Nutritional Epidemiology

Formative Evaluation of Pictorial Methods for Portion Size Estimation in Malawi (E05-01)

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Objectives: Current dietary recall methods used in low-resource settings are prone to errors in portion size estimation. This study investigated the preference for, ease of use perceptions, and accuracy of visual variables in portion size estimation aids (PSEAs) for dietary recall in Malawi. Visual variables tested included food shapes compared with photos, number of portion size options, photo angle, and simultaneous compared with sequential portion size image presentation.

Methods: Ninety-six women aged 18–45 y served themselves portions of 5 foods (groundnuts, bananas, nsima, bean relish, vegetable relish) and water, which were weighed before and after consumption. We administered a meal recall through the use of a digital or printed PSEA 30 min after eating and assessed participants' preferences for and ease of use perceptions of the PSEAs through a structured interview. Across participants and foods, we calculated the percentage of PSEA selections within 20% of the actual gram weight of food or water consumed.

Results: Participant preference and ease-of-use perceptions favored photos, 45° photo angle, and simultaneous presentation. Three- and 5-portion sizes had similar preference and ease-of-use perceptions, but 3 portions were slightly more accurate than 5 (28% compared with 25% within 20% of actual gram weight). A 45° photo angle was more accurate than a 90° photo angle (35% compared with 25%), as was a simultaneous compared with sequential presentation of images (41% compared with 31%). Accuracy was similar for other visual variables. Differences in preference and ease-of-use perceptions between digital and printed PSEAs were inconclusive, but will be further tested in an upcoming validation study.

Conclusions: The results indicate that PSEA visual variables can be optimized to improve participants' experiences during, and enhance accuracy of, dietary recall. The results of this formative evaluation and the planned validation study can inform the development of PSEAs for dietary intake data in low-resource settings.

Funding Sources

RTI International.

Supporting Images/Graphs

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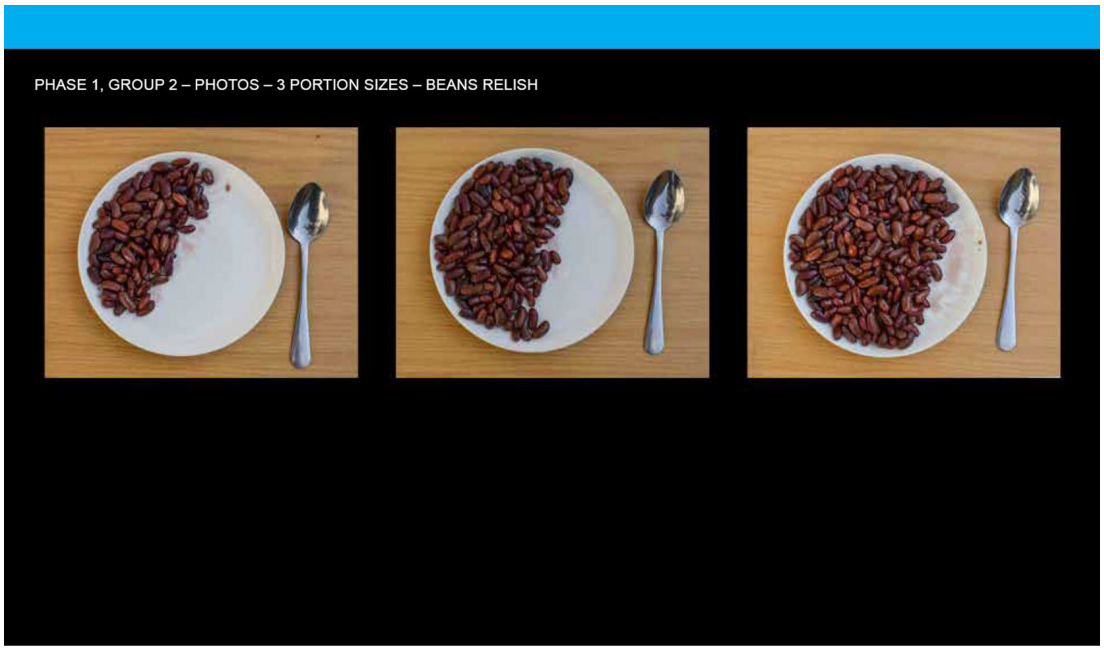

FIGURE E05-01-1 Photographs of 3 portion sizes, beans relish.

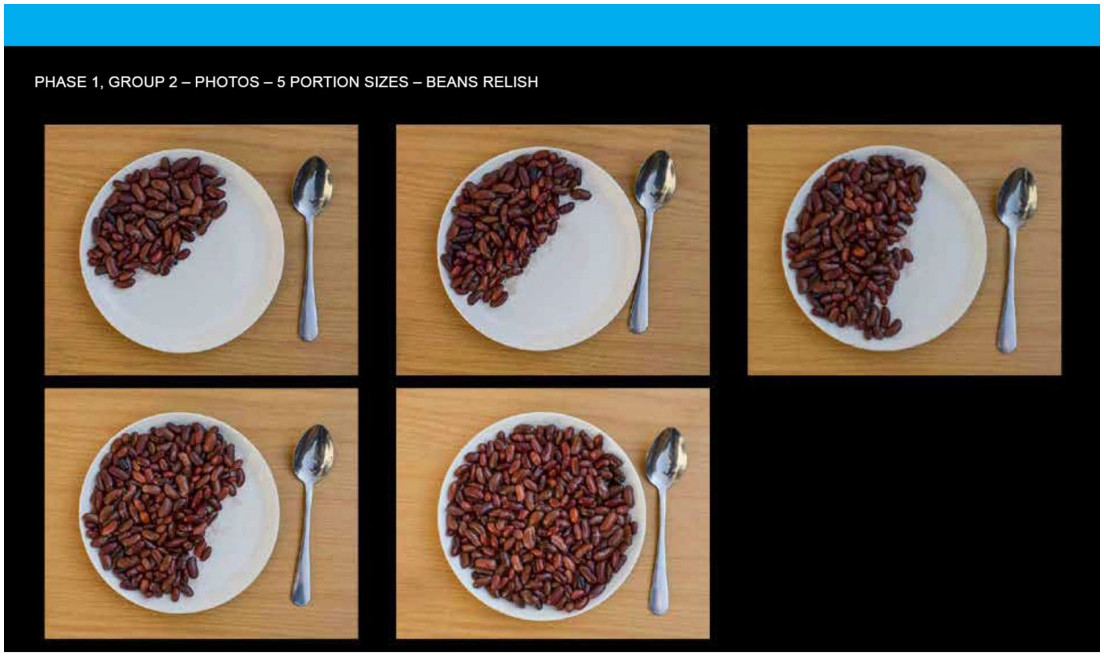

FIGURE E05-01-2 Photographs of 5 portion sizes, beans relish.

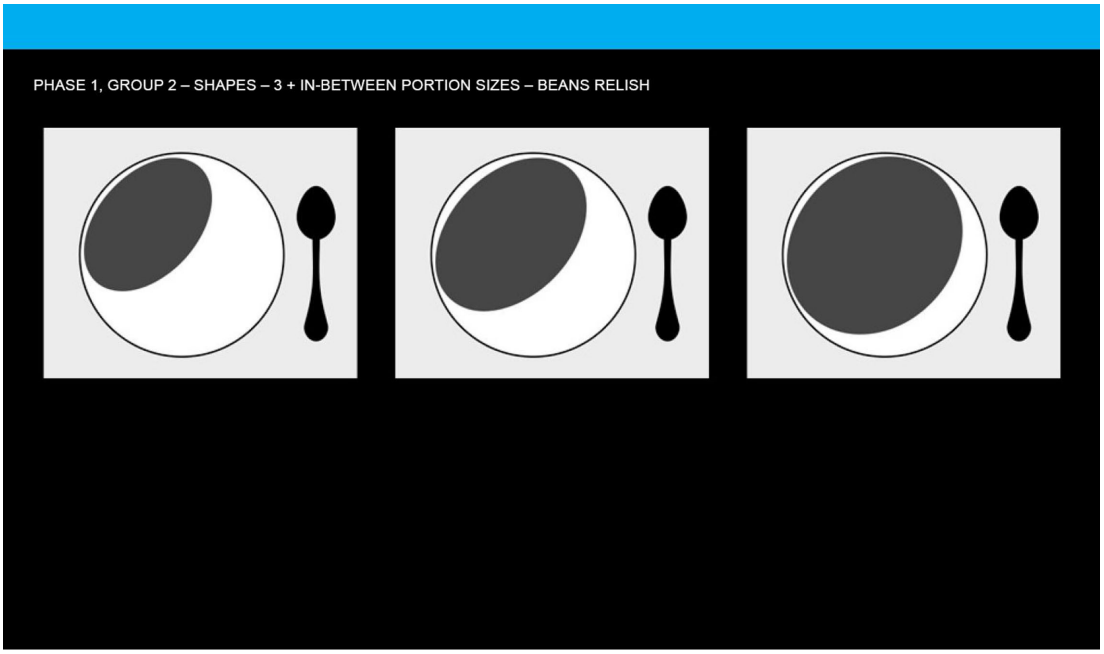

FIGURE E05-01-3 Shapes, E05-01-3 with in-between portion sizes, beans relish.

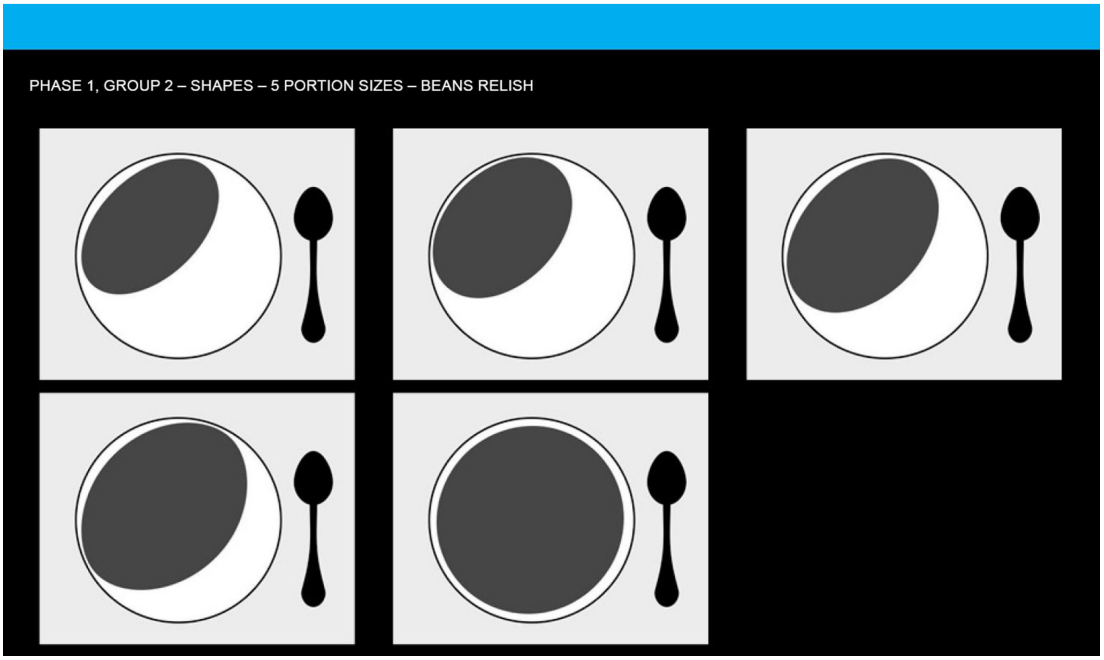

FIGURE E05-01-4 Shapes, 5 portion sizes, beans relish.

Reliability and Validity of Digital Images to Assess Plate Waste in a Restaurant Setting (E05-02)

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Objectives: Current methods for assessing child dietary consumption in restaurants are limited, particularly for large-scale use. Digital images (DIs) are valid and reliable for assessment in cafeterias, yet only preliminary evidence exists for restaurants. Given the significant increase in foods consumed away from home, an accurate and feasible method of determining consumption is critical. The objective of this study was to develop a robust digital imaging methodology and test reliability and validity compared with weighed plate waste (PW) for assessing consumption in the restaurant setting.

Methods: Participants were 656 parents (mean ± SD age = 35.9 ± 8.6 y; 69.1% female; 59.3% had not attended college) of children (mean ± SD age = 7.1 ± 2.5 y; 44.8% female; 58.4% Hispanic) who placed an order at 1 of 11 restaurants in 2 Massachusetts communities. Participants completed a survey and provided their child's PW to be measured in grams with a food scale. For DIs, PW was arranged on grid paper, details were annotated on the paper (e.g., packaging), and two angles were imaged. Two coders compared these images to reference images and, without referring to weighed plate waste data, used a modified Comstock scale to estimate the percentage of the original portion consumed. To calculate kcal consumed, grams consumed (DI and PW) were multiplied by kilocalories per gram (based on the restaurant's nutrition information). Intraclass correlations, Spearman correlations, Wilcoxon Signed Rank tests, and Bland-Altman plots assessed correspondence between methods.

Results: Coders demonstrated acceptable reliability overall (ICC = 0.84) and within each meal component (e.g., entrées, side dishes; ICCs = 0.65 to 0.97). DI estimates were highly correlated with PW overall (kcal $r = 0.96$, $P < .001$) and within meal components (rs = 0.85–0.98). DIs underestimated kcal by a small amount overall (mean diff = −1.61 kcal). Mean differences were statistically significant for 3 out of 5 components (Ps < 0.01), but actual discrepancies were only 0.69 to −2.68 calories.

Conclusions: The results demonstrate feasibility and reliability of using DIs to assess child meal consumption in restaurant settings, including both purchased food and leftovers, with additional improvements to validity recommended for some meal components.

Funding Sources

The JPB Foundation/

Validity of Estimated Intake of Flavonoids, Gluten, and the Whole Foods from which They Are Derived (E05-03)

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Objective: There is increasing interest in the impact of non-nutritive dietary components, such as flavonoids and gluten, on human health. Although food-frequency questionnaires (FFQs) are common dietary assessment tools in epidemiologic studies, their validity has rarely been examined for non-nutritive dietary components. We aimed to assess the validity of flavonoid and gluten intake, and the foods from which they are derived, as measured by FFQ compared to 7-d diet records.

Methods: The Men's Lifestyle Validation Study (MLVS) was conducted between 2012 and 2013 among 650 US men (mean ± SD age 69 ± 6 y) recruited from the Health Professionals Follow-up Study. Participants completed a 152-item semiquantitative FFQ at baseline and month 12, and 2 weighed 7-d dietary records (7DDR) at months 3 and 9. Data from USDA and Phenol-Explorer databases were used to derive FFQ and 7DDR intake estimates. The validity of FFQ-derived estimates was determined by comparing estimated intake by the second FFQ (focused on intake in the previous year) to estimated intake by the average of the 2 7DDRs through the use of Spearman rank correlation coefficients adjusted for total energy intake and within-person variation in 7DDR. We repeated the analysis without adjusting for total energy intake. We also assessed the validity of whole food intake estimates from the FFQ to assess factors contributing to the validity of dietary component estimates.

Results: The Spearman correlation coefficient (r) comparing total flavonoid intake from the second FFQ with average 7DDR was 0.55, with flavonoid subclasses having a median correlation of 0.45. Flavanone intake had the greatest validity ($r = 0.71$), and flavone intake was the only flavonoid subclass to have a correlation coefficient <0.40 ($r = 0.33$). The correlation coefficient for gluten was 0.58 and foods rich in gluten had a median correlation of 0.60 (ranging from $r = 0.11$ for sweet rolls to $r = 0.82$ for beer). Removing adjustment for total energy intake had little impact on the results.

Conclusion: FFQ-derived total flavonoid and gluten intakes generally demonstrated moderate to high validity when compared with 7DDR. This 152-item semiquantitative FFQ is appropriate for measuring these non-nutritive dietary compounds in large population-based studies.

Funding Sources

The Men's Lifestyle Validation Study was supported by supported by NCI U01CA152904 and UM1 CA167552. AS is supported by American Heart Association grant 16POST29660000. KLI is supported by a National Health and Medical Research Council early career fellowship.

All other authors have reported that they have no conflicts of interest to disclose.

Accuracy of 24-Hour Recalls Completed by Women with Low Incomes Using the Automated Self-Administered 24-Hour Dietary Assessment Tool (ASA24) (E05-04)

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Objective: The Automated Self-Administered 24-Hour Dietary Assessment Tool (ASA24) has been shown to perform well in capturing true intake among adults, but evidence to inform its use with low-income populations is lacking. This study was conducted to evaluate the accuracy of intake reported with ASA24 among women with low incomes.

Methods: True intake for 3 meals provided on one day was documented for 302 women, aged ≥18 y and with incomes below the thresholds for the Supplemental Nutrition Assistance Program. On the following day, women were randomly allocated to complete unannounced recalls with ASA24-2016, either independently ($n = 148$) or with assistance from a trained paraprofessional in a small group setting ($n = 154$). True and reported consumptions were compared and regression analyses applied to examine differences in agreement by condition for foods and beverages (matches, exclusions, and intrusions); energy, nutrient and food group intakes; and portion sizes.

Results: Participants who completed ASA24 independently compared with assistance reported 71.9% and 73.5% ($P = 0.26$) of items truly consumed, respectively. For both conditions, exclusions (consumed but not reported) were highest for lunch (at which participants consumed about twice the number of distinct foods/beverages on average compared to breakfast and dinner). Commonly excluded foods were additions to main dishes (e.g., tomatoes in salad). The average number of intrusions (reported but not consumed) was 2.4 and 2.5 ($P = 0.57$) for the independent and assisted conditions, respectively. The gaps between true intake and intake based upon reported consumption were significantly different between conditions for iron and folate. Within conditions, gaps were significant for protein, vitamin D, and meat (both conditions); vitamin A, iron, and magnesium (independent condition); and folate, calcium, and vegetables (assisted condition). For foods and beverages for which matches were reported, no difference in the gap between true and reported portion sizes was observed ($P = 0.11$).

Conclusions: ASA24 performed relatively well in capturing intake; however, accuracy was somewhat lower than that previously observed among a higher-income sample of adults. The provision of assistance did not significantly impact accuracy.

Funding Sources

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Examining the Value of Using Multiple Web-Based Dietary Assessment Instruments to Measure Population Dietary Intake—The PREDISE Study (E05-05)

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Objective: Web-based dietary assessment instruments offer distinct advantages over traditional methods including efficiency of administration and data processing. However, the value of combining multiple web-based 24-h recalls (HR) with a web food-frequency questionnaire (FFQ) to improve the precision of dietary intake estimates has not been investigated. The aim of this study was to compare combinations of instruments in their ability to measure dietary intakes.

Methods: In this cross-sectional multicenter investigation, adult men and women completed 3 randomly allocated web-based 24HRs and a web-FFQ within 21 d. Usual intake distributions of nutrients and foods from 24HRs were estimated through the use the National Cancer Institute (NCI) method with weekend, sequence, age, and FFQ (if applicable) as covariates. The reference method (Combination A, **Table 1**) was based on one 24HR in all participants plus a second recall in 40% of randomly selected participants, consistent with national dietary survey methodologies in Canada.

Results: A total of 1025 participants (50.2% female; mean ± SD age 42.9 ± 13.5 y) completed all questionnaires. Analyses showed no significant difference among the combinations in estimates of mean usual intake for saturated fats (SFAs), sodium, fish, fruits, and vegetables (**Table 1**). Moreover, compared with the reference method, the use of data from 3 web-24HRs only slightly narrowed the range of the 95% CIs for estimated intake of SFAs (−6.7%), sodium (−3.1%), fish (−6.5%), fruits (−30.2%), and vegetables (−2.0%). Considering data from a web-FFQ in combination with data derived from 3 web-24HRs did not further modify the 95% CI range for intake of SFAs (−0.7%), sodium (0.8%), fish (−1.2%), fruits (+9.7%), and vegetables (−2.7%).

Conclusions: These preliminary analyses suggest that with the NCI method, data from a single web-based 24HR repeated in only a subsample of individuals provide stable estimates of mean usual intake for selected nutrients and foods in a large cohort of French Canadians. Using web-24HRs on repeated occasions or in combination with data from a web-FFQ has marginal impact on the precision of estimated intake for most nutrient and foods even for seldom consumed foods such as fish.

Funding Sources

Canadian Institutes of Health Research.

Combinations	A	B	C	D
Days of web-24HR	1 + a second in 40% of participants	2	3	3
web-FFQ	No	No	No	Yes
Saturated fats (% of energy)	11.78 (11.42 to 12.14)	11.79 (11.46 to 12.13)	11.79 (11.46 to 12.13)	11.79 (11.46 to 12.13)
Sodium (mg/d)	3483 (3217 to 3749)	3473 (3200 to 3746)	3468 (3210 to 3725)	3469 (3209 to 3728)
Fish (servings/d)	0.25 (0.20 to 0.29)	0.24 (0.20 to 0.29)	0.24 (0.20 to 0.28)	0.24 (0.20 to 0.28)
Fruits (servings/d)	1.37 (1.28 to 1.46)	1.36 (1.27 to 1.44)	1.37 (1.31 to 1.43)	1.37 (1.30 to 1.44)
Vegetables (servings/d)	2.49 (2.41 to 2.57)	2.48 (2.41 to 2.56)	2.49 (2.41 to 2.56)	2.49 (2.42 to 2.56)

TABLE E05-05-1 Combinations of web-based dietary assessment instruments with corresponding mean estimates of usual dietary intake with 95% CIs for selected nutrients and foods in 1025 French Canadian men and women

The Grocery Purchase Quality Index-2016 Performs Similarly to the Healthy Eating Index-2015 in a National Survey of Household Food Purchases (E05-06)

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[1]University of Utah; and [2]Utah State University

Objective: The aim of this study was to validate the Grocery Purchase Quality Index-2016 (GPQI-2016) by comparing it with the Healthy Eating Index-2015 (HEI-2015). The GPQI-2016, a tool for assessing grocery food purchase quality, is based on expenditure shares for food categories found in the USDA Food Plans. It includes 8 adequacy components (Total Vegetables, Greens & Beans, Total Fruit, Whole Fruit, Whole Grains, Dairy, Total Protein Foods, and Seafood & Nuts) and 3 moderation components (Refined Grains, Sweets & Sodas, and Processed Meats).

Methods: In 2012 the USDA Economic Research Service conducted the National Household Food Acquisition and Purchase Survey. Household members recorded all foods acquired for a week. Using these data, the authors mapped foods to the 29 food categories used in USDA Food Plans and collapsed them into the 11 components of the GPQI-2016. Expenditure shares were estimated for each component. USDA food codes, provided in the survey database, were used to calculate the HEI-2015. After scoring purchases from food stores by participating households ($n = 4276$), the Spearman's correlation coefficient was used to compare GPQI-2016 scores with HEI-2015 scores. Linear regression models with fixed effects were used to determine differences among various subgroups of households.

Results: The correlation coefficient for the total GPQI-2016 and the total HEI-2015 scores was 0.70. Among the component scores, the lowest correlation was for Sweets & Sodas in the GPQI-2016 and Added Sugars in the HEI-2015 (0.65); the highest was for Whole Fruit (0.90), which is in both indexes ($P < 0.01$ for all components). Both the GPQI-2016 and the HEI-2015 were significantly different in expected directions for characteristics such as region, income, race/ethnicity, education, use of Nutrition Facts panels, and shopping with a list.

Conclusions: Overall, the GPQI-2016, estimated from a national survey of households, performed similarly to the HEI-2015. The tool has potential for use in nutritional epidemiology and for evaluating policies and interventions aimed at improving food environments and household purchases, including retail-oriented interventions when the nutrient content and gram weights of foods purchased are not available, as is typically the case.

Funding Sources

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Periodic Variations in Indicators of Malnutrition based on SMART Surveys in the Sahel (E05-07)

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Background: Malnutrition data are essential to assess the severity of a humanitarian crisis and guide decision-making for aid assistance. In low-income communities, the seasonal variations in malnutrition are likely to be pronounced and linked to food availability, food price fluctuations, harvest seasons, and their transitory proxies, including meteorologic factors. In communities affected by a crisis, such periodic variations may disappear. The stochastic erratic aperiodic spatiotemporal variations coupled with high prevalence of malnutrition could be indicative of severity.

Objectives: We aim to establish spatiotemporal patterns in malnutrition and examine the predictive capacity of meteorologic indicators to characterize those patterns and crisis severity.

Data and Methods: We abstracted nutrition records from 570,453 children (aged 6–59 mo) from 857 nutrition surveys in 12 countries across the Sahel (1/2005–6/2015) through the use of the Standardized Monitoring and Assessment of Relief and Transitions (SMART) approach. We compiled monthly averages of height-for-age (HAZ), weight-for-age (WAZ), and weight-for-height z scores (WHZ); as well as monthly average temperature, precipitation, soil moisture, and vegetation indexes from multiple public sources. We assessed spatiotemporal associations with the use of standard tools and mixed-effects harmonic models.

Results: Preliminary findings indicate large spatial variations across and within the Sahel region in prevalence of key malnutrition indicators: underweight, wasting, and stunting (of 20–36%, 8–19%, and 18–47%, respectively) (Figures 1 and 2). There are also substantial differences in temporal trends in key indicators, e.g., in Sudan the monthly mean HAZ is declining by 0.12 per year (P)

Conclusions: The observed associations will be examined on refined scales to take climate, security, and infrastructure into consideration, with the goal to better understand the spatiotemporal interactions between malnutrition and crisis situations.

Funding Sources
DARPA.

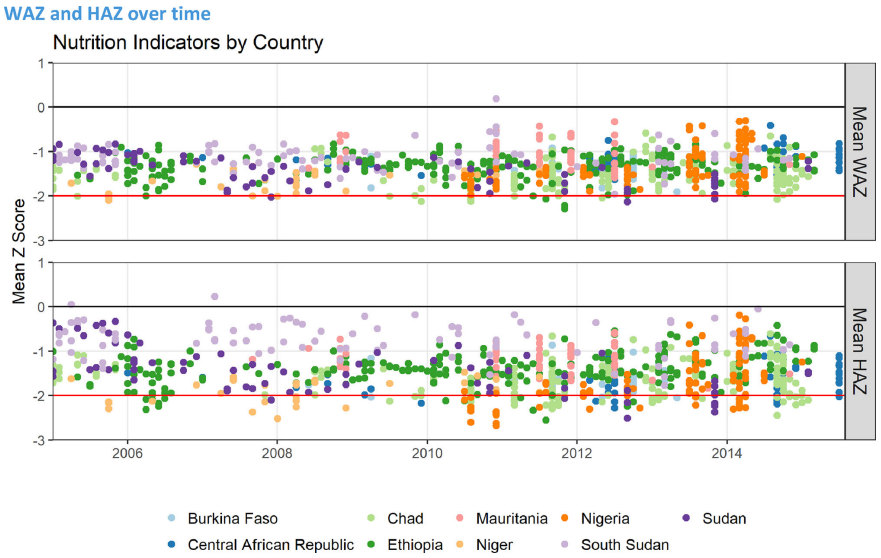

FIGURE E05-07-1 Weight-for-age and height-for-age *z* scores over time.

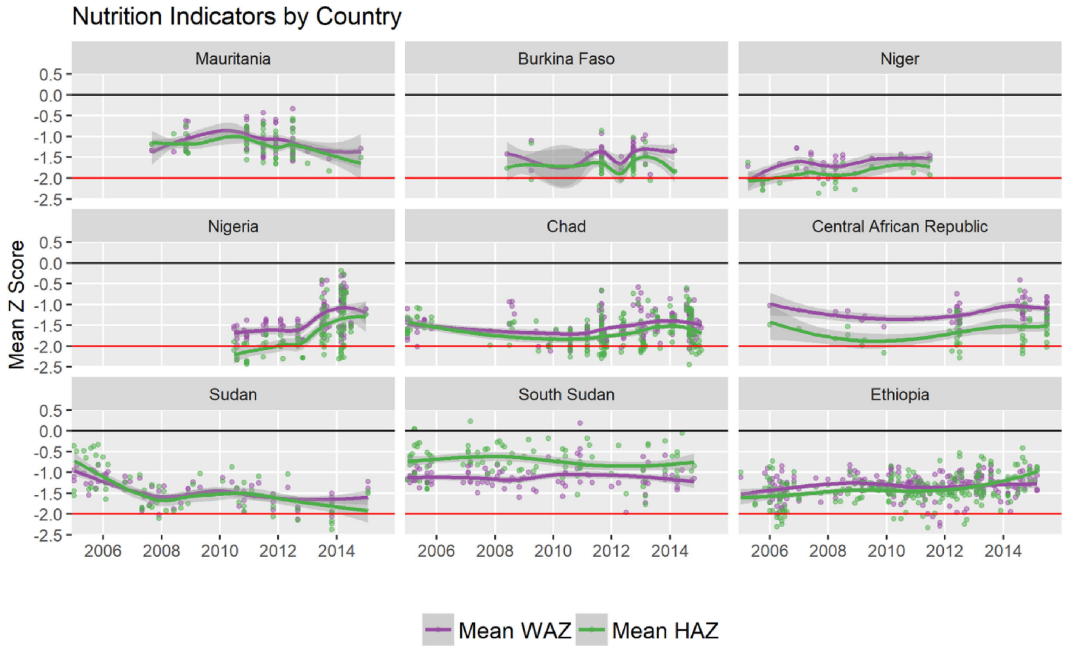

FIGURE E05-07-2 Weight-for-age and height-for-age *z* score trends by country.

Plant- and Animal-Based Diet Quality and Mortality among US Adults: National Health and Nutrition Examination Survey, 1999–2010 (OR18-01)

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Objectives: Increasing intake of plant-based foods and reducing intake of animal foods have been recommended for chronic disease prevention. However, not all plant- or animal-based diets exert the same health effects due to their various compositions. We aim to assess the quality of plant- compared with animal-based diet in relation to mortality among US adults.

Methods: Using dietary data collected from a nationally representative sample of 29,113 US adults from NHANES 1999–2010, we created a comprehensive Diet Quality Index (*c*DQI) to distinguish the quality of plant- and animal-based dietary components. Higher intake of healthful plant- or animal-based components received higher scores, whereas higher intake of less healthful components received lower scores. Mortality from all causes, cardiovascular diseases (CVD), and cancer were obtained from the National Death Index. Cox proportional hazard models were used to estimate HRs and 95% CIs after multivariable adjustments.

Results: During a median follow-up of 7.8 y, 2860 total deaths occurred, including 726 CVD deaths and 671 cancer deaths. Compared with individuals in the lowest quartile, those in the highest quartile of *c*DQI had 27% lower all-cause mortality (HR = 0.73, 95% CI: 0.62, 0.87; *P*-trend = 0.001) and 37% lower cancer mortality (HR = 0.63, 95% CI: 0.43, 0.92; *P*-trend = 0.03). After controlling for animal-based components, a higher quality of plant-based components remained significantly associated with lower all-cause mortality (Q4 compared with Q1: HR = 0.74; 95% CI: 0.62, 0.89; *P*-trend < 0.001) and cancer mortality (Q4 compared with Q1: HR = 0.62; 95% CI: 0.43, 0.91; *P*-trend = 0.02), whereas no associations were found for the animal-based components. The lower mortality associated with plant-based diet was stronger among individuals with comorbidities at baseline (all-cause mortality: HR = 0.69, 95% CI: 0.57, 0.83; *P*-trend < 0.0001; CVD mortality: HR = 0.66, 95% CI: 0.45, 0.98; *P*-trend = 0.04; cancer mortality: HR = 0.44, 95% CI: 0.24, 0.80; *P*-trend = 0.003).

Conclusion: Improving the quality of plant-based dietary components may play a more important role in reducing mortality than improving the quality of animal-based ones, especially among individuals with chronic health conditions.

Funding Sources

NIH/NIMHD 1R01MD011501.

Supporting Images/Graphs

Components	Max. Score	Standard for Max. Score	Standard for Min. Score of 0	Mean (95% CI)
Plant-based Components	65	*range: 0-65*		29.7 (29.2 -30.2)
Healthful				
Whole grains[1]	10	≥ 1.5 oz. equiv./1,000 kcal	No whole grains	2.08 (2.00 -2.17)
Vegetables excluding white potatoes[2]	10	≥ 1.25 cup equiv./1,000 kcal	No vegetables excluding white potatoes	4.45 (4.36 -4.55)
Whole fruits[1]	10	≥ 0.4 cup equiv./1,000 kcal	No whole fruit	4.34 (4.18 -4.51)
Nuts/seeds/legumes[2]	10	≥ 0.5 oz. equiv./1,000 kcal	No nuts, seeds or legumes	3.22 (3.11 -3.34)
Unhealthful				
Fruit juices[3]	5	No fruit juices	≥ 0.35 cup equiv./1,000 kcal	3.54 (3.48 -3.60)
Refined grains[1]	5	≤ 1.8 oz. equiv./1,000 kcal	≥ 4.3 oz. equiv./1,000 kcal	2.99 (2.94 -3.03)
White potatoes[3]	5	No white potatoes	≥ 0.35 cup equiv./1,000 kcal	3.08 (3.01 -3.15)
Added sugars[1]	10	≤ 6.5% of energy	≥26% of energy	6.02 (5.87 -6.17)
Animal-based Components	35	*range: 0-35*		18.9 (18.7 -19.1)
Healthful				
Fish/shellfish[2]	5	≥ 0.5 oz./1,000 kcal	No fish or shellfish	0.95 (0.91 -1.00)
Dairy[1]	5	≥ 1.3 cup equiv./1,000 kcal	No dairy	2.51 (2.46 -2.56)
Unhealthy				
Processed meats[3]	5	No processed meats	≥ 1 oz. equiv./1,000 kcal	3.32 (3.26 -3.37)
Red meats [3]	10	No red meats	≥ 1.6 oz. equiv./1,000 kcal	6.08 (5.97 -6.18)
Saturated fat[1]	10	≤ 8 % of energy	≥ 16% of energy	6.07 (5.98 -6.17)
Total *c*DQI score	100	*range: 0-100*		48.7 (48.0 -49.3)

1. Minimum and maximum scores are based on Healthy Eating Index (HEI)-2015 scoring criteria
2. Minimum and maximum scores are based on Alternative Healthy Eating Index (AHEI) scoring criteria adjusted to per 1,000 kcal
3. Minimum and maximum scores are based on the 80th percentile of intake among U.S. adults in NHANES 1999-2012

TABLE OR18-01-1 Components, scoring standards and mean score for the comprehensive diet quality Index (cDQI)

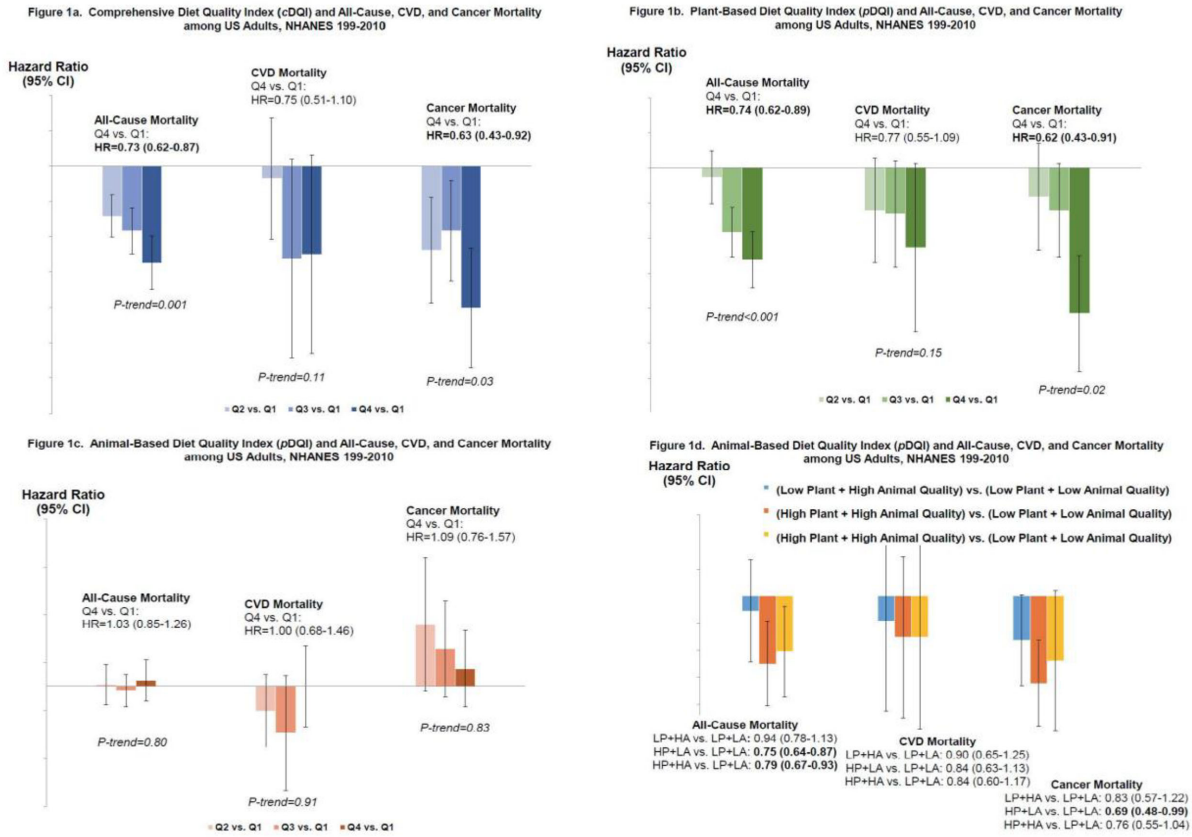

FIGURE OR18-01-1 Plant- and animal-based diet quality and all-cause, cardiovascular disease, and cancer mortality among US adults.

Dietary Intake and Food Sources of Total Sugars in the Quebec Population and their Impact on Health (OR18-02)

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Objectives: Health Canada recommends limiting the intake of total sugars to <20% of energy intake. Total sugars include sugars added to foods during processing and preparation, but also sugars naturally present in foods. The aim of this study was to examine dietary intake and food sources of total sugars in the Quebec population and their association with health indicators.

Methods: A nationally age- and sex-representative cohort of 1025 adults, aged 18–65 y, was used for this study. Total sugar intake was measured with 3 web-based 24-h dietary recalls. Body mass index (BMI), waist circumference (WC) and fasting high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides (TG), glucose, and insulin were also measured.

Results: More than one-third of adults (38%) exceeded Health Canada's cut-off for total sugars. Median intake was 106 g/d, representing 18.4% of energy intake. Percentage of energy from total sugars was higher for women than men (18.8% compared with 18.0%; $P = 0.03$). Most important food sources were sugar-sweetened beverages (SSBs, 18.7%), fruits (16.3%), milk and alternatives (13.5%), sweets (11.9%), and grain products (11.8%) in women, and SSBs (22.4%), grain products (12.8%), desserts (12.6%), milk and alternatives (12.5%), and fruits (12.0%) in men. A higher percentage of energy from total sugars was associated with higher insulin ($r = 0.11$, $P = 0.01$) in women and with lower BMI ($r = -0.12$, $P = 0.009$), WC ($r = -0.09$, $P = 0.05$), TG ($r = -0.10$, $P = 0.02$), and glucose ($r = -0.09$, $P = 0.04$) in men. In addition, associations between total sugar intake and health indicators varied according to the food sources. For example, in women, total sugar intake from fruits was associated with lower insulin levels ($r = -0.11$, $P = 0.01$), whereas total sugar intake from SSBs was associated with higher insulin ($r = 0.13$, $P = 0.004$).

Conclusions: A large proportion of adult Quebecers exceed the recommendation for total sugar intake. However, the association of total sugar intake with cardiometabolic health outcomes varies according to food sources. These findings suggest that dietary guidelines focusing on food sources and types of sugars (naturally present compared with added sugars) rather than on total sugar intake may be more relevant from a public health perspective.

Funding Sources

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Biomarker-Calibrated Total Sugar Intake and Risk of Obesity-Related Cancer in the Women's Health Initiative Observational Study (OR18-03)

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Objective: The aim of this study was to prospectively investigate biomarker-calibrated total sugar intake and risk of obesity-related cancers in the Women's Health Initiative (WHI) Observational Study.

Methods: A total of 71,656 postmenopausal women recruited from 40 clinical centers across the United States were followed up to 16 y. Total sugar (sum of glucose, fructose, galactose, sucrose, lactose, and maltose) and energy intake assessed by the WHI food-frequency questionnaire (FFQ), and self-reported physical activity (PA) were calibrated with the use of equations derived from a WHI biomarker substudy ($n = 450$) based on the use of the predictive biomarker for total sugars (i.e., 24-h urine sucrose and fructose) and the recovery biomarker for energy intake (i.e., doubly labeled water), respectively. We report multivariable HRs and 95% CIs for obesity-related cancer (breast, colorectal, endometrial, pancreatic, and kidney) and individual cancers for a 20% increase in calibrated total sugar density (g/1000 kcal) calculated from cancer-specific energy substitution Cox proportional hazards regression models adjusted for age, calibrated total energy intake, calibrated PA, and other covariates.

Results: We identified 6384 cases of obesity-related cancer, of which 4340 were breast, 1077 colorectal, 773 endometrial, 357 pancreatic, and 242 kidney cancer. The median calibrated total sugar intake in this population was 86 g/1000 kcal (IQR: 66, 111 g/1000 kcal). The age- and energy-adjusted HR for obesity-related cancer for a 20% increase in calibrated total sugars was 0.94 (95% CI: 0.91, 0.96), an association that was attenuated to nonsignificance in a multivariable model (1.01; 95% CI: 0.96, 1.06). None of the individually investigated cancers were associated with calibrated total sugars in multivariable models; HR for a 20% increase in calibrated total sugars was 0.99 (95% CI: 0.95, 1.04) for breast; 1.02 (95% CI: 0.91, 1.15) for colorectal; 1.03 (95% CI: 0.93, 1.14) for endometrial; 1.06 (95% CI: 0.90, 1.24) for pancreatic; and 1.03 (95% CI: 0.86, 1.23) for kidney cancer.

Conclusions: We found no association between calibrated total sugar consumption and obesity-related cancers. The biomarker-based calibration equation for total sugars explained only 34% of variation in "true" sugar intake, so null findings may be due to residual measurement error.

Funding Sources

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Dietary Patterns and Incidence of Type 2 Diabetes in Middle-Aged and Older Korean Adults: Results from the Korean Genome and Epidemiology Study (OR18-04)

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Objective: We tested the hypothesis that dietary patterns of middle-aged and older Korean adults are prospectively associated with an increased risk of type 2 diabetes mellitus (T2DM).

Methods: We used data from the Health Examinee Study of the Korean Genome and Epidemiology Study. This study included a total of 54,767 Korean adults aged ≥40 y with no history of T2DM or cancer at baseline. Dietary intake was assessed with a 106-item food-frequency questionnaire, and dietary patterns were derived by factor analysis. New T2DM cases were identified as any participant with fasting blood glucose levels ≥126 mg/dL, or those who were diagnosed with T2DM during the follow-up period. Multivariable Cox proportional hazards models were used to determine the HRs and 95% CIs for associations between T2DM risk and each dietary pattern after adjusting for sex, age, education, smoking, total alcohol intake, physical activity, family history of diabetes, survey site, body mass index, and total energy intake.

Results: During the 4.9 y of follow-up, 2545 participants developed T2DM. Using factor analysis, 4 major dietary patterns were identified: *1*) "high vegetables, mushrooms, and seaweeds", *2*) "high meat and fish", *3*) "high flour-based food and sweets", and *4*) "high white rice; low multigrain rice". In the study population, the "high vegetables, mushrooms, and seaweeds" pattern was inversely associated, whereas the "high meat and fish" pattern was positively associated, with incident T2DM. The multivariable-adjusted HRs for the highest compared with the lowest quintiles of the "high vegetables, mushrooms, and seaweeds" and "high meat and fish" pattern scores were 0.81 (95% CI: 0.71, 0.92; P-trend = 0.0103) and 1.22 (95% CI: 1.07, 1.39; P-trend = 0.0007), respectively. However, no associations were found between T2DM incidence and other two dietary patterns, i.e., "high flour-based food and sweets" and "high white rice; low multigrain rice".

Conclusions: Our findings suggest that dietary patterns, including high intakes of vegetables, mushrooms, seaweeds, fruits, and soy products, and low intakes of meat, fish, and poultry may potentially play a protective role in lowering the risks of T2DM in middle-aged and older Korean adults.

Nut Consumption after Diabetes Diagnosis in Relation to Subsequent Risk of Cardiovascular Disease and Mortality (OR18-05)

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Objectives: The aim of this study was to examine total and specific types of nut consumption, including tree nuts and peanuts, in relation to subsequent risk of cardiovascular disease (CVD), coronary heart

disease (CHD), total mortality, and CVD mortality among adults with incident diabetes.

Methods: We included 12,926 participants with incident diabetes diagnosed during follow-up (8715 women from the Nurses' Health Study and 4211 men from the Health Professionals Follow-Up Study), who were free of CVD and cancer at the time of diabetes diagnosis. Nut consumption before and after diabetes diagnosis was assessed with the use of a validated food-frequency questionnaire and updated every 4 y.

Results: During 154,932 person-y of follow-up, we documented 2396 incident CVD cases (including 1848 CHD cases) and 3837 deaths (including 1195 deaths from CVD). Higher nut consumption after diabetes diagnosis was associated with a lower risk of CVD incidence and mortality, after adjustment for potential risk factors. The multivariate HRs for participants who consumed 1 serving of nuts ≥5/wk, compared with those who consumed <1/m, were 0.83 (95% CI: 0.70, 0.98; *P*-trend = 0.009) for CVD incidence, 0.78 (95% CI: 0.65, 0.94; *P*-trend = 0.03) for CHD incidence, 0.84 (95% CI: 0.74, 0.95; *P*-trend) for total mortality, and 0.69 (95% CI: 0.55, 0.87; *P*-trend = 0.002) for CVD mortality. Consumption of tree nuts (≥2 times/wk) was associated with a 17% lower risk of CVD, a 18% lower risk of CHD, a 27% lower risk of total mortality, and a 42% lower risk of CVD mortality, whereas consumption of peanuts (≥2 times/wk), but not peanut butter, was associated with a 21% lower risk of total mortality. In addition, compared with participants who maintained the consumption of total nuts <1 time/wk before and after diabetes diagnosis, those participants who increased consumption of total nuts from <1 time/wk before diabetes diagnosis to ≥1 time/wk after diabetes diagnosis had a 17–30% lower risk of CVD incidence and mortality.

Conclusions: After diabetes diagnosis, higher consumption of nuts, especially tree nuts, was associated with a lower risk of subsequent CVD incidence and mortality. In addition, a greater increment in nut consumption from pre- to post-diabetes diagnosis was also associated with a lower risk of CVD incidence and mortality.

The Alternative Mediterranean Diet Score and Blood Pressure: A Cross-Sectional Study of US Participants in the INTERMAP Study (OR18-06)

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Objectives: Limited studies have investigated the relation between Mediterranean diet (MedD) and blood pressure (BP) outside of Mediterranean populations. Here, we assess possible BP benefits of a MedD in American adults through the use of the alternative MedD (aMed) a priori dietary score.

Methods: The International Study on Macro/Micronutrients and Blood Pressure (INTERMAP) surveyed 2195 American participants and collected standardized quality-controlled measures including, four 24-h dietary recalls, 2 timed 24-h urine collections and 8 blood pressure (BP) measurements. Diet was calculated as the average number of servings consumed per day with the use of the Nutrient Data Software for Research (University of Minnesota). The aMed score applies 1 point each for servings of vegetables, fruits, nuts, whole grains, legumes, fish, and monounsaturated-to-saturated fat ratio above the sex-specific median intake; 1 point for total red meat consumption below the median; 1 point for alcohol intake of 5–15 g/d; or 0 points for each uneaten food group. The possible score range for aMed was 0–9, with a higher score representing closer adherence to the MedD, which was categorized into 4 groups: 0–2, 3–4, 5–6, and 7–9 points.

Results: Mean ± SD aMed score was 4.12 ± 1.78 for men and 4.09 ± 1.78 for women. Persons with aMed score 7–9 points (n = 212) had lower sex-age-sample-energy adjusted mean ± SE intake of red meat (1.25 ± 0.12 compared with 3.57 ± 0.09 servings/d, $P < 0.0001$), significant higher intakes ($P < 0.0001$) of fish (1.23 ± 0.07 compared with 0.23 ± 0.05 servings/d), fruits (3.02 ± 0.12 compared with 0.89 ± 0.09 servings/d), vegetables (3.58 ± 0.10 compared with 1.43 ± 0.07 servings/d), whole grains (1.47 ± 0.07 compared with 0.28 ± 0.05 servings/d), compared with those scoring 0–2 points (n = 425). They had the lowest adjusted mean systolic (118.6 ± 1.1 compared with 124.2 ± 0.8 mm Hg, $P < 0.0001$) and diastolic (73.9 ± 0.8 compared with 76.8 ± 0.5 mm Hg, $P = 0.002$) BP. They also had the lowest adjusted mean body mass index and urinary sodium excretion and the highest adjusted mean urinary potassium excretion.

Conclusions: Our findings support following a lower sodium MedD for prevention/control of population-wide adverse BP levels. Further work is required to determine whether ethnicity/body mass index–specific or combined nutritional components contribute to BP control.

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Alcohol Consumption and Risk of Heart Failure: A Prospective Cohort Study and a Meta-Analysis (OR18-07)

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Objectives: The association between alcohol consumption and risk of heart failure (HF) remains controversial. The aim of this study was to examine the association between alcohol consumption and incident HF in Chinese adults, and to conduct a meta-analysis to summarize prospective data on alcohol and HF.

Methods: The prospective study included 97,310 Chinese men and women (mean age 51 ± 12 y) from the Kailuan Study who were free of HF in 2006 (baseline) and were followed up to December 2015. Baseline alcohol consumption was assessed via a questionnaire, and was grouped as never drinkers, former drinkers, light (women: 0–0.4 drinks/d, men: 0–0.9 drinks/d), moderate (women: 0.5–1 drinks/d, men:1–2 drinks/d), and high (women: >1 drinks/d, men: >2 drinks/d) alcohol intake. Incident HF at follow-up was defined as a first HF event, confirmed by review of medical records. The multivariable Cox proportional HR was used to examine the association between alcohol consumption and time to HF, adjusting for potential covariates including age, sex, education, monthly income, occupation, smoking status, physical activity, body mass index, hypertension, diabetes, and total cholesterol. A meta-analysis including 13 published prospective studies on alcohol and

heart failure, and this current study, was conducted through the use of random-effects models.

Results: During an average of 8.8 y follow-up, we documented 1597 incidentHF cases. Compared with never and past drinkers, the corresponding adjusted HRs for light, moderate, and high alcohol intake were 0.71 (95% CI: 0.59, 0.86), 0.84 (95% CI: 0.62, 1.13), and 0.63 (95%CI: 0.52, 0.76), respectively. In the meta-analysis including 491,374 participants, we observed a significantly lower risk for HF among light-drinkers [pooled HR for light alcohol intake compared with non-drinkers was 0.84 (95% CI: 0.80, 0.89)]. In contrast, we did not find significant associations between moderate and high alcohol intake and HF risk.

Conclusions: Alcohol intake was associated with a lower risk for HF incidence. Meta-analysis confirmed the lower risk of HF associated with light alcohol intake. However, because of large heterogeneity across studies, particularly for the moderate- and high-intake categories, the results should be interpreted with caution.

Results: Education modified the association of MxDQI and MxAHEI with total cholesterol and LDL cholesterol in men (P-interaction < 0.05). In men with the lowest education, a 10-unit increase in MxDQI and MxAHEI score was associated with a reduction in total cholesterol of 9.1% (95% CI: −16.0, −2.2%) and 11.6% (95% CI: −19.4, −3.8%), respectively. For men with the highest education, a 10-unit increase in MxAHEI score was associated with an increase in total cholesterol of 6.2% (95% CI: 1.7, 10.7%). A 10-unit increase in MxDQI score was associated with LDL cholesterol changes of −9.0% (95% CI: −17.5, −0.4%) and 4.1% (95% CI: 0.2, 7.9%), in men with the lowest and the highest education, respectively. In women, education modified the association of MxDQI and MxAHEI with glucose (P-interaction < 0.05). Among women with ≥10 y of school, a 10-unit increase in MxDQI and MxAHEI score was associated with increases in glucose of 2.5% (95% CI: 0.6, 4.4) and 3.5% (95% CI: 0.7, 6.4%), respectively.

Supporting Images/Graphs

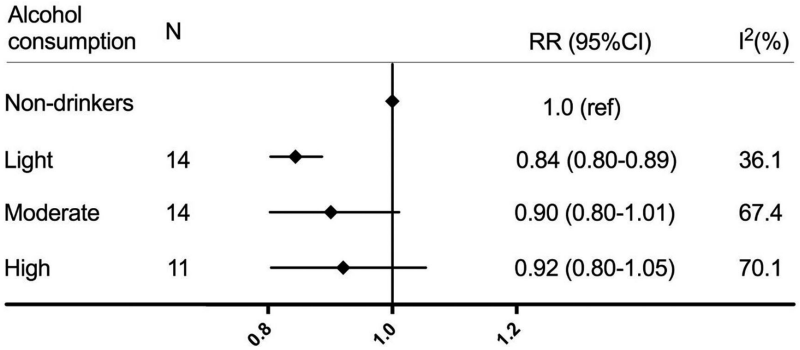

FIGURE OR18-01-1 Overall relative risk with 95% CIs of heart failure for light (0.1–7 drinks/wk), moderate (7.1–14 drinks/wk), and high (>14 drinks/wk) alcohol consumption compared with nondrinkers. *N*, number of included studies.

Education Modifies the Association of the Diet Quality with Cardiometabolic Biomarkers in Mexican Adults (OR18-08)

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Objective: The aim of this study was to determine the association of diet quality with cardiometabolic biomarkers, by education level, among Mexican men and women.

Methods: We used data on 633 men and 865 nonpregnant women without previous diagnosis of type 2 diabetes or hypertension from the Mexican National Health and Nutrition Survey 2012. We analyzed information of cardiometabolic biomarkers [glucose, insulin, triglycerides, total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and C-reactive protein] and constructed 2 diet quality indices [the Mexican Diet Quality Index (MxDQI) and the Mexican Alternate Healthy Eating Index (MxAHEI)]. Sex-specific multivariable regression models by education level (illiterate, literate or 3–9 y of school, and ≥10 y of school) were computed with the use of survey weights to account for complex design and adjusted for potential confounders. Outcome variables were transformed by taking the natural logarithm due to skewed data. We back-transformed the logged outcomes into percentage change to allow for interpretability.

Conclusions: The association between diet quality and cardiometabolic risk differs by sex and education level among Mexican adults. Improvement of diet quality represents an area for potentially reducing the cardiometabolic risk in illiterate men, for whom an inverse association of diet quality with total cholesterol and LDL cholesterol was observed.

Funding Sources

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The Influence of Food Processing Level on Overall Diet Quality of US Grocery Purchases: Findings from the National Household Food Acquisition and Purchase Survey (OR23-01)

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Objective: Little is known regarding the influence of processing level of food purchases on household (HH) diet quality. We sought to examine the association between processing level of HH grocery purchases and diet quality in a nationally representative US sample.

