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Nutrition

Dietary Patterns

Impact of Nationwide Lockdowns Resulting from the First Wave of the COVID-19 Pandemic on Food Intake, Eating Behaviors, and Diet Quality: A Systematic Review

Cristiana Mignogna, Simona Costanzo, Anwal Ghulam, Chiara Cerletti, Maria Benedetta Donati, Giovanni de Gaetano, Licia Iacoviello, et. al. *Advances in Nutrition*, nmab130, 2022.doi.org/10.1093/advances/nmab130. **Article link**

Significance: This systematic review investigates changes in food intake, eating behaviors, and diet quality during COVID-19 lockdown as compared with before the lockdown. Changes in intake of most major food groups were in line with the definition of a traditional Mediterranean diet, indicating a consistent moderate improvement in dietary habits worldwide.

The lockdowns resulting from the first wave of the coronavirus disease 2019 (COVID-19) pandemic impacted deeply on all life activities, including diet. We performed a systematic review to investigate changes in food intake, eating behaviors, and diet quality during lockdown as compared with before the lockdown. A literature search was performed using 3 electronic databases from inception until 13 June 2021. Observational studies evaluating changes in general populations during the COVID-19 pandemic lockdown were eligible. Of 1963 studies retrieved from the search strategy, 95 met inclusion criteria (85 in adults, 10 in children/ adolescents), and the majority were of high quality (72.6%). Most of the studies were web-based surveys using convenience sampling, mainly focused on variations in the consumption of foods and eating behaviors during lockdown, whereas only 15 studies analyzed diet quality through dietary indices. On the basis of the definition of a healthful diet as reflected by a traditional Mediterranean diet, an increase in recommended foods such as fruit and vegetables, legumes, cereals, and olive oil was observed, although a sharp decrease in fish intake and an increase in dairy products were documented. Accordingly, a reduction in foods that should be eaten less frequently was reported—namely, red and processed meat. However, a higher consumption of unhealthy foods (e.g., snacks and sweets) was also observed. Results indicated improved diet quality in Europe, especially among Mediterranean countries, with the exception of France, while a switch to poor nutrient patterns was observed in Colombia and Saudi Arabia. Analyses of eating behaviors suggest an increase in food intake, number of daily meals, and snacking. In conclusion, changes in intake of major food groups, apart from fish intake, were in line with the definition of a traditional Mediterranean diet, indicating a consistent moderate improvement in dietary habits worldwide.

Taste of Modern Diets: The Impact of Food Processing on Nutrient Sensing and Dietary Energy Intake

Pey Sze Teo, Rachel Tso, Rob M van Dam, Ciarán G Forde. *The Journal of Nutrition*, Vol. 152, Issue 1, January 2022, Pages 200–210, doi.org/10.1093/jn/nxab318. **Article link**

Significance: Regardless of degree of processing, taste-nutrient relationship was maintained. Foods higher in "savory–fatty" taste were linked to increased energy intakes and overweight in a study with adults (21-75 years) from the Singapore Multi-Ethnic Cohort Phase 2.

Background: Both fresh and processed foods are available in the modern food environment where taste can signal presence of nutrients. However, whether these taste–nutrient relationships are maintained across different degrees of food processing is not well understood, and less is known about the relative contribution of different taste qualities to population energy intakes. **Objectives:** To investigate the association between perceived intensity of 6 taste modalities

