary intake directly.