Methods: We analyzed grocery purchasing data (15,142 transactions) of 3952 US HHs participating in the nationally representative National Household Food Acquisition and Purchase Survey 2012/13. The NOVA classification was used to group all foods purchased for home consumption as minimally processed (MP), processed culinary ingredients (PI), processed foods (PF), or ultraprocessed foods (UPF). For each HH, calories from foods in each processing group were summed and divided by total energy purchased to estimate the groups' relative contributions to total energy purchased (% kcal). Healthy Eating Index (HEI)-2015 component and total scores were also calculated for HH purchases. Mean HEI-15 scores across NOVA food processing groups were computed, and substitution analysis with multivariable adjustment was used to examine the effect of replacing UPF and PF, respectively, with PI and MP foods on HEI-15 scores. Differences in foods purchased between HHs in the top compared with bottom tertile of UPF purchases (<43 compared with >67% kcal) with HEI-15 total score in the top compared with bottom tertile (<40 compared with >60) were examined by *t* test.

Results: MP, PI, PF, or UPF provided a mean ± SD of 28.5 ± 18.8%, 6.6 ± 12.8%, 9.2 ± 11.0%, and 55.7 ± 21.8% of purchased calories, respectively. Mean ± SD HEI-15 score was 54.7 ± 13.2. Substituting 10% of calories from MP and PI for UPF was associated with a 1.8-point decrease in HEI-15 score ($\beta = -1.8$; 95% CI: −2.1, −1.5). HHs with high UPF purchases and high HEI-15 score ($n = 179$) bought fewer soft drinks, cakes, cookies, ice cream and desserts, and more MP fruit, vegetables, and legumes than HHs with high UPF purchases and low HEI-15 score ($n = 398$, $P < 0.05$). Raw and cured meats, animal fats, and cheese provided 33% of calories purchased by HHs with low UPF purchases and low HEI-15 score ($n = 101$).

Conclusions: UPF provide over half of calories purchased by US families and greater UPF purchases are associated with lower diet quality. Our findings highlight the need to increase consumption of unrefined plant-foods and reduce consumption of highly processed high-sugar foods in the US population.

Funding Sources

This study was unfunded.

Simulating the Impact of Sodium Reduction in Packaged Foods on Population Intake and Sociodemographic Disparities among Americans (OR23-02)

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Objectives: Key packaged foods that are top sources of sodium intake among Americans have been identified as priority targets for sodium reduction, yet there have been few studies examining the impact that sodium reductions in these products would have on population intake, particularly in subpopulations for whom health disparities persist. We aimed to simulate the impact of sodium reductions in packaged foods on population intake among US adults and children, overall and for critical subpopulations, through the use of a comprehensive database of nutrition label data.

Methods: This study used 24-h dietary recall data for 2948 children and 4878 adults from NHANES 2011–2012. For each store-bought packaged food product reported by NHANES participants, we generated sales-weighted sodium content at the mean and 25th percentile through the use of the Nutrition Facts Panel data from 193,195 barcoded products purchased by US households in the Homescan Consumer Panel. We modeled the potential impact of reducing sodium levels in packaged foods from the mean to 25th percentile on population intake, overall and by race/ethnicity, income, and education.

Results: US adults and children could have decreased their sodium intake from packaged foods by 8.7% (−109 mg/d) and 8.0% (−97 mg/d), respectively, if the top 10 packaged food group sources had sodium content reduced from the mean to the 25th percentile levels. If all packaged foods had sodium content reduced, sodium intake from packaged foods could have decreased by 13.3% (−167 mg/d) among adults and 11.9% (−145 mg/d) among children. Predicted relative decreases in sodium intake resulting from sodium content reductions were smaller among those with lower compared with higher income or education.

Conclusions: Reducing sodium content levels in packaged foods to levels currently achieved by one-quarter of existing products reflects a technologically feasible sodium reduction that could significantly decrease sodium intake from packaged foods among Americans by up to 15%. However, differential impact by socioeconomic status indicates that sodium reduction in packaged foods may not result in equal improvements in sodium intake among disadvantaged populations. These findings help inform development of federal sodium reduction targets in the United States.

Funding Sources

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Exploring Diet Quality Differences of Food Purchases between WIC Households and Eligible non-WIC Households (OR23–03)

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New York University

Objective: One goal of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is to improve the diet quality of low-income children and pregnant women. The purpose of this analysis is to evaluate the differences in the diet quality of food purchases for WIC households and eligible non-WIC households, and assess whether diet quality changes when additional assistance is received from the Supplemental Nutrition Assistance Program (SNAP).

Methods: Food purchasing data from 2442 WIC eligible households in the National Household Food Acquisition and Purchase Survey (FoodAPS) were used in this analysis. FoodAPS defines WIC-eligible households as those with a female aged 14–49 y and at least 1 child <6 y old. Diet quality was assessed according to the Healthy Eating

Index-2015 (HEI), with higher numbers indicating better diet quality. All analyses were done with SAS version 9.4.

Results: Of the WIC eligible households, 16% reported participating in the WIC. Average total HEI scores did not differ between WIC households and eligible non-WIC households (51.3 and 51.4, respectively). Eligible non-WIC households had significantly higher mean HEI component scores for total vegetables (2.8) and total protein (3.6) compared with WIC households (2.5 and 3.5, respectively) ($P < 0.05$). The mean HEI component score for total fruit was higher among WIC households (2.4) compared with eligible non-WIC households (2.1) ($P < 0.01$). Approximately 63% of WIC households and ∼34% of eligible non-WIC households reported participating in SNAP. SNAP participation did not affect total HEI score for WIC households. Average total HEI scores differed by SNAP participation for eligible non-WIC households, with SNAP households having a lower mean total HEI score compared with non-SNAP households (48.0 and 53.2, respectively) ($P < 0.01$).

Conclusions: This study indicates that although overall diet quality does not differ between WIC and eligible non-WIC households, differences do exist within certain food groups (fruits and vegetables), and nutrients (protein). These results also reveal that SNAP participation is associated with worse overall diet quality of food purchases for eligible non-WIC households. Future analyses will assess the relation between diet quality of food purchases and obesity in this population.

Energy Density of Packaged Products Purchased by Mexican Households at Different Store-Types: Pre-and Post-Taxation Results (OR23-04)

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Objectives: The aim of this study was to examine the energy density of packaged food and beverage purchased by Mexican households in different store-types from 2012 to 2015, and determine whether this differs by socioeconomic status (SES).

Methods: A repeated cross-sectional analysis of household packaged food and beverage purchases from the Nielsen Mexico Consumer Panel Survey from 2012 to 2015 linked with nutritional information was done (household $n > 5500$). Sampling weights provided by Nielsen were used to calculate unadjusted means of energy density (kcal/100 mL or 100 g) of purchases by store-types (i.e., convenience stores, supermarkets, traditional retailers, wholesalers, and others). Changes in energy density over time by store-type and SES were examined with *t* tests.

Results: From 2012 to 2015, the energy density for total, taxed, and untaxed beverages purchased at convenience stores increased by 11, 5, and 10 kcal/100 mL ($P = 0.001$), respectively. For the total population, the energy density of taxed beverages purchased at supermarkets and wholesalers increased by 12 and 23 kcal/100 mL ($P < 0.001$), respectively, whereas the energy density of untaxed beverages purchased at supermarkets and wholesalers decreased by 6 and 21 kcal/100 mL ($P = 0.004$, $P < 0.001$), respectively.

In the same period, the energy density of total food purchases and taxed food purchases in wholesalers increased by 62 kcal/100 g ($P = 0.007$) and 177 kcal/100 g ($P = 0.001$), respectively. The energy density of taxed foods purchased at supermarkets decreased by 9 kcal/100 g ($P = 0.04$) overall, and by 16 kcal/100 g in the medium SES, whereas the energy density of taxed foods purchased at traditional retailers increased by 7 kcal/100 g ($P = 0.04$) overall and by 9 kcal/100 g ($P = 0.02$) in the medium SES. No significant changes in energy density were observed for the low SES, whereas the high SES presented an increase in energy density of 245 kcal/100 g in taxed food purchases made at wholesalers.

Conclusions: The increase in energy density of taxed beverages at convenience stores and wholesalers suggests that beverages with higher calories could have been purchased more in these store-types than in others in 2015 compared with 2014. Furthermore, the rise in the energy density of taxed foods purchased at wholesalers suggests that consumers could have turned to these outlets to obtain the taxed products more cheaply.

Funding Sources

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Trends in Dietary Sources of Protein in US Adults: Results from the National Health and Nutrition Examination Survey 1999–2010 (OR23-05)

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Objectives: Since 2000, US Dietary Guidelines have encouraged consumption of poultry, fish, and plant protein instead of red and processed meat. These healthier alternatives are considered to have reduced climate and water footprints as compared to ruminant meat (beef, lamb), but recent trends in the United States show that red or processed meat intake has remained stable over the last decade. There has been no study investigating if the intakes of subtypes of meat, which differ in environmental impacts, have changed. We delineate trends in sources of protein in US adults over the last decade.

Methods: Analyses were based on adults with one valid 24-h dietary recall in 6 survey cycles of NHANES 1999–2010. We used the Food Commodity Intake Database to convert all food items reported in dietary recalls to one of the following: beef, pork, lamb/goat, chicken, turkey, fish and shellfish, milk and milk products, eggs, legumes, and nuts and seeds. We examined the mean intake of each commodity item in the total sample and the percentage of participants consuming the item on a given day. Intake of all commodity items (g) was adjusted for body weight and expressed as g/kg. We used survey-weighted linear regression with survey cycles as a categoric variable to test for trend.

Results: Intake of chicken (0.47 to 0.52 g/kg), turkey (0.09 to 0.13 g/kg), fish and shellfish (0.21 to 0.27 g/kg), and legumes (0.21 to 0.26 g/kg) significantly increased, whereas intake of milk and milk products decreased (3.56 to 3.22 g/kg) in the total population from 1999 to 2010 ($P < 0.03$). On a given day, the proportion of the US population consuming chicken (44% to 49%), turkey (22% to 26%), fish and shellfish (18% to 21%), and nuts and seeds (75% to 78%) increased, whereas those consuming pork decreased (64% to 58%; all $P < 0.01$). Intake of beef, lamb/goat, and eggs did not change over time.

When we examined the trends by subgroups, those with higher incomes decreased the intake of beef, pork, lamb/goat, but the level of intake did not change among those with lower incomes.

Conclusions: Over the last decade, several dietary changes were observed, such as higher intake of poultry and plant protein. However, despite recommendations to reduce consumption, beef consumption does not appear to have changed in the total population or in lower-income participants.

Funding Sources

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Assessing Human Health Burden from Protein-Rich Foods with the Use of the Health Nutritional Index (HENI) (OR23-06)

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Objectives: The density and composition of dietary protein, an important source of essential amino acids, varies greatly within foods and there is a need to better understand the effect of these foods on health. Most dietary assessment tools fail to quantify the varying effects of major food groups and nutrients on health. We propose the Health Nutritional Index (HENI), a dietary assessment tool based on a comprehensive set of dietary risk factors, and use it to quantify the health burden associated with dietary protein sources.

Methods: HENI estimates the overall health quality of foods based on the consumption of 15 food elements identified as dietary risk factors by the Global Burden of Disease (GBD). For each food item, HENI quantifies the marginal reduction (+) or increase (–) in all-cause disease burden, in avoided disability adjusted life years per serving. It is calculated as the weighted sum of the amount of each the 15 risk factors in each food item ($g_{risk\ factor}$/srv), weighted by the marginal impact per $g_{risk\ factor}$ (avoided μDALY/$g_{risk\ factor}$). Age- and gender-adjusted weights are calculated through the use of information on disease incidence rates, disease severity, and GBD risk ratios. Food item composition is determined based on publically available databases. We calculate the HENI scores for 1393 food items identified as "protein foods" and "milk and dairy" in the USDA food coding scheme within the What We Eat America 2007–2012 dataset.

Results: HENI scores for protein-rich foods range from an impact of −105 avoided μDALY/srv (85 g cured meat) to a benefit of 100 avoided μDALY/srv (85 g fish), with milk being close to neutral. Results support a category-specific variation with substantial differences between negative scores for red and cured meats (health damage) and positive scores for plant-based foods and seafood (health benefit, Figure 1). When adjusted for protein density, variations within each protein group was reduced (Figure 2). Plant-based foods scored the highest benefit per $g_{protein}$, ranging between −15 and 60 avoided μDALY/$g_{protein}$ with a median of 1 avoided μDALY/$g_{protein}$.

Conclusions: HENI scores vary by categories of protein and dairy foods and identify seafood and plant-based foods as better protein sources that improve health. HENI could be an informative tool for nutrition education, health promotion, and personal dietary decision-making.

Funding Sources

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Diabetes Status in Relation to Discrepancy of Perceived and Measured Diet Quality in US Adults (OR23-07)

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Objective: The aim of this study was to examine the relation between diabetes status and discrepancy of Perceived Diet Quality (PDQ) and Measured Diet Quality (MDQ) through the use of the Healthy Eating Index 2010 (HEI-2010) and the Alternate Healthy Eating Index 2010 (AHEI-2010).

Methods: This study used a representative sample of US adults aged ≥20 y (n = 4097) in NHANES 2007–2010. PDQ was based on a 5-point Likert scale question that assesses self-perceived diet. MDQ was based on total HEI-2010 and AHEI-2010 scores as objective measures of diet quality. Both indices were calculated with the use of data from the first 24-h dietary recall. Discrepancy scores were calculated separately for HEI-2010 (PDQ-MDQ-HEI2010) and AHEI-2010 (PDQ-MDQ-AHEI2010) to determine the direction of the difference in PDQ and MDQ (discrepancy score = perceived – measured). Design-adjusted Rao-Scott chi-square test was used to examine bivariate associations among the predictors of discrepancy scores. Multinomial logistic regression was used to examine the associations between diabetes status and PDQ-MDQ-HEI2010 and PDQ-MDQ-AHEI2010, in tandem with controlling for sociodemographics, perceived health status, and attitudinal factors.

Results: The majority of participants in the sample overrated their diet quality for both PDQ-MDQ-HEI2010 and PDQ-MDQ-AHEI2010 (∼39.4% and ∼58.3%, respectively). Nondiabetics were more likely to overrate their diet than diabetics (PDQ-MDQ-HEI2010: 44.2%; PDQ-MDQ-AHEI2010: 43.9%). Diabetics were more likely to underrate their diet (PDQ-MDQ-HEI2010: 15.8%; PDQ-MDQ-AHEI2010: 16.4%). For the unadjusted models, results showed significant associations between diabetes status and discrepancy scores (PDQ-MDQ-HEI2010: P = 0.0178; PDQ-MDQ-AHEI2010: P = 0.0134). However, the associations were not significant after adjusting for perceived health status (PDQ-MDQ-HEI2010: OR = 1.2; 95% CI: 0.9, 2.0; PDQ-MDQ-AHEI2010: OR = 1.1; 95% CI: 0.7, 1.7). This suggests that individuals' perceived health has strong predictive power in relation to dietary misperception.

Conclusions: Diabetes status was significantly associated with the direction of the discrepancy between PDQ and MDQ. Interventions should target individuals who have inaccurate perceptions of their diet.

A Dietary Inflammatory Index Is Associated with Serum High-Sensitivity C-Reactive Protein in Korean Adults: The 2015 Korea National Health and Nutrition Examination Survey (OR23-08)

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Objective: The purpose of this study was to examine the association between the dietary inflammatory index (DII) scores and serum high-sensitivity C-reactivity protein (hs-CRP) in the Korean adult population.

Methods: A cross-sectional study was undertaken based on the Korea National Health and Nutrition Examination Survey (KNHANES) 2015 dataset, and making use of data from Korean adults aged ≥19 y for whom hs-CRP values were available. The final analytic sample for the present study is composed of 3496 Korean adults (1574 men and 1922 women). DII scores were calculated from one 24-h dietary recall, and hs-CRP was measured by the immunoturbidimetric method. To test the effect of the DII score on serum hs-CRP as continuous or dichotomous (>2 mg/l compared with ≤2 mg/l), multivariable linear and logistic regression analyses were performed from which adjusted linear regression coefficients (β) and adjusted odds ratios (AORs) and corresponding 95% CIs were computed. All statistical analyses were conducted with SAS version 9.4 (SAS Institute).

Results: Compared with the lowest DII quartile (representing the most anti-inflammatory diet), the adults in the highest quartile of the DII (representing the most proinflammatory diet) had higher levels of hs-CRP ($\beta = 0.037$, $P < 0.05$). Korean adults in the highest quartile of the DII in comparison with the lowest quartile of the DII had an increased odds of having elevated hs-CRP (>2 mg/l) (AOR = 1.54, 95% CI: 1.06, 2.24; P-trend = 0.02), after controlling for age, sex, education, marital status, alcohol consumption, smoking, body mass index, high-density lipoprotein cholesterol, and physical activity.

Conclusions: Consistent with previous findings, these results suggest that the DII is positively associated with hs-CRP, providing support for the pathway of how diet may influence the risk of inflammation-related diseases or conditions in the Korean adult population. Future studies are warranted to examine the effect of the DII on other inflammatory biomarkers and chronic disease outcomes in Korean populations.

Funding Sources

None.

Characterizing the Weight-Glycemia Phenotype of Type 1 Diabetes in Young Adults (OR28-01)

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Objectives: Young adults with type 1 diabetes (T1D) vary in their glycemic control and weight status. Our aim was to identify subgroups sharing a clinical phenotype of T1D based on weight status and glycemic control who may benefit from similar strategies to co-optimize weight and glycemia.

Methods: Data from 1817 young adults with clinician-diagnosed T1D in the SEARCH for Diabetes in Youth Study were analyzed. During a follow-up visit ≥5 y after T1D diagnosis, body mass index z score (BMIz) and hemoglobin A1c (HbA1c) were measured; other data were collected via survey. Participants were clustered by hierarchic agglomerative clustering with Ward's method based on joint distribution of BMIz and HbA1c, defined by the means, variances, and covariance generated from reinforcement learning tree predictions and denoised by 28 covariates. Gap statistics and elbow plots were used to select cluster number. Clusters were characterized by sociodemographic and clinical features, dietary intake, and physical activity (PA) levels. Poor glycemic control was defined as mean HbA1c ≥9%; overweight was defined as mean BMIz ≥1.04 corresponding to ≥85th percentile.

Results: The study sample was 49.5% female and 55.5% non-Hispanic White (NHW); mean ± SD age = 17.6 ± 4.5 y, T1D duration = 7.8 ± 1.9 y, BMIz = 0.61 ± 0.94, and HbA1c = 9.1 ± 1.9%. Six clusters were identified (Figure 1). The normal-weight subgroups with the best mean glycemic control (Cluster 1, 34.0%) had the highest proportion of NHW participants and reported the highest measures of socioeconomic status (SES) and insulin pump use, the greatest adherence to a DASH-style diet, highest levels of PA, and the lowest sedentary time (all $P < 0.001$). Overweight and obese subgroups (Cluster 5, 7.5%; Cluster 6, 15.4%) were predominantly female (66% and 55%, respectively). Subgroups with the poorest glycemic control (Cluster 4, 4.4%; Cluster 5, 7.5%) had the lowest proportion of NHW participants and reported the lowest SES, adherence to a DASH-style diet, and PA levels with the highest sedentary time (all $P < 0.001$).

Conclusions: There are distinct subgroups of young adults with T1D who share weight-glycemia phenotypes. Interventions to improve weight and glycemia may address differences in dietary quality and physical activity across phenotypic subgroups.

Funding Sources

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Supporting Images/Graphs

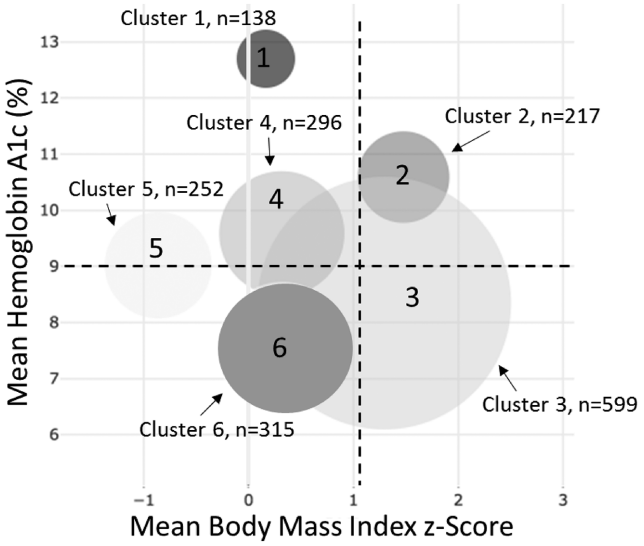

FIGURE OR28-01-1 Weight-glycemia phentotypic clusters from the SEARCH for Diabetes in Youth Study plotted by mean BMIz and HbA1c. Size of circle represents relative number of individuals per cluster. Shade represents correlation between BMIz and HbA1c. Dotted lines denote BMIz cutoff for overweight (BMIz $\geq$ 1.04) and HbA1c cutoff for poor glycemic control (HbA1c $\geq$ 9%), based on cluster means. Cluster 1: Normal weight, poor glycemic control (n = 138, mean BMIz 0.16 $\pm$ 0.81, mean HbA1c 12.7 $\pm$ 1.5) Cluster 2: Overweight, poor glycemic control (n = 217, mean BMIz 1.48 $\pm$ 0.45, mean HbA1c 10.6 $\pm$ 8.4); Cluster 3: Overweight (n = 599, mean BMIz 1.30 $\pm$ 0.55, mean HbA1c 8.4 $\pm$ 1.2); Cluster 4: Normal weight, poor glycemic control (n = 296, mean BMIz 0.32 $\pm$ 0.41, mean HbA1c 9.6 $\pm$ 1.3); Cluster 5: Borderline poor glycemic control (n = 252, mean BMIz $-$0.86 $\pm$ 0.68, mean HbA1c 9.0 $\pm$ 1.7); Cluster 6: Normal weight (n = 315, BMIz 0.33 $\pm$ 0.48, mean HbA1c 7.5 $\pm$ 0.9).

Longitudinal Change of Perceived Salt Intake and Stroke Risk in a Chinese Population (OR28-02)

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Objectives: Data elucidating the relation between salt intake and stroke have been inconsistent. This inconsistency could be because the majority of studies evaluated salt intake at a single time point, which may be insufficient to accurately characterize salt intake throughout the observation period. We thus examined whether salt intake trajectories were associated with incident stroke in a Chinese population.

Methods: In total 77,605 participants from the Kailuan Study were included in this work. We assessed perceived salt intake via a validated questionnaire in 2006, 2008, and 2010. Salt intake trajectories during 2006–2010 were identified through the use of latent mixture models. Incident stroke cases were identified during 2010–2015 and confirmed by review of medical records. A Cox proportional hazards model was used to examine the association between salt intake trajectories and stroke risk, after adjusting for possible confounders, including age, sex, lifestyle, social economic status, body mass index, use of medicines, blood pressure, and lipoprotein profiles.

Results: We identified 5 distinct salt intake trajectories: moderate-stable (n = 59,241), moderate-decreasing (n = 9268), moderate-increasing (n = 2975), low-increasing (n = 2879), and high-decreasing (n = 3242). During the 5-y follow-up period there were 1564 incidentstroke cases. Compared with individuals with the moderate-stable salt intake trajectory, individuals with moderate-decreasing salt intake trajectory had significantly lower cerebral infarction stroke risk (adjusted HR: 0.77; 95% CI: 0.62, 0.95), but not intracerebral hemorrhage risk (adjusted HR: 0.84; 95% CI: 0.55, 1.29). Further adjustment for 2006 or 2010 perceived salt intakes generated similar results. When baseline perceived salt intake only was used as the exposure, a significant dose-response relation between higher perceived salt intake and higher stroke risk was observed (P-trend = 0.006).

Conclusions: Changes in salt intake were associated with stroke risk. These data support the dietary recommendation to reduce of salt intake.

Funding Sources

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Supporting Images/Graphs

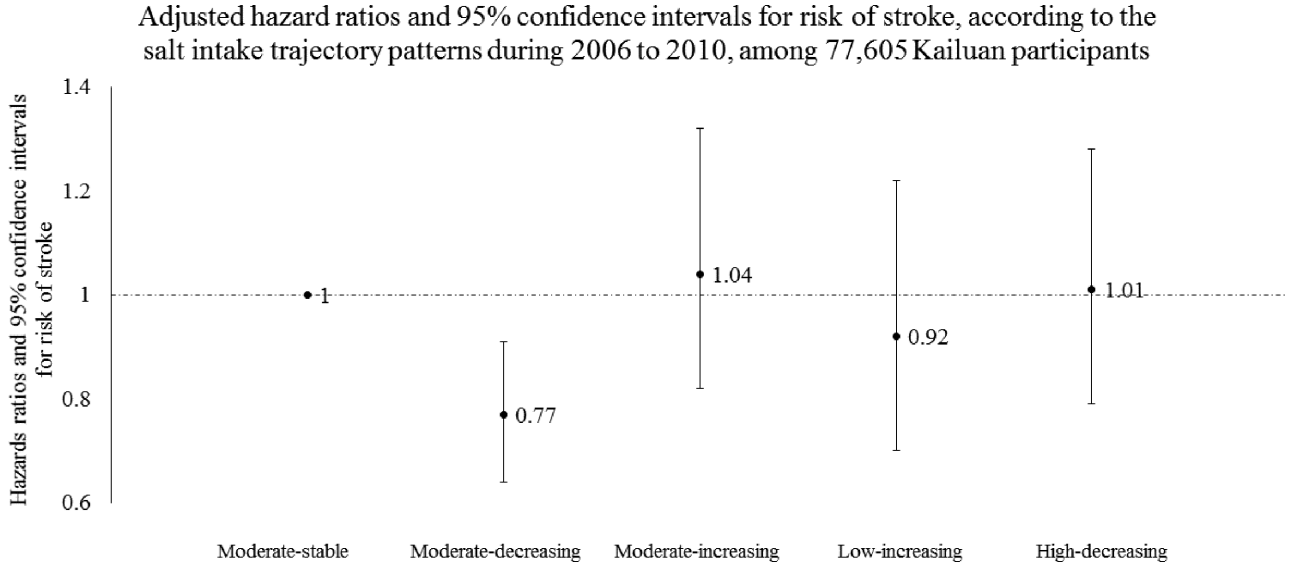

FIGURE OR28-02-1 Salt intake and stroke.

Diet Beverage Intake and Risk of Incident Stroke in People with Type 2 Diabetes: An Individual-Level Meta-Analysis (OR28–03)

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Objectives: Diet beverages are calorie-free beverages sweetened with nonnutritive sweeteners. People with diabetes are the highest per-capita consumers of diet beverages, tending to consume them as a replacement for dietary sources of sugar, especially in place of sugar-sweetened beverages. This behavior is endorsed by dietetic and scientific organizations, and diet beverages are marketed synonymously with better health. The underlying concern is the lack of data to support or refute this concept. To begin addressing this gap, we examined the association between diet beverage intake and incident stroke in a population at high risk for cardiovascular disease (CVD_.

Methods: We pooled the data sets of the Atherosclerosis Risk in Communities (ARIC) study (1987–2014), the Cardiovascular Health Study (CHS) (1989–2014), the Framingham Offspring Study (FOS) (1995–2014), the Jackson Heart Study (JHS) (2000–2012), and the Multi-Ethnic Study of Atherosclerosis (MESA (2000–2013) to conduct a prospective examination of the association of diet beverage intake with the incidence of stroke among participants with clinically ascertained type 2 diabetes (T2D) without prevalent stroke/CVD and with valid dietary data ($n = 3999$). We carried out a 2-step meta-analysis that used individual-level, cohort-specific Cox regression analyses with identical adjustment for demographic, lifestyle, overall diet quality (Alternative Healthy Eating Index), energy intake, and clinical risk factors (total cholesterol, blood pressure, fasting glucose) to generate effect estimates that were pooled together through the use of fixed- and random-effects meta-analysis.

Results: In total, 514 participants had an adjudicated stroke during follow-up. There was a positive association between diet beverage intake and risk of incident stroke. Compared with individuals reporting no intake of diet beverages, those consuming >0 and ≤1 diet beverage/d had a pooled relative risk (RR) of 1.25 (95% CI: 1.00, 1.56) and those consuming ≥1 beverage/d had a pooled RR (95% CI) of 1.33 (95% CI: 1.06, 1.67).

Conclusions: Diet beverage intake was associated with an increased risk of stroke in a diverse population with T2D. These results suggest the need to further evaluate the role and health effects of diet beverages in this high-risk population.

Funding Sources

American Heart Association.

Long-Term Diet Quality and Risk of Type 2 Diabetes among Urban Chinese Adults (OR28-04)

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Objectives: Little evidence exists regarding long-term diet quality and risk of type 2 diabetes among Asian populations, who have undergone a nutrition transition and a diabetes epidemic.

Methods: A total of 117,919 Chinese men and women, aged 40–74 y, free of diabetes, cardiovascular disease, and cancer at baseline, were followed from 1996 to 2015. Diet quality was assessed by a healthy diet score (HDS) based on 8 commonly consumed food groups previously suggested to be related to diabetes. Long-term diet quality and its changes were assessed by repeated surveys performed with food-frequency questionnaires.

Results: We identified 6111 incident diabetes cases during a mean follow-up of 11.5 y. Higher HDS was associated with lower diabetes risk: HR = 0.85 (95% CI: 0.78m 0.92) in the highest compared with lowest quintile, P-continuous < 0.0001, after adjustment for potential confounders including body mass index. Maintaining a high HDS

during follow-up was associated with 26% lower risk than a consistently low HDS: HR = 0.74 (95% CI: 0.63, 0.85). The inverse association between HDS and diabetes was observed regardless of participants' age, sex, smoking and exercise habits, obesity status, and metabolic disease status, but was more prominent among those who had leisure-time exercise (*P*-interaction = 0.004). When considered jointly, a sustained high HDS plus exercise was associated with 45% reduced risk of diabetes: HR = 0.55 (95% CI: 0.45, 0.67).

Conclusions: A high-quality diet, especially maintained for the long term and in conjunction with leisure-time exercise, is associated with lower risk of type 2 diabetes among urban Chinese adults.

Funding Sources

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Association of Plasma Vitamin D Metabolites with Incident Type 2 Diabetes: EPIC-InterAct Case-Cohort Study across Eight European Countries (OR28-05)

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Background and Objectives: Existing evidence for the prospective association of vitamin D status with type 2 diabetes (T2D) is focused almost exclusively on circulating total 25-hydroxyvitamin D [25(OH)D] without distinction between its subtypes: nonepimeric and epimeric $25(OH)D_3$ stereoisomers; and $25(OH)D_2$, the minor component of 25(OH)D. We aimed to investigate the prospective associations of circulating levels of the sum and each of these 3 metabolites with incident T2D.

Methods: This analysis in the EPIC-InterAct case-cohort study for T2D included 9671 incident T2D cases and 13,562 subcohort members. Plasma vitamin D metabolites were quantified by LC-MS [nonepimeric $25(OH)D_3$, $n = 22{,}651$; epimeric $25(OH)D_3$, $n = 8986$; $25(OH)D_2$, $n = 1012$, with missing data due to concentrations lower than the detection limit]. We used multivariable Prentice-weighted Cox regression to estimate the HRs of T2D for each metabolite. Analyses were performed separately within country, and estimates combined across countries through the use of random-effects meta-analysis.

Results: The mean ± SD concentrations of total 25(OH)D, nonepimeric $25(OH)D_3$, epimeric $25(OH)D_3$, and $25(OH)D_2$ were 41.1 ± 17.2, 40.7 ± 17.3, 2.13 ± 1.31, and 8.16 ± 6·52 nmol/L, respectively. Plasma total 25(OH)D and nonepimeric $25(OH)D_3$ were inversely associated with incident T2D [multivariable-adjusted HR per 1 SD = 0.81 (95% CI: 0.77, 0.86) for both variables], whereas epimeric $25(OH)D_3$ was positively associated: per 1 SD HR = 1.16 (95% CI: 1.09, 1.25). There was no statistically significant association with T2D for $25(OH)D_2$: per 1 SD HR = 0.94 (95% CI: 0·76, 1·18). These results remained similar in categoric analyses including participants whose concentrations were too low to detect.

Conclusions: Plasma nonepimeric $25(OH)D_3$ was inversely associated with incident T2D, consistent with it being the major metabolite contributing to total 25(OH)D. The positive association of the epimeric form of $25(OH)D_3$ with incident T2D warrants further investigation in diabetes aetiology.

Funding Sources

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Has the Prevalence of Overweight, Obesity, and Central Obesity Leveled-Off in the United States? Trends and Disparities of the Obesity Epidemic and Future Projections (OR28-06)

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Objective: The aim of this study was to systematically examine time trends and disparities in prevalence and projected adiposity and obesity (OB) measures in the United States by socioeconomic and ethnic groups, and geographic region.

Methods: We analyzed NHANES 1999–2016 and Behavioral Risk Factor Surveillance System (BRFSS) 2011–2016 data, and conducted projections for US adults and children. Standard definitions were used to classify overweight (OW), OB, and severe obesity (SOB), based on body mass index cut-points and percentiles. Central obesity (CO) was assessed based on waist circumference cut-points in adults and waist-height ratio cutoffs in children.

Results: While OB prevalence has consistently risen since 1999, considerable disparities were detected across groups and regions. Among adults, men's OB (33.7%) and OW/OB (71.6%) leveled off in 2009–2012, but resumed their increase to 38.0%/74.7%, respectively, in 2015–2016. Women showed uninterrupted increases in OB and OW/OB prevalence since 1999, reaching 41.5% and 68.9%, respectively, in 2015–2016. SOB levelled off in 2013–2016 (men: 5.5–5.6%; women: 9.7–9.5%), after annual increases of 0.2% since 1999. Non-Hispanic (NH) blacks had the highest levels of OB/SOB among women and SOB among men. Boys' OB prevalence rose continuously to 20.6% and SOB to 7.5% in 2015–2016, unlike girls. If trends continue, by 2030, most of Mexican American will be OW/OB; ∼50% of adults will be OB, whereas ∼33% of children (aged 6–11 y) and ∼50% of adolescents (aged 12–19 y) will be OW/OB. During 1999–2014, CO was steadily rising overall and is projected to reach 55.6% in men and 80.0% in women, 44.0% among girls and 39.0% among boys by 2030. BRFSS data show regional differences in adult obesity prevalence (2011–2016) and across ethnicities, with the South (32.0%) and the Midwest (31.4%) showing the highest rates.

Conclusions: US OB and OW prevalence has been on the rise in recent years, with a brief leveling-off in 2009–2012. Wide disparities

exist across sex, age, race/ethnicity, and geographic region. Sustainable, effective, and culturally tailored interventions are needed.

Funding Sources

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Longitudinal Associations of Dietary Behaviors in Childhood with Adiposity in Adolescence (OR28-07)

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[1]Harvard Medical School—Harvard Pilgrim Health Care Institute, MA; and [2]Massachusetts General Hospital

Objectives: Despite the growing prevalence of overweight and obesity in children, the contributing role of dietary behaviors throughout childhood remains poorly understood. We examined longitudinal associations of dietary behaviors throughout childhood with body mass index *z* scores (BMIZ), waist circumference (WC), and whole-body fat percentage (WBF%) in adolescence.

Methods: Among 1027 children from Project Viva, a prebirth cohort from eastern Massachusetts, we examined associations of maternal- or child-reported dietary behaviors (breakfast and fast-food intake, family dinner, and watching television during meals) annually from ages 4 to 12 y with BMIZ, WC, and WBF% (estimated by dual-energy X-ray absorptiometry; $n = 735$) in adolescence (median 12.9 y). We used mixed-effects models adjusted for maternal education, prepregnancy BMI, marital status and parity, and child's ages at exposure and outcome, sex, and race/ethnicity.

Results: The frequency of healthful dietary behaviors decreased with advancing child age from age 4 to 12 y: eating breakfast daily from 86% to 64%, eating dinner together with family daily from 57% to 34%, eating fast food meals <1 time/wk from 77% to 61%, and watching television during meals <1 time/wk from 63% to 53%. BMIZ (mean ± SD: 0.37 ± 1.06 units) in adolescence was lower in children who reported daily breakfast eating (β −0.14; 95% CI: −0.20, −0.07), daily family dinner (β −0.09; 95% CI: −0.13, −0.04), fast food <1 time/wk (β −0.08; 95% CI: −0.13, −0.03), and television during meals <1 time/wk (β −0.09; 95% CI: −0.13, −0.04) throughout childhood. WC (mean ± SD: 73.1 ± 11.8 cm) and WBF% (mean ± SD 28.5% ± 7.5%) in adolescence were also lower with daily breakfast (β −1.35; 95% CI: −2.06, −0.64; and β −1.35; 95% CI: −1.88, −0.82) and television during meals <1 time/wk (β −1.18; 95% CI: −1.69, −0.66; and β −0.64; 95% CI: −1.03, −0.25) throughout childhood. Family dinner was not associated with WC or WBF%, and eating fast food <1 time/wk throughout childhood was associated with a lower WC (β −0.74; 95% CI: −1.27, −0.21), but not with WBF% in adolescence.

Conclusions: Healthful dietary behaviors throughout childhood are associated with lower BMIZ and adiposity measures. Healthier dietary behaviors, which are possibly associated with a healthier overall diet quality, could be translated into simple and applicable dietary advice for families and communities.

Funding Sources

National Institutes of Health—NICHD.

The Effect of an Inflammatory Diet on Sleep Parameters and Apnea Severity in Sleep Apnea Patients (OR28-08)

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Background: Studies have demonstrated an association between inflammatory diet and several diseases, including asthma, obesity, and cancer; however, there are no studies analyzing the effect of this diet on sleep architecture and apnea severity in obstructive sleep apnea (OSA) patients.

Objectives: The aim of this study was to evaluate the effect of an inflammatory diet on sleep parameters and apnea severity in OSA patients; in addition, trends in nutrient intake and anthropometric measures on inflammatory diets were also observed.

Methods: A total of 296 OSA patients were evaluated in this cross-sectional and observational study in a private clinic in a city of Minas Gerais state, Brazil. Sleep architecture and apnea severity were evaluated by an overnight polysomnography examination. Anthropometric measures included neck circumference, weight, and height. Dietary intake was obtained by a food-frequency questionnaire to calculate the dietary inflammatory index (DII). Higher DII scores indicated a greater proinflammatory potential of the diet, whereas lower scores indicated more anti-inflammatory diets. DII values were converted to quintiles (Q) (Q1 < -2.37; Q2 $= -2.37$ to -1.68; Q3 $= -1.67$ to -0.86; Q4 $= -0.85$ to -0.23; and Q5 > -0.24). Trends were tested for variables and pro- and anti-inflammatory food parameters across quintiles of DII score. A result was deemed significant if $P < 0.05$.

Results: The data showed increasing trends across quintiles of DII for weight ($P < 0.01$) and neck circumference ($P < 0.01$), both factors that contribute to a worsening in OSA severity, whereas significant decreasing trends were observed for age ($P < 0.01$) and sleep efficiency ($P = 0.04$). Apnea severity and sleep stages did not present significant results across quintiles. A significant increasing trend was observed across quintiles for total and saturated fat ($P < 0.01$ for both), proinflammatory nutrients, as for monounsaturated fat ($P = 0.02$), and significant decreasing trends were observed for anti-inflammatory nutrients, fiber and ω-3 (n–3) ($P < 0.01$ for both), as for carbohydrates ($P < 0.01$).

Conclusions: A trend for worse sleep and apnea patterns was found in OSA patients with a more inflammatory diet. This outcome showed that food patterns may be a relevant factor to consider in nutritional strategies as these patterns could have a negative influence on sleep quality and OSA severity.

Funding Sources

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Comparison of Existing Models to Predict Reductions in Neural Tube Defects Due to Folic Acid Fortification: Case Study from Cameroon (OR40-01)

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Objectives: A variety of models have been developed to predict the effectiveness of flour fortification programs at preventing neural tube defects (NTDs), but each relies on different assumptions. Our objective was to compare these predictive models that quantify the relation between folic acid fortification and the number of NTD cases or deaths averted in Cameroon, and to better understand the sources of differences in predicted effects.

Methods: We used 24-h dietary recalls and serum folate concentrations from the Cameroon National Micronutrient Survey ($n = 902$) to compare the Lives Saved Tool (LiST), and models developed by Arth et al., Wald et al., and ourselves to predict the effect of folic acid fortification of wheat flour (5.0 μg folic acid/g flour) on the reduction of the incidence of NTDs. In sensitivity analyses, we assessed how various fortification levels influence the estimated number of NTDs averted. Based on biological plausibility, we expected the number of NTDs to decrease as fortification levels increase and then ultimately plateau.

Results: The predictive models differed in terms of data sources, assumptions, and outcome measures (NTD cases compared with deaths averted). The estimates of NTDs averted due to folic acid fortification at 5.0 μg/g varied by predictive model, with 15% of NTD cases averted in Wald et al.'s model, 21–23% of NTD deaths averted in the LiST and our models, and 75% of NTD cases averted in Arth et al.'s model. As the fortification level increased from 1.0 to 7.0 μg/g, the predicted number of NTDs averted increased and then plateaued in the LiST and our models; increased continuously in Wald et al.'s model; and had a sharp increase from 37.5% to 75% of NTD cases when the fortification level surpassed 3.0 μg/g in Arth et al.'s model.

Conclusion: The 4 models predicted substantially different reductions of NTDs. Only the LiST and our model predicted the expected effects of increasing fortification levels. These inconsistencies pose challenges for policymakers interested in the potential benefits of national fortification strategies. A global system that tracks and compiles the data on NTDs and women's folate status required to validate these models is urgently needed.

Funding Sources

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Supporting Images/Graphs

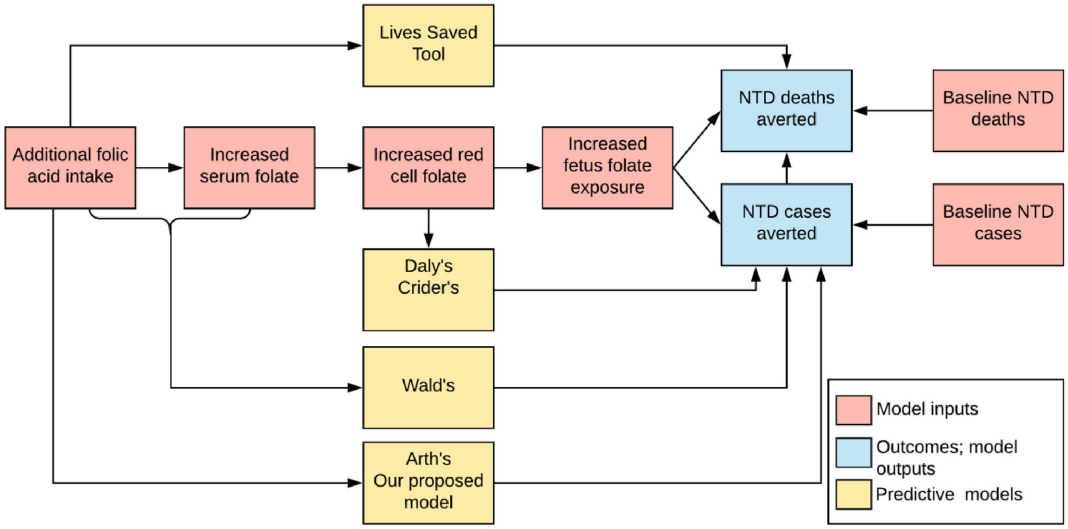

FIGURE OR40-01-1 Biological pathway of folic acid-neural tube defect (NTD) predictive models.

The Influence of Household Income and Participation in Women, Infants, and Children on Prenatal Diet Quality (OR40-02)

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Objectives: Few studies have explored income disparities in prenatal diet quality and whether participation in Women, Infants, and Children (WIC) improves maternal nutrition. Given the importance of prenatal diet to maternal and child health, this study examined whether household income and participation in WIC influences prenatal diet quality.

Methods: This cross-sectional, secondary analysis examined a subset of 1444 pregnant women in the Infant Feeding Practices Survey cohort with demographic and dietary data. Diet history was collected with a modified Diet History Questionnaire in the third trimester; diet quality scores were calculated according to the Alternative Health Eating Index for Pregnancy (AHEI-P). Women were categorized into 4 groups: WIC participants (30%), income-qualified WIC nonparticipants [18%, poverty income ratio (PIR) $\leq$1.85], middle-income (35%, PIR $>$1.85 but $<$4), and high-income (17%, PIR $\geq$4). Generalized linear models adjusted for age, smoking status, race, and energy intake were used to compare mean AHEI-P overall and component scores among the 4 groups of women; Tukey adjustment was used for all post-hoc comparisons between groups.

Results: Study participants were generally highly educated (39% college graduates) and non-Hispanic white (84%) with a mean age of 28.9 y. Nearly 30% participated in WIC. Mean AHEI-P scores were 60.6 (out of 130 points). In the age- and multivariable-adjusted models, AHEI-P scores were different across the 4 groups ($P < 0.0001$). In the age-adjusted model, post-hoc comparisons indicated that high-income women scored significantly higher than WIC participants but similar to the other groups. After multivariable adjustment, the groups scored similarly except for high-income women who scored significantly higher (61.8 $\pm$ 1.0) than middle-income women (59.6 $\pm$ 0.8, $P = 0.03$), income-qualified WIC nonparticipants (58.3 $\pm$ 0.9, $P = 0.002$), and WIC participants (57.8 $\pm$ 0.8, $P < 0.0001$).

Conclusions: The results suggest that women with higher income have higher diet quality than middle-income and income-eligible WIC and non-WIC participants. Further research should examine the impact of WIC participation on prenatal diet quality in larger, low-income samples.

Funding Sources

This research did not have a funding source.

Rearranging Protein Food Intake with Simple Changes in Portions to Increase Nutrient Adequacy: What Works for All and What Depends on the Initial Dietary Protein Pattern (OR40-03)

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Objectives: The aim of this study was to identify which modifications of protein food intake could increase the most the overall nutrient adequacy in French individuals.

Methods: We used protein food intake data for 1678 adults from a representative French national dietary survey, and nonnegative-matrix factorization followed by cluster analysis to identify dietary protein patterns. For each individual, we simulated every possible substitution of one portion of protein food for one portion of another protein food, and selected the substitution that increased the most the nutrient adequacy (through the use of PANDiet probabilistic scoring). This process was iterated 20 times, under 2 scenarios (S1, S2): the substitutions were allowed only between protein foods already consumed by each individual (S1) or between foods consumed by each individual and food consumed by 10% of the individuals who are in the same cluster (S2).

Results: The modifications increasing nutrient adequacy the most were primarily the reduction of portions of delicatessen, prepared foods, high-fat meat, cheese, and poultry in the 2 scenarios, and the increase of portions of bread, pastas, low-fat meat and cheese, and fish (S1) or legumes, yogurts, fish, vegetables, and low-fat meat (S2). However, differences were observed depending on the initial dietary protein pattern: for example, in S1, 'Take-away eaters' increased their intakes of poultry (contrary to the other clusters), and decreased their intakes of prepared food more than the overall population. In S2, different rearrangements were implemented to increase nutrient adequacy as some food groups intakes were highly increased in some clusters and not in others: legumes for 'Poultry', 'Traditional' and 'Fish' eaters, low-fat meat for 'Take-away' eaters, and vegetables for the other patterns. The increases in PANDiet scores were similar in the different clusters, but this was the result of different changes in the adequacy of different nutrients: for example, eicosapentaenoic acid and docosahexaenoic acid adequacy did not increase in 'Take-away' eaters, but did in all other clusters.

Conclusions: The initial dietary protein pattern is key to identifying the protein food groups most likely to improve the overall nutrient adequacy of groups of individuals.

Dietary Intake Timing and Overall Diet Quality in US Emerging Adults: An Observational, Prospective, National Cohort Study (OR40–04)

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Objectives: Meal timing (time and frequency of eating occasions) is associated with numerous health indicators, but implications for diet quality are unclear. This study tests relations of intake timing with overall diet quality in emerging adults.

Methods: Data come from the first 4 y of NEXT Plus, an observational cohort study of a national sample of US adolescents ($n = 566$) enrolled in 2009–10 (baseline mean $\pm$ SD age = 16.5 $\pm$ 0.5 y) and assessed annually. Dietary variables were calculated from three 24-h dietary recalls collected annually: Outcomes included daily energy intake (EI, kcal), Healthy Eating Index-2010 (HEI) and percentage intake from empty calories (%EC); exposures included meal frequency (occasions/d), eating spread (duration between first and last eating occasion), meal spacing (mean hours between occasions), time of first eating occasion, and main meal timing (time of greatest

energy intake). Linear generalized estimating equations examined time-varying associations of diet quality with intake timing. Covariates included body mass index from measured height and weight, moderate-to-vigorous physical activity from 4-d accelerometry, and self-reported age and sociodemographics.

Results: Greater eating frequency was associated with greater EI ($\beta \pm$ SE $= 200.3 \pm 16.7$, $P < 0.001$), HEI ($\beta \pm$ SE $= 9.8 \pm 10.0$, $P < 0.001$), and %EC (0.5 ± 0.2, $P = 0.04$). Greater eating spread (h) was associated with greater EI (57.6 ± 6.9, $P < 0.001$) and HEI (0.3 ± 0.1, $P = 0.002$), but unassociated with %EC. Longer meal spacing was associated with lower EI (-89.8 ± 10.0, $P < 0.001$) and %EC (-0.3 ± 0.1, $P = 0.01$), and unassociated with HEI. Later main meal timing was associated with lower HEI ($\beta \pm$ SE-0.2 ± 0.09, $P = 0.01$), and unassociated with EI or %EC. Later timing of first eating occasion was associated with lower EI (-27.1 ± 7.8, $P = 0.001$) and HEI (-0.6 ± 0.1, $P < 0.001$), but higher %EC (0.2 ± 0.1, $P = 0.01$).

Conclusions: The relative magnitude of associations suggests that intake timing may be more strongly related to overall EI than to diet quality in US emerging adults. Interventions are warranted to test whether changing intake timing can impact EI without harming diet quality.

Funding Sources

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Associations Between Regulation of Eating Behaviors and Diet Quality in a French Canadian Population—The PREDISE Study (OR40-05)

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Objectives: The research purpose was to investigate how regulation of eating behaviors is associated with diet quality in a French Canadian population.

Methods: As part of the PREDISE study, women ($n = 529$) and men ($n = 516$), aged 18–65 y, from the Province of Quebec, Canada, were recruited to complete online questionnaires. The Regulation of Eating Behavior Scale, based on the self-determination theory, assessed 6 types of regulation of eating behaviors (i.e., intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation, and amotivation). Three web-based 24-h food recalls were also completed over a 3-wk period, and were used to compute the Healthy Eating Index (HEI), a global diet quality indicator based on the Canadian guidelines for healthy eating.

Results: Women had higher mean $\pm$ SD HEI score (60.6 ± 13.0) than men (53.6 ± 14.4, $P < 0.0001$). HEI was positively associated with age ($r = 0.06$, $P = 0.04$), intrinsic motivation ($r = 0.34$, $P < 0.0001$), integrated regulation ($r = 0.44$, $P < 0.0001$), and identified regulation ($r = 0.32$, $P < 0.0001$), whereas negative associations were found between HEI and external regulation ($r = -0.09$, $P = 0.006$) as well as amotivation ($r = -0.32$, $P < 0.0001$). Introjected regulation was not associated with HEI ($r = 0.03$, $P = 0.41$). Given at least one interaction term to assess if associations between regulation styles and HEI differed by age groups was significant, subsequent analyses were stratified by age. A multivariate linear regression revealed that, in participants aged 18–34 y, integrated regulation ($\beta = 3.56$), amotivation ($\beta = -2.69$), and identified regulation ($\beta = -1.58$) were significantly associated with HEI. In participants aged 35–49 y and 50–65 y, gender (being male; $\beta = -5.81$ and $\beta = -4.57$, respectively in the 2 age groups), integrated regulation ($\beta = 4.04$ and $\beta = 3.56$), and amotivation ($\beta = -3.80$ and $\beta = -2.69$) were significantly associated with HEI.

Conclusions: These results suggest that in all age groups higher integrated regulation and lower amotivation are associated with a better diet quality. Further analyses will be performed in the large PREDISE study sample to better understand the unique role of regulation of eating behaviors in explaining diet quality.

Funding Sources

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Associations between Diet Quality Indexes and Depression in the 2009–2014 National Health and Nutrition Examination Surveys (OR40-06)

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Objectives: The physical health benefits of a healthy dietary pattern have been well established, but few studies have focused on mental health outcomes. We herein investigated associations between diet quality indexes and clinical depression in a nationally representative sample of US nonelderly adults.

Methods: This analysis was conducted with the use of cross-sectional data from the NHANES 2009–2014. Dietary intake was evaluated according to the Healthy Eating Index 2010 (HEI-2010) and the Alternative Healthy Eating Index 2010 (AHEI-2010), estimated from the average of two 24-h dietary recalls. The study population was composed of 6828 adults (20–65 y). Depression was assessed according to the validated 9-item Patient Health Questionnaire (PHQ-9). Associations between dietary quality indexes and depression were evaluated by multivariable logistic regression models, adjusted for sociodemographic characteristics, health behaviors, and total energy intake.

Results: In the sample, the mean $\pm$ SD HEI-2010 score was 50.8 ± 12.8 (out of 100) and the mean $\pm$ SD AHEI-2010 score was 43.8 ± 13.4 (out of 110). For both diet quality indexes, individuals in the bottom, second, and third quartiles had significantly higher odds of depression compared with individuals in the top quartile (HEI-2010: OR 1.52, 95% CI: 1.21, 1.91 for bottom quartile;

P-trend > 0.0001; AHEI-2010: OR 1.35, 95% CI: 1.08, 1.70 for bottom quartile; *P*-trend = 0.015). A 1-SD increase in HEI-2010 and AHEI-2010 scores were both associated with lower odds of depression (HEI-2010: OR 0.87, 95% CI: 0.80, 0.94; AHEI-2010: OR 0.87, 95% CI: 0.80, 0.94), after multivariable adjustment.

Conclusions: Our results suggest that in this nationally representative population, low diet quality may be associated with higher likelihood of depression in US nonelderly adults.

Behavioral Risk Factors and Successful Aging among Older Puerto Ricans (OR40-07)

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Objectives: The aim of this study was to identify individual and combined behavioral risk factors that predict successful aging as a composite score of physical, cognitive, and psychosocial well-being among Puerto Rican older adults.

Methods: Data were analyzed from participants (n = 933, age 45–75 y) of the Boston Puerto Rican Health Study at baseline and 2-y follow-up, with complete in-person questionnaires and physical measurements. Behavioral risk factors included smoking, alcohol use, sleep quality and quantity, physical activity, and the Alternate Healthy Eating Index-2010 (AHEI); all were analyzed independently and combined in a behavioral score (range 0–8; higher indicative of healthier behaviors). A successful aging score was defined by assigning positive values for healthy outcomes of cognitive function, physical function, 7 chronic diseases (or medication use), social network and support, depression, and perceived stress, for a total score of 0–17 (higher indicative of healthier aging). Subscores for the physical conditions (range 0–10) compared with the cognitive-psychosocial markers (0–7) were created. Linear regression models for baseline behavioral risk factors predicting successful aging score at 2 y were adjusted for sex, age, income, and education.