and a food's nutrient content in the context of food processing and to further examine the relative contribution of different taste clusters to total energy intakes, stratified by weight status. **Methods**: Diet and lifestyle data from the Singapore Multi-Ethnic Cohort Phase 2 (N = 7011; aged 21–75 y) were collected through interviewer-administered questionnaires. Taste and nutrient profiles for each of the 269 Singaporean foods were derived using a published taste database and food composition table. Each food was then categorized into the NOVA food-processing classification (unprocessed, processed, ultra-processed) to compare the strength of taste–nutrient relationships. Multivariable-adjusted models were used to examine associations between relative consumption of foods from different taste clusters and processing categories, energy intake, and BMI (in kg/m2) within a population cohort. **Results:** Sweet taste and mono- and disaccharide content of foods were significantly associated across all processing categories, although this association was weaker among ultra-processed foods (UPFs) (r = 0.42) than among unprocessed foods (r = 0.72). In contrast, associations between fat sensation and fat content (r = 0.74), as well as salt taste and sodium content (r = 0.84), were stronger for UPFs. Individuals who had higher energy intakes or were overweight (BMI >23) derived significantly greater percentage of energy from processed foods rather than UPFs, and this energy was higher from "savory–fatty" and lower from "neutral" tasting foods than those with lower energy intakes and normal weight (all P < 0.001). Eighty percent of individuals' dietary energy was from both "savory–fatty" and "neutral" foods, independent of differences in total energy intake and weight status. **Conclusions:** Taste–nutrient relationships are maintained across different degrees of food processing. Greater consumption of foods that have a high "savory–fatty" taste was associated with increased energy intakes and overweight in the Asian population.

Characterizing Patterns of Dietary Exposure Using Metabolomic Profiles of Human Biospecimens: A Systematic Review

Stephanie Andraos, Kathryn Louise Beck, Mary Beatrix Jones, Ting-Li Han, Cathryn Anne Conlon, Jamie Violet de Seymour. *Nutrition Reviews*, nuab103, 12 Jan 2022. doi.org/10.1093/nutrit/nuab103. **Article link**

Significance: Factors influencing the diet-disease relationship (dietary pattern, genetics, phenotypic and environmental) impact metabolomic profiles. Further study is needed to evaluate association between dietary patterns and metabolomic profiles in different populations. Establishing diet–disease associations requires reliable assessment of dietary intake. With the rapid advancement of metabolomics, its use in identifying objective biomarkers of dietary exposure has increased.

Objective: The aim of our review was to systematically combine all observational studies linking dietary intake patterns with metabolomic profiles of human biospecimens. **Data Sources**: Five databases were searched – MEDLINE, Embase, Scopus, Web of Science, and Cochrane CENTRAL – to March 2020. **Data Extraction**: Of the 14 328 studies initially screened, 35 observational studies that met the specified inclusion criteria were included. **Data Analysis**: All reviewed studies indicated that metabolomic measures were significantly correlated with dietary patterns, demonstrating the potential for using objective metabolomic measures to characterize individuals' dietary intake. However, similar dietary patterns did not always result in similar metabolomic profiles across different study populations. **Conclusion**: Metabolomic profiles reflect a multitude of factors, including diet, genetic, phenotypic, and environmental influences, thereby providing a more comprehensive picture of the impact of diet on metabolism and health outcomes. Further exploration of dietary patterns and metabolomic profiles across different population groups is warranted.

Carbohydrates

The Effects of Low-Fat, High-Carbohydrate Diets vs. Low-Carbohydrate, High-Fat Diets on Weight, Blood Pressure, Serum Liquids and Blood Glucose: A Systematic Review and Meta-Analysis

Qing Yang, Xinyue Lang, Wei Li, Yan Liang. *Eur J Clin Nutr*. 2022 Jan;76(1):16-27. doi: 10.1038/s41430-021-00927-0. **Article link**

Significance: Analysis of eleven studies found diets low in carbohydrate and high in fat or high in carb and low in fat are both effective in reducing weight and cardiovascular risk factors such as lean mass, fat mass, systolic blood pressure, diastolic blood pressure, triglycerides, and glucose. More long term follow-up studies are needed to confirm these results.

Our aim was to determine the relative effectiveness of two dietary macronutrient patterns (LFHC (low-fat, high-carbohydrate) diets and LCHF (low-carbohydrate, high-fat) diets) on weight loss and cardiovascular risk factors. We searched four databases including MEDLINE, EMBASE, Cochrane Library, and Web of Science to identify the eligible studies on March 13, 2020. Randomized clinical trials (RCT) were included which compared the effect of two diets (LFHC and LCHF) on weight loss, blood pressure, serum liquids, and blood glucose in overweight or obesity adults. Standardized mean difference (SMD) and 95% confidence interval (CI) were used for the pooled results. This paper included eleven studies involving 739 participants. Compared with LFHC diets, LCHF diets had a greater effect on weight loss (SMD = -1.01 kg; 95% CI -1.99 to