Results: The combined behavioral score was positively associated with the successful aging score ($\beta \pm$ SE: 0.29 $\pm$ 0.06; $P < 0.0001$). Significant associations were noted for the subscores of physical conditions (0.12 $\pm$ 0.03; $P = 0.0002$) and cognitive-psychosocial markers (0.21 $\pm$ 0.04; $P < 0.0001$). AHEI was associated with a higher 2-y successful aging score ($\beta \pm$ SE: 0.022 $\pm$ 0.010; $P = 0.03$). Those with moderate physical activity (compared with sedentary) had a higher successful aging score at 2 y (mean $\pm$ SE: 10.5 $\pm$ 0.36 compared with 9.1 $\pm$ 0.14; $P < 0.001$), and those in the highest tertile of sleep score (compared with lowest) had a higher successful aging score (9.7 $\pm$ 0.16 compared with 9.1 $\pm$ 0.14; $P = 0.003$). Alcohol use and smoking were not associated with a significant increase in aging score.

Conclusions: In an older adult population of Puerto Ricans, individual as well as combined behavioral risk factors significantly predict 2-y successful aging, defined as a composite score of physical, cognitive, and psychological well-being. Healthy lifestyles may have wide-ranging and cumulative aging benefits.

Funding Sources

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Meat Consumption in Midlife and Risk of Cognitive Impairment in Old Age: The Singapore Chinese Health Study (OR40-08)

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Objectives: Dietary patterns with high intake of red meat or low intake of fish have been shown to be associated with increased risk of cognitive impairment. However, few studies have directly investigated this risk with quantity of meat intake. We examined the association between intakes of different types of meat in midlife and cognitive impairment in old age in the Singapore Chinese Health Study.

Methods: This study was conducted in a population-based prospective cohort of 63,257 middle-aged and elderly Chinese living in Singapore. Diet was measured through the use of a validated 165-item semiquantitative food-frequency questionnaire during recruitment (1993–1998). Cognitive impairment was assessed through the use of the Mini-Mental State Examination (MMSE) questionnaire during follow-up III interviews (2014–2016). A total of 16,948 surviving subjects who participated in follow-up III interviews were included in this study. Their mean age at recruitment was 53.5 y (range 43.5–74.8), and it was 73.2 y (range 61.0–96.0) at MMSE assessment, with a mean follow-up of 19.7 y (range 15.7–23.0). Multivariable logistic regression models were used to estimate ORs and 95% CIs with adjustment for potential confounders of lifestyle and dietary factors.

Results: Using education-adjusted cutoffs for the MMSE scores, 2443 participants showed cognitive impairment. Compared with the lowest quartile, the highest quartile of red meat intake was associated with an increased risk of cognitive impairment (OR: 1.16; 95% CI: 1.01, 1.32; *P*-trend = 0.009), whereas the ORs comparing extreme quartiles of poultry (mainly chicken) and fish/shellfish intake were 0.89 (95% CI: 0.78, 1.02; *P*-trend = 0.10) and 0.89 (95% CI: 0.78, 1.02; *P*-trend = 0.09). Replacement of 50 g/d of red meat with same amount of poultry or fish/shellfish was associated with 27% and 14% risk reduction of cognitive impairment, respectively. Additional adjustment for dietary intakes of saturated fat, cholesterol, or heme iron did not materially change the association between red meat and cognitive impairment.

Conclusions: Among Chinese in Singapore, a higher intake of red meat in midlife was associated with an increased risk of cognitive impairment in later life, whereas substitution with poultry or fish/shellfish was associated with a lower risk.

Funding Sources

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Supporting Images/Graphs

Meat type and model	Quartile of meat intake				*P* for trend[a]
	Q1	Q2	Q3	Q4	
Red meat					
Cases/n	610/4237	585/4237	636/4237	612/4237	
Median intake, g/d	11.81	23.75	33.06	48.61	
Model 1[b]	1.00	0.95 (0.83-1.08)	1.09 (0.96-1.24)	1.13 (1.00-1.28)	0.02
Model 2[c]	1.00	0.94 (0.82-1.07)	1.07 (0.94-1.22)	1.09 (0.96-1.24)	0.05
Model 3[d]	1.00	0.97 (0.84-1.10)	1.12 (0.98-1.29)	1.16 (1.01-1.32)	0.009
Model 4[e]	1.00	1.02 (0.87-1.18)	1.19 (1.01-1.41)	1.25 (1.03-1.51)	0.01
Poultry					
Cases/n	645/4237	642/4237	602/4237	554/4237	
Median intake, g/d	6.00	15.22	22.68	37.18	
Model 1[b]	1.00	0.96 (0.84-1.09)	0.95 (0.83-1.08)	0.92 (0.81-1.05)	0.24
Model 2[c]	1.00	0.95 (0.84-1.09)	0.94 (0.82-1.07)	0.92 (0.81-1.05)	0.24
Model 3[d]	1.00	0.94 (0.83-1.07)	0.91 (0.79-1.04)	0.89 (0.78-1.02)	0.10
Model 4[e]	1.00	0.96 (0.84-1.11)	0.93 (0.79-1.09)	0.92 (0.77-1.11)	0.39
Fish/shellfish					
Cases/n	652/4237	605/4237	593/4237	593/4237	
Median intake, g/d	28.46	45.77	61.11	83.95	
Model 1[b]	1.00	0.92 (0.81-1.04)	0.89 (0.79-1.01)	0.92 (0.81-1.04)	0.19
Model 2[c]	1.00	0.92 (0.81-1.04)	0.88 (0.77-1.00)	0.90 (0.79-1.02)	0.09
Model 3[d]	1.00	0.91 (0.80-1.04)	0.87 (0.77-0.99)	0.89 (0.78-1.02)	0.09
Model 4[e]	1.00	0.94 (0.83-1.07)	0.91 (0.80-1.04)	0.95 (0.83-1.10)	0.50

[a] Linear trend was tested by using the median values of quartiles as a continuous variable in logistic models

[b] Model 1: adjusted for age at interview, gender, educational level, marital status, dialect groups, and total energy intake

[c] Model 2: further adjusted for body mass index, physical activities, smoking status, alcohol consumption, sleep duration and self-reported physician-diagnosis of diabetes, hypertension, heart disease, stroke and cancer

[d] Model 3: further adjusted for vegetables-fruit-soy dietary pattern, and the other two types of meat

[e] Model 4: further adjusted for heme-iron, saturated fat, and cholesterol intake

TABLE OR40-08-1 Odds ratio (95% CI) of cognitive impairment according to meat intake types in the Singapore Chinese Health Study.

Effect of Epigallocatechin Gallate–Loaded Nanoparticles on Macrophage Cholesterol Accumulation and Inflammation (P20-001)

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Objectives: Macrophages play a critical role in atherosclerosis development by facilitating cholesterol accumulation and increasing inflammatory response. We have synthesized void nanoparticles (V-Nano) and epigallocatechin gallate (EGCG)–loaded nanoparticles (E-Nano). We have also incorporated ligands (oxidized phospholipids) on the surface of V-Nano and E-Nano to make LV-Nano and LE-Nano, respectively, which can target macrophages via binding their CD36 receptors. The objectives of this study are to determine the effects of these nanoparticles on macrophage cholesterol accumulation and inflammation in vitro and in vivo.

Methods: Elicited mouse peritoneal macrophages were treated with 1× phosphate-buffered saline (PBS), free EGCG, E-Nano, LE-Nano, V-Nano, and LV-Nano at an EGCG dose of 20 μg/mL for 16 h. Macrophage total cholesterol (TC) and free cholesterol (FC) content was measured with an HPLC system. Gene expression and secretion of inflammatory factors [monocyte chemoattractant protein 1 (MCP1), tumor necrosis factor α (TNFα), interleukin 6 (IL-6)] were measured by real-time PCR and ELISA, respectively. Male LDLr$^{-/-}$ mice were fed an atherogenic diet and were given weekly intravenous injections of above treatments at a dose of 25 mg of EGCG/kg body weight for 22 wk. Plasma TNFα, IL-6, and MCP-1 concentrations were measured with Quantikine ELISA kits.

Results: Compared with free EGCG, LE-Nano decreased macrophage TC (9.63%) and FC (34.2%) content, but the difference did not reach statistical significance. Compared with 1×PBS, LE-Nano significantly decreased secretion of MCP-1, TNFα, and

IL-6 from mouse macrophages. The extent of inhibition was increased in the treatment order of V-Nano, LV-Nano, free EGCG < E-Nano < LE-Nano. However, LE-Nano compared with 1×PBS significantly increased macrophage TNFα mRNA levels. No significant differences were found in macrophage MCP-1 and IL-6 mRNA levels among treatment groups. LV-Nano significantly decreased plasma concentrations of MCP-1 (compared with free EGCG) and TNFα (compared with LE-Nano). Plasma IL-6 concentrations did not reach statistical significance among treatments.

Conclusions: LE-Nano decreased macrophage cholesterol content, but did not reach statistical difference. Even though LE-Nano and E-Nano decreased inflammatory factor secretion from mouse peritoneal macrophages, the mice plasma data were not consistent with the macrophage data.

Funding Sources
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Higher Sugar-Sweetened Beverage Intake Was Associated with Increased Risk of Elevated Systolic Blood Pressure in Pre- but Not Postmenopausal Women or Men (P20-002)

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Objective: The aim of this study was to examine sex-specific associations between sugar-sweetened beverage (SSB) intake and elevated systolic blood pressure (SBP).

Methods: Logistic regression was used to examine associations between quartiles of SSB intake from food-frequency questionnaire data and elevated SBP (≥120 mm Hg) among 2003–2006 NHANES participants aged 20–74 y ($n = 2398$). Because of the potential influence of sex hormones on hypertension, analysis was conducted in men ($n = 1367$) and women ($n = 1031$) separately, and further dichotomized by menopausal status. Women were classified as premenopausal if having menses in past 2 mo ($n = 846$); postmenopausal if age >40 y and having no menses in past 12 mo ($n = 185$). Women reporting hysterectomy or oophorectomy or not meeting these criteria were excluded.

Results: A 31% increased risk of elevated SBP was observed in the highest (mean = 3.27 servings/d) compared with the lowest SSB quartile (mean = 0.03 servings/d) after adjustment for sex, age, race, body mass index, alcohol use, physical activity, and smoking (OR: 1.31; 95% CI: 0.99, 1.73; $P = 0.057$). In sex-specific analysis, an 89% increased risk of elevated SBP in the highest compared with the lowest SSB quartile was found in women (OR: 1.89, 95% CI: 1.14, 3.12; $P = 0.013$) but not in men, after adjustments. Similar to men, no association was found in postmenopausal women; however, premenopausal women had a >2-fold increase in risk of elevated SBP in the highest compared with the lowest SSB intake quartile (OR: 2.42, 95% CI: 1.35, 4.36; $P = 0.003$).

Conclusions: The association between higher SSB intake and increased risk of hypertension for pre- but not for postmenopausal women and men may suggest a role of sex hormones in this relation and indicates the need to conduct analysis of nutrition and cardiometabolic outcomes by menopausal status.

Protein Intake Is Maintained within a Narrow Range in US and International Populations and May thus Influence Food Choice (P20-003)

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Background and Objective: The optimal macronutrient composition of the diet is a controversial topic, and many adults attempt to regulate their intake of specific macronutrients for various health-related reasons. Our objective was to determine if protein intake is stable and restricted to a narrow range across multiple adult populations, potentially limiting the ability of individuals to successfully alter the macronutrient composition of their diet.

Methods: US dietary intake data from NHANES 2009–2014 were used to determine macronutrient intake as a percentage of total energy intake. A measure of variability of intake, IQRs of macronutrient intake distribution were calculated as the difference between the 75th and 25th percentiles (Q3–Q1). In addition, intake data from 14 countries were used to assess variability of intake internationally. Only nations with a per-capita gross domestic product >$10,000 were considered.

Results: Current protein, fat, and carbohydrate intakes (NHANES 2009–2014) were 15.7 ± 0.1, 32.9 ± 0.1, and 48.1 ± 0.1 % kcal, respectively and did not significantly change over the last decade. The IQR of protein intake distribution (3.73 ± 0.11 % kcal) was 58% of the IQR of fat intake distribution (6.40 ± 0.14 % kcal) and 41% of the IQR of carbohydrate intake distribution (9.18 ± 0.20 % kcal). IThe QR of protein intake distribution was not affected by demographic and lifestyle factors including sex, race, income, physical activity, and body weight status. The IQRs of fat and carbohydrate intake distribution were significantly influenced by age and race. International mean protein intake was 16.3 ± 0.2 % kcal, similar to US protein intake, and there was less variation in protein than fat or carbohydrate intake.

Conclusion: Protein intake in adults in the United States and in multiple international populations was consistently ∼16% of total energy intake, suggesting a level of biological control that tightly regulates protein intake and, perhaps, intake of other macronutrients and food constituents.

Funding Sources
DMRP/MRMC.

Usual Nutrient Intakes of Preschool and School-Aged Children from the 2013 Filipino National Nutrition Survey (P20-004)

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Objectives: Despite regular national nutrition surveys, age-specific assessments of nutrient intakes among children in the Philippines are limited. The objective of this study was to evaluate usual intakes of energy and selected nutrients of preschool and school-aged children.

Methods: Data were from a nationally representative sample of 8992 children aged 3–12 y who participated in the 2013 National

Nutrition Survey. Trained interviewers collected dietary intake data from the children or their parents with the use of a 24-h dietary recall. A second 24-h recall was collected from 50% of the sample on a nonconsecutive day. Usual intakes and distributions of energy and nutrients were estimated in three subgroups, i.e. preschool children (3–5 y, $n = 2427$), and younger and older schoolchildren (6–9 y, $n = 3594$ and 10–12 y, $n = 2971$, respectively), with the use of the PC-side program from Iowa State University (version 1.0). This program estimates the percentiles of usual nutrient intake distributions, as well as the proportion below estimated average requirements (EARs) defined by the Philippine Dietary Reference Intakes 2015. Nutrients reported in this study included protein, calcium, iron, zinc, vitamin C, thiamine, riboflavin, vitamin A, vitamin B-6, vitamin B-12m and folate. Energy inadequacy was assessed by estimated energy requirements (EERs) calculated with the use of the equation of the Institute of Medicine and the sedentary physical activity level.

Results: The average energy intake was 11% lower than the EER in preschool children and met the EER in schoolchildren. A high prevalence of inadequate nutrient intakes, defined as the percentage of children with intakes less than the EAR, was found. The prevalence of inadequate intakes generally increased with age. Percentages below the EAR were: protein 10–21%, calcium 84–94%, iron 75–90%, zinc 28–47%, vitamin C 60–89%, thiamine 43–63%, riboflavin 43–81%, vitamin A 43–68%, folate 61–81% and vitamin B-6 29–35%. However, a lower rate was observed for vitamin B-12 5–9%.

Conclusions: This study, based on analysis of usual intakes, demonstrated that the intakes of many micronutrients in Filipino children were markedly inadequate. To understand why nutrients are lacking from the diet and to form improvement strategies, studies looking into food sources and food consumption patterns are currently underway.

Funding Sources

Nutrition Research Center.

Development and Content Validation of a Questionnaire on the Feasibility of a Mobile Dietary Self-Monitoring Device (P20–005)

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Objectives: Information technology–based healthcare has been increasingly perceived to be an effective way to prevent and manage chronic diseases. Dietary assessment and monitoring is an essential part of healthcare. However, to our knowledge, an instrument to assess the feasibility of a mobile dietary self-monitoring device has not been developed or validated in Korea. We developed a questionnaire to assess the feasibility, and performed a content validation of the questionnaire.

Methods: We developed a feasibility questionnaire containing items to assess overall usage and application, usability, usefulness, satisfaction, and intention to use. A total of 10 expert panels comprised of nutrition, medical, computer science, or mobile health care specialists evaluated the relevance of the questions to usage experience of mobile applications, usability, usefulness, satisfaction, and intention to use on a 5-point scale. The item-level content validity index (I-CVI) was calculated as the proportion of experts giving a rating 4 or 5 among all experts. Scale-level content validity index (S-CVI) was also calculated by averaging the I-CVI scores of all items. Expert panels provided comments on each item.

Results: The S-CVI score of 69 items of the questionnaire was 0.86. Fifty-eight out of 69 items received an I-CVI score of $\geq$0.8. We decided to retain these 58 items, but combined, revised, or separated 20 items according to experts' comments. As a result, a total of 58 items were included on the questionnaire, and the S-CVI score of these 58 items of the questionnaire was 0.91.

Conclusions: We developed a questionnaire on the feasibility of a mobile dietary self-monitoring device, and performed a content validation of the questionnaire resulting in a revised version. We plan to conduct a construct validation study of the questionnaire.

Funding Sources

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Nutritional Factors Influencing Mammographic Density of Newly Diagnosed Breast Cancer Patients (P20-006)

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Objectives: Breast cancer is one of the most common cancers among women in the world. Many studies have been done worldwide to investigate the relation between nutritional factors and mammographic density, but no such studies exist for Saudi Arabia. The purpose of this study was to assess the nutritional factors influencing mammographic density of newly diagnosed breast cancer patients.

Methods: The study was prospective cross-sectional study conducted in King Fahad Hospital of NGHA-Riyadh. We selected 28 women who were newly diagnosed with breast cancer. The indices that we used to assess the nutritional factors influencing mammographic density were anthropometric measurements, and dietary variables such as body mass index, food consumption scores, etc.

Result: Among 28 women, 46% had mammograms showing scattered fibroglandular densities, and were aged 41–60 y. Morbidity status showed that 64% of the subjects were obese. Moreover, all the subjects were nonvegetarian and consumed high intakes of protein, fat and carbohydrate; studies have shown a positive association between dietary fat intake and breast cancer.

Conclusion: This study is the first of its kind in Saudi Arabia, and showed the relation between nutritional factors and demographic density, and the risk of breast cancer.

Funding Sources

None.

Healthy Eating Index Compared with Alternate Healthy Index in Relation to Diabetes Status and Health Markers in US Adults (P20-007)

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Objective: The aim of this study was to determine whether the Alternate Healthy Eating Index 2010 (AHEI-2010) provides a more accurate assessment of dietary quality than the Healthy Eating Index 2010 (HEI-2010) in relation to type 2 diabetes (T2DM).

Methods: This study used a representative sample of US adults aged ≥20 y ($n = 4097$) from the NHANES 2007–2010. Total HEI-2010 and the AHEI-2010 scores were used to measure dietary quality and were calculated with data from the first 24-h dietary recall. Health markers evaluated include anthropometrics, blood pressure, lipid and inflammatory markers, and presence of comorbid diseases. Least squares means were computed to determine differences across diabetes status for total and subcomponent HEI-2010 and AHEI-2010 scores, and to determine differences across total HEI-2010 and AHEI-2010 quartiles for health markers. Covariate-adjusted logistic regression was used to examine the association between total HEI-2010 and AHEI-2010 scores and diabetes status.

Results: Overall, HEI-2010 (mean ± SD total score = 47.3 ± 0.4) and AHEI-2010 (mean ± SD total score = 38.2 ± 0.4) both indicate that US adults need improvements in their dietary patterns. However, individuals with the highest total HEI-2010 and AHEI-2010 scores in the sample had significantly better health marker values compared with those with the lowest scores ($P < 0.01$). Diabetics showed higher HEI-2010 and AHEI-2010 scores compared with prediabetics and nondiabetics but did not have better health markers. There were significant differences in some of the subcomponent HEI-2010 and AHEI-2010 scores across T2DM status ($P < 0.01$). For HEI-2010 component scores, diabetics had the highest scores for total protein foods and empty calories. For AHEI-2010 component scores, diabetics had the highest scores for sugar-sweetened beverages, fruit juice, and sodium, and the lowest scores for alcohol and red or processed meats. However, the results suggest that neither total HEI-2010 nor AHEI-2010 scores were significant predictors of T2DM ($P > 0.05$).

Conclusion: Neither total HEI-2010 nor AHEI-2010 scores performed better in terms of their relation with diabetes status. The HEI-2010 and AHEI-2010 were not developed specifically for use in assessing dietary quality in diabetics. Future research is needed to improve the assessment of dietary quality among individuals with T2DM.

Funding Sources
None.

Dietary Patterns in the Pregestational Period and their Association with Neonatal Outcomes: A Prospective Cohort (P20-008)

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Objective: The aim of this study was to evaluate the association of dietary patterns (DPs) in the pregestational period with neonatal outcomes.

Methods: A prospective cohort ($n = 189$) was followed in Rio de Janeiro, Brazil, during pregnancy (weeks 5–13, 20–26, and 30–36) and 30–40 d postpartum. A food-frequency questionnaire was administered at the 1st trimester. A reduced rank regression procedure was used to identify DPs that explain the response variables: fiber density, dietary energy density, and percentage of energy from saturated fat. Infants' birth weight and length were retrieved from medical records and classified according to Intergrowth-21st percentiles for sex and gestational age at birth [small and adequate for gestational age, ≤90th percentile compared with large for gestational age (LGA), >90th percentile]. The Apgar score was measured at the 1st minute [<7 (health risk) compared with ≥7 (normal)]. The associations between DP tertiles and the outcomes were determined with the use of multiple logistic regression models. Confounders were established based on a direct acyclic graph.

Results: The pregnant woman had a mean ± SD daily energy intake of 2422 ± 822 kcal. The mean ± SD birth weight and length were 3277 ± 529.7 g and 49.6 ± 3.1cm, respectively. LGA occurred in 16% and Apgar score <7 in 14.2%. Three DPs were identified: "fast food and candies" (characterized by high intakes of fast food and snacks, cakes/cookies/crackers, and candies/desserts); "beans, bread and fat" (characterized by high intakes of beans, cakes/cookies/crackers, bread, and fats used as spreads); and "vegetables and dairy" (characterized by high intakes of green vegetables/legumes, dairy products, fish, tea, fruits/fruit juices, and candies/desserts). In the adjusted logistic regression analysis, women with the highest adherence to the "fast food and candies" DP presented a higher risk of LGA (OR = 4.38; 95% CI: 1.27, 15.02) and birth length >90th percentile (OR = 5.03; 95% CI: 1.85, 13.64). The highest adherence to the "beans, bread and fat" DP was inversely associated with Apgar score <7 (OR = 0.14; 95% CI: 0.03, 0.69). We found no associations between the "vegetables and dairy" DP and neonatal outcomes.

Conclusions: The adherence to a "fast food and candies" prepregnancy DP was positively associated with birth length and increased the risk of LGA births.

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Associations between Hair Cortisol Concentration, Anthropometric Measures, and Macronutrient Intakes among First-Year College Students (P20-009)

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Objectives: The aim of this study was to examine cross-sectional associations between hair cortisol concentrations, as a measure of long-term chronic stress, and anthropometric measures, as well as macronutrient intake among first-year college students.

Methods: Macronutrient intake was obtained with the use of the Harvard Food-Frequency Questionnaire among participants in the UMass Healthy Campus Study ($n = 215$). Height, weight, and waist circumference (WC) were taken by trained researchers. Hair samples were collected from the posterior vertex area of the scalp. Hair cortisol was extracted by standard procedures and cortisol concentrations were measured by enzyme immunoassay ($n = 140$ women and $n = 52$ men, aged 18.4 ± 0.5 y). Linear regression was used to examine associations between continuous hair cortisol concentrations and anthropometric measures, as well as macronutrient intake. Data were transformed with natural logarithms and all models were adjusted for age, sex, race, hair length, hair washing frequency, steroid medication use, and total energy intake (only used in the macronutrient models).

Results: Most participants were in the normal body composition range as measured by mean body mass index (BMI) $= 23.8 \pm 4.2$ kg/m^2 (women $= 23.4 \pm 4.2$ kg/m^2, men $= 24.8 \pm 4.1$ kg/m^2), and mean WC $= 77.5 \pm 9.0$ cm for women and 84.1 ± 10.5 cm for men. Mean intakes of total protein (17.3%), carbohydrates (51.0%), and total fat (31.7%) were within the recommended ranges for this age group. Higher hair cortisol concentrations were associated with higher BMI and WC ($P < 0.05$). For macronutrients, higher hair cortisol levels were positively associated with intakes for total protein ($P < 0.05$) in the unadjusted model; no associations were seen for carbohydrate or fat intakes. After adjusting for covariates, no statistically significant differences were seen.

Conclusion: This is the first study to examine hair cortisol, as an objective measure of stress, and its association with macronutrient intake. We found a positive association between elevated hair cortisol and BMI and WC; however, there was no association seen with protein, carbohydrate, or fat intake among first-year college students. Future research should examine the associations between macronutrient components of diet quality, such as added sugar, and hair cortisol.

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Is Cooking with Shea Butter Associated with Lower Blood Pressure? (P20-010)

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Objectives: The cardiovascular health benefits of shea butter, an edible fat derived from a tree native to West Africa and with known medicinal properties, has not been investigated. We ascertained whether cooking with shea butter is associated with lower blood pressure (BP) in the Ghanaian population.

Methods: Data from the 2014 Ghana Demographic and Health Survey, a nationally representative population-based survey, were analyzed for this study. A total of 9396 women and 4388 men were selected from 12,831 sampled households and interviewed for the survey. Respondents with average BP of $\geq$140/90 mm Hg, and those previously diagnosed with hypertension by a physician were classified as hypertensive. Multivariable logistic regression accounting for potential confounders was used to establish the degree of association between shea butter intake and hypertension.

Results: The overall prevalence of hypertension in the population was 9.3%. Shea butter use was associated with 32% [adjusted odds ratio (AOR) = 0.68; 95% CI: 0.51, 0.91] reduced odds of elevated BP compared with use of frytol and other vegetable oils. The reduced odds of elevated BP observed among shea butter users was slightly attenuated in sensitivity analysis, restricting the analysis to respondents with data on body mass indez (AOR = 0.81; 95% CI: 0.57, 1.15). The confidence interval, however, included the null value.

Conclusions: The study found an association between shea butter consumption and lower BP, and provides the rationale for further investigation through rigorous study designs to evaluate the benefits of shea butter consumption for prevention of hypertension and improved cardiovascular health.

Funding Sources

No funding was received for this work.

Differences in Food Characterization in the Different Tables and Databases of Nutritional Composition (P20-011)

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Objective: The aim of this study was to analyze differences in nutrients from different food composition databases (DBs).

Methodology: Within the framework of a larger project on the environmental footprint of food waste, the nutrient differences in 5 food composition DBs have been analyzed. DBs from one country in each of the WHO's global regions have been selected: United States (Region of the Americas), Tanzania (African Region), Spain (European Region), India (South-East Asia Region), and New Zealand (Western Pacific Region). The 3 most consumed foods according to the FAO have been compared: milk, wheat, and rice. Water, lipids, proteins, carbohydrates, vitamin C, and sodium were analyzed according to the denomination, availability, value, and units. The coefficient of variation (CV) was calculated to estimate the variability of nutritional values.

Results: All nutrients of the 3 foods were available in the databases studied, except for the percentage of water in Tanzania's DB that could only be estimated indirectly. Nutrients were expressed in all cases in the same units, grams for macronutrients, or milligrams for micronutrients, for every 100 g of edible portion. The Indian DB was the only one to offer the SD of nutritional values, revealing their approximate nature. The nutritional composition of the inedible portion was not available in any case. Apart from language differences, there was uniformity in the denominations. The concentrations of all nutrients showed variations due to the origin of the foods and the chemical analysis used to measure them. The greatest variation was found in the values of vitamin C in milk (CV = 1.02) and sodium (CV = 0.91) and lipids (CV = 0.33) in rice. The food with the least variability in its nutrients was wheat (CV < 0.26 in all nutrient values).

Conclusions: The greatest differences were found in micronutrients. Dietary calculations made from DBs should always be understood as approximate. Global unification of measurement methods and data is recommended. Future research should study data on inedible portions,

important for food waste research, both at the household level and in other parts of the food chain.

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New Release of the Dietary Supplement Ingredient Database: Content of Green Tea Dietary Supplements (P20-012)

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Objectives: For dietary supplements (DSs) containing a single botanical [e.g., green tea (GT); *Camelia sinensis*], the label information required by the FDA is the weight of the GT extract or the GT leaf powder. Some manufacturers also voluntarily list concentrations for GT phytochemicals. We assessed the accuracy of the mandatory and voluntary labels and the usability of the label information for DS consumers and phytochemical intake calculations.

Methods: Two lots of 32 representative single-ingredient GT DSs were purchased from a variety of market channels and in various dosage forms. Samples were sent for analysis to 3 experienced laboratories. Means and SDs for the analytically measured content of epigallocatechin gallate (EGCG; the most prevalent catechin), total catechins ($n = 7$), and caffeine were derived for each product and compared with its label information.

Results: The mean values for analytically measured EGCG, total catechins, and caffeine showed wide ranges among these DSs (2.0–630, 4.2–1070, and 0.25–130 mg/d, respectively). For DSs with label claims for EGCG ($n = 18$), total catechin ($n = 10$), or caffeine ($n = 9$) the percentage differences from label claims ranged from −35% to +186%, −36% to +45% and −84% to +70% of label, respectively. The EGCG content was within ±20% of the label content claim in more than half of the tested DSs ($n = 10$). DS with concentration claims had significantly higher phytochemical content compared with the DSs without such information. The mandatory label claims for GT ranged from 150 to 2000 mg/serving, with 500 mg/serving being the most commonly labeled level ($n = 9$). However, within the group of DSs labeled at this single level, the analytically confirmed mean values for EGCG differed more than several hundred fold: from 0.5 to 315 mg/serving. This extremely wide range was also confirmed for total catechin content: from 1.4 to 411 mg/serving.

Conclusions: Voluntary label information for catechin and caffeine concentrations better predicted the analytically confirmed content than the required information for GT content. For consumers and researchers to more accurately estimate phytochemical intakes, additional analytic testing must be performed unless manufacturers provide accurate extract concentration levels on labels.

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Sucrose and Fructose in Spot Urine Compared with 24-Hour Urine as a Biomarker of Sugars Intake (P20-013)

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Objectives: Twenty-four-hour urinary sucrose and fructose (24h-uSF) has been developed as a dietary biomarker of total sugar intake. Collection of 24-h urine is associated with high costs and heavy participant burden, while collection of spot urine can be easily implemented in research protocols. This analysis aims to investigate the utility of uSF in spot urine as a biomarker of sugar intake, with 24h-uSF serving as a surrogate measure of intake.

Methods: Fifteen participants aged 22–49 y completed a 15-d feeding study in which they consumed their usual diet under controlled conditions, and recorded the time at which each meal was consumed. Throughout the study, participants collected two nonconsecutive 24-h urine samples, placing each void in a separate container. Four timed voids (morning, afternoon, evening, and next day) were identified based on time of void and meal time. Urine samples were measured for sucrose, fructose, and creatinine. Variability of uSF excretion was assessed by coefficient of variation (%CV) and within- to between-subject variance ratios. Pearson correlation coefficient and multiple linear regression were used to investigate the association between uSF in each timed void and the corresponding 24h-uSF excretion.

Results: The 2-day mean ± SD uSF was 50.6 ± 29.5 mg for the 24-h urine, and ranged from 4.5 to 7.5 mg/void for the timed voids. The afternoon void uSF had the lowest within-subject variability (49.1%) and lowest within- to between-subject variance ratio (0.2). The morning and afternoon void uSF had the strongest correlation with 24h-uSF when both were expressed in mg/void ($r = 0.80$ and $r = 0.72$) and mg/creatinine ($r = 0.72$ and $r = 0.67$), respectively. Finally, the afternoon void uSF in mg/void along with age and time since last meal explained the greatest percentage of variation in 24h-uSF excretion (adjusted $R^2 = 0.69$; $P = 0.002$), whereas the morning void uSF in mg/g creatinine best predicted 24h-uSF excretion (adjusted $R^2 = 0.58$; $P = 0.008$).

Conclusions: The afternoon void uSF had the most favorable reproducibility, a strong correlation with 24h-uSF excretion, and explained greatest percentage of variation in 24h-uSF. USF in mg/void may be better to use than uSF in mg/g creatinine as a potential biomarker of sugar intake. These findings are to be yet confirmed in a larger study.

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Associations between Acute Stress and Added Sugar Intake among Participants in the UMass Healthy Campus Study (UMHCS) (P20-014)

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Objectives: The aim of this study was to assess the associations between acute stress domains and added sugar intake, an indicator of

poor diet quality, among first-year college students. Stress is experienced by over half of all college students, especially first years, and has been associated with dietary patterns, health, and academic performance.

Methods: Four validated stress domains were assessed by the Acute Stress Questionnaire: *1*) Social (relation with friends, roommates, classmates, and recreation activities); *2*) Authority (relation with parents, professors, and transportation); *3*) Home (work, finances, relation with significant other); and *4*) School (schoolwork and time management). Each domain has a Likert scale score range of 0 (no stress) to 4 (high stress) with scores (mean, range) as follows: Social (0.79, 0–2.80), Authority (0.5, 0–2.66), Home (0.91, 0–3.66), and School (1.98, 0–4). Added sugar intake, assessed by the Harvard Food-Frequency Questionnaire, was dichotomized [≤ compared with >American Heart Association (AHA) recommendations, 25 g added sugar/d for women, 36g/d for men]. Linear regression analysis evaluated cross-sectional associations between added sugar and each stress domain among men ($n = 65$) and women ($n = 150$) (mean age 18.9 y) in the UMHCS, a study of diet, physical activity, and health.

Results: Among men and women, added sugar intake >AHA recommendations was associated with higher stress for Social (1.80 unit increase, $P = 0.03$) and Home (1.97, $P = 0.05$) domains. The association with Social remained significant when adjusted for age and sex ($P = 0.04$), but not with further adjustment for total energy ($P = 0.45$). The association with Home domain was no longer significant in the adjusted models. No significant associations were found with the Authority or School domains. In sex-stratified analyses, added sugar intake >AHA recommendations was associated with higher stress for the Authority domain (1.22 unit increase, $P = 0.03$) among women but not men, in models adjusted for age, body mass index, and total income, but were no longer significant with further adjustment of total energy. No associations were found for the other domains.

Conclusions: Our results suggest no associations between 4 domains of acute stress and added sugar among first-year college students.

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Assessment of Dietary Nitrate Intake in Humans: A Systematic Review (P20-015)

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Objective: The nitrate content of foods and water is highly variable, and this has implications for the compilation of food composition databases and assessment of dietary nitrate intake. This systematic review was conducted to ascertain the dietary assessment methods used and to provide estimates of daily nitrate intake in humans.

Methods: Relevant articles were identified by a systematic search of 3 electronic databases (PubMed, Web of Science, and Embase) from inception until November 2017. Observational studies conducted in adult populations and reporting information on dietary assessment methods and daily nitrate intakes were included. Ecologic analyses were conducted to explore the association of nitrate intake with gross domestic product (GDP, in US dollars).

Results: In total, 54 articles were included, 42 of which investigated associations between nitrate intake and disease risk. Of these studies, 36 studies examined the association between nitrate intake and cancer risk, whereas the remaining studies showed the association between nitrate intake and risk of diabetes, glaucoma, kidney failure, hypertension, and atherosclerotic vascular disease. The majority of studies used food-frequency questionnaires to assess nitrate intake ($n = 43$). The median daily nitrate intake in healthy and patient populations was 109 and 110 mg/d, respectively. We found a significant inverse correlation between nitrate intake and GDP ($r = -0.45$, $P < 0.001$).

Conclusions: The median estimated daily nitrate intakes by healthy and patient populations were similar and these values were below the safe upper limit of daily intake (3.7 mg nitrate ion/kg body weight). However, there is considerable heterogeneity in the application of food composition tables, which may have implications for the accuracy of estimated daily nitrate intakes. Epidemiologic studies are needed to investigate associations between nitrate intake and risk of cardiometabolic diseases.

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Dietary Cholesterol Intake Is Not Associated with Long-Term Risk of Diabetes or Impaired Fasting Glucose in the Framingham Study (P20-016)

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Objectives: Beginning in the 1960s, it was recommended that dietary cholesterol (DC) intake be restricted to <300 mg/d for prevention of heart disease. Although the 2015 *Dietary Guidelines* concluded that this restriction was no longer necessary, some investigators remain concerned about the role of DC in the onset of type 2 diabetes mellitus (T2DM). To address this issue, we evaluated whether the long-term risk of T2DM or impaired fasting glucose (IFG) associated with DC intakes, both alone and in combination with other lifestyle factors, including diet patterns, physical activity, baseline body mass index, smoking, or alcohol intake, might explain the earlier findings.

Method: Data for 2522 35- to 64-y-old adults without T2DM in the Framingham Offspring Study were included. DC from 3-d food records collected during exams 3 and 5 were used to classify intake as.

Results: Men and women who consumed ≥300 mg/d of DC (compared with less) had the lowest FG levels at baseline ($P < 0.0001$). These subjects were 11% less likely to develop T2DM or IFG (95% CI: 0.75, 1.07) over 20 y. Subjects with healthier diet patterns (e.g., higher intakes of whole grains, fruits and vegetables, fish, fiber) tended to have 15%–20% lower risks for developing T2DM/IFG, regardless of DC intake. Thus, higher DC intake was not associated with risk of T2DM/IFG regardless of other diet patterns. As expected, overweight and obesity were strongly independently associated with higher risks of T2DM and IFG but there was no association between DC and T2DM/IFG regardless of body weight. Finally there was no association between DC and T2DM/IFG regardless of smoking status or physical activity levels.

Conclusions: These results suggest dietary cholesterol intake is not associated with the risk of T2DM or IFG in healthy adults.

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American Egg Board.

Methodological Challenges with Incorporating Nutrient Intakes from Dietary Supplements with the Diet to Produce Total Usual Nutrient Intake Estimates (P20-017)

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Objectives: The use of dietary supplements (DSs) is pervasive in the United States. DSs can provide substantial amounts of nutrients to those that use them; therefore, incorporating nutrient intakes from DSs is critical to enhance exposure classification when characterizing dietary intakes or assessing relations between nutrient intakes and health outcomes. The objectives of this study are to describe the major challenges that should be considered when estimating usual total nutrient intakes, including DSs, in research studies and to offer a lessons-learned approach to help researchers handle many issues when working with DSs.

Methods: The available methods are not straightforward for combining nutrient intakes from foods and DSs, particularly in NHANES, which captures the use of DSs through the use of 2 different time frames. Little is known about the best methods to assess DSs, and virtually nothing is known about the measurement error of DS reporting. Furthermore, DSs can be consumed either daily or episodically, and can deliver discrete and often very high doses of nutrients that are not bound by energy intakes, contributing to bimodal and severely skewed distributions. Labels on DSs often provide nutrient forms (e.g., folic acid) that differ from forms found in conventional foods (e.g., folate) and their databases. Substantial overages have been documented when analytic values are compared with label amounts and should be accounted for in analysis. Finally, the bioavailability of many nutrient-containing DSs is not known and may not be the same as nutrients in a food matrix. Current usual intake methods are not designed specifically to handle nutrient intakes from DSs.

Conclusions: Understanding the major challenges in working with DSs will provide insights to improving methods to estimate usual total nutrient intakes. The use of a standardized method to quantify total usual intakes will help further our understanding of links between nutrient exposures and health outcomes.

Funding Sources
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Protein Intake Trends and Adherence to the Dietary Reference Intakes in the United States (P20-018)

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Background: Systematic analysis of dietary protein intake may identify demographic groups within the US population not meeting the Dietary Reference Intakes (DRIs).

Objectives: This study analyzed protein intake trends (2001–2014) and evaluated recent conformance to the DRIs (2011–2014) according to age, sex, and race/ethnicity in the US population.

Methods: Usual protein intakes and trends during 2-y cycles of NHANES 2001–2014 (n = 57,980; 2+ y) were calculated as absolute (g/d) and relative [g/kg ideal body weight (IBW)/d] intakes and as a percentage of total energy intake. Sex and race/ethnicity [Asian, Hispanic, non-Hispanic black (NHB), and non-Hispanic white (NHW)] differences were determined for protein intake and percentage of the population below the Estimated Average Requirement (EAR), Recommended Dietary Allowance (RDA), and above and below the Acceptable Macronutrient Distribution Range (AMDR).

Results: Protein intakes (g/d) averaged 55 ± 1 (children, 2–3 y) to 88 ± 1 (adults, 19–30 y). Protein comprised 14–16% (all age groups) of total energy intakes. Relative protein intakes (g/kg IBW/d) averaged 1.10 ± 0.01 (adults, ≥71 y) to 3.63 ± 0.07 (children, 2–3 y), and were above the EAR in all demographic groups (≥0.99). Asian (1.32 ± 0.02) and Hispanic (1.35 ± 0.02) populations ≥19 y consumed more relative protein (g/kg IBW/d) than NHB and NHW (1.18 ± 0.01). Relative protein intakes did not differ by race/ethnicity in the 2- to 18-y population. Adolescent (14–18 y) females and older (≥71 y) NHB males had the largest population percentages below the EAR (11% and 13%, respectively); whereas <1% of any demographic group had intakes above the AMDR.

Conclusions: The majority of the US population exceeds minimum recommendations for protein intake. Protein intake remains well below the upper end of the AMDR, indicating protein intake, as a percentage of energy intake, is not excessive in the American diet.

Funding Sources
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Nutrition Patterns Are Associated with Semen Health (P20-019)

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Objective: The recent decline in semen quantity and quality is attributed mainly to nutrition and lifestyle. Our aim was to study the association of semen quality with known dietary pattern indexes, reflecting factual dietary practices and the numerous combinations in which foods are consumed: Healthy Eating Index, Dietary Approaches to Stop Hypertension, Alternate Mediterranean Diet score, and Alternative Healthy Eating Index.

Methods: This was a cross-sectional, single-center study of men ($n = 280$) attending a fertility center between 2012–2015. Food-frequency questionnaires, and semen and sperm parameters (semen volume, concentration, motility, total count, and morphology) were analyzed.

Results: Men in the highest quartiles of all nutrition indexes tested had significantly higher adjusted means of semen and sperm parameters.

Conclusion: Adherence to any of the 4 dietary indexes was associated with better sperm quality. The best association was with the Alternative Healthy Eating Index. We thus recommend the Alternative Healthy Eating Index to the public to attain better semen quality through nutrition.

Dietary Fat Intake and Risk of Parkinson's Disease in a Large Swedish Cohort (P20-020)

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Objectives: The aim of this study was to investigate the association between the intake of total fat and specific types of fat with the risk of Parkinson's disease through the use of prospective data from a cohort including 43,863 participants. With a growing aging population, the number of patients diagnosed with Parkinson's disease will increase. Determining modifiable lifestyle factors associated with the disease is therefore important for primary prevention if a causal association exists.

Methods: Data from the Swedish National March Cohort including women and men, with follow-up from 1997 to 2010, were analyzed. Dietary intake was assessed at baseline through the use of a food-frequency questionnaire. A dichotomous variable of low compared with high total fat intake and tertiles for intake of saturated, monounsaturated, and polyunsaturated fat were analyzed, with the lowest intake category used as reference. Participants were followed through linkage to Swedish population–based registers. Cox proportional hazards regression models were used to obtain HRs with 95% CIs, comparing categories of fat intake. Isocaloric substitution models were also fitted to investigate substitution effects.

Results: During follow-up, 292 cases of Parkinson's disease were identified. A high intake of total fat or saturated fat was associated with increased incidence rates of Parkinson's disease (HR: 1.31; 95% CI: 1.04, 1.66 and HR: 1.87; 95% CI: 1.11, 3.15, respectively). No statistically significant associations were seen for monounsaturated or polyunsaturated fat. In substitution models, replacing 5% of energy from polyunsaturated fat with energy from saturated fat was associated with an increased incidence rate (HR: 2.75; 95% CI: 1.02, 7.40). No other statistically significant associations were seen.

Conclusions: Our results suggest an adverse association between intake of total fat and saturated fat with Parkinson's disease. Limiting intake of saturated fat may be beneficial for disease prevention.

Funding Sources

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A Collaborative Study to Evaluate the Associations among Biological, Social and Nutritional Status for Adolescent Women and their Babies Using Electronic Health Records Data (P20-021)

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Objectives: The aim of this study was to build a multisite de-identified database of female adolescents and their subsequent offspring from electronic health records (EHRs). Our objective was to test the following hypotheses: *1*) obese adolescents will exhibit poorer health status and pregnancy outcomes than nonobese adolescents; *2*) babies born to obese adolescents exhibit worse outcomes than babies born to nonobese adolescents.

Methods: We created a community-academic partnership that included New York City Community Health Centers ($n = 4$) and Hospitals ($n = 4$), The Rockefeller University, The Sackler Institute for Nutrition Science, and the Clinical Directors Network (CDN). We used the Community-Engaged Research Navigation model to establish a multisite de-identified database extracted from EHRs of female adolescents aged 12–21 y (January 2011–December 2012) and their offspring through 24 mo of age. These patients received their primary care between 2011 and 2015.

Results: The analysis included all female adolescents ($n = 122{,}556$) and a subset of pregnant adolescents for whom offspring data were available ($n = 2917$). Patients were mostly from the Bronx; 43% of all adolescent females were overweight (22%) or obese (21%), and showed higher systolic and diastolic blood pressure, blood glucose levels, hemoglobin A1c, total cholesterol, and triglycerides levels than normal-weight adolescent females ($P < 0.05$). This analysis was also performed looking at the nonpregnant females and the pregnant females separately. There was a statistically significant association between the body mass index status of mothers and infants' birth weight, with underweight/normal-weight mothers having more low-birth-weight babies and overweight/obese mothers having more large babies.

Conclusions: This EHR database uses available measures from routine clinical care as a "rapid assay" to explore potential associations, and may be useful to detect the presence and direction of associations. This partnership has engaged community clinicians, laboratory and clinical investigators, and funders in study design and analysis, as demonstrated by the collaborative development and testing of hypotheses relevant to service delivery.

Funding Sources

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An Innovative Technology-Assisted Food Frequency (TAFFY) Method for Elementary and Middle School Children: A Pilot Study (P20-022)

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Objectives: Tools to assess dietary intakes in older children (7–13 y) are limited. Currently, available assessment tools tend to be time consuming, rely on caregiver report/assistance, and require a paper-based format. This pilot study aimed to develop a technology-based, self-administered, and validated dietary assessment tool for older children that can be used in both clinical and research settings.

Methods: This study utilized a convenience sample of 60 boys and girls aged 7–13 y who lived in the New York City metropolitan area. Children who were not fluent in English, reported eating primarily ethnic cuisines, or had severe dietary restrictions are not eligible for participation. To date, 20 children (6 boys) have completed the study. The study has 3 components: *1*) completion of a self-administered, web-based, pictorial food-frequency questionnaire (FFQ); *2*) completion of a 3-d (2 weekdays/1 weekend day), paper-based food record; *3*) participation in a focus group. The FFQ includes 1200 food images with up to 6 portion options and is scientifically validated in adults to assess nutrient intakes/food use patterns for the previous 90 d. During an in-person study visit, children complete the FFQ with the use of a tablet device with minimal assistance. Children then complete the food record within 7 d following the visit. Focus groups are scheduled at the midpoint and end of the study to obtain qualitative data.

Results: The median age of children was 10 y (range 7–13 y). Half of the children were non-Hispanic white, 2 were Hispanic, and the remaining were mixed race/other. Mean ± SD FFQ completion time was 29.5 ± 12.6 min, and the mean ± SD reported calories was 1178.7 ± 632.2. Nine children had calorie intakes <1000, which suggests incorrect completion of the FFQ. Average percentages of calories from carbohydrate, fat, and protein were 51.1%, 36.9%, and 15.0%, respectively. Upon study completion, we will compare energy, and macro- and micronutrient intakes between the FFQ and 3-d food record.

Conclusion: This pilot study will provide data to develop and validate a self-administered, web-based FFQ in older children. The food record and focus groups will capture missing items and necessary modifications for the FFQ. The focus groups will also identify areas for improvement, including ease of use.

Classifying Food Items During an Eating Occasion: A Machine Learning Approach (P20-023)

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Objectives: Monitoring caloric intake is becoming necessary as the number of pathologies related to obesity and overweight increase. New wearable devices may help people to automatically record their nutrition intake. Wrist-band triaxial accelerometers have been proposed as potentially useful devices for monitoring caloric intake but never for food classification. Instead, acquiring food classification information during eating is important for monitoring diet adherence in all unstructured contexts (e.g. restaurant or out-of-home meals). This study aims to develop more robust and effective methods for food intake classification from data obtained while eating.

Methods: A supervised pilot study was conducted on 20 healthy young people (10 women and 10 men aged 20–31 y). Each subject was equipped with 2 wearable devices (Garmin Fenix 5), one for each wrist, and 7 food items then had to be eaten under seminaturalistic conditions. All meals were registered and acceleration data were then extracted and analyzed. We added 2 other time series, the magnitude of the acceleration and decomposition into principal components. The features proposed in this paper are quite popular among the experts in this field. Mean, SD, energy, correlation, and entropy were extracted from acceleration data. Food recognition on these features was performed with the use of several classifiers. We evaluate the performance of the classifiers by traditional means of splitting training and testing data.

Results: Overall, recognition accuracy is highest for weighted *k*-nearest neighbors with an accuracy rate of 96% (CI: 95%, 97%), compared with 95% (CI: 94%, 96%) achieved by support vector machine and random forest, and 90% (CI: 88%, 92%) achieved by bagging.

Conclusions: Our pilot work shows that monitoring food items via the use of simple wrist-band wearable devices is feasible and accurate. Machine learning tools are necessary to deal with the complexity of signals gathered by the devices, and research is ongoing to investigate the following aspects: *1*) further improvements in accuracy; *2*) interactions between wrists and with other devices (e.g. mobiles); and *3*) large-scale implementation and testing.

Use of Dietary Supplements in Association with Mortality among US Adults: National Health and Nutrition Examination Survey, 1999–2010 (P20-024)

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Objectives: The impact of dietary supplement use on mortality is controversial. We evaluated the use of dietary supplements and nutrient intake from foods and supplements in association with all-cause, cardiovascular disease (CVD), and cancer mortality among US adults.

Methods: We evaluated the prevalence of dietary supplement use in the past 30 d in 32,403 US adults aged ≥20 y in NHANES 1999–2010. Nutrient intake from dietary supplements was estimated by combining the frequency of use with information on ingredients, serving size, and amounts of ingredient per serving. Nutrient intake from food sources was estimated based on dietary data averaged from two 24-h diet recalls. All-cause mortality, CVD mortality, and cancer mortality were assessed from the National Death Index and linked with NHANES. Cox

proportional hazard models were used to estimate HRs and 95% CIs after multivariable adjustments of confounders. Sampling weights were used and reconstructed to account for unequal probabilities of sample selection.

Results: During a median follow-up of 6.2 y, a total of 3622 total deaths occurred, including 946 CVD deaths and 808 cancer deaths. Use of dietary supplements significantly contributed to an increased level of intake for all 25 nutrients (all *P*s < 0.01), but none of the supplement use was associated with mortality outcomes. Intakes ≥the Estimated Average Requirement (EAR) of vitamin A, niacin, phosphorus, iron, and magnesium [or ≥the Adequate Intake (AI) of vitamin K and fiber] were associated with reduced all-cause or CVD mortality, but the associations were confined to nutrient intake from foods and not to supplement use. In contrast, total intake of calcium >the Tolerable Upper Intake Level (UL) was associated with an increased risk of cancer mortality (>UL compared with ≤UL: HR = 1.58; 95% CI: 1.17, 2.14) and the association was attributed by higher calcium intake from supplements (≥1000 compared with <100 mg/d: HR = 1.97; 95% CI: 1.03, 3.77).

Conclusions: Use of dietary supplement is not associated with mortality benefits. While adequate nutrient intake from foods may contribute to a reduced risk of mortality, excess intake of calcium from supplements can have an adverse effect on cancer mortality.

Funding Sources

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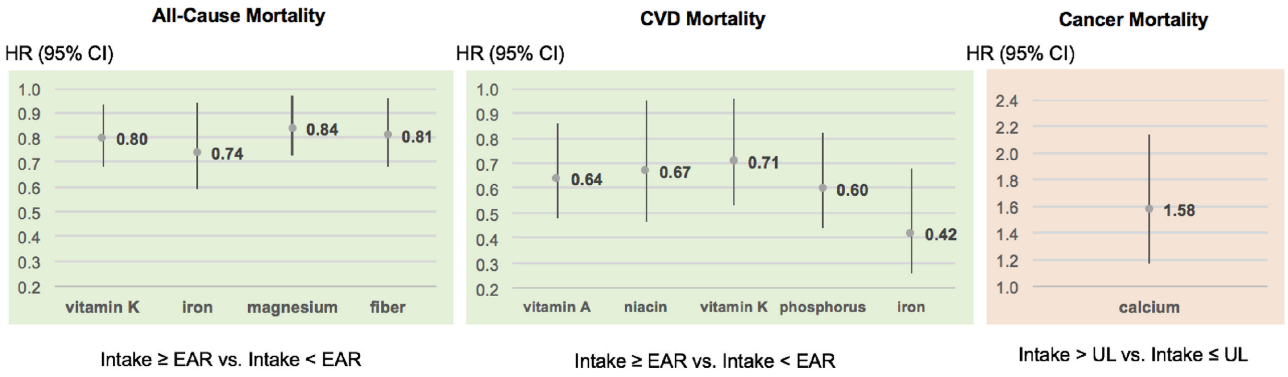
Supporting Images/Graphs

	Person-Years (Users/ Nonusers)	All-Cause Mortality			CVD Mortality			Cancer Mortality		
		Total Death (Users/ Nonusers)	Model 1 HR (95% CI)	Model 2 HR (95% CI)	CVD Death (Users/ Nonusers)	Model 1 HR (95% CI)	Model 2 HR (95% CI)	Cancer Death (Users/ Nonusers)	Model 1 HR (95% CI)	Model 2 HR (95% CI)
Any Supplement[2]	100272/101777	2006/1616	0.82 (0.76-0.88)	1.05 (0.94-1.17)	529/417	0.85 (0.73-1.00)	1.14 (0.91-1.43)	440/368	0.91 (0.77-1.08)	1.05 (0.83-1.32)
MVM Supplement[3]	75533/126516	1420/2202	0.81 (0.74-0.88)	1.04 (0.92-1.16)	374/572	0.81 (0.70-0.94)	1.09 (0.90-1.31)	314/494	0.88 (0.73-1.06)	1.01 (0.80-1.28)

1. Model 1 was adjusted for age, sex, race/ethnicity; and Model 2 was additionally adjusted for education, physical activity, smoking, alcohol, HEI-2015, BMI, and comorbidities. HRs and 95% CIs were weighted.
2. Any supplement use was defined as the use of one or more dietary supplements.
3. Multivitamin/mineral (MVM) supplement use was defined the use of supplements containing three or more vitamins with or without minerals.

TABLE P20-024-1 The association between supplement use and all-cause, CVD, and cancer mortality (users compared with non-users), NHANES 1999–2010



* Only nutrient intakes (food + supplement) that had significant associations with mortality were shown. For vitamin K and fiber where EARs are not available, intake ≥ AI vs. <AI was used instead.

FIGURE P020-024-1 Associations between AI (≥EAR) and Excess Intake (>UL) of nutrients and all-cause mortality, CVD mortality, and cancer mortality among US adults, NHANES 1999–2010. Intake represents levels of nutrient intake from food + supplement. AI, Adequate Intake; CVD, cardiovascular disease; EAR, Estimated Average Requirement; UL, Tolerable Upper Intake Level.