-0.04, p = 0.04) and HDL-cholesterol changes (SMD = 0.82 mmol/l; 95% CI 0.43 to 1.21, p < 0.0001), but a smaller effect on total cholesterol decrease (SMD = 0.63 mmol/l; 95% CI 0.18-1.08, p = 0.006) and LDL-cholesterol decrease (SMD = 0.59 mmol/l; 95% CI 0.11-1.18, p = 0.05). Between the two groups, changes in lean mass, fat mass, systolic blood pressure, diastolic blood pressure, triglycerides, and glucose were non-significant. To conclude, both diets are effective for weight control and reduction of cardiovascular risk factors. And further studies with long-term follow-up are needed to confirm our results.

Protein

Dairy and Dairy Alternative Supplementation Increase Integrated Myofibrillar Protein Synthesis Rates, and Are Further Increased when Combined with Walking in Healthy Older Women.

Tanner Stokes, Yixue Mei, Freddie Seo, James McKendry, Chris McGlory, Stuart M Phillips. *The Journal of Nutrition,* Volume 152, Issue 1, January 2022, Pages 68–77, doi.org/10.1093/jn/nxab358. **Article link**

Significance: A study with 22 older women found that increasing physical activity through walking was sufficient to stimulate muscle protein synthesis, irrespective of protein intake level above 0.8 g/kg/d.

The stimulation of muscle protein synthesis (MPS) by dietary protein is reduced with age. We hypothesized that twice-daily milk consumption would increase daily rates of MPS in older women relative to a nondairy milk alternative and that MPS would be enhanced by increased physical activity (PA). **Methods:** Twenty-two older women were randomly assigned to 1 of 3 experimental groups: whole milk (WM; n = 7, 69 ± 3 y), skim milk (SM; n = 7, 68 ± 3 y), or an almond beverage (AB; n = 8, 63 ± 3 y). From days 1 to 3, participants consumed a standardized diet (0.8 g protein/ kg−1 / d−1) and performed their habitual PA (Phase 1, Baseline). From days 4 to 6, participants continued to perform habitual PA, but consumed an intervention diet consisting of the standardized diet plus twice-daily beverages (250 mL each) of either WM, SM, or AB (Phase 2, Diet Intervention). Finally, from days 7 to 9, the intervention diet was consumed, and PA via daily steps was increased to ~150% of habitual daily steps (Phase 3, Intervention Diet + PA). Deuterated water was ingested throughout the study, and muscle biopsies were taken on days 1, 4, 7, and 10 to measure MPS. **Results:** Daily MPS rates were not differentially affected by the addition of WM, SM, or AB to a standardized diet. There was, however, a significant effect of study phase such that, when collapsed across conditions, MPS was significantly increased from Phase 1 to Phase 2 (+0.133% / d−1; 95% CI: 0.035–0.231; P < 0.01) and further increased from Phase 2 to Phase 3 (+0.156% / d−1; 95% CI: 0.063–0.250; P < 0.01). **Conclusions:** Increasing PA through walking was sufficient to increase daily MPS rates in older women, irrespective of whether dietary protein intake is increased beyond the recommended intake of 0.8 g / kg−1 / d−1. The trial was registered at clinicaltrials.gov as NCT04981652.

Low- and No-Calorie Sweeteners

The Challenge of Measuring Sweet Taste in Food Ingredients and Products for Regulatory Compliance: A Scientific Opinion

Dustin E Starkey, Zhuzhu Wang, Kommer Brunt, Lise Dreyfuss, Philip A Haselberger, Stephen E Holroyd, Kaushik Janakiraman, et. al. *Journal of AOAC INTERNATIONAL,* 18 Jan 2022. doi.org/10.1093/jaoacint/qsac005. **Article link**

Significance: While carbohydrates and other sweet-tasting ingredients in foods can be exactly measured, this review found that there are no available methods to analytically measure sweet taste. The inability to objectively measure sweet taste may impact regulation of sweetness of products like follow-up formula, a drink with added nutrients for young children aged 6-36 months.

IAFNS' Director of Science Programs Marie Latulippe served on this panel.

The Codex Alimentarius Commission, a central part of the joint Food and Agricultural Organization/World Health Organizations Food Standards Program, adopts internationally recognized standards, guidelines, and code of practices that help ensure safety, quality, and fairness of food trade globally. Although Codex standards are not regulations per se, regulatory authorities around the world may benchmark against these standards or introduce them into regulations within their countries. Recently, the Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU) initiated a draft revision to the Codex standard for follow-up formula (FUF), a drink/product (with added nutrients) for young children, to include requirements for limiting or measuring the amount of sweet taste contributed by carbohydrates

in a product. Stakeholders from multiple food and beverage manufacturers expressed concern about the subjectivity of sweetness and challenges with objective measurement for verifying regulatory compliance. It is a requirement that Codex standards include a reference to a suitable method of analysis for verifying compliance with the standard. In response, AOAC INTERNATIONAL formed the Ad Hoc Expert Panel on Sweetness in November 2020 to review human perception of sweet taste, assess the landscape of internationally recognized analytical and sensory methods for measuring sweet taste in food ingredients and products, deliver recommendations to Codex regarding verification of sweet taste requirements for FUF, and develop a scientific opinion on measuring sweet taste in food and beverage products beyond FUF. Findings showed an abundance of official analytical methods for determining quantities of carbohydrates and other sweet-tasting molecules in food products and beverages, but no analytical methods capable of determining sweet taste. Furthermore, sweet taste can be determined by standard sensory analysis methods. However, it is impossible to define a sensory intensity reference value for sweetness, making them unfit to verify regulatory compliance for the purpose of international food trade. Based on these findings and recommendations, the Codex Committee on Methods of Analysis and Sampling agreed during its 41st session in May 2021 to inform CCNFSDU that there are no known validated methods to measure sweetness of carbohydrate sources; therefore, no way to determine compliance for such a requirement for FUF.

Natural Sweeteners: Sources, Extraction and Current Uses in Foods and Food Industries.

Roberto Castro-Muñoz, Mariela Correa-Delgado, Rafael Córdova-Almeida, David Lara-Nava, Mariana Chávez-Muñoz, Valeria Fernanda Velásquez-Chávez, Carlos Eduardo Hernández-Torres, et. al. *Food Chem*. 2022 ;370:130991. doi: 10.1016/j.foodchem.2021.130991. **Article link**

Significance: This review of resources, properties and extraction methods for sweeteners includes several emerging technologies that offer improvements to traditional extraction techniques.

Food producers have leaned towards alternative natural and synthetic sweeteners in food formulations to satisfy market demands. Even so, several synthetic sweeteners (e.g., aspartame, saccharin, sucralose) are becoming less popular due to health-related concerns, lower nutritional values, and controversies around their safety. Conversely, natural sweeteners confer favourable customer perceptions due to their association to a healthier lifestyle and higher nutritional values. This article discusses the evidence of natural sweeteners in the available commercial products. A comprehensive review of natural sweeteners is presented, which includes their resources, properties and extraction methods, as well as a discussion on several emerging technologies that offer improvements to the traditional extraction methods. Finally, the progress of natural sweeteners in the food industry is assessed, and the commercial food products containing these natural sweeteners are mentioned.

Cognitive Health

Long-Term Dietary Protein Intake and Subjective Cognitive Decline in US Men and Women

Tian-Shin Yeh, Changzheng Yuan, Alberto Ascherio, Bernard A Rosner, Deborah Blacker, Walter C Willett *The American Journal of Clinical Nutrition,* Vol. 115, Issue 1, Jan. 2022, P199–210, doi.org/10.1093/ajcn/nqab236. **Article link**

Significance: Findings from the Nurse's Health Study and Health Professional Study reported lower odds of subjective cognitive decline with protein intake (compared isocalorically with carbohydrate) and with plant vs. animal protein sources.