TABLE P20-024-2 Adequacy and Excess Intake of Nutrients and All-Cause, CVD, and Cancer Mortality by Food Source and Supplement Source, NHANES 1999-2010 [1]

	All-Cause Mortality			CVD Mortality			Cancer Mortality		
	Food + Supplement	Food Source	Supplement Source	Food + Supplement	Food Source	Supplement Source	Food + Supplement	Food Source	Supplement Source
Vitamin A									
Adequacy Intake	0.87 (0.75-1.01)	**0.81 (0.71-0.91)**	1.03 (0.80-1.33)	**0.64 (0.48-0.86)**	**0.52 (0.39-0.68)**	1.13 (0.70-1.84)	1.04 (0.78-1.39)	0.93 (0.73-1.18)	1.49 (0.93-2.39)
Excess Intake	1.06 (0.57-1.97)	1.58 (0.71-3.50)	1.02 (0.73-1.42)	1.22 (0.36-4.13)	2.30 (0.64-8.35)	1.15 (0.59-2.27)	1.61 (0.54-4.84)	2.12 (0.64-7.01)	1.07 (0.61-1.87)
Niacin[2]									
Adequacy Intake	0.89 (0.76-1.05)	**0.84 (0.74-0.96)**	1.09 (0.84-1.41)	**0.67 (0.47-0.95)**	**0.66 (0.48-0.90)**	1.07 (0.63-1.81)	0.79 (0.58-1.09)	**0.67 (0.51-0.88)**	1.24 (0.71-2.14)
Excess Intake	0.91 (0.73-1.14)	NA	0.96 (0.67-1.39)	1.08 (0.75-1.57)	NA	1.18 (0.58-2.41)	0.80 (0.54-1.18)	NA	0.97 (0.52-1.82)
Vitamin K[3]									
Adequacy Intake	**0.80 (0.68-0.93)**	**0.82 (0.70-0.96)**	1.15 (0.92-1.44)	**0.71 (0.53-0.96)**	**0.71 (0.51-0.99)**	**1.48 (1.03-2.11)**	0.87 (0.63-1.20)	0.86 (0.60-1.23)	0.90 (0.55-1.47)
Excess Intake	NA	NA	1.15 (0.77-1.70)	NA	NA	1.53 (0.77-3.02)	NA	NA	0.71 (0.33-1.52)
Phosphorus									
Adequacy Intake	1.01 (0.85-1.19)	0.99 (0.84-1.16)	1.17 (0.92-1.48)	**0.60 (0.44-0.82)**	**0.62 (0.45-0.85)**	1.28 (0.86-1.90)	1.06 (0.70-1.62)	0.89 (0.60-1.32)	1.17 (0.75-1.82)
Excess Intake	1.73 (0.85-3.51)	1.54 (0.62-3.82)	1.09 (0.80-1.48)	0.35 (0.04-2.80)	0.46 (0.06-3.76)	0.92 (0.52-1.62)	0.05 (0.01-0.42)[4]	NA	1.16 (0.60-2.21)
Iron									
Adequacy Intake	**0.74 (0.59-0.94)**	**0.77 (0.64-0.93)**	**1.36 (1.05-1.77)**	**0.42 (0.26-0.68)**	**0.48 (0.31-0.75)**	1.40 (0.83-2.35)	0.89 (0.58-1.38)	0.95 (0.65-1.39)	**1.93 (1.16-3.20)**
Excess Intake	1.21 (0.96-1.51)	0.76 (0.53-1.10)	1.42 (0.99-2.02)	1.25 (0.82-1.90)	0.48 (0.13-1.71)	1.64 (0.78-3.45)	0.99 (0.64-1.54)	0.54 (0.20-1.46)	1.13 (0.58-2.24)
Magnesium[5]									
Adequacy Intake	**0.84 (0.73-0.97)**	**0.82 (0.71-0.96)**	1.00 (0.75-1.33)	0.85 (0.64-1.13)	0.78 (0.57-1.07)	0.71 (0.40-1.26)	0.99 (0.76-1.28)	0.85 (0.63-1.13)	1.30 (0.66-2.54)
Excess Intake	1.00 (0.70-1.42)	NA	1.01 (0.71-1.45)	1.09 (0.64-1.84)	NA	0.58 (0.32-1.05)	1.50 (0.83-2.70)	NA	1.20 (0.57-2.51)
Calcium									
Adequacy Intake	1.01 (0.89-1.14)	1.01 (0.89-1.14)	1.06 (0.85-1.33)	0.94 (0.74-1.20)	0.91 (0.68-1.21)	1.03 (0.74-1.43)	0.96 (0.77-1.18)	0.88 (0.68-1.15)	1.22 (0.77-1.92)
Excess Intake	1.16 (0.94-1.44)	0.91 (0.66-1.25)	1.12 (0.81-1.54)	1.28 (0.89-1.84)	0.86 (0.37-2.01)	1.50 (0.85-2.62)	**1.58 (1.17-2.14)**	1.05 (0.46-2.40)	**1.97 (1.03-3.77)**
Fiber[3]									
Adequacy Intake	**0.81 (0.68-0.96)**	**0.82 (0.69-0.98)**	1.49 (0.72-3.11)	0.72 (0.50-1.05)	0.76 (0.53-1.10)	1.58 (0.21-11.92)	0.79 (0.54-1.15)	0.79 (0.53-1.17)	1.17 (0.51-2.65)
Excess Intake	NA	NA	0.58 (0.26-1.29)	NA	NA	0.23 (0.06-0.90)[4]	NA	NA	0.37 (0.04-3.20)

For nutrients from food + supplement and food only, adequacy intake represents intake ≥EAR vs. <EAR and excess intake represents intake >UL vs. ≤UL; for nutrients from supplement only, adequacy intake represents intake ≥median vs. <median and excess intake represents intake higher dose vs. lower dose. Median dose for supplements: vitamin A, 685 RAE mcg/d; niacin, 18 mg/d; vitamin K, 20 mcg/d; phosphorus, 60 mg/d; iron, 18 mg/d; magnesium, 50 mg/d; calcium, 200 mg/d; fiber, 2 g/d. Higher dose and lower dose for supplements: vitamin A, ≥1000 vs. <350 RAE mcg/d; niacin, ≥25 vs. <10 mg/d; vitamin K, ≥25 vs. <10 mcg/d; phosphorus, ≥105 vs. <40 mg/d; iron, ≥20 vs. <8 mg/d; magnesium, ≥100 vs. <20 mg/d; calcium, ≥1000 vs. <100 mg/d; fiber, ≥5 vs. <1 g/d.

1. Models were adjusted for age, sex, race/ethnicity, education, physical activity, smoking, alcohol, HEI, BMI, and history of comorbidities. HRs and 95% CIs were weighted.
2. UL is not available for dietary niacin since only synthetic niacin from fortified foods contributes to the UL, which is not available in NHANES data.
3. ULs are not available for vitamin K and fiber.
4. The significant results possibly resulted from the small sample size and low statistical power in subgroups.
5. UL is not available for dietary magnesium since UL for magnesium represents intake from a pharmacological agent only and does not include intake from food and water.

Relation between Fruit Consumptionand Dietary Sugar in Korean Adults (P20-025)

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Objectives: Fruit intake is known to be beneficial to health outcomes. However, many people are concerned about high sugar intake through fruit consumption. The purpose of this study was to characterize the people by their fruit consumption and examine dietary sugar intake due to fruit consumption.

Methods: Using data from the 2012–2015 Korea National Health and Nutrition Examination Survey, a total of 10,460 adults (4082 men and 6378 women) aged >19 y were included in this study. Fruit consumption was evaluated based on a food-frequency questionnaire: ≤1 time/wk (rarely), 2–6 times/wk (sometimes), 1–3 times/d (daily). Dietary sugar intake was calculated based on the data from the 24-h dietary recall, and evaluated by the major food sources; white milk, fresh fruits (including 100% fresh fruit juice, but not fruit drinks), processed foods, and commodity-type foods.

Results: The proportions of people who consumed ≥1 serving of fresh fruits per day were 21.3% in men and 39.8% in women. People who consumed fruits more often were more likely to have higher income and education level, or better lifestyle behaviors, such as no smoking in both men and women ($P < 0.0001$). Total sugar intake increased according to fruit consumption groups. The daily sugar intake in people who consumed fruits rarely was 73.5 g in men and 63.7 g in women, whereas in people who consumed fruits daily these intakes were 96.5 g in men and 79.5 g in women. However, the dietary sugar intake by food source showed a different trend. The sugar intake from white milk and fresh fruits increased according to fruit consumption groups in both men and women (P-trend < 0.0001). However, the sugar intake from processed foods decreased across fruit consumption in women (P-trend < 0.0001).

Conclusions: Our findings suggest that women who consume fresh fruits daily have lower sugar intakes from processed foods, which may contribute to health benefits.

Funding Sources

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Longitudinal Trajectories in Dietary Intake during the Transition from Adolescence to Young Adulthood (P20-026)

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Objective: The transition from adolescence to young adulthood is linked to declines in dietary quality and increases in weight. However, the timing and extent of dietary changes that occur during young adulthood are not well understood. The aim of this study was to describe among a population-based cohort how dietary intake as an adolescent predicted later intake as a young adult, and how dietary intake changed over time in young adulthood.

Methods: This study involved a longitudinal analysis of 3 waves of survey data collected in 1998–1999, 2008–2009, and 2015–2016 as part of the Project EAT (Eating and Activity in Teens and Young Adults) study. The analytic sample represents 1664 participants (58% women) who were initially recruited as adolescents in Minneapolis-St

Paul, Minnesota public schools and were aged 25–36 y in 2015–2016. Dietary intake was measured via a semiquantitative food-frequency questionnaire. Least squares means were calculated to compare mean dietary intake for participants in each quartile, adjusting for age and adolescent sociodemographic characteristics and body mass index (BMI).

Results: In adjusted models, participants who started in lower quartiles for intake of fruit, vegetables, whole grains, and dairy as adolescents continued to have the lowest mean intake for each marker in adulthood (e.g., young adult men in the bottom quartile during adolescence consumed an average of 1.91 ± 0.24 servings of vegetables compared with 2.93 ± 0.24 servings for those in the top quartile, $P < 0.05$). However, participants in all 4 quartiles generally increased daily dietary intake of fruit, vegetables, and whole grains over 5 y in young adulthood (e.g., young adult women in the bottom quartile during adolescence consumed an average of 2.72 ± 0.27 servings of vegetables when surveyed in 2008–2009, and 4.32 ± 0.34 servings 5 y later). In contrast, dairy intake decreased for all quartiles among both men and women.

Conclusions: Participants with low dietary intake of fruit, vegetables, whole grains, and dairy during adolescence remained low in dietary intake of these variables during young adulthood; however, intake of fruit, vegetables, and whole grains generally increased over young adulthood.

Funding Sources

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Associations of Healthy Eating Index-2015 with Increased Abdominal Obesity in children and Adolescents By Race/Ethnicity: NHANES 1999–2006 (P20-027)

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Objectives: Abdominal obesity is a strong predictor of metabolic dysfunction, but it remains unclear whether overall diet pattern influences this body composition phenotype, especially in children. In this study, we examined associations of diet pattern with abdominal-to-peripheral body fat ratio (APR) in US children and adolescents.

Methods: Data from $n = 9130$ children (aged 8–18 y) in NHANES 1999–2006 were used. Body composition was assessed by dual-energy X-ray absorptiometry and an APR (%) was calculated by dividing grams of trunk fat mass by the sum of arm and leg fat mass. Healthy Eating Index (HEI)-2015 total and component scores were calculated from 24-h dietary recall data. Survey-weighted linear regression was used to assess associations of HEI scores with APR. Effect modification by sex and race was assessed and stratified if significant. Models were also adjusted for age, income level, total energy intake, and body mass index percentile.

Results: Overall, the mean ± SE for HEI total score was 42.6 ± 0.2 and for APR was 71.6% ± 0.3%. We found a significant association between higher HEI score and lower (more favorable) APR ($\beta = -0.04$; 95% CI: −0.08, −0.003). However, this association was modified by race, such that in stratified analyses the association of HEI with APR was only significant among non-Hispanic white children. For individual HEI components, after controlling for HEI total score, total and whole fruit scores were significantly inversely associated with APR among non-Hispanic white children only ($P < 0.01$ for both), and fatty acid ratio [(monounsaturated fatty acids + polyunsaturated fatty acids)/saturated fat] score was significantly positively associated with APR among children of "other" race/ethnicity only ($P < 0.05$).

Conclusions: These findings suggest that, among US children and adolescents, the relation between overall diet pattern, assessed in relation to the *Dietary Guidelines for Americans*, and APR appears to be moderated by race, as the association was only significant among non-Hispanic white children. More research is warranted on factors contributing to abdominal obesity in other racial/ethnic subgroups.

Funding Sources

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Supporting Images/Graphs

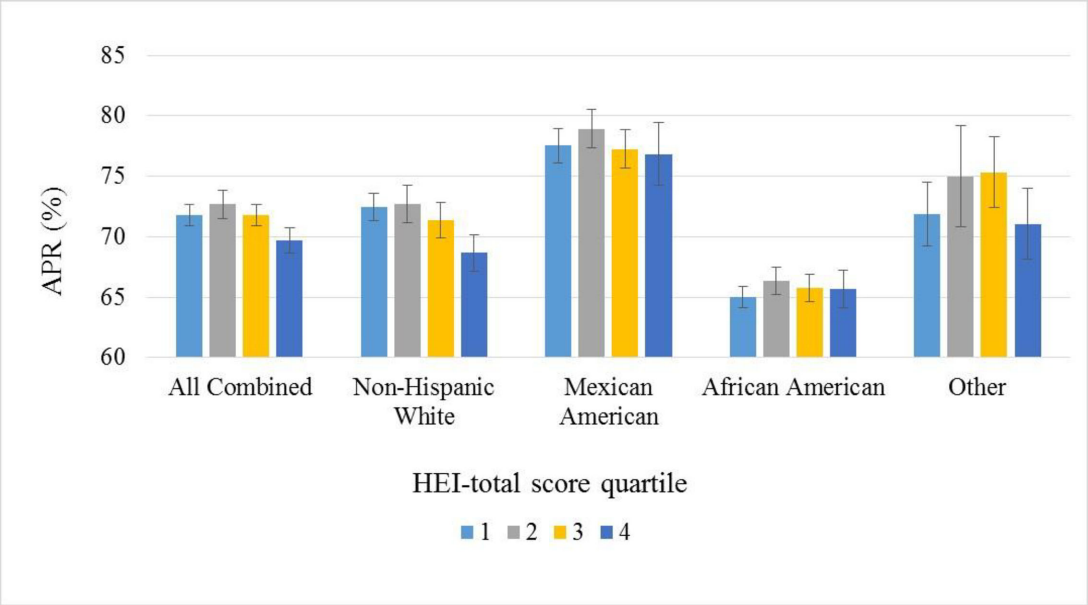

FIGURE P20-027-1 Mean APR (%) according to HEI-total score quartile and racial/ethnic group among children and adolescents (8–18 y), NHANES 1999–2006. Error bars represent 95% CIs. Estimates are unadjusted. APR, abdominal-to-peripheral body fat ratio; HEI, Healthy Eating Index.

How Federal Agencies Capture Use of Dietary Supplements in Electronic Medical Records (EMRs) (P20-028)

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Objectives: Of importance to federal agencies that administer health care facilities is capturing patient use of dietary supplements (DSs) to avoid potential drug-supplement interactions. A survey was conducted to determine how information on DSs is being collected, recorded, and processed in electronic medical records (EMRs) across federal agencies.

Methods: Four federal agencies providing direct health care services to large numbers of men and women in the United States were surveyed on current practices regarding the recording and processing of information on DS use either on an outpatient or inpatient basis. A point of contact for each of the following federal agencies was identified, and a 14-question survey was sent to each for completion: NIH Clinical Center, Department of Defense (DoD) Military Nutrition Committee, Veterans Health Administration (VHA) Office of Specialty Care Services, and the Indian Health Service (IHS), Office of Information Technology. The survey requested database-specific information, as well as specific questions regarding linkage of the EMRs to the pharmacy.

Results: All 4 agency representatives completed the survey. No agency used the same EMR software reporting system. Most EMRs have searchable fields that are in a structured format, but some information is free text and allowed entry by multiple members of the health care team. Three different medication formulary or drug knowledge databases were utilized across the agencies. In some EMRs, DSs were cross-referenced with medications in structured fields and were free text in others. How DS medication interactions were flagged, as well as the individual responsible for coding interactions, varied across the agencies based on the EMR in use.

Conclusions: Most agencies that use EMR management systems have adequately described procedures for entering and charting information on DSs. The responsibility for charting, however, varies across agencies whether captured by the admitting doctor, nurse, dietitian, or pharmacist. Direct linkage between the pharmacy system and the drug knowledge database is a feature of the EMRs for the NIH Clinical Center, the VHA, and the IHS, but not across the DoD at this time. Establishing common EMR practices could facilitate monitoring the use and potential interactions of DSs with prescribed drugs.

Funding Sources

NIH Office of Dietary Supplements.

Prevalence of Dietary Supplement Use Differs with Poverty Indicators among US Adults (P20-029)

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Objective: The aim of this study was to examine the relation between dietary supplement (DS) use and demographic characteristics including selected poverty indicators [poverty-to-income ratio (PIR),

food security status, and Supplemental Nutrition Assistance Program (SNAP) participation].

Methods: Data were analyzed from 11,451 US adults (aged ≥19 y) participating in the nationally representative NHANES from 2011 to 2014. DS use was ascertained via an in-home interview and questionnaire that collected participants' usage of DSs in the past 30 d. Prevalence of use and selected types of DS products used were estimated and associations with indicators of socioeconomic status were assessed. Socioeconomic status was classified based on PIR (≤130%, >130 to ≤350%, and >350%), household food security status (food insecure compared with food secure) based on the US Household Food Security Module, and SNAP participation status (current participants, income-eligible nonparticipants, and income-ineligible nonparticipants). Descriptive statistics were analyzed with SUDAAN proc descript. All results were stratified by sex, age, and race/ethnicity.

Results: Half of US adults (52.1%) reported taking at least 1 dietary supplement in the past 30 d. Multivitamin-mineral (MVM, 56%) products were the most commonly reported supplement type consumed among DS users. DS use was more prevalent among women (59%) than men (45%), and increased linearly with age. DS use was also significantly higher among the highest PIR group, those who were food secure, and SNAP-ineligible individuals across all sex, age, and race/ethnic groups with the exception of Hispanic and Mexican Americans, when compared with low-PIR, food-insecure, and SNAP-eligible individuals. Individuals in the highest PIR group were also more likely to use >1 DS product than were individuals in lower PIR groups.

Conclusions: Among US adults, income is associated with DS use and also with the type and number of products consumed. DS use, specifically MVM use, was lowest among adults classified as food insecure, those at <130% PIR, and current SNAP participants. Taking nutrient-containing DSs is one strategy to reduce the risk of nutrient inadequacy without adding energy in these populations.

Funding Sources

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Assessing the Association between Serum β-Carotene, Body Mass Index, and Markers of Inflammation in US Adults (P20-030)

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Objectives: Obesity rates are high worldwide, and therefore understanding the health consequences and mortality risk associated with obesity is important. The relations between obesity, low-grade inflammation, and oxidative stress are well established in longitudinal studies. However, how serum carotenoid concentrations correlate with obesity-related inflammation in population samples is not well understood. Our primary objective is to test the hypothesis that serum β-carotene concentrations are independently associated with body mass index (BMI) and the inflammatory marker high-sensitivity C-reactive protein (hsCRP), utilizing datasets from NHANES.

Methods: Data from 9349 male and nonpregnant female participants aged 20–85 y in the NHANES 2003–2006 nationally representative, cross-sectional survey were analyzed to estimate the relations among BMI, hsCRP, and serum β-carotene. Due to skewing, we log transformed serum β-carotene and hsCRP. Multiple linear regression estimated log(serum β-carotene) based on BMI and log(hsCRP) adjusted for age, sex, and ethnicity.

Results: The prevalence of low serum β-carotene concentrations (<50 μg/dL) was 86.7%, and the prevalence of obesity was 32.6%. Mean ± SD was 2.51 ± 0.85 for log(β-carotene) and −1.65 ± 1.31 for log(hsCRP). Mean ± SD BMI was 28.27 ± 6.55 kg/m^2. Log(serum β-carotene) was inversely associated with BMI ($r = -0.19$, $P < 0.0001$) and log(hsCRP) ($r = -0.16$, $P < 0.0001$), and the correlation of BMI with log(hsCRP) was $r = 0.44$ ($P < 0.0001$). Mean untransformed serum β-carotene was significantly lower in obese subjects than in normal weight subjects (14.39 ± 14.87 compared with 21.80 ± 24.46 μg/dL, $P < 0.001$). The log of serum β-carotene concentration was lower by 0.13 ± 0.01 μg/dL for each 1SD higher BMI and lower by 0.18 ± 0.01 μg/dL for each 1SD higher log(hsCRP), which are respectively 15% and 21% of the SD of log(serum β-carotene).

Conclusions: Substantial associations were found among serum β-carotene concentrations and BMI and hsCRP. These factors may contribute to the increased risk of chronic disease, particularly in obese individuals.

Overweight and Obesity in Children and Adolescents: Recent Tendencies, 2012–2016 Health and Nutrition National Surveys Comparison (P20-031)

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National Institute of Public Health

Objective: The aim of this study was to estimate recent overweight and obesity prevalences in a Mexican population <20 y old from the Health and Nutrition National Survey ENSANUT-MC-2016 and to compare the results with ENSANUT-2012.

Methods: ENSANUT-MC-2016 is a probabilistic national survey that gives representative information from national, regional, and rural/urban levels. Body mass index *z* score was estimated through weight and height, and was then classified into overweight risk, or overweight or obesity according to WHO growth reference standards. Association between overweight and sociodemographic information was analyzed through logistic regression models.

Results: Overweight and obesity prevalence was 5.1% in girls 0–5 y and 6.5% in boys 0–5 y; 32.8% in girls 5–11 y and 33.7% in boys 5–11 y; and 39.2% in adolescent females and 33.5% in adolescent males. Adolescent females from rural localities showed an increase in the prevalence of overweight and obesity prevalence from 27.7% in 2012 to 37.2% in 2016.

Conclusions: Overweight and obesity increased in girls and females, mainly from rural areas. The implementation of strategies focused on containing this phenomenon should be encouraged.

Funding Sources

Ministry of Health.

Health-Related Quality of Life among Breast Cancer Survivors in Trinidad and Tobago (P20-032)

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The University of the West Indies, St Augustine, Trinidad

Objective: The aim of this study was to determine the health-related quality of life (HRQOL) among breast cancer survivors.

Methods: A case-control design was used. Cases were female breast cancer survivors and controls were females without breast cancer. Face-to-face interviews were conducted with the use a standardized questionnaire consisting of the 12-Item Short Form Health Survey (SF-12), Functional Assessment of Cancer Therapy-Breast (FACT-B), physical activity, and sociodemographic items. The FACT-B consists of the FACT-General (FACT-G) plus the Breast Cancer Subscale (BCS), which complements the general scale with items specific to QL in breast cancer. SF12 and FACT-B items were used to compute associated subscales and summary scores. Increased risk for poorer HRQOL in subscales and summary scores was defined as a score of

Results: In total 734 women (cases = 120; controls = 614) participated in the study. Cases were significantly older and heavier than controls. They were significantly more likely than controls to be overweight and obese (63.3 compared with 49.3%; $P = 0.008$). Breast cancer survivors had significantly lower SF-12 summary and subscale scores than participants without breast cancer. Cases were more likely than controls to have higher levels of general health (20.0% compared with 2.5%; $P < 0.001$), bodily pain (20.0% compared with 10.7%; $P = 0.01$), and physical functioning (61.7% compared with 28.3%; $P < 0.001$) scores

Conclusion: Breast cancer survivors were at increased risk of poorer HRQOL compared with their noncancer counterparts.

Funding Sources

None.

Dietary Pattern, Nutrient Intakes and Associated Factors among Breast Cancer Survivors in Trinidad and Tobago (P20-033)

Nequesha Dalrymple and Selby Nichols

The University of the West Indies, St Augustine, Trinidad

Objective: In this study we evaluated nutrient and dietary patterns among breast cancer survivors.

Methods: A case-control study design was used. Cases were female breast cancer survivors and controls were females without breast cancer. Participants completed a questionnaire consisting of sociodemographic, food frequency, and physical activity items. Participation was voluntary. Nutrient intakes were analyzed with nutrient analysis software (Nutrigene 7.0) and SPSS version 24. Nutrient intakes were expressed per 1000 kcal. Anthropometry was assessed according to standard procedures. The study was approved by the Ethics Committee of The University of the West Indies.

Results: In total, 734 women (cases = 120; controls = 614) participated in the study. Cases were significantly older and heavier than controls. They were also significantly more likely than controls to be overweight and obese (63.3% compared with 49.3%; $P = 0.008$). In addition, they were less likely than controls to report participating in physical activity $\geq$3 times/wk (52.0% compared with 36.7%; $P = 0.003$). Cases had significantly lower mean energy intakes than controls (1806 ± 326 compared with 2294 ± 342 kcal; $P < 0.001$). Breast cancer survivors had significantly higher mean intakes of niacin, vitamin B-12, calcium, and vitamin E than their noncancer counterparts. Noncancer participants had higher mean intakes of sodium and vitamin A than women with breast cancer. With the exception of mean vegetable intakes, breast cancer survivors reported significantly lower intakes of all food groups than their noncancer cancer counterparts.

Conclusion: Overall, breast cancer survivors reported lower mean intakes of the various food groups with the exception of vegetables. We found no difference in mean macronutrient intakes, although there were significant mean differences in several micronutrients expressed per 1000 kcal.

Funding Sources

None.

Causal Inference of the Factors Leading Individuals to Choose Protein-Rich Foods Using Directed Acyclic Graphical Models (P20-035)

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A better understanding of the determinants of preferences for high-protein food would be of great value in formulating efficient dietary advice, particularly in a general context where reduction of meat consumption is recommended. The aim of this study was to identify causal factors of choices for protein-rich sources.

We conducted an online survey on food preferences that consisted of collecting from adults subjects individual information, and current levels of hunger and thirst, as well as preferences between pairs of pictures of food items at the time of the survey. Foods were selected among a representative subset of common dishes varying in protein content. We aimed to measure the causal effect of the different parameters on the preference for protein-rich foods.

The preference for protein-rich foods was computed as the mean difference between the actual content in the chosen food and the content of rejected food. As causal links cannot be discovered with standard statistical methods (since correlation does not imply causality), we created directed acyclic graphical models representing the relations between all collected parameters. We used a back-door criterion to determine which variable had an identifiable causal effect. We used several matching methods and propensity score methods to estimate the causal effects.

Among all the considered variables, we identified the state of hunger and the gender as causal factors for choosing high-protein food. In future studies, this promising methodology should be applied to bigger datasets from large numbers of participants to yield precise information on factors leading individuals to choose protein-rich foods.

Funding Sources

AgroParisTech, INRA.

Food Sources of Energy and Nutrients in Filipino Preschool and School-Age Children (P20-036)

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Objectives: Dietary intake research shows that diets of children in the Philippines contain insufficient nutrients. The objective of this study was to understand food sources of energy and nutrients of Filipino children.

Methods: Data were from 8992 preschool and schoolchildren who participated in the Philippines 2013 National Nutrition Survey (3–5 y, $n = 2427$; 6–9 y, $n = 3594$; and 10–12 y, $n = 2971$). One 24-h dietary recall was collected for all children via face-to-face interviews with the child or the mother or guardian. All foods and beverages consumed during the previous day were recorded and processed with FNRI's Dietary Evaluation System. All reported food and beverages were assigned to 1 of 80 food groups developed for the study. The percentage contribution of each food group to energy and nutrient intakes was calculated. Only food groups that contributed >1% of the daily nutrient intakes were reported.

Results: Refined rice, sweet bakery products, bread, pork, sugar-sweetened beverages, and noodles were the top 5 sources of energy. Of these, refined rice alone provided 41–55% of total energy. Consequently, in all age groups, refined rice was the main source of a number of key nutrients including protein (27–37%), iron (21–31%), zinc (26–37%), and thiamine (22–35%), and in 61–2 y olds, rice was the main source of riboflavin (16–19%). Among 3–5 y olds, milk contributed 7% of energy but its contribution became <1% by 10–12 y of age. Although fish ranked from 6th to 10th as a source of energy (3%), it was the primary source of vitamin B-12 (60–66%) in all age groups and the main source of calcium (20–23%) in 6–12 y olds. Sugar-sweetened beverages (mostly fruit based) were the leading source of vitamin C (38–40%). Top sources of vitamin A were local green leafy vegetables (23–37%), pork (6–11%), and fish (8–9%). Overall, vegetables and fruits did not contribute or contributed little to other nutrient intakes.

Conclusions: This study showed that refined rice and other food items with low densities of nutrients, such as sweet bakery products, were the core foods consumed by Filipino children. The fact that refined rice was the main source of many key nutrients, whereas milk, meats, fruits, and vegetables were not important sources of key nutrients, explains why many nutrients are lacking from the diets of this population.

Phytochelatin database (PyCDB): An Omics Resource For Metal-Phytochelatin Complexes in Food and Nutrition (P20-037)

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Objectives: Phytochelatins are a large group of metal chelators which can impact bioavailability of essential and toxic metals from plants and plant-derived foods in the human diet. The objective of this project was to develop a phytochelatin-metal complex database to support mass spectrometry (MS)–based metabolomics and metallomics studies of phytochelatins. Authentic standards and high-resolution metabolomics of common foods were used to test the usefulness of the database.

Methods: We conducted a literature review and used binding chemistry to compile elemental formulas of phytochelatin-metal complexes. We used the elemental formulas with a modification of the R package OrgMassSpecR, to generate monoisotopic masses for each phytochelatin. We confirmed MS detection of predicted adducts (H^+, Na^+, and other forms) for representative phytochelatins and phytochelatin complexes. We analyzed 8 samples each of onion, carrot, and lettuce, and used the phytochelatin database in xMSannotator to identify mass spectral features annotated as adducts of specific phytochelatins and phytochelatin-metal complexes.

Results: We obtained a phytochelatin database containing >45,000 unique elemental formulas. Comparison of the database with plant food metabolomics data resulted in hundreds of annotations, including high-confidence matches for a diverse range of phytochelatin-metal complexes, including copper, iron, and manganese forms across multiple food types. Onion samples yielded high- and medium-confidence annotations for 70 phytochelatins; >200 additional phytochelatins were annotated at lower confidence. Shorter-length phytochelatins were more common than longer forms, and the most common complexes had 1 metal bound. Similar patterns were observed for carrots and lettuce, but specific phytochelatin-metal complexes differed.

Conclusions: This study demonstrates that hundreds of phytochelatin-metal complexes are present in a small number of food samples. Given the large number of plants included within human diets, the results indicate that phytochelatin-metal complexes are more diverse than the available literature suggests. Studies are needed to more fully characterize the diversity of dietary phytochelatins and their impacts on metal bioavailability.

Funding Sources

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Quantity and Quality of Dietary Intake and its Relation to Nutrition-Inflammation Status among Hemodialysis Patients (P20-038)

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Background: Hemodialysis patients are at risk of impaired nutritional status and inflammation. Poor diet quality is one of the main predictors for the development of malnutrition with a subsequent increase in the risk of mortality in this population.

Objective: The aim of this study was to examine the Alternative Healthy Eating Index (AHEI, 2010)—a measure of diet quality—dietary intake and its relation to nutritional status among hemodialysis patients.

Methods: This study involves a cross-sectional analysis of 50 hemodialysis patients. Nutrition status was assessed by the Subjective Global Assessment (SGA) and Malnutrition-Inflammation Score (MIS); 24-h dietary recalls were obtained to calculate AHEI-2010, dietary protein intake (DPI), and dietary energy intake (DEI). We compared these parameters with the current recommendations of 1.2 g/kg of protein and 30–35 kcal/ kg daily to prevent wasting by the National Kidney Foundation Dialysis Outcomes Quality Initiative (KDOQI)

Results: Participants had a mean ± SD age of 65.5 ± 14.2 y, and body mass index of 27.6 ± 5.0 kg/m^2; 28% were women, 16% were Hispanic, 34% African American, 10% West Indian, and 60% were diabetics. The mean MIS was 5.8 ± 2.6. The mean ± SD DEI was 1841 ± 400.3 kcal/d, the mean ± SD DPI was 85.5 ± 26.4 g/d, and the mean ± SD AHEI was 59.8 ± 13.0. Only 59% of participants met the KDOQI recommendations for daily protein intake, and 25% met the energy intake, but only 20% met both recommendations for daily protein and energy intakes. The SGA showed that 60% were well nourished, 38% at moderate nutritional risk, and 2% were malnourished. A mean strong correlation was found between MIS and SGA ($r = 0.59$, $P < 0.05$). There was an inverse correlation between DEI and MIS ($r = -0.55$, $P < 0.05$) and between DPI and MIS ($r = -0.25$, $P < 0.05$), and a direct correlation between DEI and AHEI ($r = 0.33$, $P < 0.05$)

Conclusions: Higher diet quality scores were strongly associated with energy intake. Only 20% of the patients met protein and energy recommendations, and 40% were moderately to severely malnourished. These results suggest that patients should be encouraged to meet their energy and protein requirements to prevent malnutrition. The relation between diet quality and nutritional status warrants longitudinal follow-up.

Almond Snack Consumption Is Associated with Better Diet Quality in UK Adults: National Diet and Nutrition Survey (NDNS) Rolling Programme 2008–2014 (P20-039)

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King's College London, UK

Objectives: The aim of this study was to examine the association of almond snack consumption with nutrient intake, nutrient adequacy, and diet quality in a UK adult population from the National Diet and Nutrition Survey (NDNS) 2008–2014.

Methods: Cross-sectional analysis was conducted with the use of data from 4738 adults (aged ≥19 y) who completed a 4-d food diary. Almond snack consumption was defined as the average intake of any amount of *1*) kernel only (K), or *2*) kernel only plus the proportion of almond kernels in mixed nuts (M). Specific data on the amount of almonds in mixed nut products were not available, and therefore data were estimated from the average proportion of almonds in UK commercial mixed-nut products. Nutrient intakes were calculated and percentages of the intakes below the Estimated Average Requirement (EAR), Dietary Reference Values (DRV), or Reference Nutrient Intakes (RNI) were determined. To estimate diet quality, modified Mediterranean Diet Score (MDS), modified Healthy Diet Score (HDS) and Eating Choices Index (ECI) were applied. Dietary patterns were also derived via principal-component analysis (PCA) based on 60 food groups. Multivariate linear regression models were used to investigate associations of almond snack consumption with diet quality including covariates (age, sex, region, ethnicity, socioeconomic and smoking status, and energy intake).

Results: K and M consumers had significantly higher intakes of *cis*-monounsaturated fatty acids, n–6 (ω-3) polyunsaturated fatty acids, dietary fiber, vitamin E, folate, vitamin C, potassium, magnesium, phosphorus, iron, copper, and manganese than nonconsumers. A smaller percentage of K and M consumers than nonconsumers were below the EAR for vitamins A, riboflavin, folate, vitamin C, calcium, magnesium, iron, and zinc; the DRV for dietary fiber; and the RNI for potassium, copper, iodine, and selenium. MDS, HDS and ECI scores were significantly higher in K and M consumers. Regression analysis showed that increments in almond snack consumption (g/1000 kcal of total energy intake) significantly and positively changed MDS, HDS, and ECI scores by 0.112 (K) and 0.134 (M), 0.110 (K) and 0.105 (M), and 0.103 (K) and 0.115 (M), respectively. Six dietary patterns were derived by PCA in the total population, and almond snack consumption was associated with a Mediterranean-style pattern.

Conclusion: Almond snack consumers are more likely to meet dietary guidelines.

Funding Sources

Almond Board of California.

Almond Snack Consumption Is Associated with Lower Cardiovascular Disease Risk in UK Adults: National Diet and Nutrition Survey (NDNS) Rolling Programme 2008–2014 (P20-040)

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Objectives: The aim of this study was to examine the association of almond snack consumption with risk factors of cardiovascular disease (CVD) in a UK adult population from the National Diet and Nutrition Survey (NDNS) rolling programme 2008–2014.

Methods: Cross-sectional analysis was conducted through the use of NDNS 2008–2014 data from 4738 adults (aged ≥19 y) who completed a 4-d estimated food diary. Almond snack consumption was defined as average intake of any amount of *1*) kernel only (K), or *2*) kernel only plus the proportion of almond kernels in mixed nuts (M). Specific data on the amount of almonds in mixed nut products were not available, and therefore data were estimated from the average proportion of almonds in UK commercial mixed-nut products. Comparison of the means of CVD risk markers, including body mass index (BMI), waist circumference (WC), systolic and diastolic blood pressure (SBP and DBP), total cholesterol (TC), triglycerides (TAG); high-density lipoprotein (HDL) cholesterol; low-density lipoprotein (LDL) cholesterol, and C-reactive protein (CRP) between almond snack consumers and nonconsumers was performed with the use of analysis of covariance by adjusting for covariates (age, sex, region, ethnicity, socioeconomic and smoking status, and energy intake). Multivariate linear regression models were used to investigate associations of almond snack consumption with these CVD risk markers, including the covariates. Transformation was conducted for nonnormally distributed data.

Results: Almond snack consumers, both K and M, had significantly lower BMI [$P = 0.047$ (K), $P = 0.035$ (M)], WC [$P = 0.002$ (K and M)], and CRP [$P = 0.047$ (K), $P = 0.020$ (M)] than nonconsumers (see Table 1). In addition, M had significantly lower SBP ($P = 0.004$) and higher HDL cholesterol ($P = 0.004$). Fully adjusted regression analysis showed that increments in almond snack consumption (g/1000 kcal of total energy intake) did not statistically change these markers.

Conclusion: Almond snack consumers may have a more favourable CVD risk profile but there is no clear linear relation between almond snack intake and markers of CVD.

Funding Sources

Almond Board of California.

Supporting Images/Graphs

TABLE P20-040-1 Cardiovascular disease risk marker values in UK adults (≥19 y) based on National Diet and Nutrition Survey (NDNS) rolling programme 2008-2014, n = 4,738, by almond snack consumption.

CVD risk marker	Mean ± SD			
	K		M	
	Consumers, n = 121	Non-consumer, n = 4,617	Consumer, n = 226	Non-consumer, n = 4,512
BMI (kg/m²)	26.2 ± 0.6*	27.5 ± 0.2	26.4 ± 0.5*	27.5 ± 0.2
WC (cm)	91.4 ± 0.7*	94.0 ± 0.2	92.0 ± 0.6*	94.0 ± 0.2
SBP (mmHg)	122.3 ± 1.9*	126.7 ± 0.6	121.7 ± 1.5*	126.9 ± 0.6
DBP (mmHg)	72.7 ± 1.3	73.8 ± 0.4	72.7 ± 1.0	73.8 ± 0.4
TC (mmol/l)	5.1 ± 0.2	5.1 ± 0.0	5.2 ± 0.1	5.1 ± 0.0
TAG (mmol/l)	1.2 ± 0.1	1.3 ± 0.0	1.2 ± 0.1	1.3 ± 0.0
HDL-C (mmol/l)	1.5 ± 0.1	1.4 ± 0.0	1.6 ± 0.0*	1.4 ± 0.0
LDL-C (mmol/l)	3.1 ± 0.1	3.1 ± 0.0	3.1 ± 0.1	3.1 ± 0.0
HDL-C:TC	3.6 ± 0.2	3.7 ± 0.0	3.6 ± 0.1	3.7 ± 0.0
CRP (mg/l)	3.0 ± 0.8*	4.7 ± 0.2	3.0 ± 0.6*	4.7 ± 0.2

K: Almond snack kernel only

M: Almond snack kernel only plus the proportion of almond kernels in mixed nut products

*p<0.05 indicating a significant difference; Analysis of Covariance (ANCOVA) fully adjusted for covariates (age, sex, region, ethnicity, socio-economic and smoking status, and energy intake)

Ingredients and Terms Associated with Substance Dependence in the Updated Dietary Supplement Label Database (DSLD) (P20-041)

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Background: Some Americans use dietary supplements (DSs) for unproven indications, such as opioid dependence. Kratom (*Mitrogyna speciosa*) is a plant used as a traditional medicine in tropical Asia.

Objectives: The aim of this study was to identify products containing the controversial ingredient kratom that claimed implied benefits as opioid substitutes or for managing the side effects of opioid dependence/withdrawal.

Methods: We used search options in the Dietary Supplement Label Database (DSLD), a public-use DS label database, to identify labels with the ingredients kratom, *M. speciosa*, mitragyna, and its bioactive alkaloids mitragynine and hydroxymitragynine; brand names of products seized by the FDA; the names of manufacturers producing those products; and labels containing these search terms: opioids, heroin, withdrawal, addiction, dependence, cravings, or habit.

Results: Search terms appearing on labels were used in product names, cautionary statements, and use statements. Of the 46,811 on-market labels in DSLD, only 1 listed *M. speciosa* as an ingredient, with a label claim "promotes deep sleep and mental/cognitive recovery," but no label listed kratom, mitragyna, mitragynine or hydroxymitragynine. No names of previously seized products or associated manufacturers were found. No labels specifically mentioned opioids or heroin in the product name or directly claimed to assist in opioid/heroin withdrawal. Only 76 product names used the words withdrawal, addiction, dependence, habit, or cravings. None referred specifically to opioids; most frequently they referred to specific conditions (overweight, tobacco/nicotine, caffeine, and alcohol).

Conclusions: Submission of labels to DSLD, a large DS database with updated features that ease use for researchers, clinicians, and other stakeholders, is voluntary. Therefore, DSLD may not contain labels of all kratom products. Nevertheless, DSLD did contain the label of one product that contained *M. speciosa* and a number of labels that made claims that might be construed as drug claims (prohibited for DS products).

Funding Sources

Office of Dietary Supplements, NIH.

Distance Metrics Optimized for Clustering Temporal Dietary Patterning among US Adults (P20-042)

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Objectives: Few attempts to determine dietary patterns have incorporated concepts of time, specifically time of energy intake, frequency of intake, and proportion of energy consumed throughout a day, despite the intrinsic nature of time to patterning. Modified dynamic time warping (MDTW) has been previously developed as an appropriate distance metric for patterning these aspects of dietary patterns to determine temporal dietary patterns (TDPs) according to the 1999–2004 NHANES dataset. The objective of this study was to further explore DTW distance metrics ("unconstrained", "constrained," and MDTW) with modern spectral clustering methods to optimize the classification of TDPs related to dietary quality based on this dataset. The hypothesis was that MDTW would classify the TDPs with the strongest relations to dietary quality among US adults aged 20–65 y of NHANES 1999–2004.

Methods: Proportional energy intake by time of day and frequency metrics were optimized from complete day-one 24-h dietary recalls to create MDTW, conventional "unconstrained" DTW with only

a standard local constraint, and "constrained" DTW with both a standard local and global banding constraint. All 3 distance metrics were clustered through the use of spectral clustering. The association between each TDP distance metric clustering and mean dietary quality, as indicated by the 2005 Healthy Eating Index (HEI-2005), were determined through the use of multiple linear regression controlled for potential confounders. Strength of association for each model was compared through the use of adjusted R^2.

Results: Four clusters representing distinct TDPs for each distance metric by spectral clustering were generated among participants. MDTW exhibited TDP clusters with strong associations to HEI and the widest significant differences ($P < 0.0001$) in HEI-2005 (at 35.7 points, 2.1 SE and 51.9 points, 0.5 SE) among clusters compared with the TDP clusters generated from unconstrained and constrained DTW.

Conclusions: MDTW paired with spectral clustering is an ideal method for integrating multiple aspects of time with dietary data to determine TDPs.

Funding Sources

Purdue University.

Evaluation of New Technology-Based Tools for Dietary Intake Assessment (P20-043)

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Objectives: There is growing pressure in the area of dietary intake assessment to improve the accuracy and reduce costs of data collection and processing. New technology-based tools are available and more are under development, including web-based programs, mobile applications, and digital image–assisted and digital image–based tools, among others. The ILSI Europe Dietary Intake and Exposure Task Force launched this project to characterize and evaluate technology-based dietary assessment tools in order to develop general quality standards for future applications.

Methods: A comprehensive literature review identified new technology-based tools that use keyword searches with the following inclusion criteria: publications were in English, papers were published from 2011 to July 2017, and the tool features, functions, and uses were detailed. A total of 43 dietary assessment tools were identified. Scoring criteria were developed to evaluate tool features, results outputs, sources, and completeness of food composition data, target audience, and suitability for research. Each tool was rated on 25 attributes.

Results: Most of the tools identified (34/43) relied on self-reporting of dietary intake data, either through web-based programs or mobile apps. Fourteen used digital images to help identify foods consumed, and 3 used barcode scanners. Only 28/43 had integrated databases for estimating energy or nutrients. Most reported energy (28/43) and macronutrients (30/43), but fewer reported micronutrients (23/43) and food groups (29/43). Only 23/43 generated automatic reports. Most tools reported on usability (33/43) and some compared their tool with another method of assessment (32/43).

Conclusion: Dietary assessment methods that utilize technology provide rapid feedback to users and offer potential cost-savings for researchers. There remain gaps in many of these tools before they will be ready to replace more traditional interview-based methods for research purposes, and most require validity testing, additional description of the food composition tables used, and details on how the foods are identified and quantified. This project will provide perspective on quality standards that could be recommended for future development and reporting of technologies in the area of dietary intake assessment.

Funding Sources

This research was supported by ILSI Europe, Dietary Intake and Exposure Task Force.

Dietary Patterns Are Associated with Glucose and Lipid Biomarkers even within Near-Normal Range in the Nutritionists' Health Study (NutriHS), SP/Brazil (P20-044)

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Objective: The aim of this study was To evaluate if dietary patterns (DPs) are associated with glucose and lipid biomarkers in near-normal range healthy women from the Nutritionists' Health Study (NutriHS) baseline.

Methods: This cross-sectional analysis included 190 women aged ≤45 y without diabetes or cancer. Diet was assessed by food-frequency questionnaire. Total cholesterol (TC), high-density lipoprotein (HDL) cholesterol and triglycerides (TG) were measured by enzymatic colorimetric method, and low-density lipoprotein (LDL) cholesterol was calculated. Fasting plasma glucose and insulin (immunoenzymatic assay) were used to estimate the homeostasis model assessment of insulin resistance (HOMA-IR). Factor analysis by principal components was used to obtain DPs, analyzed in tertiles (T) taking T1 as reference. DPs were exposures in multiple logistic regression models performed to estimate ORs to be classified in T3 of biomarkers [compared with T1 + T2 (ref)]. Model 1 was adjusted for age, education, physical activity, and smoking. Model 2 further included energy intake.

Results: Median age was 22 y and mean values of TC and glucose were 173.2 ± 34.6 and 81.8 ± 8.9 mg/dL, respectively. Processed, Prudent, Brazilian, and Vegetarian DPs were identified, which accounted for 27% of total variance. Women classified in T2 of Processed DP had a higher chance of being classified in the higher T of glucose compared with those who were less adherent (T2: OR 2.95, $P = 0.013$; T3: OR 2.16; $P = 0.13$), and those in T3 showed a higher chance of having higher TC (T2: OR 1.76, $P = 0.26$; T3: OR 2.96; $P = 0.034$) and LDL cholesterol (T2: OR 1.83; $P = 0.19$; T3: OR 5.34, $P = 0.002$). Prudent DP was inversely associated with TG (T2: OR 0.35, $P = 0.027$; T3: OR 1.22, $P = 0.69$) and LDL cholesterol (T2: OR 0.55; $P = 0.20$; T3: OR 0.28; $P = 0.022$) in all models and with LDL cholesterol/HDL cholesterol ratio only in model 2 (T2: OR 0.52; $P = 0.15$; T3: OR 0.32; $P = 0.031$). In contrast, the association with glucose verified in model 1 (T2: OR 0.37; $P = 0.025$; T3: OR 0.35; $P = 0.016$) was lost after adjustment for energy. Brazilian DP was inversely associated with LDL cholesterol (T2: OR 0.26; $P = 0.003$; T3: OR 0.53; $P = 0.22$). Vegetarian DP was directly associated with LDL

cholesterol/HDL cholesterol ratio in model 2 (T2: OR 1.40; $P = 0.45$; T3: OR 2.73; $P = 0.029$). DPs were not associated with insulin or HOMA-IR.

Conclusion: Harmful associations of Processed DP with glucose, TC, and LDL cholesterol, and favorable associations of Prudent and Brazilian DPs with lipid biomarkers in healthy women reinforce the impact of dietary habits on metabolic parameters even when they are still within the near-normal range.

Funding Sources

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Association of Atherosclerotic Cardiovascular Disease Risk with Western Dietary Patterns in a Racially and Socioeconomically Diverse Urban Population (P20-045)

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Objectives: The aim of this study was to determine the dietary patterns typically consumed by urban African American and white populations, and their association of the diet quality of these patterns with 2013 American College of Cardiology/American Heart Association 10-y risk for atherosclerotic cardiovascular disease (ASCVD).

Methods: Subjects were persons who completed two 24-h dietary recalls during the follow-up wave of the Healthy Aging in Neighborhoods of Diversity across the Life Span study, 2009–2013. Of the 2140 persons with 2 recalls, 1358 had sufficient data to calculate the 10-y ASCVD risk score. Hierarchical case clustering was used to generate 4 dietary patterns (DPs) based on food group energy contribution. The Healthy Eating Index (HEI)-2010 was used to evaluate diet quality. The four DPs were then used as a grouping factor in linear regression, adjusting for sex, race, and income with Tukey honestly significant difference test multiple comparisons used for post hoc comparison of diet quality and ASCVD risk score means.

Results: All the patterns had sandwiches as the first or second food group contributing the majority of daily energy (10.30–16.06%). The pattern with the highest HEI-2010 score included sandwiches (10.12% of energy) along with vegetables (9.87%) and cheese/yogurt (4.99%). Persons consuming this pattern had significantly lower 10-y ASCVD risk (6.3 ± 0.8) compared with the meats/sandwiches DP (9.6 ± 0.9) and the sandwiches/bakery products DP (9.2 ± 0.4) ($P = 0.0208$ and $P = 0.0031$, respectively).

Conclusions: HEI-2010 scores indicated improvements in diet quality were warranted to achieve a healthful diet. The findings provided evidence that variations of the Western DP were associated with different ASCVD 10-y risks.

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Inadequate Dietary Intake of Micronutrients in 8 Latin American Countries—ELANS Study (P20–046)

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Objectives The aim of this study was to estimate the prevalence of dietary vitamin and mineral inadequacies across 8 Latin American countries.

Methods: Data were obtained from the Latin American Study of Nutrition and Health (ELANS), a multicenter household population–based cross-sectional survey ($n = 9218$; aged 15–65 y,mean age = 35.8 y; 47.8% males). Dietary intake was measured through the use of two 24-h dietary recalls, and the habitual micronutrient intake was estimated according to the multiple source method. The prevalence of inadequate dietary intake was estimated for calcium, iron, and vitamins A, C, and D, according to Dietary Reference Intake methods: the probability approach for iron, and the EAR cut-point method to the others.

Results: In general, calcium and vitamin D showed the highest dietary inadequacies (77.3–99.0%, and 99.5–100%, respectively), whereas iron revealed the lowest dietary inadequacies (1.7–20.7%), and vitamin A (39.0–53.6%) and C (30.5–39.7%) had mild inadequacies. Considering the countries singly, the highest inadequacies for vitamin D (100%) were observed among all sex and age groups from Argentine, Brazil, Costa Rica, and Venezuela, and among Chilean men and women aged ≥19 y; for calcium (100%) among Brazilian women aged 15–18 y, Costa Rican women aged 15–18 y and 51–65 y, and Peruvian men and women aged 15–18 y and women aged 51–65 y; for vitamin C (87.5%) among Argentine women aged 15–18 y; for vitamin A (80.0%) among Chilean men aged 15–18 y; for iron (43.3%) among Brazilian women aged 19–50 y. Otherwise, the lowest inadequacies were observed for iron (0.0%) among Colombian and Ecuadorian men aged 19–50 y, and Peruvian men aged 51–65 y; for vitamin C (10.2%) among Ecuadorian women aged 19–50 y; for vitamin A (21.5%) among Peruvian women aged 15–18 y; for calcium (52.8%) among Argentine men aged ≥19 y; and for vitamin D (82.1%) among Ecuadorian men aged 51–65 y.

Conclusions: Specific measures are required in order to reduce the prevalence of inadequacy for all countries and age groups for calcium and vitamin D intake, and specifically for women of childbearing age with reference to iron consumption. Differences were found between countries and sexes; therefore, studies of the contributing food sources which identify these differences were suggested.

Funding Sources

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Vitamins A, C, and E: Dietary Intake and Plasma Status in a Population-Based Study in São Paulo, Brazil (P20-047)

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Objective: Ths aim of this study was to assess the dietary intake and plasma status of vitamins A, C, and E of residents in São Paulo, Brazil.

Methods: Data were obtained from the 2015 Health Survey of São Paulo, a cross-sectional population-based study of a representative sample of the urban area of the city. Individuals who answered a structured questionnaire, had at least one 24-h dietary recall, and had blood sample collected were included in the present analysis ($n = 889$, age range 12–93 y). Dietary information was collected through the multiple-pass method and inserted in the Nutrition Data System for Research software, version 2014. The values of vitamins A, C, and E were checked against Brazilian's national composition tables. The usual intake of the vitamins was estimated through the use of the multiple-source method. The prevalence of individuals with inadequate dietary intakes was determined based on the estimated average requirement cutoff point, suggested by Dietary Reference Intakes. Vitamin A (retinol), vitamin C (ascorbic acid), and vitamin E (α-tocopherol) were measured in heparinized plasma by HPLC. Plasma deficiency was considered to be <0.70 μmol/L for vitamin A, <11.4 μmol/L for vitamin C, and <20.0 μmol/L for vitamin E.

Results: The prevalence of inadequate intake varied from 42.1% (women, 12–13 y) to 94.8% (men, 31–50 y) for vitamin A, from 10.4% (women, 12–13 y) to 38.2% (men, 19–30 y) for vitamin C, and from 92.8% (women, 12–13 y) to 100.0% (women, 31 y or more) for vitamin E. Plasma status varied from 0.0% (women, 31–50 y) to 9.64% (men, 19–30 y) for vitamin A, 7.6% (women, > 70 y) to 33.4% (women, 12–13 y) for vitamin C, and 33.2% (women, 51–70 y) to 82.6% (men, 14–18 y) for vitamin E.

Conclusions: There was a high prevalence of inadequate intake especially for vitamin E, which also showed a high prevalence of plasma deficiency. Although vitamin C had the lowest dietary inadequacies, plasma vitamin A showed the lowest plasma deficiencies. In general, the dietary inadequacies assessed were higher than the plasma status deficiencies, which could be a reflection of homeostasis as the body attempts to maintain its vitamin status despite dietary inadequacy.

Funding Sources

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Plasma Vitamin B-12 Is Positively Associated with Leukocyte Telomere Length in School-Age Girls (P20-048)

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Objective: We examined whether micronutrient status biomarkers were associated with leukocyte telomere length (LTL) in school-age children.

Methods: We conducted a cross-sectional study of 330 boys and 393 girls aged 5–12 y from Bogotá, Colombia. We quantified blood concentrations of hemoglobin, ferritin, zinc, vitamin A, folate, and vitamin B-12; and measured LTL by quantitative polymerase chain reaction in DNA extracted from buffy coat. We estimated mean differences in LTL by quartiles of micronutrient status biomarkers and categories of relevant sociodemographic and anthropometric covariates with the use of linear regression.

Results: In girls, plasma vitamin B-12 was positively associated with LTL (adjusted LTL difference between extreme vitamin B-12 quartiles = 0.11; P-trend = 0.02). LTL was also positively associated with birth order in girls (P-trend = 0.02). In boys, LTL was not related to the micronutrient status biomarkers but, unexpectedly, it was positively associated with birth weight ($P = 0.02$), height-for-age z score (P-trend = 0.01), and serum C-reactive protein (P-trend = 0.02).

Conclusions: LTL is associated with vitamin B-12 status among girls. LTL is also associated with birth weight, height, and C-reactive protein in boys.

Funding Sources

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Last Decade Changes in Carbohydrate Quality Intake in a Representative Population of São Paulo, Brazil (P20-049)

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Objectives: The aim of this study was to assess dietary carbohydrate quality in residents of São Paulo in the years 2003, 2008, and 2015.

Methods: Data were obtained from 3 versions of the Health Survey of São Paulo (2003, 2008, and 2015), a cross-sectional population-based study with a representative sample of individuals living of ≥12 y in the urban area of São Paulo. Individuals who answered a structured questionnaire and had at least one 24-h dietary recall were included in the present analysis (2003, $n = 2402$; 2008, $n = 1662$; 2015, $n = 1742$). Dietary information was collected through the multiple-pass method and inserted in the Nutrition Data System for Research software. Carbohydrate quality was assessed by total carbohydrate, total dietary fiber, cereal, fruit and vegetable fiber, glycemic index, added sugar, starch, carbohydrate from total grains, carbohydrate from whole grains, carbohydrates from solid foods, and the ratios carbohydrate from whole grain to carbohydrate from total grains, carbohydrate from solid foods to total carbohydrate, total fiber to total carbohydrate, cereal fiber to total carbohydrate, total fiber to starch, and cereal fiber to starch. Energy adjustment was made through the use of the nutrient density ($g \cdot 1000\ kcal^{-1} \cdot d^{-1}$). Metrics of years 2003, 2008, and 2015 were compared with the use of linear regression models considering the study design.

Results: Mean ± SD vegetable fiber increased from 1.50 ± 2.03 g/d in 2003 to 1.86 ± 2.30 g/d in 2015; carbohydrates from whole grains increased from 1.42 ± 5.95 to 2.88 ± 8.99 g/d; carbohydrate from total grains decreased from 70.45 ± 26.94 to 67.29 ± 25.28 g/d; the

ratio carbohydrate from whole grains to carbohydrate from total grains increased from 0.02 ± 0.08 to 0.04 ± 0.17 g/d; the ratio cereal fiber to total carbohydrate decreased from 0.019 ± 0.01 to 0.018 ± 0.02 g/d; added sugar increased from 9.84% ± 8.66% to 10.84% ± 8.61% of the total energy in the period assessed.

Conclusions: According the different metrics used, there was a small improvement in the quality of dietary carbohydrate among the residents of São Paulo from 2003 to 2015. However, added sugar intake increased in the period assessed. In general, values of whole grains and fiber from varying sources are lower than reported by studies which showed a protective effect from these components.

Funding Sources

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Alcohol Drinking Patterns and Risk of Hip Fractures in Postmenopausal Women and Men Aged 50 and Older (P20–050)

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Objectives: The aim of this study was to prospectively examine the association between total alcohol and specific alcoholic beverage consumption and risk of hip fractures in US men and women.

Methods: Health, lifestyle information, and hip fractures were self-reported on biennial questionnaires between 1980 and 2014 in 74,540 postmenopausal women from the Nurses' Health Study, and between 1986 and 2014 in 35,451 men aged ≥50 y from the Health Professionals Follow-up Study. Diet was assessed approximately every 4 y with a food-frequency questionnaire. Relative risks (RR) were computed for nontraumatic hip fracture through the use of Cox proportional hazards models, adjusting for potential confounders.

Results: We ascertained 2360 incident nontraumatic hip fractures in women and 741 in men. Among women, alcohol consumption <20 g/d was associated with a lower risk of nontraumatic hip fractures compared with nondrinkers (RR for 10 to < 20 g/d = 0.82; 95% CI: 0.71, 0.95 g/d) but not for quantities ≥20 g/d (RR = 0.91; 95% CI: 0.78, 1.09 g/d). In men, a significant inverse association was observed (RR comparing ≥20 g/d with none = 0.71; 95% CI: 0.54, 0.92 g/d; *P*-trend = 0.003). An inverse association was observed for red wine among women (RR = 0.62; 95% CI: 0.48, 0.81 for each serving/d). Among drinkers, the lowest risk among women was observed with a consumption pattern of 3–4 d/wk (RR compared with <1/wk = 0.65; 95% CI: 0.51, 0.84) compared with <1 d/wk, even after controlling for total alcohol intake, although we had limited power for those who reported daily drinking. Among men, the lowest risk was observed with 5–7 d/wk of consumption (RR = 0.68; 95% CI: 0.46, 0.98). We did not find an association between the maximum number of drinks per drinking occasion in a typical month and risk of nontraumatic hip fractures.

Conclusion: In these two US cohorts, moderate alcohol intake was associated with a lower risk of nontraumatic hip fracture.

Funding Sources

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Comparison of Methods for Estimating Dietary Food and Nutrient Intakes and Intake Densities from Household Consumption and Expenditure Data in Mongolia (P20-051)

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Objectives: Household consumption and expenditure surveys are frequently conducted around the world and usually include data on household food consumption. The applicability of these data to nutrition research is limited partly by their collection at household level rather than individual (dietary) level. Using a combination of household food consumption and individual dietary intake data from Mongolia, this study's objective was to evaluate the validity of 4 approaches for estimating diet from household surveys.

Methods: The following 4 approaches were evaluated: *1*) direct inference from per-capita household consumption; disaggregation of household consumption according to *2*) a statistical method based on a regression approach and *3*) the "adult male equivalent" (AME) method based on relative caloric requirements; and *4*) direct prediction of dietary intake given the availability of different household- and individual-level variables with which to build a model.

Results: Per-capita household consumption overestimated dietary energy in single- and multiperson households by factors of 2.63 and 1.89, respectively (correlation: 0.09 and 0.29). Performance of disaggregation methods was variable in terms of mean bias (range: +302 to +1088 and −918 to +163 kcal/d for AME and statistical methods, respectively, across 2 household surveys analyzed), whereas the statistical method exhibited less bias than the AME method in estimating intake densities (per 100 kcal) of most dietary components in both surveys. Increasingly complex prediction models explained 54–72% of in-sample variation in dietary energy (mean absolute error: 229 to 178 kcal/d), with consistent marginal benefits to model fit incurred by additional inclusion of basic dietary measurements and eating behaviors.

Conclusions: In Mongolia and elsewhere, differences in how household and dietary measurements are recorded make their comparison challenging. Validity of disaggregation methods depends on household survey characteristics and the dietary components considered. Relatively precise prediction models of dietary intake can be achieved by integrating basic dietary assessment into household surveys, which should be considered for nutrition surveillance in developing countries.

Funding Sources

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Association between Sociodemographic Characteristics and Food Group Consumption in Mexican Adolescents (P20-052)

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National Institute of Public Health, Mexico

Objective: The aim of this work was to study the association between sociodemographic characteristics and the number of recommendable and nonrecommendable food group consumed by Mexican adolescents from the 2016 National Health and Nutrition Survey.

Methods: From a national representative sample of 2440 adolescents, sociodemographic and dietary data from a semiquantitative food-frequency questionnaire for 7 d were obtained. Foods and beverages were classified into 13 food groups, then into recommended food groups (RFGs) and nonrecommended food groups (NRFGs). RFGs included fruits, vegetables, legumes, meats, poultry and fish, plain water, eggs, and dairy products. NRFGs were cured meats, fast food and fried Mexican snacks, salty snacks, candies and desserts, sweetened cereals, sweetened beverages, and sweetened dairy beverages. One point was assigned to each food group if at least 10 g/d was consumed on 3 d/wk; 7 d/wk was the criterion for fruits, vegetables, and plain water. RFG and NRFG scores were estimated by the sum of food group points.

Sociodemographic characteristics (SDCs) were a well-being index (WBI), constructed based on the household characteristics and family assets by a principal-component analysis, and divided into tertiles; and the education level of the household head, being from an indigenous group, and country regions: Northern, Center, Mexico City, and Southern. The association between food group scores and SDCs was evaluated by linear regression models taking into account the complex survey design and sample weights.

Results: In our sample, 48.8% were female adolescents, 9.7% were indigenous, and 22.3% households had a head with at least high school education. RFGs were negatively associated with indigenous ($\beta = -0.34$, $P = 0.013$) and positively associated with high school or greater education level ($\beta = 0.54$, $P < 0.001$) and high WBI ($\beta = 0.49$, $P < 0.001$). NRFGs were positively associated with medium ($\beta = 0.27$, $P = 0.026$) and high WBI ($\beta = 0.34$, $P = 0.015$).

Conclusions: Low education, being from an indigenous group, and WBI could negatively affect the consumption of RFGs; nevertheless, a high WBI also could increase the consumption of NRFGs. A deeper study on the impact of SDCs and consumption of healthy diets is necessary.

Funding Sources

Mexican Ministry of Health.

Seafood Intake, Sexual Activity, and Time to Pregnancy (P20-053)

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Objective: The aim of this study was to examine the relation of male and female seafood intake with time to pregnancy (TTP).

Methods: Our prospective cohort study included 501 couples planning pregnancy in the Longitudinal Investigation of Fertility and the Environment Study (2005–2009). Couples were followed for up to 1 y or until a pregnancy was detected by an in-home test. Daily seafood intake and sexual intercourse frequency (SIF) were collected during follow-up in daily journals. Multivariable Cox proportional odds models for discrete survival data were used to estimate the fecundability odds ratios (FORs) and 95% CIs adjusting for female age, the difference in male and female age, female race, male exercise, male and female alcohol intake, and menstrual cycle length.

Results: After multivariable adjustment, couples where the male and female partners consumed ≥8 seafood servings/cycle had 47% (95% CI: 7%, 103%) and 60% (95% CI: 15%, 122%) higher fecundity (shorter TTP) compared with couples where male and female partners consumed ≤1 seafood serving/cycle. Couples in which both partners consumed ≥8 seafood servings/cycle had 61% (95% CI: 17%, 122%) higher fecundity and 13% lower absolute difference in incidence of infertility compared with couples consuming less. The daily odds of sexual intercourse were 39% higher when both partners consumed fish on the same day compared with neither consuming fish. After adjustment for SIF, the association between couple seafood intake and fecundity, although attenuated, remained significantly elevated (FOR: 1.49%, 95% CI: 1.08%, 2.06%).

Conclusions: Higher male and female seafood intake was associated with higher frequency of sexual intercourse and fecundity among a large prospective cohort of couples attempting pregnancy. Our results do not suggest that women planning to become pregnant should limit their preconception seafood consumption.

Funding Sources

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Supporting Images/Graphs

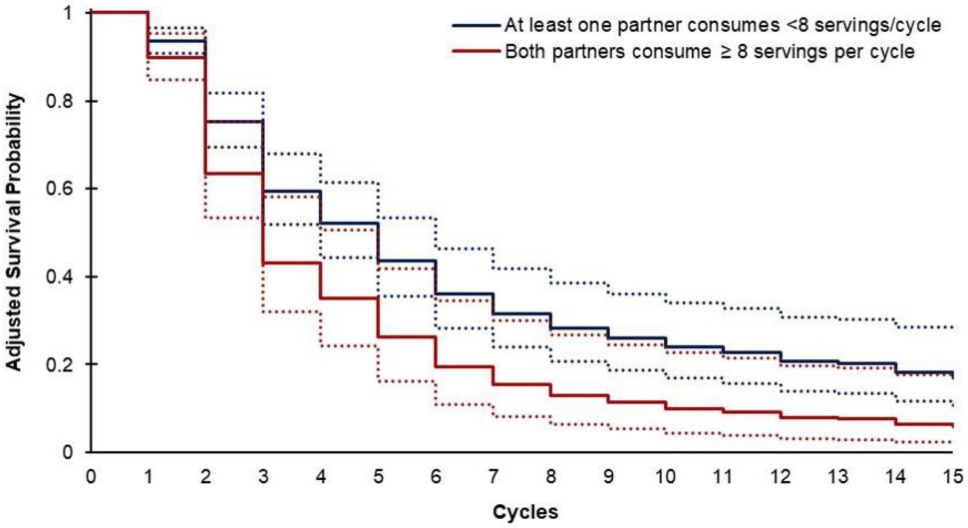

FIGURE P20-053-1 Interaction between male and female partner seafood intake during follow-up on time to pregnancy.

Apple Consumption and Risk Factors for Cardiovascular Disease (P20-054)

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Objective: Apples contain phytochemicals that have been connected to cardiovascular health. The aim of this study was to summarize research related to apple consumption and cardiovascular disease (CVD) risk through the use of systematic reviews and meta-analyses.

Design: Medline, Cochrane Central, and CAB databases were searched between 1960 through October 2016 for English-language publications on apple intake and CVD risk factors. Studies in adults [healthy or with CVD risk factors (obesity, dyslipidemia, diabetes, hypertension at baseline)] of all designs that quantified apple intake were included. CVD risk factors of interest included serum lipids, blood pressure, body weight, blood glucose, inflammatory markers, and clinical outcomes of CVD. The minimum duration of follow-up for blood lipid outcomes was 3 wk.

Results: The search resulted in 7 randomized control trials (RCTs, 471 subjects) and 13 eligible observational articles (13 cohorts). All trials reported quantitative data for at least 1 outcome of interest, and 5 reported qualitative data for other outcomes. Ten observational studies reported quantitative data and 3 qualitative data. One trial and 8 cohorts reported exposure of apple combined with pear.

Apple intake significantly decreased body mass index (BMI, 3 studies, net change −0.39 mg/dL, 95% CI: − 0.59, −0.20 mg/dL). There was no significant change in body weight, low-density lipoprotein, total cholesterol, high-density lipoprotein or triglycerides. In observational studies apple intake showed a decreased association with coronary heart disease [4 cohorts, summary risk ratio (RR) 0.84, 95% CI: 0.73, 0.98), cerebrovascular disease (3 cohorts, net change 0.84, 95% CI: 0.72, 0.99), cardiovascular death (3 studies, summary RR 0.76, 95% CI: 0.62, 0.92), diabetes (4 studies, summary RR 0.76, 95% CI: 0.66, 0.89), and all-cause mortality (4 studies, summary RR 0.83, 95% CI: 0.74, 0.92). No significant association was found between apple intake and risk of cerebral infarction or intracerebral hemorrhage.

Conclusion: RCTs of apple intake did not show a statistically significant change in many risk factors for CVD. Observational studies found a decreased risk of coronary heart disease, cerebrovascular disease, cardiovascular death, and all-cause mortality with apple intake. Apple consumption may be of benefit to CVD prevention.

Funding Sources

US Apple Association and USDA 8050-51000-095-015.

Taste and Smell Abilities among Cannabis Users: Data from the National Health and Nutrition Examination Survey (NHANES) 2011–2014 (P20–055)

Amy Gelfand and Christy Tangney

Rush University Medical Center, IL

Objective: The aim of this study was to assess if cannabis use affects taste and smell abilities.

Methods: NHANES is a population-based survey of US civilians. Data from NHANES years 2011–2014 were used, specifically, demographics, taste and smell questionnaire, drug-use questionnaire, smoking behaviors, and medical questionnaires. Data from 2 consecutive 2-y cycles were combined, and appropriate weights applied with the use of the Complex Sampling plans. Rao-Scott chi-square tests were run with SPSS version 22.0 Premium. Cannabis users were categorized as not using marijuana in the last month ($n = 2826$), marijuana use 1–15 d in the last month ($n = 196$), or marijuana use 16–30 d in the last month ($n = 95$). Ages of participants were limited to 40–59 y due to the inclusion criteria of the taste and smell questionnaire. Participants were only included if they completed the taste and smell questionnaire, and the drug-use questionnaire. Participants classified as not using marijuana in the last month includes subjects who have never used cannabis and those with no use in the last month.

Results: Marijuana use groups differed in gender ($P = 0.007$), income-to-poverty ratio ($P < 0.0001$), education ($P < 0.0001$), race/ethnicity ($P = 0.005$), and marital status ($P = 0.001$). Marijuana

use groups also differed in terms of presence of head injuries resulting in a loss of consciousness ($P < 0.015$), having a broken nose or serious injury to the face or skull ($P < 0.001$), having a persistent dry mouth ($P = 0.016$), and in having a change in ability to taste sour flavor ($P = 0.043$). There were no significant differences across the 3 marijuana use groups with respect to problems with smell or taste in the past 12 mo, other than the noted dry mouth.

Conclusions: Recent cannabis use may influence the ability to taste sour items. Data were likely limited by the small sample size of marijuana users compared with nonusers, as well as age restrictions. More research is needed to investigate the effect of cannabis on taste and smell.

Funding Sources
Rush University Medical Center.

Identification of Urinary Biomarkers of Fruit and Vegetable Intake through the Use of Ionomics (P20-056)

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Objectives: Fruit and vegetable (F&V) intake inversely correlates with risk of many chronic diseases; however, the ability to assess F&V intake is hampered by a lack of reliable biomarkers. Identification of such biomarkers would enhance current dietary assessment methods and provide a quantifiable, nonbiased measurement to evaluate compliance in epidemiologic studies and monitor nutrition education programs. Here, we conducted a 2-arm, fully controlled feeding study to identify urinary ions that are predictive of dietary F&V intake. Using inductively coupled plasma mass spectrometry (ICP-MS), we explored ion profiles useful in distinguishing between high- and low-F&V diets.

Methods: We enrolled 21 male and female volunteers aged 18–65 y old with body mass indexes of 20–29.9 kg/m^2. Enrolled participants completed 2 ASA24 dietary recalls and provided baseline urine samples prior to the intervention. All participants consumed a low-F&V lead-in diet for 4 d, followed by a second urine collection. Participants were then assigned to either high F&V intake with low diversity, or high F&V intake with high diversity. Intervention diets were followed for 4 d. On day 9 of the intervention, participants provided a third pooled urine sample. Treatment meals were provided by CSU Dining Services through the use of predesigned menus that varied in amount and diversity of F&V. Dietary compliance was determined from pre- and postmeal photos. Urinary concentrations of 26 ions and minerals were analyzed via ICP-MS. Values were evaluated with the use of internal and external standards and normalized to urinary creatinine levels.

Results: All participants who provided baseline samples completed the study. Dietary compliance, as evidenced by meal photos was ~92.6%. Preliminary ICP-MS data suggest that selenium, sodium, calcium, and aluminum are reduced with a high-F&V diet relative to low-F&V lead-in. Baseline ion profiles, combined with ASA24 data, will be used to test the discriminatory ability of identified biomarkers and future analyses will be directed at determining if ion profiles can distinguish different levels of dietary botanical diversity.

Conclusions: Urinary concentrations of several ions differed with varying levels of F&V intake, suggesting that this is a suitable low-cost platform for dietary biomarker identification.

Funding Sources
Colorado Agricultural Experiment Station.

Eating Yogurt and Greek Yogurt Is Associated with Decreased Risk for Adiposity and Diabetes (P20-057)

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Objective: The aim of this study was to determine the association between yogurt consumption, adiposity, and diabetes indicators within a nationally representative sample of US adults.

Methods: Yogurt consumption patterns were evaluated in a sample of 4686 nonpregnant adults (≥18 y) who participated in the 2013–2014 NHANES. During the NHANES, 2 d of dietary recall data were collected; participants provided specifics about each food and beverage item consumed, including time of day that the item was consumed. Participants were identified as yogurt consumers by specific USDA food codes. Yogurt consumers were further categorized as consumers of regular yogurt and consumers of Greek yogurt. During the NHANES, data were collected regarding participant body mass index (BMI), waist circumference, fasting glucose, fasting insulin levels, and diabetes diagnosis. Models were adjusted for age, sex, race, socioeconomic status (PIR), educational attainment, smoking status, physical activity level, and energy intake.

Results: Of the sample, 588 individuals were categorized as yogurt or Greek yogurt consumers and 4097 were categorized as nonconsumers. Those who consumed yogurt or Greek yogurt had significantly lower BMI (27.5 compared with 28.4 kg/m^2, $P = 0.03$), waist circumference (95 compared with 98 cm, $P = 0.04$), and fasting insulin levels (10.8 compared with 12.5 mg/dL, $P = 0.001$) than nonconsumers. In addition, those who consumed yogurt were less likely to report a diabetes diagnosis (6.3% compared with 9.9%; $P = 0.04$).

Conclusions: These results indicate that consuming yogurt and Greek yogurt is associated with decreased risk for adiposity and diabetes among US adults. As a nutrient-dense food, yogurt and Greek yogurt can be recommended as part of a healthy dietary pattern.

Funding Sources
Chobani, LLC.

Measuring Beverage Consumption in Children and Adolescents: A Systematic Review, 2007–2017 (P20-058)

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Objectives: Beverage consumption is a key determinant of health outcomes for children and adolescents. However, little unified guidance exists for assessing beverage consumption in youth. Further, it is unknown what methods are commonly used by researchers and whether these methods are reliable and valid. This study aimed to systematically review articles assessing beverage consumption in youth.

Methods: We searched PubMed and SCOPUS for the terms "beverage AND consumption AND children," and all synonyms and cognates, yielding 17,165 articles published between 2007 and 2017. Two investigators double-screened abstracts and full texts to identify English-language, peer-reviewed, original studies from the United States that reported on beverage consumption among 2–18 y olds. A total of 589 articles describing 615 beverage assessment methods were extracted.

Results: The most commonly used assessment methods were questionnaires (used by 65% of articles) and recalls (24%). Diaries, observations, and direct measurement were each used by ∼4% of articles. The most common referent periods for questionnaires and recalls were "yesterday/past 24 hours" (used by 37% of methods) and "past week/7 days" (19% of methods). Questionnaires queried recent consumption slightly more often than usual consumption (41% compared with 37%; remainder did not specify). Only 40% of questionnaires assessed portion size. Most articles (71%) did not address the validity of any measures, and 80% did not address reliability. Study populations were diverse: 55% of articles indicated they included low-income children, and 90% included non-white children. Forty-six articles focused exclusively on a particular racial/ethnic minority group. The most commonly assessed beverage categories were sugar-sweetened beverages, milk, and water.

Conclusions: Recent research assessing beverage consumption in youth excels in some areas. For example, recalls and questionnaires used short referent periods, which may facilitate accurate reporting by youth. Nevertheless, there are definite areas for improvement, including that researchers need to more consistently report measures' psychometric properties, questionnaires should assess portion size, and low-cost validated measures are needed.

Funding Sources

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Supporting Images/Graphs

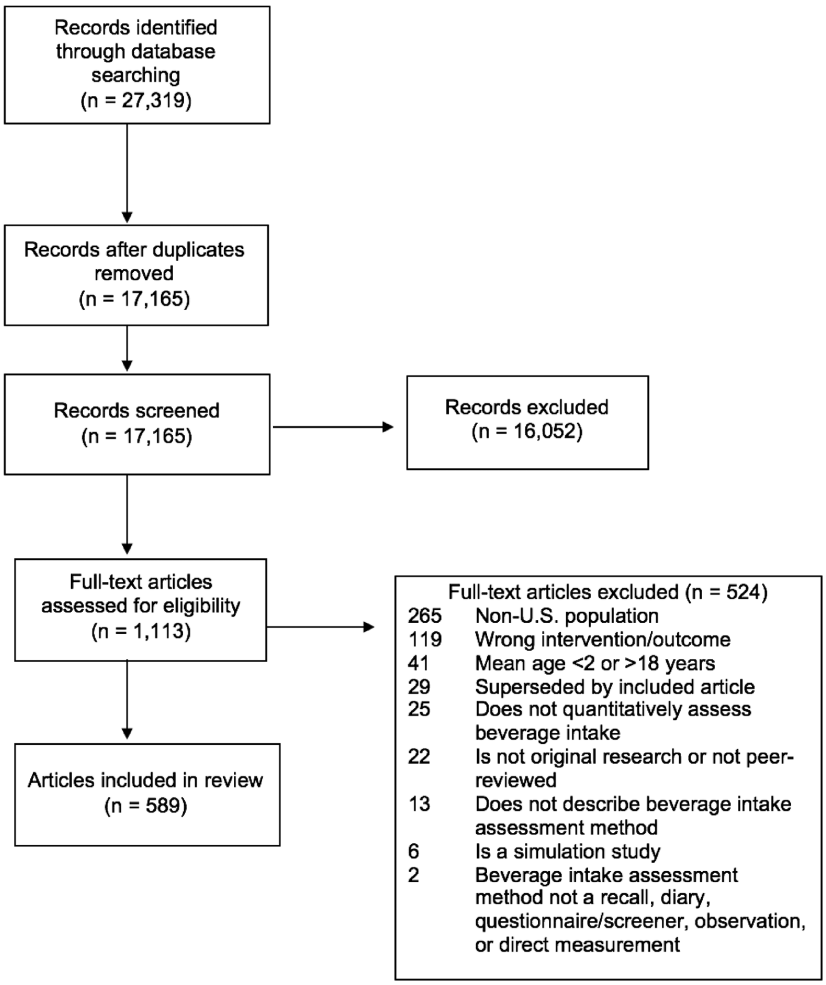

FIGURE P20-058-1 PRISMA diagram.

General and Abdominal Obesity Operate Differently as predictors of Falls and Falls Requiring Medical Care in Older Women: A Population-Based Cohort Study in Spain (P20-059)

Pilar G Guallar Castillon,[1] Helena Sandoval-Insausti,[2] Luz M León-Muñoz,[3] Carolina Donat-Vargas,[3] Belen Moreno-Franco,[4] Juan Gutierrrez-Fisac,[3] Fernando Rodriguez-Artalejo,[3] and Ygor Hermenegildo[3]

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Objective: The aim of this study was to examine the association of both general obesity (GO) and abdominal obesity (AO) with falls requiring medical care in a population-based cohort of older adults from Spain.

Methods: A cohort of 2246 individuals aged ≥60 y, of whom 1185 were women (52.8%), was established between 2008 and 2010 and followed up throughout 2012. A physical examination was done to obtain information on weight, height, and waist circumference according to standardized techniques. Body mass index (BMI) was calculated as kg/m^2, and participants were classified according to the WHO (normal: <25 kg/m^2; overweight: 25–29.9 kg/m^2; obese: ≥ 30 kg/m^2). AO was defined as waist circumference >102 cm in men and >88 cm in women. Participants were asked about the number of falls in the previous year, and the clinical consequences of these falls. Logistic regression was used to estimate ORs and their 95% CIs. Models were mutually adjusted for GO and AO, and for the main confounders. We used the likelihood ratio test for interaction testing.

Results: During 1-y follow-up, 336 women suffered from falls, 168 required medical care, and 54 had fractures. In women, when comparing with those with normal weight, being overweight was positively associated with falling (OR: 1.76; 95% CI: 1.07, 2.91), negatively associated with falls requiring medical care (OR: 0.57; 95% CI: 0.34, 0.94), and with falls with fractures (OR: 0.27; 95% CI: 0.12, 0.63). The corresponding results for GO were OR: 2.28 (95% CI: 1.23–4.22), OR: 0.44 (95% CI: 0.24, 0.81), and OR: 0.30 (95% CI: 0.11, 0.82). On the contrary, suffering from AO was a negative predictor for suffering from falls (OR: 0.55; 95% CI: 0.34, 0.89), and a positive predictor for falls requiring medical care (OR: 1.82; 95% CI: 1.12, 2.94), and falls with fractures (OR: 2.75; 95% CI: 1.18, 6.44). In men, results were similar to women but without reaching statistical significance (P for sex interaction = 0.12).

Conclusions: In older women, GO is a risk factor for falling, and a protective predictor of falls requiring medical care. AO is negatively associate with falls, and positively associated with falls requiring medical care. BMI adjusted for waist circumference may reflect lean mass, and hip adiposity may provide mechanical protection against the adverse medical consequences of falls.

Funding Sources

Data collection was funded by the following grants: FIS PI16/1512; PI16/1460; PI16/609; PI17/1709 (State Secretary of R + D and FEDER/FSE), Spanish Ministry of Economy and Competitiveness DEP2013-47786-R grant FEDER/FSE, the FRAILOMIC Initiative (EU FP7-HEALTH-2012-Proposal no. 305483-2), the ATHLOS project (EU H2020-Project ID: 635316), the SALAMANDER project (PCIN-2016-145), and the CIBERESP, Instituto de Salud Carlos III, Madrid, Spain.

Use of Iodine-Containing Dietary Supplements Remains Low among Women of Reproductive Age in the United States: NHANES 2011–2014 (P20-060)

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Objectives: In the United States, the American Thyroid Association recommends that women take a dietary supplement containing 150 μg of iodine while pregnant, lactating, and 3 mo prior to conception to support fetal growth and neurological development. The purpose of this analysis is to describe the use of dietary supplements with and without iodine among women of reproductive age (WRA; 20–44 y), including pregnant and lactating women, in the United States.

Methods: We analyzed data from NHANES 2011–2014 to describe any dietary supplement use and use of supplements containing iodine in the past 30 d [2155 nonpregnant, nonlactating (NPNL) women; 122 pregnant women; 61 lactating women]. Descriptive statistics for daily iodine intake from supplements were derived for each participant based on the number of days the dietary supplement was used and the amount consumed based on the serving size listed on the product label. We used SAS 9.4 and SUDAAN 11.0.1 (PROC DECRIPT) to estimate prevalence of supplement use. Pairwise comparisons were used to examine differences in prevalence of dietary supplement use (with and without iodine) within sociodemographic stratifications (t statistic, $P < 0.05$). All analyses were weighted and accounted for the complex survey design.

Results: Less than half (45.3%; 95% CI: 42.0%, 48.6%) of NPNL women used a dietary supplement and 14.8% (95% CI: 12.7%, 16.8%) used a dietary supplement with iodine in the last 30 d. Non-Hispanic black and Hispanic women were significantly less likely to use a dietary supplement, with or without iodine, than non-Hispanic white or non-Hispanic Asian women ($P < 0.05$). Among pregnant women, 72.2% (95% CI: 65.8%, 78.6%) used a dietary supplement; however, only 17.8% (95% CI: 11.4%, 24.3%) used a dietary supplement with iodine. Although 3 in 4 (75.0%; 95% CI: 63.0%, 87.0%) lactating women reported consuming a dietary supplement, only 19.0% (95% CI: 8.8%, 29.2%) reported consuming a dietary supplement with iodine. Among NPNL women consuming a dietary supplement with iodine, median daily iodine intake from supplements was 75.0 μg.

Conclusions: Self-reported data suggest use of iodine-containing dietary supplements among pregnant and lactating women remains low in contrast with current recommendations.

Disintegration and Rupture Testing of Prescription Prenatal Multivitamin/Mineral Dosage Forms: A Pilot Study for the Dietary Supplement Ingredient Database (DSID) (P20-061)

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Objectives: Approximately 75% of pregnant women who participated in NHANES from 1999 to 2006 reported the use of a prenatal multivitamin/mineral (MVM). The majority of these prenatal MVMs are prescription (Rx) products distributed only through pharmacies, although an increasing number of prenatal MVMs are available over the counter. In the United States, Rx prenatal MVMs are not regulated as pharmaceuticals but as dietary supplements. It is unknown whether their manufacturers voluntarily apply specifications that would more closely follow the manufacturing regulations for drugs.

Methods: From a complete list of Rx prenatal MVMs sold by retail and mail order pharmacies in the period from June 2015 to June 2016, a list of representative products was generated through the use of a probability-weighted random sample proportional to market share. Two lots of 24 products representing an estimated 61.2% of the market share are being tested by commercial labs for their chemical content and evaluated against labeled levels for prioritized vitamins (V) and minerals (M) and docosahexaenoic acid (DHA). In addition, each product is being tested for disintegration and dissolution according to the United State Pharmacopeia (USP 39) specifications. The USP standards are intended to detect problems that may arise due to misuse of coatings, lubricants, disintegrants, and due to tablet overcompression/overdrying that would affect the release of active ingredients from dosage forms after being swallowed.

Results: The softgels contained V and M along with DHA ($n = 6$), botanicals ($n = 1$) or docusate sodium ($n = 1$), or ω-3 (n–3) fatty acids only ($n = 4$) (as part of a pack including an MVM tablet). The tablets/caplets contained V and M only ($n = 11$), along with choline ($n = 2$) or docusate sodium ($n = 3$). For the first lot of products, all 8 MVMs and 4 fish oil softgels passed the rupture test. For MVM-only caplets/tablets, 9 out of 11 passed the disintegration test. Four out of five tablets containing V and M along with choline ($n = 2$) or docusate sodium ($n = 2$) failed to disintegrate, both without and with a disk in the vessel.

Conclusions: Our tests suggest that, in contrast to satisfactory performance quality of Rx prenatal MVMs in the form of softgels, tablets and caplets of these products do not always meet disintegration standards. This raises concerns that tablets/caplets of Rx prenatal MVMs may not release ingredients properly upon consumption.

Funding Sources

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Low-Carbohydrate-Diet Score and Incident Atherogenic Dyslipidemia over 12 Years: The Korean Genome and Epidemiology Study (P20-062)

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Objectives: The long-term association of low-carbohydrate diets with metabolic disease has not been fully investigated in the Asian population, whose fat intake is relatively low. This study aimed to examine the relation between a low-carbohydrate diet and the incidence of metabolic syndrome and atherogenic dyslipidemia among middle-aged Korean adults.

Methods: Data were obtained from the population-based cohort study, the Korean Genome and Epidemiology Study (Ansan-Ansung Cohort). A total of 4261 adults (2195 men and 2066 women) aged 40–69 y without metabolic syndrome at baseline were included. Dietary intake was measured by a validated semiquantitative food-frequency questionnaire, and low-carbohydrate-diet score was calculated based on the percentage energy from carbohydrate, fat, and protein by sex. Metabolic syndrome was defined based on the National Cholesterol Education Program Adult Treatment Panel III criteria, and atherogenic dyslipidemia was defined as elevated triglyceride level and reduced high-density lipoprotein cholesterol level. Association between the low-carbohydrate-diet score and metabolic disease was examined by the Cox proportional hazards regression model.

Results: During the 12-y follow-up period, 1777 cases of metabolic syndrome and 1730 cases of atherogenic dyslipidemia were newly diagnosed. People in the highest quintile of low-carbohydrate-diet score were more likely to be younger, more educated, and have higher energy and fat intakes compared with people in the lowest quintile. After adjusting for confounding variables, no significant association was found between the low-carbohydrate-diet score and metabolic syndrome. However, there were significantly reduced risks for atherogenic dyslipidemia in the highest quintile of the low-carbohydrate-diet score in men (HR: 0.73; 95% CI: 0.57, 0.95; P-trend = 0.0051).

Conclusions: These findings indicate that low-carbohydrate diets may contribute to reduce risks for atherogenic dyslipidemia in the long term in the Asian population.

Funding Sources

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Association between Diet Quality, Weight Status and Frequency of Foods away from Home among Taiwanese Adults Living in Taipei (P20–063)

Yu-Chieh Han, Shou-Han Lu, Yih-Fong Liew, and Min-Su Tzeng

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Objectives: This study aimed to assess the association between diet quality, weight status and frequency of foods away from home (FAFH) among Taiwanese adults. The study also explored whether a higher frequency of FAFH was related to higher body mass index (BMI) and poorer diet quality.

Methods: This was a cross-sectional study conducted between May 2017 and January 2018, including 111 subjects (62 females, 49 males) aged 30–70 y living in Taipei, Taiwan. Food consumption was

assessed with the use of an online food-frequency questionnaire. Body weight, body fat, BMI, and waist circumference were measured with a body composition analyzer (IOI 353). Dietary quality was evaluated according to 2011 Taiwanese Dietary Guidelines, and was scored from 0 to 100.

Results: The mean frequency of FAFH among Taiwanese adults was 9.7 ± 5.8 times/wk. The mean BMI and dietary quality scores were 24.5 ± 4.0 kg/m^2 and 65.0 ± 9.3. Subjects in the highest quartile of FAFH frequency (>13.5 times/wk) consumed less whole grains ($P = 0.008$) and nuts and seeds ($P = 0.005$) and had higher added sugar intakes ($P = 0.04$) than those who in the lowest quartile (<5.5 times/wk). Subjects in the highest and third quartile of FAFH frequency had lower diet quality score of whole grains ($P = 0.002$) than those in the lowest quartile. However, the total diet quality scores were not significantly different among quartiles.

Conclusions: Subjects who had higher frequencies of foods away from home ate less whole grains, nuts, and seeds, and more added sugar; they also had lower dietary quality scores of whole grains.

Simplified Conditions for Shipment of Plasma Samples for Vitamin C Measurements (P20-064)

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Introduction: Vitamin C is known to be highly unstable, and readily degrades in a variety of materials, including whole blood, plasma, and processed foods. This problem of instability has resulted in the practice of shipping frozen plasma on dry ice to reference labs, to obtain a vitamin C measurement. Dry ice shipments of frozen plasma have limited practicality in many settings, especially where large numbers of samples are collected, and we considered alternative, simpler approaches.

Methods: Whole blood was drawn on lithium-heparin anticoagulant in gel-separator tubes, centrifuged promptly to obtain a separate plasma layer, and the Vacutainer placed in a Styrofoam container with multiple cold packs, which held the sample temperature at 0.1°C. Vitamin C concentrations were measured by HPLC after 30 and 48 h of sample storage within the container, and compared with vitamin C levels in plasma that was processed immediately after collection.

Results: Vitamin C losses were very moderate: after 30 h, 5% loss (±5%), and after 48 h, 7% (±5%) (Figure 1). The HPLC method had a coefficient of variation ±2%. For investigators who are screening for low vitamin C status in large cohorts, these changes should not be a significant barrier to generating population data on vitamin C status.

Conclusions: Epidemiologic studies of vitamin C status typically require collection of large numbers of samples, and need simple, convenient methods for sending specimens to a reference lab for analysis. Our method uses standard Styrofoam containers and cold packs. Multiple Vacutainers can be placed in the container for shipment. This strategy will be useful for field studies, where simplifying the workload for project staff is a very important objective, and for the clinical diagnosis of vitamin C deficiency.

Funding Sources

Fellowship, University of Massachusetts Lowell.

Supporting Images/Graphs

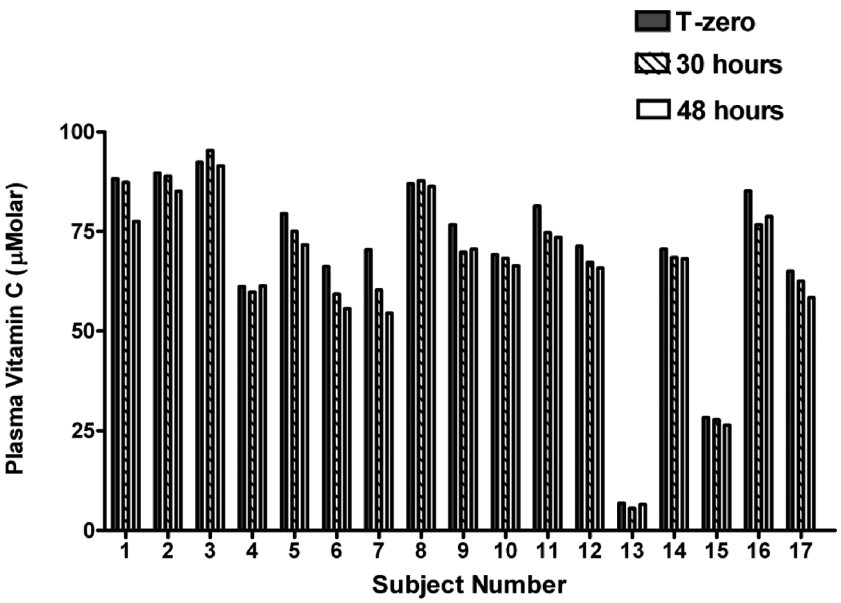

FIGURE P20-064-1

Assessment of the American Heart Association's "Life's Simple 7" Metrics for Cardiovascular Health in a French Canadian Population—The PREDISE Study (P20-065)

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Objectives: As part of its 2020 Impact Goals, the American Heart Association (AHA) developed "Life's Simple 7" (LS7) metrics to assess and promote cardiovascular (CV) health in the US population. The LS7 metrics include 7 subscales referred to as core health behaviors or health factors. Multiple studies have shown that the LS7 score is inversely associated with the risk of stroke, CV disease and mortality, and all-cause mortality. To our knowledge, the LS7 score has never been evaluated in a Canadian cohort. Therefore, the purpose of this study was to assess the overall CV health of French Canadians through the use of the LS7 score.

Methods: A total of 771 participants (366 men and 405 women, mean ± SD age 42.5 ± 13.2 y) from the PREDISE study were considered for these analyses. Their dietary intake was assessed with the use of a validated web-based 24-h recall completed on 3 occasions. Physical activity (PA) was assessed according to the International Physical Activity Questionnaire. Each metric of the LS7 score [health behaviors: smoking, PA, diet, body mass index (BMI); health factors: fasting total cholesterol and blood glucose, blood pressure (BP)] was first categorized as "ideal", "intermediate," or "poor" for each subject according to the AHA criteria. The final score ranged from 0 to 7 based on the number of metrics that met the "ideal" criteria.

Results: Only 0.1% of participants met the AHA criteria for ideal CV health. The diet score, which is based on intake of fiber-rich whole-grain products, sodium, fruits and vegetables, sugar-sweetened beverages, and fish, showed the lowest prevalence of "ideal" scores (4.8%), whereas "ideal" blood glucose (<100 mg/dL) was the metric with the highest prevalence (79.6%). The LS7 score was higher among women than men (3.9 ± 1.4 compared with 3.4 ± 1.5, $P = 0.0004$), with more women achieving the "ideal" status for total cholesterol (<200 mg/dL), BP (<120/80 mm Hg), blood glucose, and BMI (<25 kg/m^2) than men (all $P < 0.05$).

Conclusions: Consistent with other studies conducted among different populations, very few French Canadians achieve the AHA criteria for ideal CV health. These data indicate that further efforts aimed at promoting the LS7 metrics, focusing primarily on diet, could have huge impacts in terms of public health.

Funding Sources
Canadian Institutes of Health Research (CIHR).

Potato Consumption and the Risk of Overall and Cause-Specific Mortality (P20-066)

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Objective: Potato consumption has been hypothesized to be associated with an increased risk of poor health, and has previously been reported to be associated with an increased risk of hypertension, diabetes, and colorectal cancer. The aim of this study was to examine the association between potato consumption and the risk of overall and cause-specific mortality in the large prospective NIH-AARP Diet and Health Study cohort.

Methods: The NIH-AARP study recruited 566,407 persons, aged 50–72 y in 1995–1996. Potato consumption data from a validated food-frequency completed at baseline was used in Cox proportional hazard models to estimate HRs and 95% CIs for overall and cause-specific mortality. Final models were adjusted for many risk factors for mortality that might act as confounders. The lowest category of intake was used as the reference category.

Results: During the 15.6 y of follow up, 128,571 persons died, including 84,877 men and 43,694 women. Eating baked, boiled, or mashed potatoes, French fries, or potato salad ≥7 times/wk was associated with increased risk of overall mortality in both men and women, in models adjusted only for age ($HR_{C4 \text{ compared with } C1} = 1.17$; 95% CI: 1.13, 1.21 and $HR_{C4 \text{ compared with } C1} = 1.21$; 95% CI: 1.15, 1.28, respectively). These results were strongly attenuated in fully adjusted models with marginally elevated hazard ratios in men and null results in women ($HR_{C4 \text{ compared with } C1} = 1.04$; 95% CI: 1.00, 1.08 and $HR_{C4 \text{ compared with } C1} = 1.05$; 95% CI: 0.99,1.12, respectively).

Conclusion: In this large US prospective cohort study, potato consumption was correlated with numerous other indicators of premature mortality. Although age-adjusted models showed some evidence for an adverse association with higher potato consumption, the strong attenuation in our fully adjusted models suggests that the remaining associations may be due to residual confounding. Our study does not suggest compelling adverse effects of potato consumption on total mortality or death due to cancer, heart disease, respiratory disease, or diabetes, although some modest effects cannot be ruled out.

Funding Sources
Intramural Research Program of the National Cancer Institute, NIH.

Diet Quality and All-Cause Mortality in Women after Breast Cancer Diagnosis in the Breast Cancer Family Registry (P20-067)

Danielle E Haslam,[1] Esther John,[2] Julia Knight,[3] Saundra Buys,[4] Irene L Andrulis,[3] Mary Daly,[5] Mary Beth Terry,[6] and Fang Fang Zhang[1]

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Objectives: The impact of diet quality on survival of women with breast cancer remains uncertain. We assessed whether adherence to 4 dietary patterns, including the Healthy Eating Index-2015 (HEI-2015),

Alternative Healthy Eating Index (AHEI), Alternative Mediterranean Diet (aMED), and Dietary Approaches to Stop Hypertension (DASH), were associated with all-cause mortality in women with breast cancer.

Methods: Dietary intake was examined in 6253 women from North America who were diagnosed with breast cancer and enrolled in the Breast Cancer Family Registry. Prediagnosis (n = 4883) or postdiagnosis (n = 1370) dietary intakes were estimated through a food-frequency questionnaire. Diet quality was assessed through scores of 4 diet quality indices: HEI-2015, AHEI, aMED, and DASH. Cox proportional hazards models were used to estimate HRs and 95% CIs after multivariable adjustment.

Results: During a median follow-up time of 111 mo (~9.3 y), 1334 deaths occurred. Overall, women in the highest quartile for adherence to the DASH diet had an 18% lower risk of all-cause mortality than women in the lowest quartile (HR = 0.82; 95% CI: 0.69, 0.98; P-trend = 0.04). The association was confined to women who reported prediagnosis diet (HR = 0.79; 95% CI: 0.64, 0.96; P-trend = 0.03) and those with a healthy weight (body mass index = 18.5–24.9 kg/m^2) (HR = 0.69; 95% CI: 0.53, 0.89; P-trend = 0.005). Adherence to the HEI-2015, AHEI, or aMED diet was not significantly associated with all-cause mortality.

Conclusions: Adherence to the DASH diet, characterized by a high intake of fruits and vegetables along with a low intake of animal foods, may lower the risk of death after breast cancer diagnosis.

Funding Sources

NIH 5T32HL069772-15.

Supporting Images/Graphs

TABLE P20-067-1 Characteristics of Women in the Breast Cancer Family Registry (n=6,253)

	N (%) or Mean (SD)
Age at study, mean (SD)	52.5 (22.5)
Race/ethnicity, N (%)	
Non-Hispanic White	4,068 (69.4)
Black or African American	809 (11.8)
Hispanic	1,112 (16.2)
Asian/Pacific Islander	738 (10.8)
Other	118 (1.72)
Education, N (%)	
High School or less	2,520 (36.8)
Some college or bachelor's degree	3,244 (47.4)
Graduate degree	1,045 (15.3)
BMI, *kg/m^2*, mean (SD)	26.5 (5.90)
BMI status[1], N (%)	
Normal Weight	3,139 (45.9)
Overweight	1,868 (27.3)
Obese	1,479 (21.6)
Recreational Physical Activity[2], N (%)	
Active	2,954 (43.2)
Inactive	3,609 (52.7)
Cigarette Smoking, N (%)	
Never	3,967 (58.0)
Ever	2,864 (41.8)
Pack-years (among smokers), mean (SD)	17.4 (18.3)
Alcohol Use, N (%)	
Nondrinkers	4,072 (59.5)
<7 drinks/week	1,858 (27.1)
≥7 drinks/week	897 (13.1)
Treatment[3], N (%)	
Chemotherapy	3,528 (51.5)
Hormonal therapy	3,752 (54.8)
Radiation	2,929 (42.8)
Surgery	5,877 (85.9)
Total Energy Intake, *kcal*, mean (SD)	2,020 (987)
Diet Quality Score, mean (SD)	
AHEI	40.2 (9.29)
aMED	4.00 (1.80)
DASH	24.0 (4.28)
HEI-2015	70.3 (9.43)

Abbreviations: AHEI, Alternative Healthy Eating Index; aMED, Alternative Mediterranean Diet; BMI, body mass index; DASH, Dietary Approaches to Stop Hypertension; HEI-2015, Healthy Eating Index 2015; kcal, kilocalories; SD, standard deviation.

1. Weight status is defined based on adjusted BMI, normal weight as BMI =18.5-24.9 kg/m^2, overweight as BMI=25-29.9 kg/m^2, and obesity as BMI ≥30 kg/m^2.
2. Physically active is defined as moderate-to-vigorous physical activity ≥150 minutes/week.
3. Many people had multiple treatments, so this variable adds up to > 100%.

TABLE P20-067-2 Diet Quality and Total Mortality in Women with Breast Cancer, Breast Cancer Family Registry (n=6,253)

Diet Quality Score	Number of Deaths	Person-Years	Total Mortality	
			HR (95% CI)[1]	HR (95% CI)[2]
HEI – 2015				
Q1 (<64.05)	334	13,980	1.00 (ref.)	1.00 (ref.)
Q2 (64.05-70.78)	317	14,274	0.93 (0.80-1.09)	1.02 (0.87-1.19)
Q3 (70.79-72.26)	309	13,740	0.95 (0.81-1.11)	0.94 (0.86-1.18)
Q4 (≥77.27)	292	13,835	0.90 (0.77-1.06)	0.97 (0.82-1.14)
			p_{trend} = 0.25	p_{trend} = 0.67
AHEI				
Q1 (<33.45)	322	14,061	1.00 (ref.)	1.00 (ref.)
Q2 (33.45-39.62)	324	3,943	1.04 (0.90-1.22)	1.13 (0.96-1.33)
Q3 (39.63-46.16)	307	14,204	0.97 (0.88-1.22)	1.10 (0.93-1.30)
Q4 (≥46.17)	299	13,621	1.01 (0.84-1.22)	1.15 (0.95-1.38)
			p_{trend} = 0.88	p_{trend} = 0.20
aMED				
Q1 (≤3)	519	23,200	1.00 (ref.)	1.00 (ref.)
Q2 (4)	277	10,510	1.09 (0.94-1.27)	1.11 (0.95-1.29)
Q3 (5)	219	9,482	0.92 (0.78-1.09)	1.01 (0.85-1.19)
Q4 (≥6)	237	12,637	0.81 (0.69-0.96)	0.89 (0.75-1.06)
			p_{trend} = 0.01	p_{trend} = 0.23
DASH				
Q1 (<22)	408	16,329	1.00 (ref.)	1.00 (ref.)
Q2 (22-24)	341	14,358	0.99 (0.86-1.13)	1.00 (0.86-1.15)
Q3 (25-27)	295	13,155	0.89 (0.77-1.02)	0.95 (0.81-1.11)
Q4 (≥28)	208	11,986	0.76 (0.65-0.89)	0.82 (0.69-0.98)
			p_{trend} = 0.0001	p_{trend} = 0.04

1. Adjusted for age (continuous), study site, total caloric intake (quartiles).
2. Additionally adjusted for race/ethnicity (non-Hispanic White, Black, Hispanic, and Asian/Pacific Islander/other), education (high school or less, some college or bachelor's degree, or graduate degree), treatment received (surgery, radiation, chemotherapy, hormone therapy, or other treatment), tumor stage (Stage 1, 2, 3, or missing), recent recreational physical activity (moderate-to-vigorous physical activity < 150 minutes/week, or ⩾ 150 minutes/week), usual alcohol consumption (never, <7 drinks/week, or ≥7 drinks/week), smoking status (nonsmokers or smokers), and pack-years of cigarette smoking (continuous).

TABLE P20-067-3 Pre-diagnosis and Post-diagnosis Diet Quality and Total Mortality in Women with Breast Cancer, Breast Cancer Family Registry

	Pre-diagnosis Diet (n=4,883)			Post-diagnosis Diet (n=1,370)		
	Number of Death	Person Years	HR (95% CI)[1]	Number of Death	Person Years	HR (95% CI)[1]
HEI-2015						
Q1 (<64.05)	294	11,485	1.00 (ref.)	40	2,495	1.00 (ref.)
Q2 (64.05-70.78)	269	11,868	0.84 (0.82-1.15)	48	2,406	1.35 (0.88-2.06)
Q3 (70.79-72.26)	243	10,733	0.78 (0.78-1.11)	66	3,007	1.41 (0.94-2.11)
Q4 (≥77.27)	218	9,913	0.87 (0.72-1.05)	74	3,922	1.43 (0.95-2.17)
			p_{trend} = 0.13			p_{trend} = 0.11
						$p_{interaction}$ = 0.09
AHEI						
Q1 (<33.45)	273	11,475	1.00 (ref.)	42	2,585	1.00 (ref.)
Q2 (33.45-39.62)	272	11,066	1.11 (0.93-1.32)	50	2,878	1.16 (0.87-2.03)
Q3 (39.63-46.16)	253	11,162	1.04 (0.86-1.25)	64	3,042	1.05 (0.96-2.03)
Q4 (≥46.17)	226	10,296	1.05 (0.85-1.29)	72	3,325	1.51 (0.96-2.38)
			p_{trend} = 0.80			p_{trend} = 0.04
						$p_{interaction}$ = 0.15
aMED						
Q1 (≤3)	450	18,751	1.00 (ref.)	92	4,449	1.00 (ref.)
Q2 (4)	227	8,375	1.14 (0.97-1.34)	39	2,135	0.83 (0.56-1.23)
Q3 (5)	157	7,360	0.97 (0.80-1.17)	46	2,121	1.04 (0.71-1.52)
Q4 (≥6)	190	9,513	0.90 (0.74-1.09)	51	3,124	0.81 (0.55-1.21)
			p_{trend} = 0.26			p_{trend} = 0.48
						$p_{interaction}$ = 0.36
DASH						
Q1 (<22)	363	13,505	1.00 (ref.)	47	2,824	1.00 (ref.)
Q2 (22-24)	272	11,877	0.89 (0.76-1.05)	71	2,481	1.73 (1.19-2.52)
Q3 (25-27)	234	10,120	0.92 (0.78-1.09)	56	3,035	1.14 (0.76-1.71)
Q4 (≥28)	155	8,497	0.79 (0.65-0.97)	54	3,489	1.05 (0.68-1.61)
			p_{trend} = 0.03			p_{trend} = 0.63
						$p_{interaction}$ = 0.004

1. Adjusted for age (continuous), study site, total caloric intake (quartiles), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and Asian/Pacific Islander/other), education (high school or less, some college or bachelor's degree, or graduate degree), treatment received (surgery, radiation, chemotherapy, hormone therapy, or other treatment), tumor stage (Stage 1, 2, 3, or missing), recent recreational physical activity (moderate-to-vigorous physical activity < 150 minutes/week, or ⩾ 150 minutes/week), usual alcohol drinking (never, <7 drinks/week, or ≥7 drinks/week), smoking status (nonsmokers or smokers), and pack-years of cigarette smoking (continuous).