Diet is one of the modifiable risk factors for cognitive decline. However, studies on dietary protein intake and cognitive decline have remained limited and inconclusive. **Objectives**: In this study, we aimed to investigate the associations between long-term dietary protein intake and subsequent subjective cognitive decline (SCD). **Methods**: We included 49,493 women from the Nurses' Health Study (NHS) (1984–2006) and 27,842 men from the Health Professionals Follow-up Study (HPFS) (1986–2002). For the NHS, average dietary intake was calculated from 7 repeated semi-quantitative FFQs (SFFQs), and SCD was assessed in 2012 and 2014. For the HPFS, average dietary intake was calculated from 5 repeated SFFQs, and SCD was assessed in 2008 and 2012. Poisson regression was used to examine the associations between dietary protein, amino acids, and various protein food sources with subsequent SCD. **Results**: Higher protein intake compared with total carbohydrates was associated with lower odds of SCD. When substituting 5% energy from protein for the equivalent percentage of energy from total carbohydrates, the pooled multivariable-adjusted ORs (95% CIs) were 0.89 (0.85, 0.94) for total protein, 0.89 (0.84, 0.94) for animal protein, and 0.74 (0.62, 0.88) for plant protein. When substituting 5% of energy from animal protein with plant protein, the OR was 0.84 (95% CI: 0.72, 0.97). For protein food sources, higher intakes of beans/legumes, fish, and lean poultry were significantly associated with lower odds of SCD, but higher intake of hotdogs was associated with higher odds of SCD. **Conclusions**: Higher protein intake was associated with lower odds of SCD when compared isocalorically with carbohydrate. Plant protein sources were also associated with lower odds when compared with animal protein sources. Our findings suggest that

adequate protein intake, and choices of protein sources could play a role in the maintenance of cognition and should be studied further.

Long-Term Diet Quality and Its Change in Relation to Late-Life Subjective Cognitive Decline

Changzheng Yuan, Yaying Cao, Alberto Ascherio, Olivia I Okereke, Geng Zong, Francine Grodstein, Albert Hofman et. al. *The American Journal of Clinical Nutrition*, Vol. 115, Issue 1, January 2022, Pages 232–243, doi. org/10.1093/ajcn/nqab326. **Article link**

Significance: Long term adherence to healthy dietary patterns was associated with lower subjective cognitive declines in a study of women from the Nurse's Health Study. For each SD increase in diet quality change, the risk of subjective cognitive decline was reduced by 11% for AMED, 5% for DASH, and 3% for AHEI-2010, respectively.

Our findings support beneficial roles of long-term adherence to, and improvement in, healthy dietary patterns for the maintenance of subjective cognition in women. Evidence regarding the role of diet quality, especially its change, in subjective cognitive decline (SCD) is scarce. **Objectives:** We aimed to examine associations of long-term diet quality scores, including the Alternate Mediterranean Diet (AMED), Dietary Approaches to Stop Hypertension (DASH), and Alternate Healthy Eating Index 2010 (AHEI-2010), with SCD in the Nurses' Health Study. **Methods:** We followed 49,493 female registered nurses (mean age in 1984: 48 y) from 1984 to 2014. Diet scores were derived from 7 repeated FFQs in 1984, 1986, and every 4 y afterward until 2006. Self-reported SCD was assessed in 2012 and 2014 by a 7-item questionnaire on memory and cognition changes. Categorical SCD score was classified as "none" (0 points, 40.8%), "moderate" (0.5–2.5 points, 46.9%), and "severe" (3–7 points, 12.3%). **Results**: Multinomial and linear regression models were adjusted for total calorie intake, demographic characteristics, lifestyle, and clinical factors. Comparing the top with the bottom quintiles of AMED, DASH, and AHEI-2010, multivariable-adjusted ORs (95% CIs) for severe SCD compared with none were 0.57 (0.51, 0.64), 0.61 (0.55, 0.68), and 0.81 (0.73, 0.90), respectively. Similar associations remained for the 3 diet indexes evaluated 28 y before SCD assessment. Compared with participants with the lowest diet quality tertiles in both remote and recent years, the lowest odds of severe SCD were observed among those who maintained the highest diet quality tertiles over time, with 40%, 32%, and 20% lower odds of severe SCD for AMED, DASH, and AHEI-2010, respectively. Moreover, the odds of severe SCD were lower among those with improved diets over time; for each SD higher in diet quality change, the reductions in risk were 11% for AMED, 5% for DASH, and 3% for AHEI-2010, respectively. **Conclusions**: Our findings support beneficial roles of long-term adherence to, and improvement in, healthy dietary patterns for the maintenance of subjective cognition in women.

Lipids

High-Density Lipoprotein, Low-Density Lipoprotein and Triglyceride Levels and Upper Gastrointestinal Cancers Risk: A Trans-Ancestry Mendelian Randomization Study

Yanling Wu, Junyi Xin, Elizabeth A. Loehrer, Xia Jiang, Qianyu Yuan, David C. Christiani, et. al. *European Journal of Clinical Nutrition* (2022). 21 January 2022. doi.org/10.1038/s41430-022-01078-6. **Article link**

Significance: A trans-ancestry MR study found no causality between serum HDL, LDL or TG and the risk of upper gastrointestinal cancers (GC) among Chinese and Europeans but identified a potential causal role of TG in GC etiology in Japanese females. Further research is warranted to elucidate the underlying mechanism.

This study was conducted to explore the causal associations of high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglyceride (TG) with the risk of upper gastrointestinal cancers (esophageal cancer [EC] and gastric cancer [GC]). Methods: A total of 5623 Chinese and 4133 Europeans afforded the individual-level genotyping data, and 203,608 Japanese from Biobank Japan project and 393,926 Europeans from UK Biobank supported summary statistics of cancer genetic associations. Mendelian randomization (MR) analyses, including weighted genetic risk scores (wGRSs), inverse-variance weighted (IVW), weighted median and Egger-regression, were utilized to evaluate the causal effects of three blood lipids on upper gastrointestinal cancers risk. Results: There was no significantly causal relationships between three blood lipids and EC or GC risk among Chinese or Europeans but a potential causal association between TG and GC risk among Japanese (IVW: odds ratio [OR] = 1.11, P = 0.034; Phet = 0.679). In stratified subgroups, higher genetically predicted TG levels were causally associated with an increased risk of GC among Chinese males (wGRS: OR = 1.61, P = 0.021; IVW: OR = 1.57, P = 0.009; Phet = 0.653) and Japanese females (IVW: OR = 1.33, P = 0.024; Phet = 0.378). Conclusion: This trans-ancestry MR study suggested null significant causality between serum HDL, LDL or TG and the risk of upper gastrointestinal cancers among Chinese and Europeans but provided evidence for a causal role of TG involved in GC etiology in Japanese (especially females), which would support a prevention guide for high-risk groups of GC. Further research with more comprehensive information is needed to explore the underlying mechanism.

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Sodium

24-Hour Urinary Sodium and Potassium Excretion and Cardiovascular Risk

Yuan Ma,Feng J. He, Qi Sun, Changzheng Yuan, Lyanne M. Kieneker, Gary C. Curhan, Graham A. MacGregor, et al. *New England Journal of Medicine*: 2022; 386:252-263. DOI: 10.1056/NEJMoa2109794. **Article link**

Significance: Higher sodium and lower potassium intakes, from repeated 24-hour urine samples, were associated in a dose–response manner with a higher cardiovascular risk. These findings support recommendation to reduce sodium and increase potassium intakes