TABLE P20-067-4 Diet Quality and Total Mortality in Women with Breast Cancer by Body Mass Index (BMI), Breast Cancer Family Registry

	BMI <25 kg/m² (n=3,024)			BMI 25-29.9 kg/m² (n=1,801)			BMI ≥30 kg/m² (n=1,428)		
	N of Death	Person Years	HR (95% CI)[1]	N of Death	Person Years	HR (95% CI)[1]	N of Death	Person Years	HR (95% CI)[1]
HEI – 2015									
Q1 (<64.05)	162	6,565	1.00 (ref.)	89	4,013	1.00 (ref.)	83	3,402	1.00 (ref.)
Q2 (64.05-70.78)	132	6,959	0.84 (0.66-1.06)	100	4,399	1.10 (0.82-1.47)	85	2,916	1.28 (0.94-1.74)
Q3 (70.79-72.26)	132	7,338	0.78 (0.62-0.99)	83	3,917	0.98 (0.72-1.33)	94	2,484	1.52 (1.12-2.06)
Q4 (≥77.27)	133	7,759	0.80 (0.63-1.01)	87	3,600	1.01 (0.74-1.40)	72	2,476	1.26 (0.89-1.78)
			p_{trend} = 0.05			p_{trend} = 0.89			p_{trend} = 0.07
									$p_{interaction}$ = 0.02
AHEI									
Q1 (<33.45)	155	7,117	1.00 (ref.)	79	3,770	1.00 (ref.)	81	3,173	1.00 (ref.)
Q2 (33.45-39.62)	149	7,208	1.09 (0.87-1.38)	90	3,875	1.16 (0.84-1.59)	83	2,760	1.08 (0.79-1.48)
Q3 (39.63-46.16)	135	7,285	1.01 (0.79-1.30)	91	4,189	1.05 (0.76-1.46)	91	2,730	1.24 (0.89-1.71)
Q4 (≥46.17)	120	7,011	1.04 (0.79-1.38)	99	3,995	1.33 (0.93-1.90)	79	2,615	1.09 (0.76-1.57)
			p_{trend} = 0.91			p_{trend} = 0.20			p_{trend} = 0.49
									$p_{interaction}$ = 0.37
aMED									
Q1 (≤3)	263	11,248	1.00 (ref.)	134	6,742	1.00 (ref.)	145	5,210	1.00 (ref.)
Q2 (4)	113	5,307	1.03 (0.82-1.30)	84	2,943	1.36 (1.02-1.80)	69	2,259	1.00 (0.74-1.35)
Q3 (5)	73	4,889	0.76 (0.58-1.00)	69	2,856	1.25 (0.91-1.70)	61	1,737	1.19 (0.87-1.64)
Q4 (≥6)	110	7,177	0.80 (0.62-1.03)	72	3,388	1.10 (0.80-1.53)	59	2,071	0.92 (0.65-1.31)
			p_{trend} = 0.03			p_{trend} = 0.46			p_{trend} = 0.96
									$p_{interaction}$ = 0.04
DASH									
Q1 (<22)	196	7,424	1.00 (ref.)	100	4,915	1.00 (ref.)	114	3,990	1.00 (ref.)
Q2 (22-24)	141	7,350	0.80 (0.64-1.00)	121	4,084	1.43 (1.09-1.87)	81	2,925	0.89 (0.67-1.20)
Q3 (25-27)	124	6,800	0.80 (0.63-1.01)	77	3,659	1.00 (0.73-1.36)	89	2,697	1.12 (0.84-1.49)
Q4 (≥28)	98	7,047	0.69 (0.53-0.89)	61	3,272	0.94 (0.67-1.31)	50	1,666	1.11 (0.78-1.59)
			p_{trend} = 0.005			p_{trend} = 0.38			p_{trend} = 0.36
									$p_{interaction}$ = 0.0005

1. Adjusted for age (continuous), study site, total caloric intake (quartiles), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and Asian/Pacific Islander/other), education (high school or less, some college or bachelor's degree, or graduate degree), treatment received (surgery, radiation, chemotherapy, hormone therapy, or other treatment), tumor stage (Stage 1, 2, 3, or missing), current recreational physical activity (moderate-to-vigorous physical activity < 150 minutes/week, or ⩾ 150 minutes/week), usual alcohol drinking (never, <7 drinks/week, or ≥7 drinks/week), smoking status (nonsmokers or smokers), and pack-years of cigarette smoking (continuous).

Patterns of Dietary Intake at Age 1 Year Differ between First- and Second-Born Siblings (P20-068)

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Objectives: Cross-sectional studies suggest that later-born children have less healthy diets than first-born and only children, but no studies have directly compared the diets of siblings measured at the same age. We hypothesized that at 1 y of age, second-born (SB) children would be exposed to a greater variety of foods and consume high-energy density (HED) foods more frequently than their first-born (FB) sibling did at 1 y.

Methods: FB infants participated in INSIGHT, an randomized controlled trial of a responsive parenting intervention for prevention of obesity. SB siblings of INSIGHT participants were enrolled into an observational cohort. For each sibling, dietary intake was assessed at 1 y of age through the use of a food-frequency questionnaire. Frequency (times per day or week) and variety (number of different items consumed in the previous week) of intake of fruits, vegetables, dairy, meats, salty snacks, sweets, fried foods, and sugar-sweetened beverages was compared between siblings ($n = 95$ pairs).

Results: SBs were born on average 2.4 ± 0.7 y after FBs. For each food group except sugar-sweetened beverages, FB and SB intakes at age 1 y were significantly correlated ($r = 0.29$–0.46, all $P < 0.005$). Compared to FBs, SBs consumed fruits more times per day (FB 2.6 compared with SB 3.3 times/d, $P = 0.006$) and ate a greater variety of fruits (7.3 compared with 8.2, $P = 0.04$). SBs ate meat more frequently than FB, which was driven by differences in intake of processed meats (1.1 compared with 1.7 times/wk, $P = 0.01$). SBs consumed fried foods more frequently (1.1 compared with 1.8 times/wk, $P = 0.003$) than FBs did at the same age. SBs consumed a greater variety of salty snacks (1.1 compared with 1.7 items, $P < 0.0001$), but did not consume them more frequently than FBs. There were no differences between siblings in intake or variety of vegetables, dairy, sweets, or sugar-sweetened beverages.

Conclusions: SB children are exposed to more fruits at age 1 y, but are also more likely to consume some HED foods than their FB siblings were at the same age.

Funding Sources

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Characterization of the Children and Adolescent Population in Costa Rica with and without Risk Behaviors Associated with Eating Disorders (P20-069)

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Objective: The aim of this study was to describe the characteristics of the children and adolescent population of Costa Rica with and without risk behaviors associated with eating disorders.

Methods: A total of 2667 students from 40 schools and 24 high schools in the 7 provinces of Costa Rica participated in this transversal

descriptive study with a quantitative approach. Weight and height were used to assess nutritional status via the body mass index (kg/m^2). Socioeconomic status of the students was determined according to madrigal methodology. Participants were asked to rate their ideal figure and their perceived figure with the contour drawing rating scale. The discrepancy between ideal and current size scores was used as an index of body size dissatisfaction. The questions to assess behaviors that are characteristic of individuals with eating disorders were taken from the Eating Attitudes Test-26 (EAT-26) and others suggested by experts. The risk of presenting eating disorders was determined based on the index: <10 without risk; ≥ 10 with risk. Data were analyzed through the use of descriptive statistics (SPSS for Windows, version 20.0) to estimate frequencies and chi-square tests. A $P < 0.05$ was considered significant.

Results: Students with risk behaviors for eating disorders are characterized by having a medium or high socioeconomic index (72.6% compared with 70.2%; $P < 0.05$) and overweight or obesity (31.4% compared with 15.0%; $P < 0.001$). Girls presented a higher prevalence of risk behaviors associated with eating disorders than boys (55.0% compared with 45.0%, $P = 0.003$). Nearly 45% of boys were satisfied with their body image, whereas only a third of the girls were satisfied. Girls want to be thinner and boys want to be more corpulent (Figure 1). Table 1 highlights those risk behaviors for eating disorders that better discriminate between populations with and without risk.

Conclusions: There is an upward trend in eating disorders in the student population of Costa Rica. Risk behaviors were detected in youth that could enhance the development of eating disorders (anorexia and bulimia). Prevention programs must be implemented in schools to promote healthy lifestyles. Family pressure to diet and lose weight loss only to achieve a "pretty" figure at the expense of health must be discouraged.

Funding Sources

This work was supported by the Office of Vice-President for Research of the University of Costa Rica (UCR) (project 430-B1-343), the Distance State University (UNED) (project PROYO 102-2010) and Institute for Research and Education on Nutrition and Health (INCIENSA) (IC-2010-05).

Supporting Images/Graphs

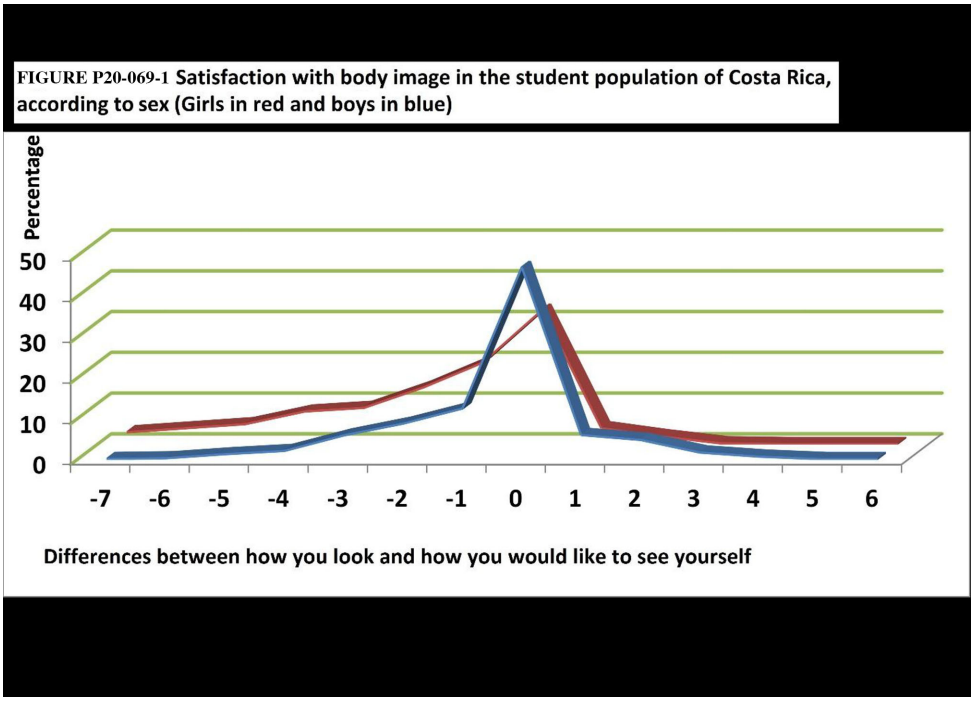

FIGURE P20-069-1 Satisfaction with body image in the student population of Costa Rica, according to sex (Girls in red and boys in blue)

TABLE P20-069-1 Main risk behaviors for eating disorders in the student population of Costa Rica

Risk behaviors	Students without risk (n=815, 30.6%)		Students with risk (n=1852, 69.4%)		*P value*
	#	%	#	%	
Feels afraid of weighing a lot	159	19.5	1016	54.9	< 0.001
Makes a Diet (all year long)	128	15.7	897	48.4	< 0.001
Eliminates consumption of sugars and fats	66	8.1	823	44.4	< 0.001
Eliminates consumption of flours	57	7.0	769	41.5	< 0.001
Counts calories when eating	76	9.3	769	41.5	< 0.001
To decide the purchase, he/she pays attention to the calories of the label	194	23.8	712	38.4	< 0.001
To decide the purchase, he/she pays attention to the "light" products	145	17.8	703	38.0	< 0.001
Does not eat even if he/she is hungry	19	2.3	574	31.0	< 0.001
Eats without control and hides	16	2.0	510	27.5	< 0.001
Takes pills or tea to lose weight	20	2.4	477	25.8	< 0.001
Feels guilty after eating	0	0.0	326	17.6	< 0.001
He/she causes vomiting	0	0.0	179	9.7	< 0.001

Lunch Nonconsumers Compared with Lunch Consumers: Children Who Miss Lunch Consume Less Energy, but More Snack Calories and Eat Less from Key Food Groups (P20-070)

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Objectives: Missing lunch has been associated with lower micronutrient intakes among children and adolescents. This aim of this work was to examine the impact of missing lunch on wider eating behaviors compared with children who eat lunch.

Methods: For this analysis, dietary intake data from NHANES 2011–2014 were combined. A linear regression model was used to compare eating behaviors of children (4–8 y, $n = 1816$; 9–13 y, $n = 1672$) who ate lunch compared with those who missed lunch, with an emphasis on differences in energy intake, snacking behaviors, and consumption of key food groups (e.g., fruits, vegetables, grains, protein foods) along with fats, and added and total sugars. Lunch consumption status was reported by the children themselves, or by their proxy. Exclusions were made for unreliable data.

Results: Children (4–8 y and 9–13 y) who missed lunch consumed less energy overall ($P \leq 0.05$) and more energy at breakfast ($P \leq 0.01$) than children of the same age who consumed lunch. Children aged 4–8 y who missed lunch consumed ~50 kcal more at the dinner meal, whereas children aged 9–13 y who missed lunch consumed 90 kcal more at the dinner meal, although this was not significant. Children (4–8 y and 9–13 y) who missed lunch consumed significantly more energy from snacks ($P \leq 0.01$) with ~170 kcal more at snacking occasions among 4–8 y olds and ~160 kcal more at snacking occasions among 9–13 y olds. Children (4–8 y and 9–13 y) who missed lunch consumed ~36% of their energy during snack occasions compared with ~25% of energy consumed at snacking occasions by children who ate lunch ($P \leq 0.01$). Children who missed lunch (4–8 y) also consumed a higher percentage of their energy from snacking after 19.00 ($P \leq 0.05$). Children aged 4–8 y who missed lunch consumed less dairy ($P \leq 0.01$) Children aged 9–13 y who missed lunch consumed less total grains ($P \leq 0.05$), less whole grains ($P \leq 0.05$), less vegetables ($P \leq 0.05$), less dairy ($P \leq 0.05$), and more added sugars ($P \leq 0.05$) than children who consumed lunch.

Conclusions: Lunch consumers typically consume more dairy, grain foods, and vegetables than those who miss lunch. Children who miss lunch may need encouragement to eat dairy, grains, and vegetables at other times during the day.

Funding Sources

Nestlé Research Center, Switzerland.

Nutrient Intakes and Diet Quality among US Adults by Salad Reporting Status, What We Eat in America, NHANES 2011–2014 (P20-071)

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ARS-USDA

Objective: The aim of this study was to compare nutrient intake and diet quality of salad reporters and nonreporters.

Methods: A cross-sectional analysis that used 1-d dietary intake data of adults aged ≥20 y ($n = 9848$) in What We Eat in America, NHANES 2011–14, was conducted. Individuals who ate raw vegetable–based salad on the intake day were designated as salad reporters. Nutrient intake from all foods and beverages (excluding supplements) was estimated for the intake day, and diet quality was evaluated based on the Healthy Eating Index (HEI) 2015 and its 12 subcomponents. Comparisons between salad reporters and nonreporters were made with the use of paired t tests, adjusting for confounding variables. Results were considered significant at $P < 0.001$.

Results: On the intake day, 23% of adults reported consuming a salad. Energy intake of salad reporters and nonreporters did not differ. Nutrient intake of salad reporters was significantly higher than nonreporters for dietary fiber (20 compared with 17 g), total fat (89 compared with 81 g), vitamin A (806 compared with 611 μg RAE), food folate (285 compared with 212 μg), vitamin C (102 compared with 76 mg), vitamin E (11 compared with 9 mg), vitamin K (221 compared with 98 μg), magnesium (333 compared with 303 mg), and potassium (3032 compared with 2634 mg). Total HEI 2015 scores of reporters were significantly higher (56 of a possible 100 points) compared with nonreporters (50 points). Reporters also had significantly better scores for 8 of 13 HEI subcomponents, including total vegetables, greens and beans, whole fruits, total protein foods, seafood and plant protein, fatty acids, refined grains, and added sugars. There were no differences in subcomponent scores for total fruits, whole grains, dairy, saturated fats, or sodium.

Conclusions: Salad consumption is associated with higher intake of many nutrients, including several identified in the Dietary Guidelines for Americans as typically underconsumed—dietary fiber, vitamins A, C, and E, magnesium, and potassium. As higher nutrient intakes are generally associated with a healthier overall eating pattern, it is not surprising that salad reporters also had higher dietary quality as measured by the HEI. However, regardless of salad reporting status, the HEI scores show that US diets need improvement. Incorporating salads into one's diet more often may be one effective way to boost nutrient intake and improve overall diet quality.

Funding Sources

Agricultural Research Service, USDA.

Age at Menarche Is Associated with Nutritional Status and Growth in Rural Bangladesh (P20-072)

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Objectives: Little is known about menarche in relation to adolescent nutritional status and growth in contemporary South Asia. We investigated, in rural Bangladesh, the extent to which attained height and body mass index (BMI) and annualized growth velocities are associated with age at menarche.

Methods: We studied a birth cohort of 12,956 (92%) of 14,059 girls aged 8–14 y, born during the JiVitA-1 antenatal vitamin A or β-carotene supplementation trial from 2001 to 2007. Starting in September 2015, anthropometry was measured twice 6–18 mo apart, scheduled on children's birth month, and dates of menarche obtained. Initial status and growth velocities in height and BMI (kg/m^2) of girls by menarcheal status were compared. Restricting data to girls who were premenarcheal at first interview ($n = 9806$), the risk (hazard) of menarche by incremental cm in attained height and kg/m^2 in BMI was computed from multivariate Cox proportional hazards models. We further assessed temporal associations between annualized growth velocities and risk of menarche, adjusting for initial characteristics and the premenarcheal portion of the interim period.

Results: The estimated mean ± SD age at menarche among postmenarcheal girls was 12.8 ± 0.9 y. Adjusting for age, postmenarcheal girls were 7.7 cm taller and 6.9 kg heavier and 1.8 kg/m^2 larger than premenarcheal girls ($P < 0.001$). Adjusting for age, education, and socioeconomic status, premenarcheal girls were, overall, 13% (HR 1.13; 95% CI: 1.12, 1.14) and 24% (HR 1.24; 95% CI: 1.22, 1.26) more likely to attain menarche in the next year per increment in initial height and BMI, respectively. In postmenarcheal girls at the first visit and in girls experiencing menarche in the follow-up period, age-adjusted, annualized linear growth was 4.0 and 0.9 cm/y lower than girls who remained premenarcheal through the second visit ($P < 0.001$). However, change in BMI was 0.16 and 0.52 kg/m^2 higher, respectively. In a Cox model with growth rate as predictor, incremental height and BMI were positively associated with risk of menarche only in younger girls (9–11 y).

Conclusions: Better-nourished young adolescent girls reached menarche earlier than their less well-nourished peers. Higher height and BMI velocities were predictive of onset of menarche only in the youngest adolescents.

Funding Sources

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Risk of Acute Malnutrition during Hospitalization and Postdischarge and Risk of Readmission among Pediatric Patients in Siddhi Memorial Hospital, Bhaktapur, Nepal (P20-073)

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Objectives: The aim of this study was to determine the prevalence and risk factors of acute malnutrition in pediatric admissions to Siddhi Memorial Hospital (SMH) in Bhaktapur, Nepal at admission and discharge, and to assess the risk of malnutrition and readmission during 6 mo of follow-up.

Methods: In this prospective cohort study, all new admissions to SMH from November 2016 to June 2017, aged 6 mo–15 y were approached for enrollment. Epidemiologic, clinical, and laboratory data were collected at admission and discharge, with phone-call follow-up at 1, 2, 4 and 5 mo postdischarge and anthropometry conducted at admission, discharge, and 3 and 6 mo postdischarge. WHO definitions were applied to define acute malnutrition. Multivariable logistic regression was used to assess risk factors of acute malnutrition and risk of readmission.

Results: We enrolled 483 patients, and 422 patients had complete data at admission and discharge. The prevalence of severe and moderate acute malnutrition (SAM, MAM) combined was 9.5% (40/422) at admission and 8.8% (37/422) at discharge. Mean weight-for-height *z* score (WHZ) improved by 0.13 units between admission and discharge (paired *t* test, $P < 0.001$). Median duration of hospitalization was 4 d (IQR: 3–5). Acute malnutrition at admission was associated with older age, 1–5 y (240/422) [adjusted odds ratio (AOR) = 4.36; 95% CI: 1.00, 19.0; $P = 0.05$] and 6–15 y (98/422) (AOR = 6.43; 95% CI: 1.41, 29.4; $P = 0.02$), compared with 6–12 mo (84/422). Families who had experienced major housing damage in the previous earthquake (147/422) had higher odds of acute malnutrition than those with no damage (129/422) (AOR = 2.86; 95% CI: 1.10, 7.45; $P = 0.03$). During follow-up, 12.6% (60/478) were readmitted, which was not associated with acute malnutrition at admission ($n = 457$, OR = 1.54; 95% CI: 0.64, 3.67; $P = 0.33$). The prevalence of acute malnutrition at 3 and 6 mo postdischarge was 4.4% (18/405) and 4.4% (17/385), which was significantly associated with having acute malnutrition at admission (OR = 78.89; 95% CI: 21.02, 296.01; $P < 0.001$; and OR = 8.50; 95% CI: 3.00, 24.12; $P < 0.001$).

Conclusions: There is a need for improved linkage of hospital- and community-based services for the prevention and treatment of malnutrition in previously hospitalized children, including those aged >5 y.

Funding Sources

None.

Relation between Multivitamin/Mineral Supplement Use and Presence of Metabolic Syndrome Biomarkers among College Students (P20-074)

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University of New Hampshire

Objectives: The purpose of this cross-sectional study was to examine the relation between frequency of multivitamin/mineral supplement (MVM) usage and presence of biomarkers for metabolic syndrome (MetS) among college students.

Methods: Data were collected between 2012 and 2015 via an ongoing college health survey at a mid-size, northeastern university. Demographic information and MVM use by college students aged 18–24 y ($n = 1926$) was reported via online survey; MetS biomarkers (elevated blood pressure, abdominal obesity, low high-density lipoprotein cholesterol, elevated glucose, and elevated triglycerides) were collected via physical assessment in the fasted state. Proportional differences between men and women were evaluated via chi-square analyses; mean differences were evaluated via ANCOVA with sex, age, measured body mass index, year of data collection, semester, academic major, and average daily kcalories serving as covariates.

Results: Mean age of students was 18.8 ± 1.0 y; 69% were female. Overall, 54% of students reported no MVM usage, 22% reported usage 1–5 times/wk, and 24% reported daily (≥6 times/wk) usage. Females were more likely than males to report more daily usage of MVM (26 compared with 20%, $P < 0.05$). More than half (51.2%) of students had no biomarkers for MetS, 34.6% had 1 biomarker of MetS, 11.2% had 2 biomarkers, and 3.0% had ≥3 biomarkers of MetS. Men were more likely than women to have ≥2 MetS biomarkers (19.1 compared with and 12.3%, $P < 0.01$). Mean number of MetS biomarkers was 0.68 ± 0.8; no significant differences in number of MetS biomarkers were observed according to the frequency of MVM usage.

Conclusions: No relation between the use of MVM and presence of biomarkers for MetS among college students was observed. These findings do not support the use of MVM to reduce cardiovascular disease risk among young adults.

Funding Sources

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Sugar-Sweetened Beverages and the Microbiome: Implementation of an Intelligent Decision Support for Precision in Statistical Modelling (P20-075)

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Objectives: The scarcity of statistical methodologies for analyzing exposure-microbiome relations is a major factor impeding translation of results from epidemiologic studies. As such, we have developed a novel framework that facilitates precision in statistical modelling by identifying the unique distributional properties of microbiome features. We investigated the utility of this framework by assessing the association of sugar-sweetened beverage intake with microbiome composition in 2 independent populations.

Methods: Sugar-sweetened beverage intake and fecal metagenome data were collected in 247 adult US males, and 100 Torres Strait Islanders (TSI) of mixed gender. We developed and implemented an Intelligent Decision Support Framework (IDSF) schematized in Figure 1. The "intelligent" framework component identifies the statistical model that best describes the unique probability distribution of each individual species, and the "decision support" framework component feeds back optimization and precision data to aid investigators to specify model constraints.

Results: Irrespective of cohort and feature type, microbiome features were most likely to possess 2- and 3-component folded normal and Gaussian, and 3-component Student, probability distributions. Even after adjusting for potential confounders and multiple hypothesis testing (Bonferroni), we identified numerous significant (PAlistipes genera as well as *Eubacterium ramulus* and *Enterobacter cloacae*. In both the US and TSI datasets, these associations were not detected with the use of traditional regression based methods. Using a 2-sample *t* test to compare, the standardized residuals resulting from the IDSF were smaller than those produced by other regression methods for 100% of the species.

Conclusions: Implementation of our novel IDSF methodology enabled us to validate associations of sugar-sweetened beverages with microbiome composition, in 2 very distinct populations. Not only does this framework have the potential to enhance the quality of statistical models, but it also has the potential to reveal meaningful biological associations that cannot be revealed by traditional regression methodologies.

Funding Sources

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Supporting Images/Graphs

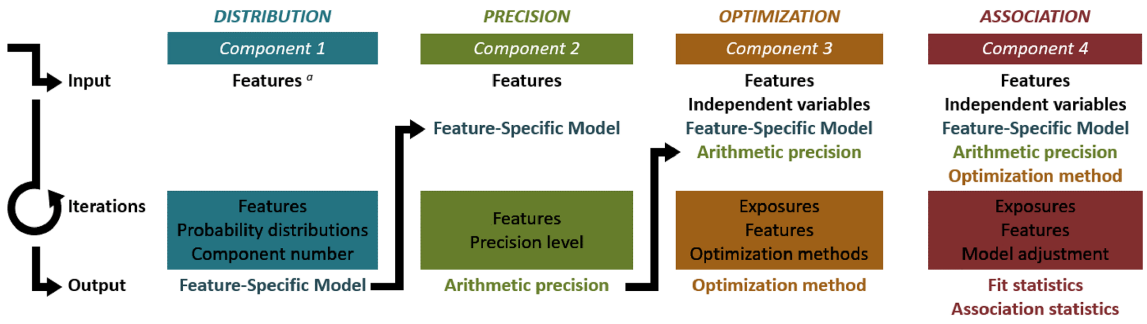

FIGURE P20-075-1 Overview of the components comprising the Intelligent Decision Support Framework.

Beverage Consumption Patterns among Infants, Toddlers and Preschool-Age Children (0–47.9 Months): Data from the Feeding Infants and Toddlers Study 2016 (P20–076)

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Objectives: Data about patterns of beverage intake in the first years of life are sparse. This study describes beverage patterns among infants, toddlers, and preschool children from the Feeding Infants and Toddlers study (FITS) 2016.

Methods: FITS 2016 is a cross-sectional survey of caregivers of children aged 0–47.9 mo in the United States. Based on a 24-h dietary recall (n = 3235), data collected on food, beverage, and supplement intake were used to calculate the percentage of children consuming specific beverages on a given day, the amount consumed (g; kcal), per capita amounts consumed (g; kcal) and the percentage contribution of beverages to total energy intake (TEI).

Results: Breast milk and infant formula provided 93% of TEI among 0–5.9 mo olds; 10% of 0–5.9 mo olds consumed water. The prevalence of beverage consumption among infants aged 6–11.9 mo was infant formula (64%; 40% TEI), water (42%), and breastmilk (39%; 18% TEI), followed by 100% fruit juice (27%; 1% TEI), cow's milk (11%; 2% TEI), and sugar-sweetened beverages (SSBs) (8.5%; 1% TEI). Water was consumed by 70% of 12–23.9 mo olds and 78% of 24–47.9 mo olds. Whole milk was consumed by 67% of 12–23.9 mo children (15% TEI) followed by 100% juice (50%; 4% TEI). SSBs and 100% juice each provided ∼4% of TEI for 24–47.9 mo olds. On a per-capita basis, milk (all types) and 100% juice provided the most calories among 12–23.9 mo olds (237 and 52 kcal, respectively), whereas among 24–47.9 mo olds, energy from milk (all types) was 176 kcal. Energy from SSBs was higher among 24–47.9 mo olds (53 kcal) than among 12–23.9 mo olds (29 kcal). With regard to nutrients, milk (all types) provided more energy and key nutrients than all other beverages, followed by 100% juice. SSBs contributed energy and added sugar. At meal times, the prevalence of SSB consumption, in the form of fruit-flavored drinks, was higher among 24–47.9 mo than among 12–23.9 mo olds. Beverages were more likely to be consumed during snack occasions, with only 23–32% consuming milk or water at lunch or dinner, compared with all eating occasions for children aged ≥12 mo.

Conclusions: Opportunities exist to further improve beverage patterns, in particular, among 12–47.9 mo olds. Future interventions may benefit from targeting snack time as a way to decrease intake of calorie-dense or nutrient-poor drinks, and promoting increased milk and water consumption during meal times.

Funding Sources

Nestlé Research Center, Lausanne, Switzerland.

Snacking Patterns among Chilean Children and Adolescents: Is there Potential for Improvement? (P20-077)

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Objectives: Snacking has increased in many countries, particularly among children and adolescents, and has been linked to increased

weight gain. Chile is a high-income country with high levels of childhood overweight and obesity. However, little is known regarding the frequency and types of foods and beverages that Chilean youth consume as snacks. The objective of this study was to examine snacking patterns and food and beverage sources of snacks in Chilean low- and middle-income children and adolescents.

Methods: This study includes dietary data (24-h recalls multipass method) from 2 cohorts recruited in the southeast region of Santiago, Chile in 2016: the Food Environment Chilean Cohort (FECHIC, $n = 958$, 4–6 y) and the Growth and Obesity Cohort Study (GOCS, $n = 752$, 12–14 y). Name and time of eating occasions were identified by participants or their mothers during the interviews. The proportion of snackers, the daily snacks/day, and calories from the top food and beverage groups consumed as snacks by each age group was determined.

Results: Overall, 97.4% of children and 91.1% of adolescents reported at least 1 snacking event; with an average of 2.6 snacks/d consumed. Snacks contributed on average to 430 kcal/d in children, and 625 kcal/d in adolescent snackers (33.8% and 29.5% mean daily energy contribution, respectively). Cookies, yogurt, sweet bakery products, fruits and vegetables, and drinks, chocolates and candies, bread, fresh fruits, and salty snacks contributed the most energy from snacks in both age groups.

Conclusions: Snacking is widespread among Chilean children and adolescents. Food categories consumed as snacks in our sample are generally considered high in energy, saturated fat, sodium, and total sugar. Future research should explore whether snacking behaviors change as the result of Chile's national regulations on food marketing and labeling and school environments.

Dietary Supplement Use Is Higher among US Children in Higher-Income Households Compared with Children in Lower Income Households (P20-078)

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Objectives: Dietary supplement (DS) use is associated with income. This study describes DS use by household income level, household food security, and federal nutrition assistance program participation status among US children.

Methods: DS use in the past 30 d was assessed by an in-home interview among children or their proxies (birth to 18 y, $n = 8290$) participating in the NHANES 2011–2014, a nationally representative, cross-sectional survey. Household income level was categorized by percentage poverty income ratio (PIR; $\leq$130, $>$130 to $\leq$350, and $>$350). Food security measured by the US Household Food Security Survey Module was categorized as food secure or insecure. Supplemental Nutrition Assistance Program (SNAP) or the Special Supplemental Nutrition Assistance Program for Women, Infants, and Children (WIC) participation was categorized as participants, income-eligible nonparticipants, and income-ineligible nonparticipants. Descriptive statistics were estimated and compared with the use of SUDAAN survey procedures.

Results: DSs were used by 32% of children (32% of boys; 33% of girls), with most consuming multivitamin-mineral or multivitamin products (82%) and taking 1 or 2 products (94%). DS use increased with household PIR category (22%, 35%, and 45%, respectively) and was higher in food-secure (35%) than food-insecure children (22%); this trend was consistent across all sex, age, and race/ethnic groups. DS use was highest among income-ineligible nonparticipants of SNAP (40%), followed by income-eligible nonparticipants (28%) and current participants (20%). Similarly, DS use was higher among income-ineligible WIC nonparticipants (47%) than either income-eligible nonparticipants (36%) or current participants (26%). The most commonly reported motivations for DS use were "to maintain health (42%)" and "to improve overall health (34%)." Children in highest-income households were more likely to report taking DS "to supplement the diet" (30%) than those with either middle (20%) or lowest (18%) PIR households (*P*

Conclusions: DS use was higher among US children in higher-income households, those in food-secure households, and those not eligible for federal nutrition assistance programs. Motivations for DS use also differ by household income level.

Funding Sources

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Measuring the Culinary Integration of Immigrants: Construction and Validation of a Visual Scale for First-Generation Immigrants in Turkey (P20-079)

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Objectives: Assessment tools on dietary acculturation neglect the content of culinary domains such as capturing basal and complementary meal constituents and cuisine-specific food preparation and cooking methods. In addition, lack of visuals hinder the comprehensibility of items for less lingually acculturated immigrants. Furthermore, previous research has mainly focused on dietary acculturation of immigrants coming to Western countries. Therefore, the objective of this study was to develop and validate a visual scale that measures the culinary integration of first-generation immigrants in Turkey.

Methods: Following an intensive literature search on Turkish cuisine, in-depth interviews with culinary and nutrition experts and 2 focus groups with immigrants that live in Turkey, Turkish cuisine was quantified in terms of foods, beverages, traditional food preparation methods, and the culture of eating in Turkey. After a content analysis of expert reviewing, refinement of items, and pilot testing the final version of the visual scale; it was administered to 256 people (163 immigrants and 93 Turkish people). The reliability of the scale (Cronbach's α) and its factorial validity was established through the use of exploratory factor analysis (EFA). Differences between Turkish people and immigrant groups were assessed with ANOVA.

Results: EFA revealed a 4-factor structure for the final culinary integration scale and led to removal of 8 items. The resulting 32-item scale had 4 subscales, namely, *1*) primary and *2*) complementary meal components, *3*) sweet foods, and *4*) food preparation methods for

Turkish cuisine. All subscales were found to be internally consistent, with Cronbach αscores of 0.75, 0.71, 0.71, and 0.80, respectively. ANOVA revealed significantly different results for Turkish cuisine scores of Turkish people compared with immigrants for 3 subscales (primary and complementary meal components and food preparation methods) ($P = 0.000$). However, the results for the sweet foods subscale did not differ significantly ($P = 0.155$).

Conclusions: A valid and reliable culinary integration scale was developed for assessing the culinary integration of immigrants who live in Turkey. This scale could also be used with Turkish migrants living abroad for bidirectional studies that assess culinary integration.

Funding Sources

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Sociodemographic and Lifestyle Factors Associated with Diet Quality in a Multiethnic Population (P20-080)

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Objective: The aim of this study was to examine associations of sociodemographic and lifestyle factors with diet quality in a multiethnic population.

Methods: The analysis included 160,353 African American, Native Hawaiian, Japanese American, Latino, and white participants aged 45–75 y, who entered the Multiethnic Cohort Study by completing a comprehensive questionnaire in 1993–1996 and did not report previous cancer or heart disease. Diet quality was assessed according to 4 diet quality indexes (DQIs): the Healthy Eating Index 2010 (HEI-2010), the Alternative Healthy Eating Index 2010 (AHEI-2010), the alternate Mediterranean Diet (aMED) score, and the Dietary Approaches to Stop Hypertension (DASH) score. The multivariate ORs for being above the median scores for each DQI were calculated.

Results: For the three DQIs HEI-2010, AHEI-2010, and DASH, mean scores were significantly higher in women (68.6, 65.1, and 24.0, respectively) than men (64.3, 64.0, and 23.9, respectively). The mean aMED score was significantly higher in men (4.14) than in women (4.08). In both men and women, age $\geq$65 y compared with <65 y (ORs for the four DQIs = 1.93–3.04), college graduate compared with $\leq$high school graduate (ORs = 1.36–1.76), vigorous physical activity >0.3 compared with <0.3/d (ORs = 1.33–1.57), and multivitamin use compared with nonuse (ORs = 1.33–1.47) were associated with higher scores of all 4 DQIs. Body mass index (BMI) $\geq$35 compared with $\leq$20 kg/m^2 (ORs = 0.59–0.85), current compared with never smoking (ORs = 0.38–0.58), and alcohol consumption $\geq$2 drinks/d compared with nondrinking (ORs = 0.41–0.72) were associated with lower scores of all 4 DQIs. Associations with race/ethnicity by sex were inconsistent by DQIs. Being widowed compared with married (ORs = 0.87–0.91), previous compared with never smoking (ORs = 0.87–0.92), and BMI 2 (ORs = 0.77–0.84) were associated with lower DQI scores in men, but not in women.

Conclusions: Diet quality was associated with sociodemographic and lifestyle characteristics in men and women. The associations with several factors, e.g., marital status, BMI, and smoking status, differed by sex. These findings may help to identify at-risk populations for nutritional screening, and to develop nutritional intervention strategies and educational materials.

Funding Sources

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Excess Fluoride in Drinking Water Affects Nutrition Status in Children (P20-081)

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Objective: Fluorosis is a public health problem in 204 districts of India. Fluoride (F) ingestion affects nutrition status in children. The objective of the present study was to determine the effect of excess F in drinking water on nutrition status of the children.

Methods: A cross-sectional study was undertaken in 1169 school-going children of Nalgonda district, Telangana State, India. Villages were categorized into control (F = 0.87 mg/L, n = 645 from 4 villages) and affected (F = 3.77 mg/L, n = 416 from 2 villages). Children were enrolled for dental grading screening for fluorosis by modified Dean index criteria. Anthropometric measurements (height and weight) were used to assess nutritional status. Water and urinary F levels were analyzed by ion-selective electrode method. Biochemical parameters such as serum T3, T4, TSH, 25(OH)-vitamin D, and 1,25$(OH)_2$-vitamin D were analyzed by radioimmunoassay kits.

Results: The study revealed that the percentage prevalence of different grades of dental fluorosis was significantly higher in affected villages than in control villages. There was a significant increase in the urinary F in affected villages compared with control villages. Higher stunting was observed in affected villages (26.3% in boys, 34.0% in girls) than in control villages (24.5% in boys and 28.6% in girls). There was a significant decrease in serum T3 and 25(OH)-vitamin D levels in affected as compared with control villages. Whereas there was a significant increase in serum T4, TSH, and 1,25$(OH)_2$-vitamin D in affected compared with control villages.

Conclusions: Excess fluoride in drinking water affects nutrition status along with vitamin D levels and thyroid function.

Funding Sources

UNICEF.

Supporting Images/Graphs

Table. The percentage of prevalence of stunting among the school children in different villages

Villages	Boys				Girls			
	Normal (HAZ > -2)		Stunting (HAZ≤-2)		Normal (HAZ > -2)		Stunting (HAZ≤-2)	
	N	%	N	%	N	%	N	%
Control	231	75.5%	75	24.5%	242	71.4%	97	28.6%
Affected	157	73.7%	56	26.3%	134	66.0%	69	34.0%

Dental fluorosis in school children from affected villages

FIGURE P20-081-1 Stunting table and dental fluorosis image

Insomnia Is Associated with Nutrient Intake and Metabolic Syndrome Risk in Middle-Aged Korean Women (P20-082)

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Objectives: This study was conducted to investigate the influence of insomnia on nutrient intake and metabolic syndrome risk in middle-aged Korean women.

Methods: Subjects were participants in the community-based Ansung and Ansan Cohort Study from 2001 to 2002, which was part of the Korean Genome and Epidemiology Study (KoGES). A total of 3646 women aged 40–64 y were classified into 2 groups according to whether they had insomnia ($n = 721$) or not ($n = 2925$).

Results: The insomnia group had a significantly higher percentage energy from carbohydrate ($P = 0.047$) and lower percentage energy from fat ($P = 0.029$) compared with normal sleepers. The risks of hypertriglycemia (OR = 1.28; 95%CI: 1.07, 1.54) and hyperglycemia (OR = 1.31; 95% CI: 1.04, 1.64) were significantly higher in the insomnia group compared to normal sleepers. Furthermore, the insomnia group showed a significantly higher odds of having metabolic syndrome [OR = 1.36; 95% CI: 1.10, 1.69) than normal sleepers.

Conclusions: These findings suggested that insomnia may increase the risk of metabolic syndrome with high carbohydrate intake in middle-aged Korean women.

Furan-Borne Risk and Nutrient-Borne Benefits in the Diet of Breastfeeding Women in Korea (P20-083)

Cho-il Kim,[1] Jee-Yeon Lee,[1] Ari Choi,[1] Do-Hee Kim,[1] Miyong Yon,[1] Seung-Ju Park,[1] Haeng-shin Lee,[1] Kwang Geun Lee,[2] and Sung-ok Kwon[3]

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Objectives: This study was conducted to investigate the influence of insomnia on nutrients intake and metabolic syndrome risk in middle-aged Korean women.

Methods: Subjects were participants in the community-based cohort study (Ansung and Ansan Cohort Study) from 2001 to 2002, which was a part of the Korean Genome and Epidemiology Study (KoGES). A total number of 3,646 women aged 40-64 years were classified into two groups according to whether they had insomnia ($n = 721$) or not ($n = 2,925$).

Results: Insomnia group had significantly higher percentage energy from carbohydrate ($P = 0.047$) and lower percentage energy from fat ($P = 0.029$) compared to normal sleeper. The risks of hypertriglycemia [OR (95%CI) = 1.28 (1.07-1.54)] and hyperglycemia [OR (95%CI) = 1.31 (1.04-1.64)] were significantly higher in insomnia group compared to normal sleeper. Furthermore, insomnia group showed a significantly higher odds of being metabolic syndrome [OR (95%CI) = 1.36 (1.10-1.69)] than normal sleeper.

Conclusions: These findings suggested that insomnia may increase the risk of metabolic syndrome with high carbohydrate intake in middle-aged Korean women.

Funding Sources

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Acrylamide-Borne Risk and Nutrient-Borne Benefits in the Diet of Pregnant Women in Korea (P20-084)

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Objectives: Acrylamide (AA) has been classified as probably carcinogenic (group 2A) by the International Agency for Research on Cancer. AA has shown developmental and reproductive toxicity in animals, as well as neurotoxic effects in humans with occupational exposures. Because it is widespread in food and can pass through the human placenta, concerns have been raised about potential developmental effects of dietary exposure in humans. In a recent Total Diet Study (TDS), mean exposure of the Korean adult population (AP) to AA has been reported to be 0.076 μg · kg body wt^{-1} · d^{-1} resulting in a margin of exposure (MOE) of 2367–4077 based on the $BMDL_{10}$ set by the Joint FAO/WHO Expert Committee on Food Additives, the category of "possible concern" in terms of risk assessment. Hence, we attempted to estimate dietary exposure of pregnant women (PW) to AA, and to investigate the major sources of AA and some vitamins and minerals in their diet.

Methods: Utilizing nonconsecutive 2-d dietary intake data of 1000 individuals collected through a Special Dietary Intake Survey on Vulnerable Population in 2011–2013 based on 24-h recalls, a nationwide representative intake data set for PW was established. Based on AA content in food samples prepared (cooked) in various ways from the aforementioned TDS, AA exposure was estimated and food sources of AA and some important nutrients were identified.

Results: Mean AA exposure of PW was estimated to be 0.060 μg · kg body wt^{-1} · d^{-1} (trimester 1), 0.054 μg · kg body wt^{-1} · d^{-1} (trimester 2), and 0.046 μg · kg body wt^{-1} · d^{-1} (trimester 3). With somewhat lower mean exposure compared with that in AP, the corresponding MOE values were 2985–6796. The foods contributing most to AA exposure (>50%) in PW were cookies, French fries, breakfast cereals, carrots, and roasted grain powder, whereas black pepper was the top AA contributor in AP. Although calcium and iron intake adequacy is low (60–80% of RDA) in Korean PW, none of these foods turned out to be a significant source of either nutrient.

Conclusions: Altogether, in balancing AA-borne risk and nutrient-borne benefits, avoiding certain foods could be an option to lower AA exposure to MOE by >10,000 during pregnancy to facilitate better fetal health. The Korean government is working on measures to lower AA exposure.

Funding Sources

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The Optimal Ratio of the Subsample Administered an Additional 24-Hour Recall to Estimate the Usual Intake in a Korean Population (P20–085)

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Objectives: Several statistical methods to estimate usual nutrient intake have been developed; however, to apply those methods, it is necessary to repeat the administration of the 24-h recall (24HR) in at least a subsample of the population to enable adjustment for within-person random error. This study was conducted to compare the distributions of usual nutrient intakes according to subsample-to-sample ratios, and to find the optimal subsample-to-sample ratio based on the the Iowa State University method.

Methods: A 1-d 24HR was administered to 9391 individuals through the 2009 Korea National Health and Nutrition Examination Survey, and an additional 24HR was conducted with a subsample of 2029 of these 9391 individuals. Using these data, we estimated 4 different distributions of the usual nutrient intakes of the 9391 individuals. The first, second and third distributions were estimated with a 5%, 10%, and 15% randomly selected subsample-to-sample ratio, respectively. The fourth distribution was estimated with the use of all subsampled subjects. The distributions of the usual intakes of energy and 13 nutrients were estimated, and we examined the homogeneity of variance through the use of 95% Bonferroni CIs among the 4 distributions.

Results: The variances of the 4 distributions were not significantly different for phosphorus, iron, potassium, vitamin A, and thiamin. However, the variance of the distribution with the 5% subsample-to-sample ratio was significantly larger than that of the distribution with the 15% or all subsample-to-sample ratios for energy, protein, fat, and sodium. In addition, the variance of the distribution with the 15% subsample was not significantly different from that of the distribution with all subsampled individuals for all nutrients.

Conclusions: The findings of this study suggest that the estimation of the usual intakes of energy and some nutrients may be problematic if the subsample-to-sample ratio is too small. To measure the usual intakes of energy and most nutrients in a Korean population with the use of an additional 24HR, the optimal ratio of the subsample that receives a second 24HR to the original sample should be >15%.

Funding Sources

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Association of n–3 Polyunsaturated Fatty Acids and Vitamin B-6 with C-Reactive Protein through the Use of NHANES 2003–2004 (P20-086)

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Objective: Cardiovascular disease (CVD) is the leading cause of death in the United States. C-Reactive protein (CRP) is one of the inflammatory biomarkers for CVD risk. Vitamin B-6 deficiency has been associated with increased CVD risks, and shown to reduce the plasma concentrations of n–3 (ω-3) polyunsaturated fatty acids (PUFAs). n–3 PUFAs may reduce CVD risks by modulating the production of inflammatory mediators. The purpose of this study was to investigate whether dietary intakes of n–3 PUFAs and vitamin B-6 were associated with serum CRP concentrations in older and younger adults from a US representative sample.

Methods: Cross-sectional data from NHANES 2003–2004 for ages 20–39 and 40–80+ y were analyzed. The final sample size was $n = 4258$ for the dietary target nutrient analysis (ages 20–39 y: $n = 1461$; 40–80+: $n = 2797$). Associations of dietary intakes of vitamin B-6 and n–3 PUFAs (eicosapentaenoic acid + docosahexaenoic acid)

with serum CRP levels were assessed with multiple regression models accounting for the complex survey design and weighting of NHANES with SAS version 9.4 (SAS Institute Inc.). The level of significance was $P < 0.05$.

Results: There were significant negative associations of dietary vitamin B-6 with serum CRP in both age groups: 20–39 y, β-coefficient = −0.042 (95% CI: −0.080, −0.004; $P = 0.03$) and 40–80+ y, β-coefficient = −0.071 (95% CI: −0.107, −0.034; $P = 0.001$). There were also significant negative associations of dietary n–3 PUFAs with serum CRP in both age groups: 20–39 y, β-coefficient = −0.059 (95% CI: −0.110, −0.007; $P = 0.028$) and 40–80+ y, β-coefficient = −0.085 (95% CI: −0.153, −0.017; $P = 0.017$).

Conclusions: Higher intakes of vitamin B-6 and n–3 PUFAs were associated with lower CRP concentrations. Adequate intakes of vitamin B-6 and n–3 PUFAs may have protective effects against CVD outcomes. Prospective studies for dietary intakes of vitamin B-6 and n-3 PUFAs are needed to confirm these associations.

Funding Sources

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Patient Portal Adoption and Use by the WHO Obesity Classification (P20-087)

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Objectives: Despite the promising potential in patient engagement and chronic disease management among patient portal users, it is unknown whether obesity classification may influence patient portal use. Patient portal use remains low, especially for low-income populations. This study hypothesized that morbidly obese and obese patients are more likely to use the patient portal than their normal-weight counterparts within a low-income population.

Methods: A total of 19,121 unique patient records with their last valid body mass index (BMI) in 2016 were extracted from the data registry of an academic medical center serving a largely low-income population in eastern North Carolina. The mean ±SD age was 51.0 ± 18.1 y, and the sample population was 50% black. Adoption is defined as activating the patient portal account. Use is defined as using the patient portal at least once during the initial 6 mo of observation period since activation of their accounts. All ORs and 95% CIs were calculated with the use of multivariate logistic regression models, adjusting for age, gender, and race.

Results: About 78% of patients were overweight or obese including 14% of morbidly obese patients (obesity III). The mean BMI was 31.6 kg/m^2 (range 13.2–88 kg/m^2). Overall, 46% of patients signed up for the patient portal, whereas 24.4% used at least 1 function of the portal. Among adopters, only 53% continued to use the portal during the initial 6 mo of the period. The results indicate that female (25.3%, OR = 1.38; 95% CI: 1.30, 1.47), white patients (34.2%, OR = 3.12; 95% CI: 2.86, 3.33), and those in the 36- to 55-y age group (28.9%, OR = 2.40; 95% CI: 2.05, 2.81) were more likely to use the patient portal than those who were male, black, and aged ≥75 y. After adjusting for age, sex, and race, the overweight and obese patients were more likely than normal weight patients to adopt and use the patient portal. There was no difference in use among the 4 classifications of obesity.

Conclusions: Additional longitudinal research is needed to determine the potential impact of portal use among different obesity groups on their weight management. Health care providers need to encourage patients to explore patient portal as a means to engage in personal health care management, especially for black patients to address observed racial disparities.

Funding Sources

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Estimation of Dietary Cadmium Intake and Major Food Sources in the US Population from NHANES 2007–2012 (P20–088)

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Objectives: Cadmium (Cd) may cause hepato- and nephrotoxicity, bone damage, reproductive dysfunction, and certain cancers. Although tobacco smoke is a major source of Cd exposure, diet is the most common source of exposure in everyday living. However, studies examining the major sources and total intake of dietary Cd in the United States are lacking. Therefore, we aimed to estimate dietary Cd intake, and to document major food sources of Cd among the US population

Methods: A total of 12,523 individuals aged ≥2 y from NHANES 2007–2012 were included in a cross-sectional, population-based study. Cd intakes were estimated from 2 d of 24-h dietary recall by matching intake data with the Cd database of the FDA's Total Diet Study (TDS) 2006–2013.

Results: Average daily Cd intake of the US population was 4.6 μg/d and weekly intake (WI) of Cd per body wt was 0.5 μg · kg body wt^{-1} · wk^{-1}, which is 22% of the tolerable weekly intake (TWI) of 2.5 μg · kg body wt^{-1} · wk^{-1}. Greater Cd intakes were observed in older adults, males, supplement users, and those with higher body mass index, poverty income ratio, and education level. Those with lowest Cd intakes were alcohol nonconsumers compared with moderate or heavy alcohol consumers. The highest WI was observed in children aged ≤10 y (38% of the TWI), underweight individuals (38% of the TWI), alcohol nonconsumers (24% of the TWI), and supplement users (22% of the TWI). Major food groups contributing to Cd intake were cereals and bread (34%), leafy vegetables (20%), potatoes (11%), legumes and nuts (7%), and stem/root vegetables (6%). Individual foods with the greatest contribution were lettuce (14%), spaghetti (8%), bread (7%) and potatoes (6%). Children aged ≤10 y had higher Cd intakes from cookies, peanuts and milk compared with other age groups, whereas lettuce and sunflower seeds contributed relatively less to total Cd. Lettuce was a major Cd source for Caucasians, whereas tortillas were a significant source for Hispanics, and rice and spinach were major sources for other ethnic subgroups including Asians.

Conclusions: This study provides critical information on dietary Cd intake in the United States and major food sources. These findings warrant further study on the health implications of Cd exposure.

The Impact of Zinc Intake on Cadmium Burden Is Differently Influenced by Smoking Status (P20-089)

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Objectives: Exposure to cadmium (Cd), a toxic heavy metal, occurs primarily through tobacco smoke and through diet in the general population. Cd has a long biological half-life in the human body and can persist in several tissue types, leading to numerous health risks. A preliminary study by our group suggested that the absorption and accumulation of Cd may be affected by zinc (Zn) intake. However, studies on the effect of Zn intake on Cd burden are lacking. It is unclear whether this Zn-Cd relation is affected by smoking status. The objective of this study was to examine whether Zn intake differentially affects blood and urinary Cd levels depending on smoking status in US adults.

Methods: A cross-sectional, population-based study was conducted with 3900 US adults aged ≥20 y from NHANES 2007–2012. Intakes of Cd were estimated from 2 d of 24-h dietary recalls by matching dietary intake data with the Cd database of the FDA's Total Diet Study (TDS) 2006–2013. Total Zn intake was estimated from both diet and dietary supplements. Geometric means of blood and urinary Cd were reported by quintiles of Zn intake and by smoking status.

Results: The arithmetic means of blood and urinary Cd concentrations were 0.50 μg/L and 0.33 μg/g creatinine, respectively. In a regression model fully adjusted for age, gender, ethnicity, body mass index, income, education level, alcohol consumption, dietary supplement use, and total calcium and dietary Cd intake, urinary Cd concentrations were inversely associated with Zn intake ($\beta = -0.045$, P-trend = 0.0005). However, when separated by smoking status, this association remained only among nonsmokers ($\beta = -0.034$, P-trend = 0.0247).

Conclusions: These findings demonstrate that the impact of Zn intake on Cd accumulation and excretion differs by smoking status, and that Zn intake may be particularly important for reducing Cd burden among nonsmokers. These results warrant further studies on how Cd exposure is influenced by Zn intake and smoking status.

Frequency of Soft Drink Consumption and Breast Cancer Mortality: The Western New York Exposures and Breast Cancer (WEB) Study (P20-091)

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Objectives: There is evidence that soft drinks are associated with increased risk of breast cancer. However, there are no previous studies investigating prediagnostic consumption of soft drinks and mortality after breast cancer diagnosis.

Methods: We examined the association between frequency of prediagnostic soft drink consumption and breast cancer mortality in 921 women with primary, incident, histologically confirmed breast cancer diagnosed between 1996 and 2001. Vital status was determined through December 31, 2013, through the use of the National Death Index. Diet in the 12–24 mo before diagnosis, including frequency of soft drink intake, was assessed through the use of a food-frequency questionnaire. Potential confounders were evaluated from an extensive epidemiologic interview and abstracted clinical data. HRs and 95% CIs for soft drink consumption with all-cause, all-cancer, and breast cancer mortality were estimated from Cox proportional hazards models, adjusting for age, race, education, body mass index (BMI), energy intake, alcohol drinking, smoking, tumor stage at diagnosis, and physical activity. Women with diabetes were excluded and stage 0 breast cancer diagnoses were excluded.

Results: Of the 921 women with complete information, 287 had died by the end of follow-up; of those, 138 died of breast cancer. Compared with those who reported never/rare soft drink consumption (<1 time/mo), women who had the highest consumption frequency (≥5 times/wk), had a statistically significant increase in the risk of breast cancer mortality (HR = 1.72; 95% CI: 1.06, 2.79; P-trend = 0.01), and all-cancer mortality (HR = 1.67; 95% CI: 1.08, 2.59; P-trend = 0.03), but not all-cause mortality (HR = 1.31; 95% CI: 0.90, 1.90; P-trend = 0.14). Among premenopausal women ($n = 64$), those with more frequent soft drink consumption, compared with never/rare consumers, had significantly higher risk for all-cause (HR = 2.85; 95% CI: 1.30, 6.26; P-trend = 0.01), breast cancer (HR = 2.71; 95% CI: 1.13, 6.50; P-trend = 0.03), and all-cancer mortality (HR = 2.85; 95% CI: 1.24, 6.59; P-trend = 0.01). Conversely, among postmenopausal women ($n = 223$), frequency of soft drink consumption was not associated with the risk of all-cause, all-cancer, or breast cancer mortality (P-trend > 0.05).