The relation between sodium intake and cardiovascular disease remains controversial, owing in part to inaccurate assessment of sodium intake. Assessing 24-hour urinary excretion over a period of multiple days is considered to be an accurate method. **Methods**: We included individual-participant data from six prospective cohorts of generally healthy adults; sodium and potassium excretion was assessed with the use of at least two 24-hour urine samples per participant. The primary outcome was a cardiovascular event (coronary revascularization or fatal or nonfatal myocardial infarction or stroke). We analyzed each cohort using consistent methods and combined the results using a random-effects meta-analysis. **Results**: Among 10,709 participants, who had a mean (±SD) age of 51.5±12.6 years and of whom 54.2% were women, 571 cardiovascular events were ascertained during a median study follow-up of 8.8 years (incidence rate, 5.9 per 1000 person-years). The median 24-hour urinary sodium excretion was 3270 mg (10th to 90th percentile, 2099 to 4899). Higher sodium excretion, lower potassium excretion, and a higher sodium-to-potassium ratio were all associated with a higher cardiovascular risk in analyses that were controlled for confounding factors (P≤0.005 for all comparisons). In analyses that compared quartile 4 of the urinary biomarker (highest) with quartile 1 (lowest), the hazard ratios were 1.60 (95% confidence interval [CI], 1.19 to 2.14) for sodium excretion, 0.69 (95% CI, 0.51 to 0.91) for potassium excretion, and 1.62 (95% CI, 1.25 to 2.10) for the sodium-to-potassium ratio. Each daily increment of 1000 mg in sodium excretion was associated with an 18% increase in cardiovascular risk (hazard ratio, 1.18; 95% CI, 1.08 to 1.29), and each daily increment of 1000 mg in potassium excretion was associated with an 18% decrease in risk (hazard ratio, 0.82; 95% CI, 0.72 to 0.94). Conclusions: Higher sodium and lower potassium intakes, as measured in multiple 24-hour urine samples, were associated in a dose–response manner with a higher cardiovascular risk. These findings may support reducing sodium intake and increasing potassium intake from current levels.

Gut Microbiome

The Gut Microbiome Is Associated with Circulating Dietary Biomarkers of Fruit and Vegetable Intake in a Multiethnic Cohort

Cara L Frankenfeld, Meredith A J Hullar, Gertraud Maskarinec, Kristine R Monroe, John A Shepherd, Adrian A Franke, Timothy W Randolph, et. al. *J Acad Nutr Diet*. 2022 Jan;122(1):78-98. doi: 10.1016/j.jand.2021.05.023. **Article link**

Significance: Increasing circulatory carotenoids, from dietary fruits and vegetables, were favorably associated with gut bacterial composition and diversity providing supportive evidence of the influence of fruit and vegetable intake on gut microbial composition.

Background: Results from observational studies suggest high diet quality favorably influences the human gut microbiome. Fruit and vegetable consumption is often a key contributor to high diet quality. **Objective**: To evaluate measures of gut bacterial diversity and abundance in relation to serum biomarkers of fruit and vegetable intake. **Design**: Secondary analysis of cross-sectional data. **Participants and Setting**: Men and women from Los Angeles, CA, and Hawai'i who participated in the Multiethnic Cohort-Adiposity Phenotype Study from 2013 to 2016 (N = 1,709). Main Outcome Measures: Gut microbiome diversity and composition in relation to dietary biomarkers. **Statistical Analysis**: Carotenoid (beta carotene, alpha carotene, cryptoxanthins, lutein, lycopene, and zeaxanthin), tocopherol (α, β + γ, and δ), and retinol concentrations were assessed in serum. The α and β diversity and composition of the gut microbiome were classified based on 16S rRNA gene sequencing of bacterial DNA from self-collected fecal samples. Global differences in microbial community profiles in relation dietary biomarkers were evaluated using multivariable

of variance. Associations of α diversity (Shannon index), β diversity (weighted and unweighted UniFrac) with center log-ratio-transformed phyla and genera abundances were evaluated using linear regression, adjusted for covariates.

Results: Increasing total carotenoid, beta carotene, alpha carotene, cryptoxanthin, and lycopene concentrations were associated with higher gut bacterial diversity (Shannon Index) (P < 0.001). Total tocopherol, α-tocopherol, and δ-tocopherol concentrations contributed significantly to more than 1% of the microbiome variation in gut bacterial community: total tocopherol: 1.74%; α-tocopherol: 1.70%; and δ-tocopherol: 1.16% (P < 0.001). Higher total carotenoid was associated with greater abundance of some genera relevant for microbial macronutrient metabolism (P < 0.001).

Conclusions: Objective biomarkers of fruit and vegetable intake, particularly carotenoids, were favorably associated with gut bacterial composition and diversity in this multiethnic population. These observations provide supportive evidence that fruit and vegetable intake is related to gut bacterial composition; more work is needed to elucidate how this influences host health.