Conclusions: Our results suggest that higher intakes of soft drinks may be associated with lower survival among women diagnosed with breast cancer, especially premenopausal women.

Funding Sources

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Randomized Controlled Double-Blind Trial: Role of Putative α-Glucosidase Inhibitor on Bone Turnover and Glucagon-Like Peptide-1 after a Mixed Meal Tolerance Test (P20-092)

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Objective: The botanical, *Salacia*, has α-glucosidase inhibitor properties that attenuate postprandial glucose concentrations and may increase secretion of glucagon-like peptide-1 (GLP-1). Evidence also indicates that GLP-1 alters bone turnover. This study was conducted to investigate whether *Salacia chinensis* would elevate GLP-1 and predict changes in markers of bone turnover.

Methods: Twenty-three overweight and obese adults (aged <60 y) were included (40% men). Fasting participants received either placebo or treatment with *Salacia* (500 mg) with a breakfast meal in a crossover design. Blood was taken before and at 30, 60, 90, 120, and 180 min after

the meal with *Salacia*. Serum GLP-1, glucose, and the bone markers C-terminal telopeptide of type 1 collagen (CTX) and osteocalcin (OC) were analyzed.

Results: The mean age was 34 ± 14 y, and body mass index was 29.0 ± 3.8 kg/m^2. Serum glucose was 86 ± 10 mg/dL and peak concentrations were attenuated with *Salacia* with to placebo ($P < 0.05$). The repeated-measures ANOVA indicated an interaction (time × treatment) for GLP-1 ($P < 0.05$) that was higher at 60 min with *Salacia* than with placebo. The integrated area under the curve for CTX was negative and larger with treatment than with placebo ($P < 0.01$), and changes from baseline were significantly lower at multiple time points ($P < 0.01$) with treatment. Serum OC did not differ significantly between groups until 180 min, when it was lower for *Salacia* than for placebo ($P < 0.001$). There was an inverse correlation between GLP-1 and CTX in the treatment group at baseline ($r = -0.59$, $P < 0.01$), and at nearly all time points after the meal ($r > 0.48$; $P < 0.05$). Serum GLP-1 did not correlate with OC at the same time points with or without treatment, but baseline GLP-1 was inversely correlated with OC after the meal (90, 120 and 180 min; $P < 0.05$) in the treatment group.

Conclusion: This study shows that *Salacia*, known to decrease glycemic indices, also markedly decreased postprandial bone resorption and may shift the balance in favor of formation over resorption. Since it has previously been shown that GLP administration decreases bone resorption, the rise in GLP-1 with *Salacia* may play a role in attenuating postprandial bone turnover.

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Supporting Images/Graphs

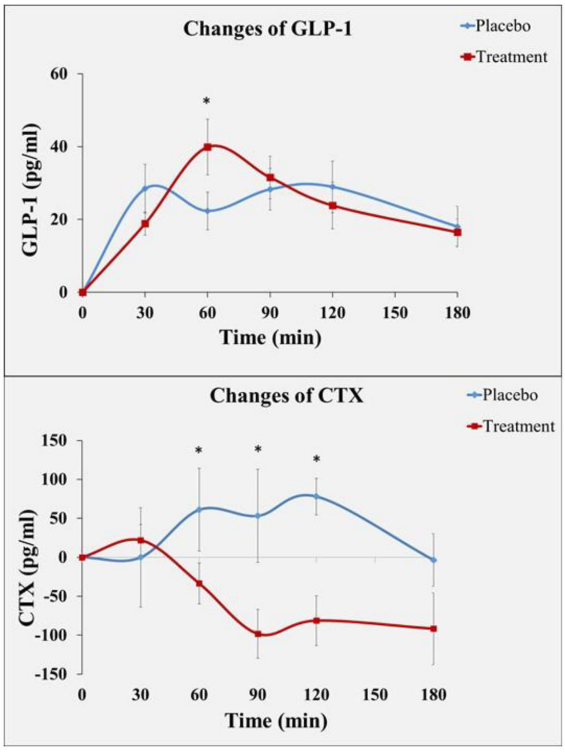

FIGURE P20-092-1 GLP-1 and CTX after a mixed meal

Development and Validation of a Screener for Diet Quality in a French-Canadian Population (P20-093)

Jacynthe Lafreniere,[1] Stephanie Harrison,[1] Danielle Laurin,[2] Chantal Brisson,[2] Denis Talbot,[3] Patrick Couture,[3] Simone Lemieux,[4] and Benoit Lamarche[4]

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Objectives: The aim of this study was to develop and validate a short, self-administered questionnaire to screen individuals with low diet quality based on the Alternative Healthy Eating Index (AHEI).

Methods: A total of 1643 adults (aged 44.6 ± 14.4 y) completed a validated web-based food-frequency questionnaire (webFFQ), and had their height and weight measured. A subsample of 940 individuals also provided a blood sample, and had their body composition and blood pressure measured. The AHEI, a score predictive of chronic disease risk, calculated from the webFFQ data, was used to arbitrarily classify the quality of diet as adequate (AHEI score ≥65/110) or inadequate (AHEI score <65/110). The screener was built with the use of a classification and regression tree (CART) approach based on individual answers to the 150 questions of the webFFQ among individuals considered to have plausible energy intake (ratio of reported energy intake to basal metabolic rate ≥1.2 and <2.4; $n = 1040$). A second cohort of 3345 adults (aged 66.5 ± 6.4 y) was used to validate the predictive values of the diet quality screener in an older population.

Results: The decision tree yielded by the CART approach included sequences of 3–6 binary questions, leading to 21 different pathways. In the development sample, the area under the receiver operating characteristic (ROC) curve was 0.92, with sensitivity, specificity, and agreement values of 89.5%, 83.9%, and 87.2%, respectively. Compared with individuals classified as having inadequate diet, individuals classified as having adequate diet were significantly older, had lower body mass index, percentage body fat, and waist circumference (all $P < 0.001$), and had lower blood pressure, triglycerides, cholesterol/high-density lipoprotein (HDL) ratio and fasting insulin as well as higher HDL cholesterol concentrations (all $P < 0.05$) in both men and women. Similar results were observed in the validation sample, although overall performance of the screener for diet quality was slightly lower than among younger individuals, with an area under the ROC of 0.79 and sensitivity, specificity, and agreement values of 73.0%, 69.0%, and 71.3%, respectively.

Conclusions: The CART approach yielded a simple and rapid screener that identifies individuals at risk of having diet of poor nutritional quality. Further studies will be undertaken to test performance of the screener in a primary care setting.

Funding Sources

None.

Bitter Taste Sensitivity, Food Intake, and Risk of Malignant cancer in the UK Women's Cohort Study (P20-094)

Joshua D Lambert,[1] Sarah VanDusen,[2] Jennie E Cockroft,[2] Elizabeth Smith,[2] Darren Greenwood,[2] and Janet Cade[2]

[1]The Pennsylvania State University; and [2]University of Leeds, UK

Objectives: There is variability in sensitivity to bitter tastes. Taste 2 Receptor (TAS2R) 38 binds to bitter tastants, including

phenylthiocarbamide (PTC). Many foods with putative cancer preventive activity have bitter tastes. We examined the relation between PTC sensitivity or *TAS2R38* diplotype, food intake, and cancer risk in the UK Women's Cohort Study.

Methods: PTC taste phenotype ($n = 5500$) and *TAS238* diplotype ($n = 750$) were determined in a subset of the cohort. Food intake was determined from a 217-item food-frequency questionnaire. Cancer incidence was obtained from the National Health Service Central Register. HRs were estimated from multivariable Cox proportional hazard models.

Results: PTC tasters (HR = 1.30; 95% CI: 1.04, 1.62), but not supertasters (HR = 0.98; 95% CI: 0.76, 1.44), had increased cancer risk compared with nontasters. An interaction was found between phenotype and age for supertasters ($P = 0.019$) but not tasters ($P = 0.54$). Among women >60 y, tasters (HR = 1.40; 95% CI: 1.03, 1.90) and supertasters (HR = 1.58; 95% CI: 1.06, 2.36) had increased cancer risk compared with nontasters, but no such association was observed among women ≤60 y (tasters HR = 1.16; 95% CI: 0.84, 1.62; supertasters HR = 0.54; 95% CI: 0.31, 0.94). We found no association between *TAS2R38* diplotype and cancer risk. We observed no major differences in bitter fruit and vegetable intake.

Conclusions: These results suggest that the relation between PTC taster phenotype and cancer risk may be mediated by factors other than fruit and vegetable intake.

Funding Sources

World Cancer Research Fund; United States Department of Agriculture Hatch Project no. 4565.

Chocolate Consumption and Risk of All-Cause, Cardiovascular Disease, and Cancer Mortality in the UK Women's Cohort Study (P20-095)

Joshua D Lambert,[1] Darren Greenwood,[2] and Janet Cade[2]

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Objective: Chocolate is a popular food, but is generally considered an indulgence because of its sugar and fat content. Previous research has shown that chocolate consumption is associated with decreased risk of cardiometabolic diseases, but few studies have examined the association between chocolate consumption and all-cause or disease-specific mortality. We examined the relation between chocolate consumption and risk of all-cause, cardiovascular disease (CVD), and cancer-related mortality in the UK Women's Cohort Study.

Methods: Chocolate intake derived from a 217-item food-frequency questionnaire was obtained from 29,253 women (mean age: 52.0 y). Mortality data was obtained from the National Health Service Central Register. HRs were estimated from multivariable Cox proportional hazard models.

Results: Chocolate intake was associated with decreased all-cause (HR = 0.92; 95% CI: 0.89, 0.95 across category of consumption), CVD (HR = 0.85; 95% CI: 0.76, 0.95), and cancer mortality risk (HR = 0.92; 95% CI: 0.85, 0.99). We found that prevalent angina at baseline was a significant modifier of the relation between chocolate consumption and all-cause mortality ($P = 0.002$). We found that among women with angina, chocolate consumption was associated with a 25% lower risk of all-cause mortality (HR = 0.75; 95% CI: 0.65, 0.86), whereas among women without prevalent angina, the risk was only 7% lower (HR = 0.93; 95% CI: 0.89, 0.96).

Conclusions: Our results demonstrate that chocolate consumption is associated with reduced risk of all-cause, CVD, and cancer mortality in women. For all-cause mortality, this association is stronger in women with angina.

Funding Sources

World Cancer Research Fund; United States Department of Agriculture Hatch Project no. 4565.

Mushroom Intake and Cardiometabolic Disease Risk in US Women and Men (P20-096)

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Harvard TH Chan School of Public Health, MA

Objectives: Mushrooms are good dietary sources of important nutrients including key B vitamins, vitamin D, and selenium. In addition, in vitro and animal models suggest that mushrooms may be important in the prevention of chronic diseases. However, data from human studies are scarce to evaluate how findings from animal studies apply to humans. Thus, we examined the association between mushroom intake and major cardiometabolic diseases with the use of 2 large prospective US cohort studies.

Methods: We included 72,339 women from the Nurses' Health Study (1986–2010) and 43,955 men from the Health Professionals Follow-up Study (1986–2010) who were free of chronic disease at baseline. Mushroom intake was assessed at baseline from a semiquantitative food-frequency questionnaire. Covariates and potential confounders were assessed at baseline and updated during the follow-up. Cox proportional hazards model was used to estimate HRs and 95% CIs of cardiovascular disease (CVD), coronary heart disease (CHD), stroke and type 2 diabetes (T2D) associated with mushroom intake in US women and men.

Results: During the 2,892,404 person-years of follow-up, we identified 12,407 CVD (7908 CHD; 4499 stroke), and 12,311 T2D cases. In the pooled multivariable-adjusted analysis, with to participants who never consumed mushrooms, those who consumed ≥2 servings of mushrooms per week had no significantly different risk of CVD (HR: 1.00; 95% CI: 0.94, 1.07), CHD (HR: 0.96; 95% CI: 0.88, 1.04), stroke (HR: 1.09; 95% CI: 0.97, 1.24), and T2D (HR: 1.06; 95% CI: 0.97, 1.14). Increasing mushroom intake by 1 serving per day was not significantly associated with risk of cardiometabolic diseases (HR: 1.00; 95% CI: 0.95, 1.05 for CVD; HR: 0.97; 95% CI: 0.90, 1.03 for CHD, HR: 1.04; 95% CI: 0.96, 1.11 for stroke; and HR: 1.02; 95% CI: 0.98, 1.07 for T2D). When we conducted subgroup analyses, we consistently found no association between mushroom intake and the aforementioned cardiometabolic diseases, regardless of age, body mass index, physical activity, smoking status, and family history of disease.

Conclusions: We found no association between mushroom intake and risks of CVD, CHD, stroke, and T2D in US women and men. More studies are warranted to confirm this association in other race/ethnicity groups.

Funding Sources

Australian Mushroom Growers Association (AMGA).

Association between Estimated Usual Intake of Fish and Seafood and Osteoporosis: Application of the Statistical Model in Estimating the Usual Intake from Two 24-Hour Recalls (P20-097)

{AUTHOR NAMES MISSING}

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Objectives: We examined the associations between estimated usual intakes of fish and seafood and the prevalence of osteoporosis by adjusting the effect of within-person variation in intake.

Methods: We included a total of 6639 adults from the Korean National Health and Nutrition Examination Survey (KNHANES) 2008–2011. We adjusted the effect of within-person variation in fish and seafood intake through the use of data from 2-d 24-h recalls of KNHANES 2009 by applying statistical analysis modified from the model developed by National Institute of Food and Drug Safety Evaluation. Bone mineral density (BMD) of the lumbar spine, hip, or femoral neck was measured by dual-energy X-ray absorptiometry, and osteoporosis was defined as BMD T-scores <-2.50. We used the multivariable logistic regression models, and calculated ORs and 95% CIs to examine the associations between intakes of fish and seafood and the prevalence of osteoporosis.

Results: We found that the associations of estimated usual intakes of fish and seafood with the prevalence of osteoporosis were more pronounced than those of intakes from 1-d 24-h recalls. When we estimated fish intake from 1-d 24 h recalls, ORs were 0.80 (95% CI: 0.61, 1.04) for 15–<30 g/d, 0.77 (95% CI: 0.55, 1.09) for 30–<45 g/d, and 0.92 (95% CI: 0.76,1.13) for ≥45 g/d compared with <15 g/d of fish intake. However, estimation of the distributions of usual fish intakes deattenuated the associations; compared with <15 g/d of estimated usual intake of fish, ORs were 0.78 (95% CI: 0.64, 0.95), 0.72 (95% CI: 0.57, 0.91), and 0.64 (95% CI: 0.49, 0.84) for the same categories, respectively (P-trend < 0.01). Similarly, we found a significant association for estimated usual intakes of seafood, but did not find a significant trend for seafood intake from 1-d 24-h recalls; compared with <30 g/d, ORs were 0.94 (95% CI: 0.79, 1.11), 0.81 (95% CI: 0.65, 1.00), 0.76 (95% CI: 0.56, 1.02) for 30–<50, 50–<80, and ≥80 g/d of estimated usual seafood intakes, respectively (P-trend < 0.05).

Conclusions: We found that usual intakes of fish and seafood were inversely associated with the prevalence of osteoporosis in Korean adults.

Funding Sources

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Night Eating Is Associated with an Increased Risk of Depression and Depressive Symptoms in Korean Adults (P20-098)

Kyung Won Lee[1] and Dayeon Shin[2]

[1]Korea National Institute of Health, Korea Centers for Disease Control & Prevention, South Korea; and [2]Syracuse University, NY

Objective: This study aimed to identify associations of night eating with the risk of depression and depressive symptoms in a Korean adult population.

Methods: This cross-sectional analysis used a nationally representative sample of 31,690 Korean adults (aged ≥19 y), from the Korean National Health and Nutrition Examination Survey conducted from 2008 to 2013. The study participants were divided into 2 groups, according to night eating status: night eaters (consuming ≥25% of total daily energy intake between 21.00 and 06.00) and nonnight eaters. Depression was defined based on diagnosis by a doctor, and depressive symptoms were defined as feelings of sadness or desperation for ≥2 wk during the past 1 y. Multivariable logistic regression analyses were performed to examine the relation between night eating and the risk of depression and depressive symptoms, adjusting for age, education, income, marital status, drinking, smoking, the day of recalled intake, physical activity, body mass index, menopausal status (women only), and total energy intake.

Results: A total of 14.3% Korean adults were night eaters. Night eaters were more likely to be men, young, less educated, drinkers, and current smokers (all $P < 0.05$). In women, night eaters had higher risks of depression [adjusted odds ratio (AOR), 1.33; 95% CI: 1.01, 1.75; P-trend < 0.05) and depressive symptoms (AOR, 1.19; 95% CI, 1.01, 1.41; P-trend < 0.05) than nonnight eaters. However, no associations of night eating with depression and depressive symptoms were found in men.

Conclusions: Our findings suggest that several sociodemographic and health-related factors were related to night eating. Night eating was significantly associated with increased risks for depression and depressive symptoms in Korean women, but not in men. Future studies are warranted to elucidate the underlying psychologic and behavioral mechanisms that may link the factors influencing night eating and the risk of depression and depressive symptoms.

The Influence of Weight Status on the Association between Night Eating and Sleep Duration of Korean Adults (P20-099)

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[1]Korea National Institute of Health, Korea Centers for Disease Control & Prevention, South Korea; and [2]Syracuse University, NY

Objective: This study aimed to investigate the influence of obesity status on the association between sleep duration and night eating among Korean adults aged 19–64 y.

Methods: We analyzed a representative sample of Korean adults ($n = 14{,}836$) from the Korean National Health and Nutrition Examination Survey 2010–2013. Sleep duration per day was assessed by self-reported questionnaire, and grouped as short (≤6 h), normal (7–8 h), and long (≥9 h). According to the information on energy intake from, and clock time of, eating episodes reported by the survey participants, night eating was defined as consuming >25% of total daily energy intake between 21.00 and 06.00. Multivariable logistic regression analyses were conducted to determine the associations of sleep duration with the prevalence of night eating, stratified by obesity status [body mass index (BMI) ≥25 kg/m^2 compared with <25 kg/m^2] after controlling for age, education, income, marital status, drinking, smoking, the day of recalled intake, physical activity, BMI, menopausal status (women only), and total energy intake.

Results: The prevalence of night eating was greater among individuals with short or long sleep duration (17.12% and 17.07%, respectively),

than those with normal sleep duration (14.96%). The multivariable-adjusted odds ratios (AOR) for individuals with short sleep duration was 1.18 (95% CI: 1.00, 1.38; P-trend < 0.05) in men and 1.30 (95% CI: 1.10, 1.54; P-trend < 0.05) in women, as compared with those with normal sleep duration. In models stratified by presence or absence of obesity, nonobese women with short sleep duration were more likely to be night eaters than their counterparts with normal sleep duration (AOR, 1.27; 95% CI: 1.04, 1.55; P-trend < 0.05). These associations were not observed in obese or nonobese men or in obese women.

Conclusions: Short sleep duration was significantly associated with an increased prevalence of night eating, particularly in nonobese Korean women. These findings suggest that there is an association between sleep deprivation and night eating. Future studies that objectively measure sleep duration, night eating patterns, and weight or weight change are warranted, to further shed light on the influence of weight status on the association between sleep duration and night eating.

A Comparison of Metabolic Syndrome and Nutritional Status in Rural and Urban Populations of Korea (P20-100)

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Ewha Womans University, South Korea

Objectives: This study was performed to investigate nutrient intake and the prevalence of metabolic syndrome (MetS) in middle-aged Koreans according to residential area.

Methods: A total of 161,326 middle-aged residents from urban (n = 142,137) and rural (n = 19,189) areas were selected from the Health Examinee cohort (HEXA) and Cardiovascular Disease Association Study cohort (CAVAS), 2 subprojects of the Korean Genome and Epidemiology Study (KoGES). Data were collected through the use of self-administered questionnaires, and analyzed for nutrient intake and MetS prevalence. MetS was defined by the modified National Cholesterol Education Program (NCEP) Adults Treatment Panel III criteria for Asians.

Results: Rural residents had a significantly lower energy intake than the urban population ($P < 0.001$). After adjustment for potential confounding variables, intakes of carbohydrate and sodium were significantly higher in the rural than in the urban population ($P < 0.001$). However, the consumption of protein, fat, and micronutrients, except sodium, were significantly lower in rural residents than those of urban dwellers. Subjects in the rural areas showed a significantly higher prevalence of MetS (39.8% in rural and 22.5% in urban, $P < 0.001$) and a higher OR of MetS risk (OR = 2.26; 95% CI: 2.19, 2.33) than urban participants.

Conclusions: Our results suggested that rural dwellers' higher consumption of carbohydrates and sodium may partially contribute to a higher risk of MetS in this population.

Association of Vitamin D Status and its Related Dietary Pattern with Metabolic Syndrome in Korean Adults: The Korea National Health and Nutrition Examination Survey 2010–2014 (P20-101)

Yousin Lee,[1] Hwayoung Noh,[2] Heinz Freisling,[2] and Simyeol Lee[1]

[1]Dongguk University, Seoul, South Korea; [2]Nutrition and Metabolism Section, International Agency for Research on Cancer, Lyon, France

Objectives: Recent studies have shown that vitamin D status is associated with risk of metabolic syndrome (MetS). However, epidemiologic evidence is limited, especially for the Korean population. This study aimed to examine the association of vitamin D status and its related dietary pattern with risk of MetS in Korean adults through the use of the Korea National Health and Nutrition Examination Survey (KNHANES) data.

Methods: The study population included 9237 adults aged 19–64 y with available data on serum 25-hydroxyvitamin D, dietary intake assessed by 24-h dietary recalls, and MetS components including waist circumference, fasting plasma glucose, serum triglyceride (TG), serum high-density lipoprotein cholesterol, and blood pressure (BP) from the KNHANES 2010–2014. A dietary pattern predicting serum vitamin D levels was derived by reduced rank regression (RRR). Associations of vitamin D status and the related dietary pattern with risk of MetS were examined by multivariable logistic regression models adjusting for relevant confounders.

Results: Men with a sufficient vitamin D status (≥20 ng/mL) had 44% lower risk of MetS (OR = 0.56; 95% CI: 0.36, 0.87) with 52% lower risk of elevated TG (OR = 0.48; 95% CI: 0.34, 0.67; P- trend$_{Q4\ vs\ Q1}$ = 0.75; 95% CI: 0.59, 0.97; P-trend = 0.004) than those with a lower dietary pattern score. No such association was observed in women (P-trend = 0.72).

Conclusions: A sufficient vitamin D status and a related dietary pattern with high intakes of fish, nuts, fruit, vegetables, and legumes were both associated with reduced risk of the MetS in Korean men, but not in Korean women. Among components of the MetS, serum TG and high-density lipoprotein cholesterol levels were likely to be affected by serum vitamin D levels.

Eating Patterns of Australian Adults: Associations with Blood Pressure and Prevalence of Hypertension (P20-102)

Rebecca M Leech, Anna Timperio, Anthony Worsley, and Sarah McNaughton

Deakin University, Australia

Objectives: Eating patterns have been linked to obesity, an established risk factor for hypertension. However, the contribution of eating patterns to hypertension is poorly understood, and studies examining the effects of meal and snack frequency and the temporal distribution of eating occasions (EOs) across the day (e.g., temporal eating patterns) are rare. This study aimed to examine associations of frequency of meals, snacks and all EOs, and temporal eating patterns, with blood pressure (BP) and hypertension.

Methods: A secondary analysis of dietary data collected via two 24-h recalls during the 2011–2012 Australian National Nutrition and Physical Activity Survey (n = 4482 adults, ≥19 y) was conducted. Frequencies of all EOs, meals, and snacks were calculated. Temporal eating patterns were determined through the use of latent class analysis. Multivariate regression models assessed associations of eating patterns with systolic BP (SBP), diastolic BP (DBP), and hypertension prevalence.

Results: Among men, a higher snack frequency was inversely associated with DBP ($\beta = -0.59$; 95% CI: −1.12, −0.07) and hypertension (OR: 0.86; 95% CI: 0.75, 0.98) after adjustment for covariates and body mass index. However, these associations disappeared after additional adjustment for total energy intake and overall diet quality. Among women, a temporal eating pattern characterized by a "later lunch" meal was associated with SBP ($\beta = 2.45$; 95% CI: 0.05, 4.84), DBP ($\beta = 1.69$; 95% CI: 0.25, 3.13) and hypertension (OR = 1.49; 95% CI: 1.00, 2.22), when compared with a "conventional" eating pattern.

Conclusions: In this study, an inverse association found between snack frequency and BP among men disappeared after adjustment for dietary factors. A "later lunch" temporal eating pattern, compared with a "conventional pattern", was also associated with higher BP in women. Future research is needed to understand the relation and potential mechanistic pathways between eating patterns and BP.

Funding Sources

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Prevalence and Trends in Dietary Supplement Use among Diabetic Adults: The National Health and Nutrition Examination Surveys, 1999–2014 (P20-103)

Jing Li,[1] Xinli Li,[2] Wambui Gathirua-Mwangi,[3] and Yiqing Song[1]

[1]Indiana University Richard M Fairbanks School of Public Health; [2]School of Public Health, Medical College of Soochow University, China; and [3]Indiana University School of Nursing

Objective: We aimed to evaluate prevalence and trends of use of any supplements, multivitamins/multiminerals (MVMMs), individual vitamins, minerals, and nonvitamin, nonmineral supplements.

Methods: Nationally representative data from NHANES collected between 1999 and 2014 were used. Information on supplement use in the preceding 30 d was collected during the interview over 8 continuous 2-y waves. Analyses were conducted among 6348 US diabetic adults aged 20–85 y (pregnant women excluded), and also stratified by age, race/ethnicity, gender, educational backgrounds, and comorbidity status.

Results: Overall, the prevalence of use of any supplement (52–59%; *P*-trend = 0.09) and that of any mineral (47–51%; *P*-trend = 0.24) seemed stable. Use of MVMMs decreased from 36% of reported use in 1999–2000 to 32% in 2013–2014 (*P*-trend = 0.008). Use of any vitamin products increased from 47% to 53% (*P*-trend = 0.04). Use of a few individual supplements, including lycopene, vitamin D, and vitamin B-12, significantly increased. The trend in supplement use varied by sex and race/ethnicity.

Conclusions: Among diabetic patients in the United States, use of any dietary supplements or any minerals remained stable, use of MVMMs slightly decreased, and use of any vitamins and several individual supplements increased over the past 16 y.

Funding Sources

Indiana University Health-Indiana University School of Medicine Strategic Research Initiative Grant and NIH grant R01CA196234.

Supporting Images/Graphs

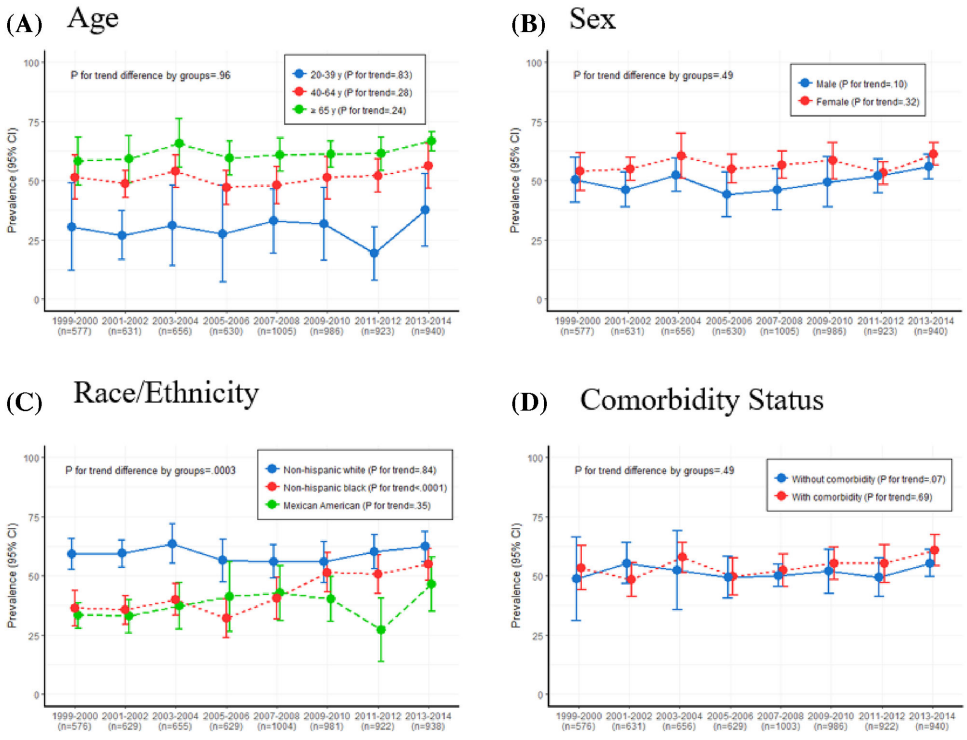

FIGURE P20-103-1 Trends in any supplement use stratified by age, sex, race, and comorbidity status in US adults aged >20 y in the NHANES 1999–2014.

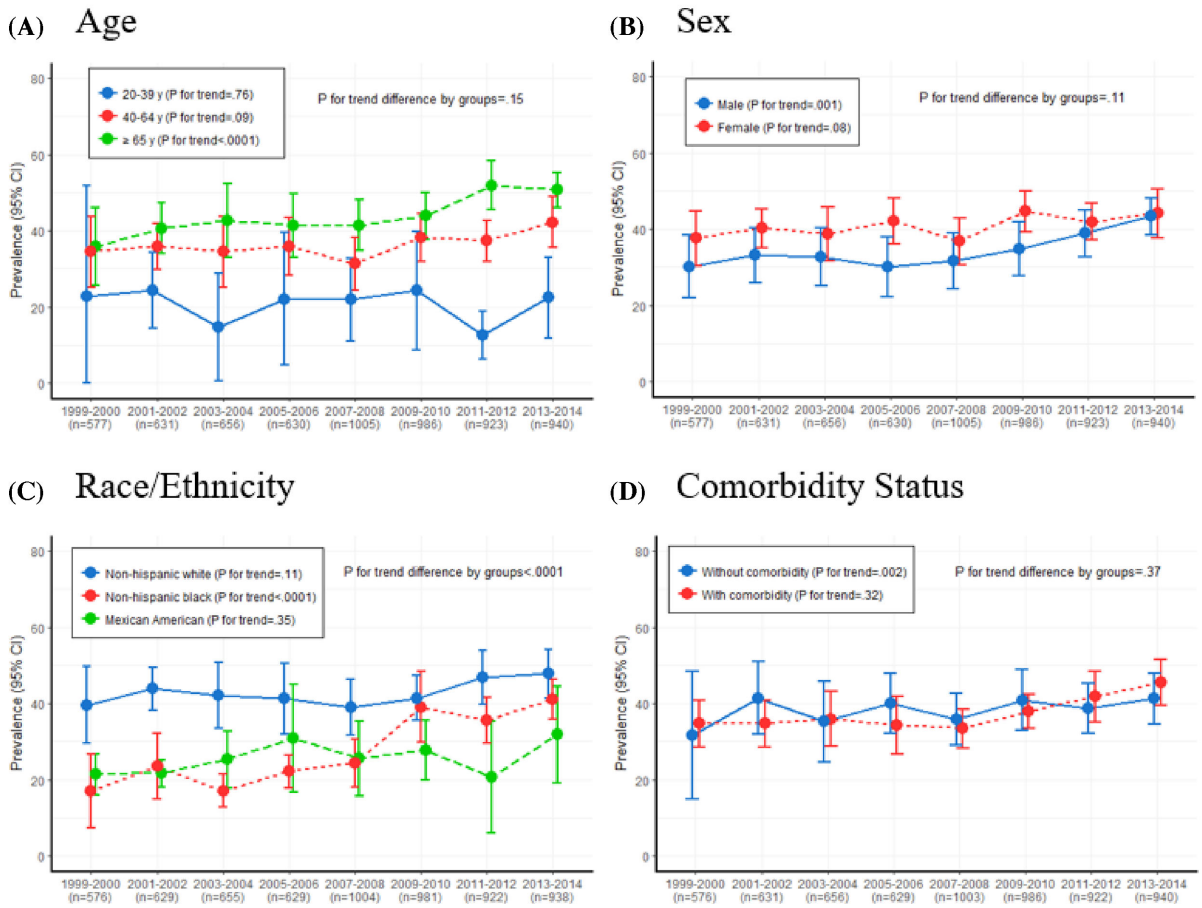

FIGURE P20-103-2 Trends in vitamin D use stratified by age, sex, race, and comorbidity status in US adults aged >20 years in the NHANES 1999–2014

Pretreatment Intake of Antioxidants in Relation to Outcomes of Infertility Treatment with Assisted Reproductive Technologies (P20–104)

Ming-Chieh Li,[1] Yu-Han Chiu,[1] Feiby L Nassan,[1] Lidia Minguez-Alarcon,[1] Paige L Williams,[1] Irene Souter,[2] Russ Hauser,[1] and Jorge Chavarro[1]

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Objectives: To examine the association of antioxidant vitamins (A, C, E) and carotenoid intake with outcomes of assisted reproductive technologies (ARTs).

Methods: We followed 338 women who underwent 503 fresh autologous ART cycles for infertility treatment at the Massachusetts General Hospital and were enrolled in an ongoing prospective cohort study. Diet was assessed before treatment through the use of a validated food-frequency questionnaire. Outcomes were abstracted from electronic medical records. The primary study outcome was live birth per initiated treatment cycle. Secondary outcomes included endometrial thickness, peak estradiol levels, oocyte yield, fertilization rates, and probabilities of implantation and clinical pregnancy per treatment cycle started. We used generalized linear mixed models with random intercepts to account for multiple ART cycles per woman, simultaneously adjusting for the other antioxidants, age, body mass index (BMI), smoking, total calorie intake, dietary patterns, alcohol and caffeine consumption, intakes of folate and vitamin B-12, and treatment protocol.

Results: Mean ±SD age and BMI were 35.0 ± 3.9 y and 24.1 ± 4.3 kg/m^2. Most women were white (83%) and had never smoked (73%). Intake of vitamins A, C, and E, and of carotenoids were not associated with the probability of live birth per initiated treatment cycle or with any of the secondary outcomes examined. The adjusted probability of live birth for women in the lowest and highest quartile of antioxidant intake were 26% (95% CI: 17%, 36%) and 31% (95% CI: 22%, 43%) for vitamin A (25th–75th percentile: 1432–2278 μg/d); 32% (95% CI: 22%, 44%) and 31% (95% CI: 22%, 42%) for vitamin C (133–249 mg/d); 37% (95% CI: 26%, 50%) and 27% (95% CI: 19%, 38%) for vitamin E (306–970 μg/d); 31% (95% CI: 22%, 43%) and 39% (95% CI: 28%, 51%) for α-carotene (306–970 μg/d); 39% (95% CI: 27%, 53%) and 31% (95% CI: 20%, 44%) for β-carotene (4029–8079 μg/d); 34% (95% CI: 25%, 45%) and 33% (95% CI: 24% 44%) for β-cryptoxanthin (52–136 μg/d); 36% (95% CI: 27%, 46%) and 36% (95% CI: 26%, 47%) for lycopene (2771–5986 μg/d); 47% (95% CI: 35%, 59%) and 27% (95% CI: 18%, 38%) for lutein and zeaxanthin (2367–4984 μg/d).

Conclusions: In this prospective cohort, intake of vitamins A, C, E, or carotenoids prior to starting infertility treatment with ART was not related to treatment outcomes.

Funding Sources

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Men's Pretreatment Intake of Antioxidants in Relation to Couple-Related Outcomes of Assisted Reproductive Technologies (P20–105)

Ming-Chieh Li,[1] Yu-Han Chiu,[1] Feiby L Nassan,[1] Lidia Minguez-Alarcon,[1] Paige L Williams,[1] Irene Souter,[2] Russ Hauser,[1] and Jorge Chavarro[1]

[1]Harvard School of Public Health, MA; and [2]Harvard Medical School, MA

Objectives: The aim of this study was to examine the association between male partner's intake of antioxidant vitamins and carotenoids and outcomes of infertility treatment with assisted reproductive technologies (ARTs).

Methods: We followed 169 couples enrolled in an ongoing prospective cohort study which evaluated outcomes of infertility treatment at the Massachusetts General Hospital. Female partners in these couples underwent 243 fresh autologous ART cycles. Diet was assessed in both partners before treatment through the use of a validated food-frequency questionnaire. The primary study outcome was live birth per initiated treatment cycle. Secondary outcome was fertilization rate (number of 2-pronuclear cells/number of metaphase II oocytes). We used generalized linear mixed models with random intercepts to account for multiple ART cycles per couple while simultaneously adjusting for the other antioxidants, male age, body mass index (BMI), smoking, folate and vitamin B-12 intakes, total caloric intake, dietary patterns, treatment protocol, initial infertility diagnosis, and female partner's age, BMI, and smoking status.

Results: Mean ±SD age and BMI were 36.6 ± 5.0 y and 27. 3 ± 4.1 kg/m^2 for men, and 34.7 ± 3.6 y and 23.8 ± 4.4 kg/m^2 for women. Vitamin C intake was positively associated with fertilization rate, with the adjusted fertilization rates in increasing quartiles of male partner vitamin C intake of 70% (62–77%), 72% (65–78%), 75% (68–80%), and 80% (73–85%), respectively (P-trend = 0.03). This relation was similar in conventional insemination and intracytoplasmic spermatozoa injection cycles. We observed no association of men's vitamin C intake with the probability of live birth despite the associations with fertilization rate. No associations with fertilization and live birth rate were observed for intakes of vitamin A, vitamin C, or carotenoids.

Conclusions: Among couples undergoing infertility treatment with ARTs, male partner intake of vitamin C prior to treatment is associated with higher fertilization rate but not probability of live birth.

Funding Sources

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Dietary Vitamin E Intake and Blood Pressure in UK Adolescents: A Longitudinal Study (P20-106)

Ziyi Li, Charlotte Evans, and Janet E Cade

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Objectives: The aim of this study was to determine the longitudinal relations between dietary vitamin E intake and blood pressure (BP) in UK adolescents.

Methods: A sample of 2126 participants was randomly selected from the Avon Longitudinal Study of Parents and Children (ALSPAC). General information and BP data were collected at age 10, 11, 12, 13, 15 and 17 y. Diet was assessed through the use of a 4-day food record at age 10 and 13 y. BP data were transformed to systolic/diastolic BP z scores (SBPZ/DBPZ). Multivariable linear regression was undertaken to explorer the relations between vitamin E intake and current or future BPZ. Gender, body mass index z score, alcohol intake, smoking status, sodium intake, energy intake, physical activity levels, parents' hypertension history, and household income were adjusted in each model.

Results: In fully adjusted models, every 1 mg increase in vitamin E intake at age 10 y was associated with 0.20 (95% CI: −0.39, −0.01) lower SBPZ and 0.23 (95% CI: −0.45, −0.02) lower DBPZ at age 10 y, but was associated with 0.21 (95% CI: 0.03, 0.39) higher SBPZ at age 17 y. Every 1 mg increase in vitamin E intake at age 13 y was associated with 0.27 (95% CI: 0.06, 0.48) higher SBPZ at age 17 y.

Conclusions: In this ALSPAC population, a negative association was found between dietary vitamin E intake and short-term SBPZ and DBPZ at age 10 y. However, a positive association was found between dietary vitamin E intake at age 10 and 13 y and future SBPZ.

Funding Sources

ZL was funded by the China Scholarship Council.

Supporting Images/Graphs

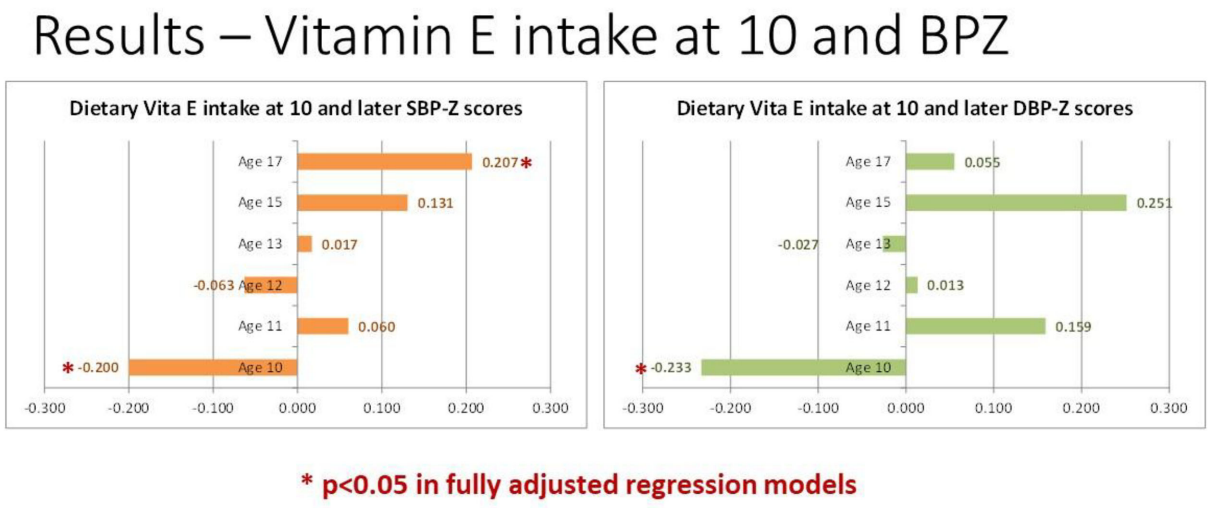

FIGURE P20-106-1 Vitamin E intake at age 10 y and blood pressure *z* score.

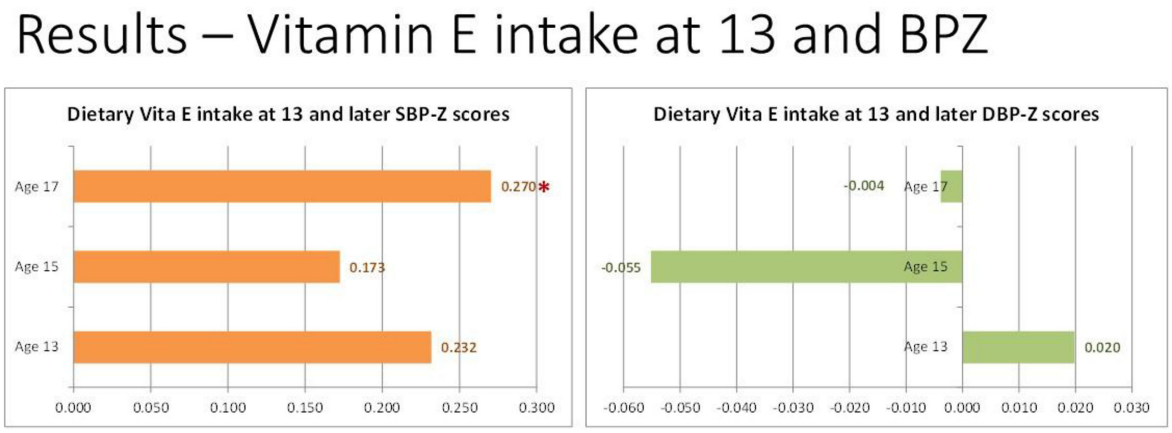

FIGURE P20-106-2 Vitamin E intake at age 13 y and blood pressure *z* score.

Web-Based Dietary Assessment in National Dietary Surveys—Experiences from Sweden (P20-107)

Anna Karin Lindroos,[1,2] Lotta Moraeus,[1] and Eva Warensjö Lemming[1]

[1]National Food Agency, Sweden; and [2]Institute of Medicine, University of Gothenburg, Sweden

Objectives: The aim of this study was to present and describe a school-based national dietary survey of adolescents carried out in 2016–2017 with focus on a new web-based 24-h dietary recall method (RiksmatenFlex).

Methods: For the validation study, 2 independent days of RiksmatenFlex were compared with 2 different independent days of 24-h recall interviews (24-h interviews) and the biomarkers carotenoids and alkylresorcinols. At this stage, 205 adolescents completed the first day with both methods, and 78 completed 2 d with both methods. For the main survey, in total 3477 students in grades 5, 8, and 11 (mean ages 12, 15, and 18 y) were recruited through schools. Based on experiences from the validation study, text messages giving reminders to complete the last day were introduced. Information on physical activity, health, and socioeconomic background was collected through web questionnaires. Physical activity was also evaluated by accelerometers. Weight and height were measured. Blood and urine samples were collected from 40% of the participants.

Results: In the validation study, the median energy intake was higher by RiksmatenFlex than by 24-h interviews: 9.4 compared with 7.5 MJ. Corresponding intakes for fruit and vegetables were 197 and 207 g and for whole grain wheat and rye ~1 g/MJ by both methods.

The Spearman correlation between fruit and vegetable intake and the carotenoids lutein/zeaxanthin was 0.47 ($P < 0.001$) and 0.28 ($P < 0.05$) and for whole-grain intake and alkylresorcinoles 0.36 ($P < 0.01$) and 0.30 ($P < 0.05$) for RiksmatenFlex and 24-h interviews, respectively. In the main survey, the response rate was 68% in total and 55% in the subsample; 89% of the participants completed the last diet day. The participants were overall representative for the population with regards to socioeconomic background and school organization. All types of municipalities were represented in the survey, and overall, the geographic distribution corresponded to the underlying population. Some differences based on school year were observed.

Conclusions: RiksmatenFlex has been well received by the participants. Text message reminders were successful, increasing the number of participants with complete diet information. The survey has been successful in providing valuable and for the first time national data on diet, physical activity, and markers of nutritional status and exposure in Swedish adolescents.

Funding Sources

This research was supported by the Swedish National Food Agency and the Swedish Civil Contingencies Agency (Project MSB dnr 2013-1556).

Research on the Relation between Vitamin D status and Food Allergy among School-Age Children from Seven Areas of China: A Cross-Sectional Study (P20-108)

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[1]Peking University, China; and [2]China National Center for Biotechnology Development =

Objective: The aim of this study was to explore the relation between vitamin D status and guardian-reported food allergy among school-age children in China.

Methods: A multistage cluster-stratified sampling was performed to investigate healthy children aged 7–12 ys from 5 cities and 2 rural areas of China. Data on sociodemographic characteristics and guardian-reported food allergy were collected by means of face-to-face interviews. Fasting venous blood samples of children was collected in the morning by professional nurses for assessment of serum 25-hydroxyvitamin D (25(OH)D) concentration with a liquid chromatography-tandem mass spectrometry method. Multivariable logistic regression analyses assessed the association mentioned above.

Results: A total of 563 school children (age 9.5 ± 1.6 y) were included. Among them, 8.3% had guardian-reported food allergy. The level of household income per capita, the food allergy history of parents and serum 25(OH)D concentration were the influencing factors of food allergy ($P < 0.05$). After adjustment of possible influential factors in multivariable logistic regression, we found both serum 25(OH)D concentration <5 ng/mL and 15–20 ng/mL were the risk factors of food allergy with reference to the ≥20 ng/mL group ($OR_1 = 10.97$; 95% CI_1: 2.61, 46.02; $OR_2 = 3.32$; 95% CI_2: 1.14, 9.67).

Conclusion: Low vitamin D status is a potential risk factor for food allergies.

Funding Sources

The Natural Science Foundation of China (grant 81573219); Key Projects of Beijing Science & Technology (grant Z1411000048140); the Natural Science Foundation of Beijing (grant Z140001); Mengniu Dairy Company Ltd (Inner Mongolia, China).

Supporting Images/Graphs

serum 25-(OH)D concentration (ng/ml)	β	P-value	OR	95%CI	
				Lower	Upper
Reference : 20-		0.006	1.00	—	—
<5	2.40	0.001	10.97	2.61	46.02
5-	0.71	0.172	2.04	0.734	5.66
15-	1.20	0.028	3.32	1.14	9.67

Association was examined by using multivariable Logistic regression. Age, gender, the level of household income per capita and the food allergy history of parents were adjusted.

FIGURE P20-108-1 Association between vitamin D status and guardian-reported food allergy.

Habitual Meat Consumption and Changes in Sleep Duration and Quality in Older Adults (P20-109)

Esther Lopez-Garcia,[1] Alberto Lana,[2] Ellen Struijk,[1] Lucia Arias-Fernandez,[2] Auxiliadora Graciani,[1] Arthur Mesas,[3] and Fernando Rodriguez-Artalejo[1]

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Objectives: The effect of dietary proteins on sleep is uncertain. Meat is of special interest because it provides high-quality protein as well as saturated and *trans* fatty acids. Furthermore, it is the main source of dietary protein in many countries. However, the effect of meat intake on sleep patterns is unclear. The aim of this study was to examine the association of habitual meat consumption with changes in sleep duration and with sleep quality in older adults.

Methods: We used data from 1341 participants in the Seniors-ENRICA cohort aged ≥60 y, followed from 2012 through 2015. Habitual meat consumption was assessed at baseline with a validated diet history. Sleep duration and quality were ascertained both in 2012 and 2015. Analyses were performed with logistic regression and adjusted for sociodemographic variables, lifestyle, morbidity, sleep duration, and poor sleep indicators at baseline.

Results: During follow-up, 9.0% of individuals increased and 7.9% decreased their sleep duration by ≥2 h/night. Compared with individuals in the lowest tertile of meat consumption, those in the highest tertile showed increased incidence of a large decrease (≥2 h) in sleep duration (OR: 1.93; 95% CI: 1.01, 3.72; *P*-trend = 0.04). Higher consumption of meat was also associated with incidence of snoring (OR: 2.06; 95% CI: 1.17, 3.60; *P*-trend = 0.01) and poor general sleep quality (OR: 1.71; 95% CI: 1.04, 2.82; *P*-trend = 0.03). Each 100 g/d increment in meat intake was associated with a 60% higher risk of both large sleep duration changes and poor sleep quality (OR: 1.60; 95% CI: 1.07, 2.40). Results were in the same direction for red and processed meat and for white meat separately, and among individuals with physical impairment.

Conclusions: Higher meat consumption was associated with changes in sleep duration and with poor sleep in older adults.

Funding Sources

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Alcohol Consumption and Sleep Quality: A Community-Based Study (P20-110)

Chaoran Ma,[1] Xiaodong Yuan,[2] Ying Liu,[2] Yujie Sun,[2] Dandan Zheng,[1] Shouling Wu,[2] and Xiang Gao[1]

[1]The Pennsylvania State University; and [2]Kailuan General Hospital, China

Objectives: Studies on alcohol intake and sleep are limited with small sample sizes and lack of information on individual alcoholic beverage consumption. We thus conducted a large-scale community-based study to systematically examine associations between different amounts and types of alcohol intake and sleep quality.

Methods: We included 11,905 participants (mean age: 47.7 y) in the Kailuan Study, free of stroke, cancer, Parkinson disease, dementia, and head injury in 2006. We collected information on insomnia, daytime sleepiness, snoring, and sleep duration in 2012. Overall sleep quality was evaluated by summarizing these 4 sleep parameters, with a score ranging from 0 (best) to 8 (worst). Amounts and types of alcohol intake were collected via questionnaire in 2006. Participants were categorized into: nondrinkers, light (women: 0.1–0.4 servings/d; men: 0.1–0.9 servings/d), moderate (women: 0.5–1.0 servings/d; men: 1–2 servings/d), and heavy drinkers (women: >1 servings/d; men: >2 servings/d). We used linear regression and logistic regression models to examine associations between alcohol intake and sleep quality score and likelihood of having individual sleep disorder, respectively, adjusting for socioeconomic status, lifestyle factors, medication use, hypertension, diabetes, body mass index, and blood lipids and urate.

Results: Compared with nondrinkers, current drinkers had worse overall sleep quality (adjusted mean difference = 0.18; 95% CI: 0.14, 0.22), especially for liquor drinkers (adjusted mean difference = 0.18; 95% CI: 0.14, 0.23). A dose-response relation between greater alcohol intake and higher sleep quality score was observed (*P*-trend < 0.001) (Figure 1). Specifically, heavy drinkers had the worst overall sleep quality (adjusted mean difference = 0.25; 95% CI: 0.17, 0.32), and higher odds of having shorter (<7 h) sleep duration (adjusted OR = 1.31; 95% CI: 1.09, 1.57), and snoring (adjusted OR = 1.38; 95% CI: 1.22, 1.56), relative to nondrinkers. We did not find significant associations between alcohol intake and insomnia, daytime sleepiness and prolonged sleep duration.

Funding Sources

This work was supported by the National Institute of Neurological Disorders and Stroke at the National Institutes of Health (NINDS 5R21NS087235-02 and 1R03NS093245-01A1).

Supporting Images/Graphs

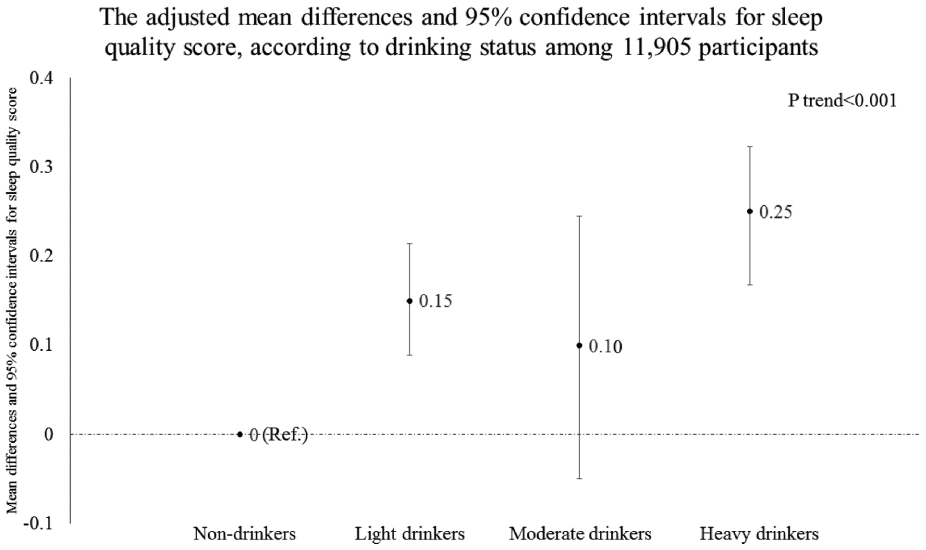

FIGURE P20-110-1 Alcohol consumption and sleep quality: a community-based study.

Predicting Serum Pyridoxal 5′-Phosphate in US Adults through the Use of a Deep Learning Algorithm (P20-111)

Chaoran Ma, Qipin Chen, Jianhong Chen, Muzi Na, Jinchao Xu, Wenrui Hao, and Xiang Gao

The Pennsylvania State University

Background/Objectives: Pyridoxal 5′-phosphate (PLP) is the biologically active form of vitamin B-6, functioning as an essential enzyme cofactor and regulator for enzyme-catalyzed reactions. Multivariate regression (MR) models were used to predict serum PLP concentrations, but with low predictability, as suggested by a low R^2 value. We thus developed a deep learning algorithm (DLA) to compute the serum PLP based on dietary intake, dietary supplements, sociodemographic, and lifestyle information.

Methods: The study included 3778 participants aged >20 y in NHANES 2007–2010 with completed information on studied variables. Serum PLP was measured by reversed-phase HPLC. Dietary intake was assessed by 24-h dietary recall and was collapsed to the 37 food groups. Information on supplements was collected via questionnaire. We also included other potential predictors for PLP in the models, including sociodemographic variables (age, sex, race-ethnicity, income, and education), lifestyle variables (smoking status and physical activity level), body mass index, medication use, blood pressure, and blood lipids, glucose, and C-reactive protein. We used a 4-hidden-layer deep neural network to predict PLP concentration, with 3400 (90%) participants for training and 378 (10%) participants for validation. As for the structure of the network, the width of each hidden layer was 30 and the probability of dropout was 0.5. We chose 0.001 for the learning rate. We also developed a prediction model that used MR. A sensitivity analysis was conducted, including only variables (e.g., age, sex, , vitamin B-6 supplement, intake of milk, fruit juices, legumes, nuts/seeds, soybean products, and poultry) identified by a stepwise regression model in the DLA/MR models.

Results: After training for 10^5 steps with the Adam optimization method, the R^2 was 0.45 for the DLA and 0.18 for the MR model in the validation dataset, and the corresponding training R^2 was 0.62 for the DLA model and 0.25 for the MR model, respectively. Similar results were observed in the sensitivity analysis (testing R^2 values were 0.44 for the DLA model and 0.18 for MR model, respectively).

Conclusions: DLA achieved better performance at predicting blood PLP concentrations, relative to the traditional MR model.

Funding Sources

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Supporting Images/Graphs

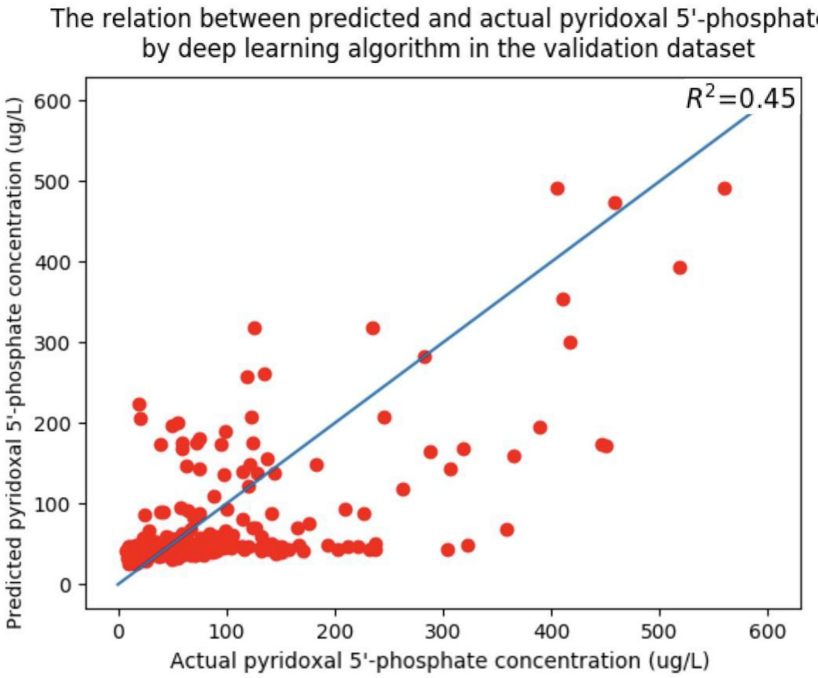

FIGURE P20-111-1 Predicting serum pyridoxal 5′-phosphate in US adults through the use of a deep learning algorithm.

Weight Perception, Dietary Intakes, and Lifestyle Behaviors among Children Aged 8–15 Years in the United States (P20–112)

Alomi Malkan, Niyati Parekh, and Andrea Deierlein

College of Global Public Health, New York University

Objectives: Weight perception plays a crucial role in weight management behavior and may lead to unhealthy strategies, such as dieting. In this study, we examine associations of children's weight perception with dietary intakes and lifestyle behaviors.

Methods: This is a cross-sectional study of children aged 8–15 y who participated in NHANES 2005–2014 ($n = 6108$). Children's weight status was categorized as normal (5th to <85th percentile), overweight (85th to <95th percentile), and obese (≥95th percentile). Weight perception was assessed by the question, "Do you consider yourself now to be [too thin, about right, overweight/fat]?" Dietary intakes were estimated from 24-h recalls. Lifestyle behaviors included physical activity, screen time, and dieting. Dieting was assessed by questions: "Which of the following are you trying to do about your weight [lose, gain, stay the same/nothing]?" and "In the past year, how often have you tried to lose weight [never, sometimes/a lot]?". Multivariable linear and logistic regression estimated associations of weight perception with dietary intakes and lifestyle behaviors. All analyses were stratified by gender and body mass index (BMI) status.

Results: Among boys and girls, respectively, 9% and 6% perceived themselves as too thin and 16% and 21% perceived themselves as overweight. Overweight and obese children were more likely to perceive themselves as overweight compared with normal-weight children ($P < 0.001$). Associations between dietary intakes and weight perception were not statistically significant, with a few exceptions. Boys who perceived themselves as overweight reported consuming 7.7 (95% CI: 1.8, 13.5) fewer grams of sugar than those who perceived themselves as just right. Overweight boys who perceived themselves as overweight reported consuming 215.5 (95% CI: 46.2, 384.8) fewer calories than those who perceived themselves as just right. Independent of BMI status, children who perceived themselves as overweight were ∼3–6 times more likely to report trying to lose weight sometimes or a lot during the past year.

Conclusions: Despite minimal differences in dietary intakes and lifestyle behaviors by children's weight perception, dieting behaviors were more likely to be reported by children who perceived themselves as overweight.

Funding Sources

There are no funding sources for this research.

Effects of Sugar-Sweetened Beverages on Metabolic Syndrome Risk Factors (P20-113)

Olivet Martinez,[1] Trevor Steele,[1] Sam Emerson,[2] Brooke Cull,[1] Stephanie Kurti,[3] and Sara Rosenkranz[1]

[1]Kansas State University; [2]Oklahoma State University; and [3]James Madison University, VA

Objectives: Reducing sugar-sweetened beverage (SSB) consumption is associated with improved metabolic health in adults, but there is limited experimental research examining the consequences of adding SSBs to the diet. The aim of the current study was to determine the acute metabolic effects of adding SSBs, in the form of caffeine-free soda and 100% fruit juice, to the diet.

Methods: College-aged participants (18–30 years; $n = 36$) were randomly allocated to 1 of 3 beverage conditions: water (W), caffeine-free soda (S), or 100% fruit juice (FJ), and completed metabolic assessments (fasting glucose, triglycerides, and high-density lipoprotein; 2-h glucose tolerance, waist circumference, and blood pressure).

Participants consumed 2 servings (~710 mL) of their assigned beverage each day for 3 wk. All baseline assessments were repeated following the 3-wk intervention.

Results: Preliminary results ($n = 27$) indicate that 17 participants had at least 1 metabolic risk factor at baseline. There were no significant effects of time or beverage for glucose tolerance (incremental area-under-the-curve) (mean ± SD; Baseline—W: 2945 ± 1417, S: 3327 ± 1752, FJ: 3165 ± 1598 mg/dL × 2 h; 3 wk—W: 2614 ± 1347, S: 3703 ± 1624, FJ: 2635 ± 1246 mg/dL × 2 h; *Ps* > 0.05). There were also no significant differences between beverage conditions for changes in metabolic syndrome risk factors: waist circumference (W: 2.99% ± 4.72%, S: −1.03% ± 2.10%, FJ: 2.04% ± 3.30%; $P = 0.06$), triglycerides (W: 5.67% ± 21.43%, S: 45.08% ± 61.94%, FJ: 50.94% ± 60.76%; $P = 0.18$), high-density lipoprotein (W: 6.73% ± 15.84%, S: 5.27% ± 12.91%, FJ: −3.87% ± 17.37%; $P = 0.32$), blood pressure (systolic—W: −3.00% ± 4.66%, S: −2.30% ± 5.97%, FJ: −2.64% ± 7.86; $P = 0.97$; diastolic—W: 1.72% ± 6.09%, S: 0.76% ± 15.35%, FJ: −2.483% ± 12.15%; $P = 0.74$), and fasting glucose (W: 5.61% ± 4.51%, S: 5.92% ± 10.47%, FJ: 6.28% ± 4.92%; $P = 0.98$).

Conclusions: Preliminary results suggest that the addition of SSBs, as caffeine-free soda or 100% fruit juice, to the diet for 3 wk does not modify metabolic health. These results will help to elucidate the acute metabolic health outcomes associated with adding SSBs to the diet.

Higher Body Mass Index Is Associated with Higher CD4 Cell Count and Metabolic Syndrome in the Miami Adult Studies in HIV (MASH) Cohort (P20-114)

Sabrina Sales Martinez, Adriana Campa, Qingyun Liu, Leslie Seminario, Jupshy Jasmin, Jacqueline Hernandez, Alicia Sneij, Alhanoof Alohaly, Colby Teeman, Javier Tamargo, Angelique Johnson, and Marinana K Baum

Florida International University

Background: During the pre-antiretroviral therapy (ART) era, higher body mass index (BMI) was shown to have a beneficial effect on HIV disease progression. However, results from studies on the relation between BMI and CD4 cell recovery in adults on ART are inconsistent. In the general population, the risk for cardiovascular disease increases with higher body mass index (BMI). The objective of this study was to evaluate the relation between body composition, CD4 cell count, a measure of HIV disease progression, and metabolic syndrome (MS) in HIV+ adults in the MASH cohort in Miami, Florida.

Methods: A cross-sectional analysis of data from an observational longitudinal study was conducted in 251 HIV+ adults on ART. Anthropometrics and bioimpedance were obtained. Blood was drawn for lipid panel and CD4 count was obtained from medical records. MS was defined as having ≥3 of the following factors: waist circumference >102 cm in men or 89 cm in women, triglycerides ≥150 mg/dL, high-density lipoprotein cholesterol ≤40 mg/dL in men or ≤50 mg/dL in women; blood pressure ≥130/85 mm Hg; and serum glucose ≥100 mg/dL. Wilcoxon, chi-square, and logistic regression analyses were completed.

Results: The median age was 53 y (IQR = 49–58 y) and 59% were male. Those with a BMI ≥25 kg/m^2 compared with those with a lower BMI had higher median levels of CD4 cell count [614 (IQR = 365–882) compared with 411 cells/μL (IQR = 314–706), $P = 0.002$]. This relation remained significant up to a BMI cut-off of 37 kg/m^2 ($P = 0.05$). A body fat mass of >25% for men or 31% for women was also associated with higher median CD4 cell counts [640 (IQR = 356–869) compared with 532 cells/μL (IQR = 310–724), $P = 0.016$]. In a linear regression model adjusting for age and gender, BMI was associated with CD4 cell count ($\beta = 0.16$, SE = 0.07, $P = 0.026$). BMI >30 kg/m^2 was associated with a 4.9 greater odds of having MS than lower BMI (OR = 4.87, 95% CI: 2.55, 9.31, P

Conclusions: We confirmed a direct relation between increased BMI, body fat mass, and CD4 cell count in an HIV-infected population on ART. However, we showed a direct relation between BMI with MS, which raises the risk for cardiovascular disease and other conditions such as diabetes and stroke. Additional research is needed to observe the interaction of HIV and obesity over time on morbidity and mortality.

Funding Sources

National Institute on Drug Abuse/NIH.

Dietary Fiber Intake on Reducing the Incidence of Cardiovascular Disease: A Review of the Meta-analyses (P20-115)

Marc McRae

National University of Health Sciences, IL

Objective: The purpose of this study was to review previously published meta-analyses on the effectiveness of dietary fiber on cardiovascular disease.

Methods: An umbrella review of all published meta-analyses was performed. A PubMed search from January 1, 1980 to October 30, 2017 was conducted through the use of the following search strategy: (fiber OR glucan OR psyllium OR fructans) AND (meta-analysis OR systematic review). Only English-language publications that provided quantitative statistical analysis on cardiovascular disease, lipid concentrations, or blood pressure were retrieved.

Results: Thirty-one meta-analyses were retrieved for inclusion in this umbrella review, and all meta-analyses comparing highest with lowest dietary fiber intake reported statistically significant reductions in the relative risk (RR) of cardiovascular disease mortality (RR = 0.77–0.83), as well as the incidences of cardiovascular disease (RR = 0.72–0.91), coronary heart disease (RR = 0.76–0.93), and stroke (RR = 0.83–0.93). Meta-analyses on supplementation studies that used β-glucan or psyllium fibers also observed statistically significant reductions in both total serum and LDL cholesterol concentrations.

Conclusions: This review suggests that individuals consuming the highest amounts of dietary fiber intake can significantly reduce their incidence and mortality from cardiovascular disease. Mechanistically these beneficial effects may be due to the actions of dietary fibers on reducing total serum and low-density lipoprotein cholesterol concentrations between 9.3–14.7 and 10.8–13.5 mg/dL, respectively.

Funding Sources

None.

Dietary Fiber Intake on Reducing the Incidence of Type 2 Diabetes Mellitus: A Review of the Meta-analyses (P20-116)

Marc McRae

National University of Health Sciences, IL

Objective: The purpose of this study was to review previously published meta-analyses on the effectiveness of dietary fiber on type 2 diabetes.

Methods: An umbrella review of all published meta-analyses was performed. A PubMed search from January 1, 1980 to October 30, 2017 was conducted according to the following search strategy: (fiber OR glucan OR psyllium) AND (meta-analysis OR systematic review). Only English-language publications that provided quantitative statistical analysis on type 2 diabetes, fasting blood glucose concentrations or glycosylated hemoglobin were retrieved.

Results: Sixteen meta-analyses were retrieved for inclusion in this umbrella review. In the meta-analyses comparing highest with lowest dietary fiber intake, there was a statistically significant reduction in the relative risk (RR) of type 2 diabetes (RR = 0.81–0.85), with the greatest benefit coming from cereal fibers (RR = 0.67–0.87). However, statistically significant heterogeneity was observed in all of these meta-analyses. In the meta-analyses of supplementation studies that use β-glucan or psyllium fibers on type 2 diabetic participants, statistically significant reductions were observed in both fasting blood glucose concentrations and glycosylated hemoglobin percentages.

Conclusions: This review suggests that those consuming the highest amounts of dietary fiber, especially cereal fiber, may benefit from a reduction in the incidence of developing type 2 diabetes. There also appears to be a small reduction in fasting blood glucose concentration, as well as a small reduction in HbA1c percentage for individuals with type 2 diabetes who add β-glucan or psyllium to their daily dietary intake.

Funding Sources

None.

Dietary Fiber Intake on Reducing the Incidence of Cancer: A Review of the Meta-analyses (P20–117)

Marc McRae

National University of Health Sciences, IL

Objective: The purpose of this study was to review previously published meta-analyses on the effectiveness of dietary fiber on reducing the incidence of cancer.

Methods: An umbrella review of all published meta-analyses was performed. A PubMed search from January 1, 1980 to October 30, 2017 was conducted according to the following search strategy: (fiber OR fibre) AND (meta-analysis OR systematic review) AND (cancer OR carcinoma). Only English-language publications that provided quantitative statistical analysis on cancer were retrieved.

Results: Nineteen meta-analyses comparing highest with lowest dietary fiber intake were retrieved for inclusion in this umbrella review. There was a statistically significant reduction in the relative risk (RR) of colorectal, esophageal, gastric, and pancreatic cancer (RR = 0.52–0.88); however, statistically significant heterogeneity was observed in the meta-analyses on esophageal, gastric, and pancreatic cancer. There was a statistically significant reduction in the relative risk of breast cancer (RR = 0.85–0.93).

Conclusions: This review suggests that those consuming the highest amounts of dietary fiber may benefit from a reduction in the incidence of developing colorectal cancer, and there also appears to be a small reduction in the incidence of breast cancer.

Funding Sources

None.

Americans' Perceptions about Fast Food and How These May Affect Fast Food Consumption and Obesity Risk (P20–118)

Jungwon Min,[1] Lisa Jahns,[2] Hong Xue,[3] Jayanthi Kandiah,[2] and Youfa Wang[2]

[1]Ball State University, IN; [2]USDA; and [3]Virginia Commonwealth University

Objectives: The aim of this study was to systematically examine Americans' perceptions of fast food, and how these perceptions might affect fast-food consumption and obesity risk.

Methods: We searched PubMed and Google for studies published in English until February 17, 2017 that reported on Americans' perceptions (defined as their beliefs, attitudes, and knowledge) regarding fast food as well as those on their associations with fast-food consumption and obesity risk. Thirteen articles met the inclusion criteria.

Results: Limited research has been conducted on these topics, and most studies were based on convenience samples. In general, one-fifth of Americans thought fast food was good for health, while two-thirds considered fast food was not good, including 73% of weekly fast-food consumers. Americans do not demonstrate high knowledge of calories in fast food (e.g., 15% correctly estimated fast-food calories). The associations between fast-food perceptions and fast-food consumption were significant. Americans were likely to purchase more fast food when they valued convenience (e.g., likelihood of weekly consumption of fast food, OR = 1.2; 95% CI: 1.1, 1.2, compared with not perceived) and taste of fast food (e.g., more frequent consumption of fast food with having taste barriers to health eating, OR = 1.3; 95% CI: 1.1, 1.4 per 1 SD change), and found more fun and socializing opportunities in fast-food restaurants than other eating places. Those who consumed less fast food seemed more likely to view fast food negatively (e.g., 43% of those who ate fast food a few times per year compared with 19% of those who ate fast food at least weekly reported fast food as "not good at all"). Available research indicates neither perceived availability of fast food nor Geographical Information System (GIS)–based fast food presence in the neighborhood had significant associations with weekly fast food consumption. No studies examined the association between fast-food perceptions and obesity risk.

Conclusions: Americans' perceptions of fast food and how these might affect fast-food consumption and obesity risk are understudied. Considerable variation was observed in Americans' perceptions and consumption of fast food. Perceptions of fast food seem to affect fast-food consumption.

Funding Sources

The study is funded in part by a research grant from the US National Institutes of Health (NIH, U54HD070725, 1R01HD064685-01A1), US Department of Agriculture Agricultural Research Service (3062-5,000-051-00D) and National Aeronautics and Space Administration (NASA) Mission X program.

Hair Lithium Is Decreased in the Hair of the Depressed Subjects (P20-119)

Berislav Momčilović,[1] Juraj Prejac,[2] and Ninoslav Mimica[3]

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Objectives: Today, depression is the most common human mental impairment in the world of unknown biochemical nature. Recent studies have revealed that low dietary lithium intake is associated with increased incidence of human suicide—the gravest form of human depression. We have already demonstrated that the adequate human lithium nutritional status is attained when H·Li concentations are within the range of 0.014–0.100 μg/g for both women and men. The aim of this study was to assess the lithium nutritional status of the depressed subjects.

Methods: The study was conducted on adult persons by strictly adhering to the Principles of the Declaration of Helsinki. Hair lithium (H·Li) was analyzed in Control (n = 655 female, 74 male) and Depressed (n = 299 female, 40 male) subjects fed on a standard mid-European diet. Depression was diagnosed according to the DSM-IV criteria by a board certified psychiatrist. Hair Li was analyzed with the inductively coupled plasma mass spectrometry at the Center for Biotic Medicine, Moscow, Russia; the frequency distribution of H·Li log-transformed data was analyzed with a median derivative model.

Results: The observed sigmoid curves had a linear range segment (μg/g): control H·Li = 0.015–0.052 (median 0.027) and depression H·Li = 0.010–0.050 (median 0.015). Hair Li concentrations for the linear (adequate) segment of the cumulative frequency distribution sigmoid curve were lower in the depressed than in the control subjects (ANOVA $P < 0.05$).

Conclusions: Our results indicate that the depressed subjects having H·Li of <0.052 μg/g would benefit if low levels of dietary Li supplementation are used as an adjuvant to the standard antidepression therapy: we tentatively suggest 50 μg oral Li every 12 h Personalized H·Li concentration monitoring is advisable to ensure an adequate and nontoxic oral Li dose intake every 3 mo.

Secular Trends of Metabolic Syndrome Prevalence among Undergraduate Students (P20-120)

Jesse S Morrell and Sherman Bigornia

University of New Hampshire

Objective: The aim of this study was to examine secular trends and sex differences of metabolic syndrome (MetS) prevalence and its criteria among undergraduate students at a public, northeastern university.

Methods: Students from all majors were recruited between 2012 and 2016 to participate in an ongoing, cross-sectional comprehensive health survey of young adults (18–24 y, $n = 2570$). Data were collected in the fasted state; anthropometric and clinical assessments were collected in duplicate and averaged. Prevalence of MetS (≥3 criteria) and individual criteria (abdominal obesity, elevated triglycerides, low high-density lipoprotein, elevated blood pressure, and elevated glucose) were determined for each academic year (2012–13, 2013–14, 2014–15, 2015–16) among men and women and prevalence estimates adjusted for age and academic semester; differences by sex were additionally adjusted for academic year.

Results: MetS (≥3 criteria) among young men was 4.0% in 2012–13, 2.1% in 2013–14, 5.6% in 2014–15, and 3.8% in 2015–16 (P-trend = 0.62) (Table 1); and among young women 2.2% in 2012–13, 3.3% in 2013–14, 2.7% in 2014–15, and 4.5% in 2015–16 ($P = 0.11$). We did not observe significant differences across academic year in the prevalence of individual MetS criteria (P-trend = 0.07–0.99 across year and age strata). Compared with women, men had a higher prevalence of elevated blood pressure (35.5% compared with 10.5%, $P < 0.01$) and elevated glucose (5.5% compared with 2.4%, $P < 0.01$), whereas we observed higher prevalence estimates of abdominal obesity among women (13.8% compared with 4.2%, $P < 0.01$). Further, men had a higher prevalence of ≥2 criteria of MetS than women (17.9% compared with 13.1%, $P < 0.01$).

Conclusions: Our results suggest that the prevalence of MetS and individual criteria among young adult college students at a northeastern university has not significantly increased since 2012. Of concern, however, is the high prevalence of multiple cardiometabolic risk factors (≥2), particularly among men.

Funding Sources

New Hampshire Agricultural Experiment Station and the USDA National Institute of Food and Agriculture Hatch Project 1010738.

Supporting Images/Graphs

TABLE P20-120-1 Secular trends in the Metabolic Syndrome and risk factor components in CHANAS

Sex	Measure	Academic Year				P-trend
		2012-13	2013-14	2014-15	2015-16	
Men		n=171	n=196	n=199	n=179	
	Metabolic syndrome, %	4.04 (1.13, 6.96)	2.05 (-0.679, 4.77)	5.55 (2.85, 8.25)	3.8 (0.931, 6.67)	0.62
	≥ 2 Criteria, %	17.7 (11.9, 23.5)	18.9 (13.5, 24.3)	19.9 (14.5, 25.3)	17.2 (11.5, 22.9)	0.98
	Abdominal obesity, %	5.19 (2.05, 8.33)	2.17 (-0.764, 5.11)	5.14 (2.23, 8.05)	5.89 (2.8, 8.98)	0.44
	Elevated Triglycerides, %	11.7 (6.92, 16.5)	14.2 (9.75, 18.7)	9.35 (4.91, 13.8)	11.4 (6.71, 16.2)	0.56
	Low HDL, %	25.4 (19, 31.8)	21.6 (15.7, 27.6)	24.5 (18.6, 30.5)	22.5 (16.2, 28.8)	0.70
	Elevated Blood Pressure, %	31.8 (24.7, 38.8)	41 (34.4, 47.6)	38.9 (32.3, 45.4)	31.8 (24.9, 38.8)	0.88
	Elevated Glucose, %	5.26 (1.78, 8.73)	3.55 (0.303, 6.8)	7.53 (4.31, 10.7)	6.15 (2.72, 9.57)	0.36
Women		n=461	n=404	n=416	n=387	
	Metabolic syndrome, %	2.23 (0.639, 3.83)	3.27 (1.57, 4.96)	2.73 (1.04, 4.41)	4.46 (2.71, 6.21)	0.11
	≥ 2 Criteria, %	12.4 (9.29, 15.4)	15.3 (12, 18.6)	9.64 (6.4, 12.9)	13.3 (9.97, 16.7)	0.71
	Abdominal obesity, %	10.8 (7.61, 14)	16.2 (12.8, 19.6)	13.4 (10.1, 16.8)	14.3 (10.8, 17.8)	0.26
	Elevated Triglycerides, %	14.2 (11.1, 17.3)	12.9 (9.54, 16.2)	12.6 (9.36, 15.9)	14.4 (11, 17.8)	0.99
	Low HDL, %	25 (21.2, 28.9)	21.6 (17.4, 25.7)	18.4 (14.3, 22.5)	20.8 (16.6, 25.1)	0.07
	Elevated Blood Pressure, %	9.8 (7.18, 12.4)	11 (8.17, 13.7)	8.11 (5.34, 10.9)	9.54 (6.66, 12.4)	0.56
	Elevated Glucose, %	2.54 (1.13, 3.95)	0.911 (-0.592, 2.41)	1.38 (-0.111, 2.87)	4.52 (2.97, 6.07)	0.09

Values are proportions (95% CI) adjusted for age and academic semester

Snack Time in America: WWEIA, NHANES, 2013–14 (P20–121)

Suzanne Morton,[1] Donna Rhodes,[2] and Alanna Moshfegh[2]

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Objectives: Snacking among American adults has increased over the past few decades, with the greatest sources of energy coming from foods and beverages with a high level of empty calories. However, data are limited on the time of day snacks are consumed. This research examines nutrient intakes from foods and beverages consumed at snack occasions by time of day.

Methods: The study included nationally representative data from 5047 adults aged ≥20y, participating in What We Eat in America, NHANES 2013–2014. Dietary intake data, obtained from an in-person 24-h recall, were collected through the use of an interviewer-administered 5-step USDA Automated Multiple-Pass Method (AMPM). For each food/beverage reported, AMPM asks for time of day eating began and name of eating occasion, self-selected from a fixed list.

All reports of snack, drink, extended consumption (including Spanish equivalent terms) were included as snack occasions. Reports consisting of only water were eliminated for this analysis. Time of day was grouped into the following: morning (03.00 to <1200), afternoon (12.00 to <18.00) and evening (18.00 to <03.00).

Results: Overall, 87% of adults reported at least 1 snack occasion, which contributed 22.9% of total daily energy. Highest consumption was during the evening (64% reporting; 11.2% of daily energy) followed by the afternoon (57% reporting; 8.2% of daily energy). Morning snacks were reported least often (36% reporting; 3.5% of daily energy). More females (61%) than males (53%) reported consuming an afternoon snack ($P < 0.001$); however, the percentage of daily energy was similar. Evening snack occasions accounted for 49%, 53%, 42%, and 44% of total snack intake of energy, saturated fat, calcium, and potassium, respectively. In comparison, morning snack occasions accounted for 16%, 13%, 28%, and 23% of energy, saturated fat, calcium, and potassium, respectively.

Conclusions: During evening snack occasions, US adults consume a substantial percentage of daily energy and saturated fat and a lower level of calcium and potassium. This information could benefit policy and intervention strategies to assist US adults in improving their diet quality.

Funding Sources

United States Department of Agriculture.

Reproductive Success among Women Undergoing Assisted Reproduction Varies According to Intake of Fish and Other Protein Sources (P20-122)

Feiby L Nassan,[1] Feiby Nassan,[1] Yu-Han Chiu,[1] Jose C Vanegas,[1] Audrey J Gaskins,[1] Paige Williams,[1] Jill Attaman,[2] Russ Hauser,[1] and Jorge E Chavarro[1]

[1]Harvard TH Chan School of Public Health, MA; and [2]Massachusetts General Hospital

Objectives: The aim of this study was to study the relation between pretreatment intake of protein sources and outcomes of infertility treatment with assisted reproductive technology (ART). We hypothesized that higher intake of red and processed meats would be related to lower success rates, whereas higher intake of fish would be related to higher success rates.

Methods: In total, 351 women who collectively underwent 598 ART cycles between 2007 and 2016 were enrolled at the Massachusetts General Hospital Fertility Center as part of a prospective cohort study. We used multivariable generalized linear mixed models with random intercepts to estimate the associations between different types of meat and the probability of live birth. Linear combinations were used to estimate the effects of substituting one protein source for another.

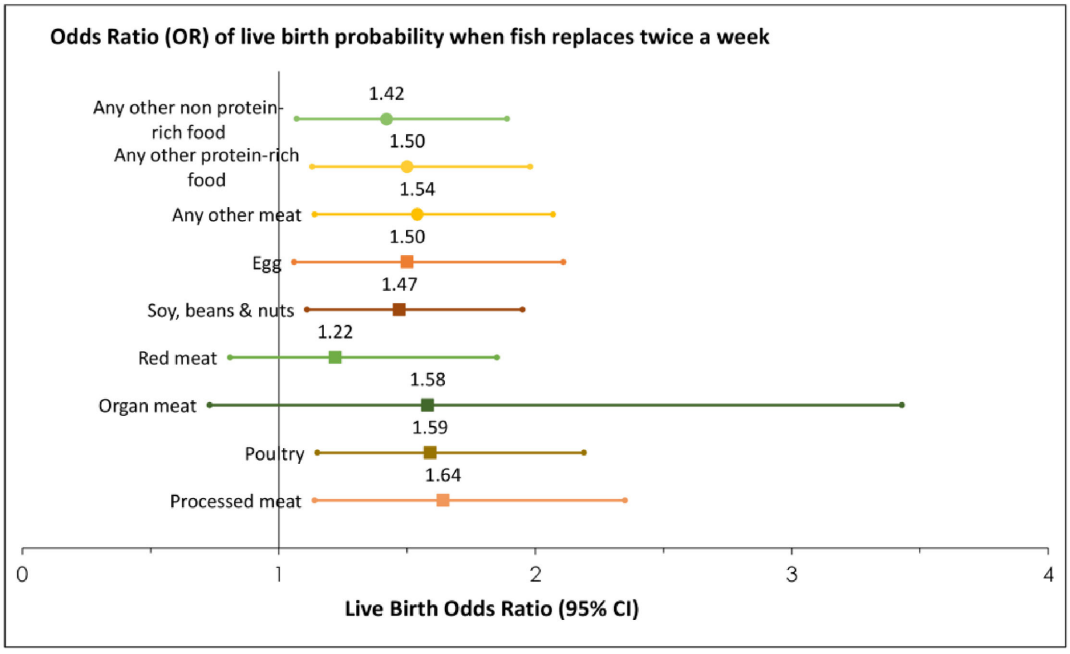
Results: Average total meat intake was 1.2 servings/d (range: 0–4.1), most of which was poultry (35%), followed by fish (25%), processed meats (22%), and red meat (17%). The multivariable-adjusted probability of live birth for women in increasing quartiles of fish intake was 34.2% (95% CI: 26.5%, 42.9%), 38.4% (95% CI: 30.3%, 47.3%), 44.7% (95% CI: 36.3%, 53.4%), and 47.7% (95% CI: 38.3%, 57.3%), respectively (*P*-linear trend = 0.04). In substitution analyses, increasing fish intake at the expense of other major sources of dietary protein was related to the most favorable outcomes. Specifically, the ORs of live birth associated with increasing fish intake by 2 servings/wk at the expense of other protein-rich foods were 1.5 (95% CI: 1.1, 2.1) when fish replaced other meats (red meats, processed meats, or poultry) and 1.5 (95% CI: 1.1, 2.0) when fish replaced any other protein-rich foods (meats, eggs, beans, nuts, and soy).

Conclusions: Women who consumed more fish than any other protein-rich foods had a higher probability of live birth as a result of infertility treatment with ART.

Funding Sources

NIH grants R01-ES009718, P30ES000002, P30DK46200, and K99ES026648.

Supporting Images/Graphs



All outcomes were analyzed using generalized linear mixed models with random intercepts, binary distribution and logit link function. All models were adjusted for total daily calorie, age, BMI, race, smoking status, supplemental dietary folate daily, supplemental vitamin B12, supplemental iron intake, supplemental omega 3 (binary, yes/no), and prudent and western dietary patterns (excluding meats). All Analyses were adjusted for all the other protein sources (i.e., processed meat, red meat, organ meat, fish, poultry and vegetarian; servings/day).

FIGURE P20-122-1 Fish intake and live births probability substitution analysis in EARTH study (N = 351 women; 598 cycles).

Sugar-Sweetened Beverage Consumption and Overweight/Obesity in adolescents in Ho Chi Minh City: A Cross-Sectional Analysis (P20-123)

Ngoc-Minh Nguyen,[1] Hong Tang,[2] and Michael J Dibley[1]

[1]University of Sydney, Australia; and [2]Pham Ngoc Thach University of Medicine, Vietnam

Objectives: The aim of this study was to describe the patterns of sugar-sweetened beverage (SSB) consumption among adolescents in Ho Chi Minh City, Vietnam, and to identify possible relations between SSBs and overweight/obesity and other main factors.

Methods: This was a secondary analysis from a population-based cross-sectional study among students aged 11–15 y students from 31 junior high schools across urban and suburban areas in Ho Chi Minh City. Students' anthropometric data were measured and beverage consumption was assessed through the use of a validated food-frequency questionnaire. Multivariate logistic regression models were used to identify the association between the consumption of SSBs and obesity and other factors.

Results: SSBs ranged widely from modern soft drinks to local traditional sugar-added fruit/leaf juices. SSBs were very popular among the 2660 participants, with 36% consuming some daily. Factors positively associated with SSB consumption were higher level of physical activeness, fast-food consumption, and daily fruit and vegetable consumption. However, we found a negative relation between SSB consumption, especially fresh milk with sugar, condensed milk, and soft drinks, with overweight and obesity status of the students.

Conclusions: SSB popularity and its relation with overweight and obesity in adolescents in Ho Chi Minh City should be further focused on and researched to effectively apply obesity prevention measures in this population.

Funding Sources

Sydney Medical School Foundation.

Supporting Images/Graphs

TABLE P20-123-1 Mean Energy (kcal) from Sugar Sweetened Beverages across different groups

N=2660	Soft drink	Tonic drink	Ice tea	Cacao powder	Fresh milk +sugar	Condensed milk	Yogurt	Soya +sugar	Leaf juice +sugar	Fruit juice	Coconut juice	All SSB
Urban	30.1	8.5	8.7	**10.8**	37.1	18.8	**56**	**56**	29.5	**20.3**	9.0	**257**
Suburban	27.2	8.0	8.1	**8.3**	35.2	22.3	**51**	**51**	31.9	**23.9**	9.3	**254**
Male	**31.8**	**10.1**	9.0	10.3	37.5	22	52	52	32.3	23.1	9.1	268
Female	**25.6**	**6.4**	7.8	8.9	34.9	19	55	55	28.9	20.1	9.2	245
Age 13-14	29.5	7.7	8.1	9.1	35.2	19.5	**56**	**56**	32.2	**23.2**	9.5	**259**
Age 11-12	28	8.8	8.7	10.1	37.1	21.3	**51**	**51**	29	**20.8**	8.8	**253**
Pre-pubertal	**29.6**	8.2	8.4	9.7	35.1	**19.3**	**56**	**56**	30.5	22.3	9.2	258
Pubertal	**25.8**	8.3	8.3	9.4	39.7	**23.7**	**48**	**48**	30.9	21.1	8.9	249
Non overweight	**29.8**	**8.7**	8.5	**10**	**39.1**	**22**	**55**	**55**	**31.8**	22.3	9.3	**265**
Overweight	**22.9**	**5.9**	7.9	**7.3**	**20.2**	**12**	**48**	**48**	**24.4**	20.2	8.5	**202**
Daily energy <EER*	29.5	8.7	8.8	10.1	37.6	21.3	**56**	**56**	**31.6**	**22.7**	**9.6**	**266**
Daily energy >= EER	25.0	7.1	7.4	9.1	30.4	16.0	**38**	**38**	**30.1**	**17.8**	**5.9**	**212**
Non-active	**25.1**	**5.5**	7.4	**8.2**	32.9	**15.3**	**47**	**47**	27.8	**19.0**	**7.8**	**220**
Active	**30.0**	**9.2**	8.8	**10.1**	37.3	**22.0**	**55.5**	**55.5**	31.5	**22.9**	**9.6**	**267.5**
Fruit & Vegetable												
Once/month	**22.9**	**6.1**	**6.7**	**7.7**	**27.1**	**16.6**	**40.5**	**40.5**	**26.4**	**16.2**	**7.6**	**202**
Twice/month - once/week	**23.9**	**5.5**	**6.2**	**10.6**	**37.8**	**19.2**	**43**	**43**	**27.0**	**18.4**	**6.6**	**223**
2-6 times/week	**29.2**	**8.3**	**9.0**	**9.7**	**42.0**	**17.6**	**53**	**53**	**26.2**	**21.7**	**8.4**	**247**
Daily or more	**34.2**	**10.6**	**10**	**10.7**	**40.5**	**24.4**	**66**	**66**	**36.1**	**27.3**	**11.2**	**308**
Fast food												
Once/month	27.4	**9.5**	8.6	**10.2**	**37.1**	**26.5**	**54**	**54**	**32.6**	**21.8**	9.6	**268**
Twice/month - 6 times/week	29.3	**8.2**	8.5	**9.7**	**35.8**	**18.8**	**52.5**	**52.5**	**30.6**	**21.9**	9.1	**253**
Daily or more	34.0	**16.5**	15.6	**20.1**	**84.6**	**64.6**	**138**	**138**	**59.6**	**40.2**	12.8	**545**
Wealth Index												
Lowest quintile	26.9	7.6	**6.8**	**8.5**	31.9	24.4	**47**	**47**	**40.4**	21.8	9.0	255
Second	29.2	7.4	**6.5**	**8.4**	31.4	24.1	**45**	**45**	**33**	20.2	8.3	245
Third	27.4	8.4	**7.9**	**8.6**	37.5	17.2	**56**	**56**	**25.4**	21	8.6	246
Fourth	30.8	9.3	**11**	**10.6**	40.3	17.0	**57**	**57**	**27.5**	22.8	10.2	263
Highest quintile	29.4	8.5	**10**	**12.1**	39.8	19.5	**63**	**63**	**26.6**	24.2	9.5	271
Total Mean	**28.7**	**8.3**	**8.4**	**9.6**	**36.2**	**20.4**	**54**	**54**	**30.6**	**22.0**	**9.1**	260+

*EER= Estimated Energy Requirement daily, by age and sex; T-test or ANOVA were used to obtain significance difference (where p-value<0.05) between 2 groups or 3 or more groups

+because of rounding, total sum may not be equal to the sum of every sweetened beverages Numbers in bold when significant difference was found among two sub-groups

Estimated mean energy intake from sugar-sweetened beverages across subgroups.

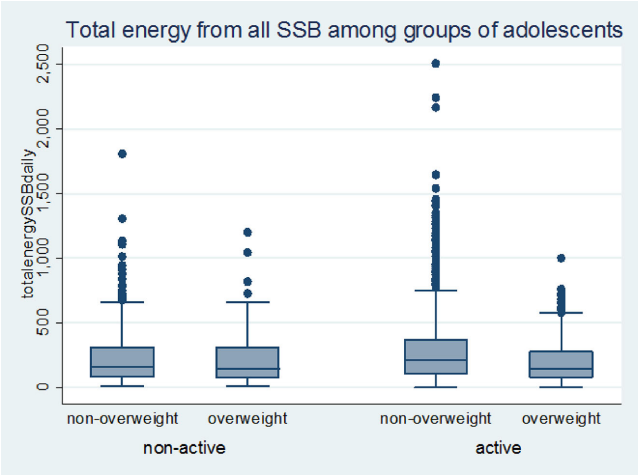


FIGURE P20-123-1 Sugar-sweetened beverages compared with obesity in adolescents in Vietnam

Energy and Macronutrient Intakes and their Associations with Body Mass Index in a Cohort Study of Adolescents in Ho Chi Minh City, Vietnam (P20-124)

Ngoc-Minh Nguyen,[1] Hong Tang,[2] and Michael J Dibley[1]

[1]University of Sydney, Australia; and [2]Pham Ngoc Thach University of Medicine, Vietnam

Objectives: The aim of this study was to track energy and assess nutrient intakes of adolescents of Ho Chi Minh City over 5 y, and to explore the possible relations between energy and percentage of energy from macronutrients with body mass index (BMI) in adolescents.

Methods: A 5-y prospective cohort study was conducted between 2004 and 2009. Height and weight were measured; and time spent for physical activity, television viewing and dietary intake were collected annually among 759 junior high school students in Ho Chi Minh City. Energy tracking and macronutrient intakes (assessed by food-frequency questionnaire) were investigated through the use of Spearman correlation coefficients and weighted κ statistics. Generalized linear latent and mixed models were used to investigate the association between energy intake and percentage energy from protein, carbohydrate, and fat with BMI.

Results: There was a significant increase in mean BMI and median energy, and macronutrient intake with increasing age, which was higher in boys than in girls (P

Conclusions: The poor to fair tracking observed in this cohort suggests that individual dietary patterns exhibited during the first year are unlikely to be predictive of energy and nutrient intake in the last year.

Funding Sources

Sydney Medical School Foundation, University of Sydney.

Grain Foods Contribute Nutrient Density in Older US Hispanic Adults (P20-125)

Yanni Papanikolaou[1] and Victor Fulgoni[2]

[1]Nutritional Strategies; and [2]Nutrition Impact

Objectives: Current Dietary Guidelines for Americans have identified several shortfall nutrients in the US population, including fiber, folate, and iron. Intake of some shortfall nutrients can be even lower in older adults, with limited data in Hispanic (H) adults. The present analyses determined the contribution of grain foods to energy/nutrients in older US H adults and compared to all food sources in the US diet.

Methods: Analyses of grain food sources were conducted through the use of a 24-h recall in H adults (aged 51–99 y; $n = 860$) based on data from NHANES 2011–2014. Sources of nutrients in foods were determined according to USDA food groupings and nutrient composition databases.

Results: All grains provided 302 ± 16 kcal/d or 16 ± 0.7% of energy in the diet, ranking as the 3rd largest source of energy in the diet. Grain foods ranked 1st for thiamin (32 ± 1.6%), iron (35 ± 1.8%), and folate (38 ± 2.0%) intake relative to 15 food groups. Grain foods ranked 2nd highest for dietary fiber (23 ± 1.0%), and 3rd for niacin (22 ± 1.5%), magnesium (17 ± 0.9%), and calcium intake (14 ± 0.7%). The subcategory breads/rolls/tortillas (BRTs) provided 174 ± 9.5 kcal/d or 9 ± 0.4% of all energy in the diet, ranking as the highest source of energy of all foods. BRTs ranked 1st of 47 foods for daily thiamin (17 ± 0.6%) and magnesium (10 ± 0.6%), and 2nd for niacin (10 ± 0.5%), dietary fiber (14 ± 0.7%), iron (13 ± 0.5%), and folate, DFE (14 ± 0.6%). BRT was the 5th largest food group contributor for calcium (8 ± 0.3%) intake. Ready-to-eat cereals (RTECs) provided 32 ± 4 kcal/d or 2 ± 0.2% of energy in the diet, ranking as the 25th largest contributor in the diet. RTECs ranked 1st for iron (15 ± 1.9%) and folate, DFE (17 ± 2.2%), 8th for dietary fiber (4 ± 0.7%), 3rd for niacin (7 ± 1.3%), 16th for magnesium (2 ± 0.4%), and 21st for calcium (2 ± 0.2%).

Conclusions: All grain foods and specific subcategories of grains provided a greater percentage of several underconsumed nutrients, including dietary fiber, iron, and folate, relative to calories. Thus, grains provide nutrient density to the American diet of older H adults.

Funding Sources

Supported by the Grain Foods Foundation.

Avoiding Morning Foods Is Linked to Lower Intakes of 2015–2020 Dietary Guidelines' Nutrients of Concern, Lower Whole Grains, and Increased Added Sugar Intake in US Children (P20-126)

Yanni Papanikolaou

Nutritional Strategies

Objectives: The purpose of this study was to identify the most commonly consumed morning food (MF) patterns in US children/adolescents (aged 2–18 y) and to compare intakes of the 2015–2020 Dietary Guidelines' nutrients of concern (dietary fiber, calcium, vitamin D, potassium) in children/adolescents who did not consume MFs.

Methods: The analyses used data from of NHANES 2011–2014. Cluster analysis was used to develop MF patterns of consumption. The USDA food coding system was used to define MFs consumed all morning and before lunch. Clusters were developed based on the percentage of calories consumed from various foods. The following patterns were identified: *1*) protein foods/breads/whole fruit/juices; *2*) milk/higher-sugar (HS) ready-to-eat cereals (RTECs); *3*) milk/pancakes/sauces; *4*) eggs/protein foods/juice; *5*) milk/HS and lower-sugar (LS) RTECs; *6*) milk/sweet pastries; *7*) milk/LS RTECs; and *8*) no MFs.

Results: All MF patterns had greater calcium intake compared with the no-MF pattern (*P*s < 0.001). Children consuming milk/lower-sugar RTECs had the greatest calcium intake compared with no MF (1227 ± 45 compared with 810 ± 21 mg/d, $P < 0.0001$). Dietary fiber was higher in all clusters except eggs/protein foods/juice relative to those consuming no MF, ranging from 2.2 to 5.7 g/d more fiber when MF was consumed. Vitamin D ($D_2 + D_3$) intake was higher in all MF patterns except sweet pastries compared with no MF (*P*s < 0.001). Potassium intake was greater in all MF patterns, with all milk/RTEC patterns representing the largest increases compared with no MF (*P*s < 0.0001). All MF patterns were associated with greater whole grain intake, except eggs/protein foods/juice and milk/sweet pastries. The largest whole grain intake was seen with LS RTECs/milk compared with no MFs (1.4 ± 0.1 compared with 0.5 ± 0.1 oz eq; $P < 0.0001$). Added sugar intake was greater in milk/sweet pastries compared with no MFs (23 ± 1.5 compared with 18 ± 0.7 tsp eq; $P = 0.0002$) and lower with LS RTECs/milk compared with no MFs (13 ± 1 compared with 18 ± 0.7 tsp eq; $P = 0.0002$).

Conclusions: Consumption of MF patterns in US children/adolescents is associated with greater consumption of 2015–2020 Dietary Guidelines' nutrients of concern, and greater whole grain and typically lower added sugar intake. Avoiding MFs may lead to nutrient and public health consequences.

Funding Sources

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Associations of Birth Weight with Adult Weight Status in the Framingham Generation 3 Cohort (P20-127)

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Objective: Birth weight is hypothesized to influence the risk of obesity and other metabolic risk factors in adult life. This study investigates the association between birth weight and adult body mass index (BMI) through the use of data from the longitudinal Framingham Heart Study Generation 3 Cohort (Gen3).

Methods: Data were from 626 participants in the Gen3 cohort who were recruited from Framingham, MA in 2001 and began in-person medical exams in 2002–2004 (exam1). Adult BMI was measured at exam 1. Maternal-reported birth weight was obtained by matching information from mothers enrolled in the Framingham Heart Study-Offspring Cohort (FOS) to their adult offspring in Gen3. Multivariable linear regression estimated the association between maternal-reported birthweight and adult offspring BMI. Adult age, sex, smoking status, and physical activity were considered as covariates.

Results: Maternal-reported birth weight was available for 303 men and 323 women in the Gen3 cohort. The average birth weight of the participants was 7.5 pounds (3.4 kg) [7.6 pounds (3.45 kg) for men and 7.4 pounds (3.36 kg) for women]. At exam 1, the mean age of participants was 40.7 y (40.6 and 40.8 y for men and women, respectively). 55.1% were overweight or obese (BMI $\geq$25 kg/m^2, 66.3% and 44.6% among men and women, respectively). There was a J-shaped relation between birth weight and adult BMI (*P*-quadratic term $= 0.013$). After adjusting for covariates, adult BMI slightly decreased with increasing birth weight, plateauing at ~6–8 pounds (~2.7–3.6 kg). Thereafter, adult BMI increased with increasing birth weight.

Conclusions: Our findings are consistent with previous literature, suggesting that birth weights >8 pounds (>3.6 kg) are associated with higher BMI during adulthood and potentially greater risk of overweight and obesity. These data suggest that interventions during the prenatal period may have an influence on the metabolic health of adult offspring.

Contribution of Dietary and Metabolic Risk Factors to Burden of Cardiometabolic Diseases in Korean Adults 2012–2016: A Comparative Risk Assessment Analysis (P20-128)

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Objectives: Although the burden of cardiometabolic diseases (CMDs) attributable to dietary and metabolic risks in Korea has increased, few studies have estimated how changes in diet and metabolic risks have contributed to these burdens. The purpose of this study was to compare the risk of dietary and metabolic factors contributing to CMD mortality in Korea, and to provide detailed information on the recent increasing burden of disease.

Method: The distribution of 8 dietary and 4 metabolic risk factors and cause-specific mortality by sex and age per year was obtained from the Korea National Health and Nutrition Examination Survey and Statistics Korea, respectively. The relative risks for the effects of the risk factors on CMD mortality were obtained from published meta-analyses. The population-attributable fraction (PAF) for the risk factors was calculated through the use of a comparative risk assessment approach across sex and age groups during 2012–2016.

Results: Among the metabolic risk factors, the CMD mortalities attributable to high body mass index (BMI) [14,328 deaths; uncertainty interval (UI): 14,156, 14,507] and systolic blood pressure (sBP) [10,560 deaths; UI: 10,309, 10,799] were not only the largest but also showed an increasing trend. Low fruit intake [10,408 deaths; UI: 9416, 11,312] was the major dietary risk for CMD mortality in Korean adults. When stratified by gender, the PAF of high sBP showed a decreasing trend only in women in contrast to the trend in men. For dietary risks, the PAFs of CMD mortality attributable to a low intake of fruit and a high intake of red meat were higher in women than in men. The PAFs of a low intake of vegetables and a high intake of red meat factor were shown to be an increasing trend in the total population.

Conclusion: The results indicate that metabolic and dietary risk factors were important contributors to CMD mortality in Korea. These

findings can provide the necessary information to develop evidence-based national government policies to manage major risk factors and prevent CMD mortality in Korea.

Funding Sources

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Osteoporosis, Rather than Vitamin D Status, May Be a Risk Factor for Osteoarthritis in Older US Adults (P20-129)

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Objectives: Osteoarthritis (OA) is frequently diagnosed in adults aged >50 y, coinciding with the age of heightened risk for osteoporosis. Older adults are advised to consume adequate vitamin D for bone health, but the association between OA, vitamin D, and osteoporosis has not been examined in a nationally representative sample. We compared vitamin D intake and status between OA patients and healthy older men and women, and independently assessed the risk for OA by vitamin D and osteoporosis status through the use of NHANES.

Methods: Mean dietary and total vitamin D intake and rate of supplement use of adults aged >50 y was determined through the use of dietary data from NHANES 2007–2010. The association between serum 25-hydroxyvitamin D [25(OH)D] and self-reported OA was assessed through the use of NHANES 2001–2010 data. Femur bone mineral density and osteoporosis medication intake was utilized to determine osteoporosis in participants of NHANES 2005–2010 and 2013–2014. Subject characteristics were compared by chi-square, and association was determined by logistic regression.

Results: Mean dietary vitamin D intake of OA and healthy subjects were 5.21 and 5.38 μg in men and 4.15 and 4.41 μg in women, respectively. Vitamin D–containing supplements were consumed more frequently by female OA patients than by healthy females (86% compared with 76%; $P = 0.0004$). A similar trend was observed in males ($P = 0.09$). Mean total vitamin D intake was not greater in OA patients. The distribution of 25(OH)D in OA patients was skewed towards higher 25(OH)D levels compared with non-OA adults in both males and females ($P < 0.05$ for both sexes). The unadjusted OR for OA in adults with low vitamin D status (<30 nmol/L) was 0.48 (95% CI: 0.32, 0.70) for men and 0.70 (95% CI: 0.55, 0.88) for women compared to vitamin D–sufficient adults (≥50 nmol/L). The associations disappeared after adjusting for covariates. Compared with healthy adults, men and women with osteoporosis had a 65% and 72% higher risk for OA, respectively (95% CI: 1.07, 2.56 and 1.18, 2.53, respectively).

Conclusions: Regardless of sex, vitamin D status was not associated with OA risk. Osteoporosis, rather than vitamin D status, may be a risk factor for OA in older US adults.

Funding Sources

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Correlation between Supplemental ω-3 Fatty Acid Intake and ω-3 Index in Adults (P20-130)

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Background: One potential way to protect the heart and reduce the risk for cardiovascular diseases is to consume sufficient long-chain ω-3 (n–3) fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), from fish or supplemental fish oil. Several recent studies reported ω-3-index (O3I) as a marker for coronary heart disease (CHD), indicating an O3I of <4% to indicate a higher risk, and ≥8% a lower risk.

Objective: The aim of the present study was to observe the correlation between RBC O3I level and EPA + DHA intake from supplemental fish oil in adults.

Methods: Seventy-six males [average age: 72 y; body mass index (BMI): 27.6 kg/m^2] and 170 females (average age: 62 y; BMI: 26.0 kg/m^2) from the United States and Canada voluntarily participated in the study after giving informed consent. Information on the supplemental ω-3 intake from EPA + DHA in ethyl ester form was obtained by online questionnaires. RBC membrane fatty acid composition was analyzed by gas chromatography from overnight fasting blood samples, and O3I levels were expressed as EPA + DHA % of total fatty acids.

Results: The average supplemental EPA + DHA intake was 1.36 g/d in all subjects, 1.26 g/d in females, and 1.58 g/d in males. The average O3I was 8.63% in all subjects, 8.59% in females, and 8.70% in males. A significant and positive correlation ($P < 0.001$) was observed between EPA + DHA intake and O3I. There was no significant difference in O3I between females and males, although females ingested significantly lower amounts of supplemental EPA + DHA than the males ($P = 0.01$).

Conclusion: The present study showed that the average O3I in adults supplementing with fish oil containing ω-3 fatty acids (average 1.36 g/d of EPA + DHA) was >8.5% in average, suggesting that O3I is influenced by their daily EPA + DHA intake from dietary supplements containing the ethyl ester form of EPA + DHA.

Funding Sources

Shaklee Corporation, 4747 Willow Road, Pleasanton, CA.

Diet Quality, Excess Body Weight, and Cardiometabolic Risk Factors in Adolescents Living in São Paulo and Hispanics/Latinos in the United States (P20-131)

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Objectives: Diet-disease associations may vary by population. We aimed to compare diet quality and its association with excess body weight (EBW, ie, overweight and obesity), central adiposity (CA), and cardiovascular disease risk factors (CVDR) among Brazilian adolescents from São Paulo, Brazil and Hispanic/Latino adolescents from the United States.

Methods: Cross-sectional data from adolescents aged 12–16 y were analyzed from the Health Survey of São Paulo (HSP; $n = 189$), and the Hispanic Community Health Study/Study of Latino Youth (SOL-Youth; $n = 787$). Socioeconomic, anthropometric, clinical, and lifestyle data were collected in person and by telephone. EBW was defined according to World Obesity Federation cutoffs; CA was defined as waist circumference >90th sex- and age-specific percentile; and CVDR was categorized as ≥3 of: obesity, high systolic or diastolic blood pressure, dyslipidemia, high fasting plasma glucose or hemoglobin A1c, or insulin resistance. Food intake was assessed by two 24-h dietary recalls and the National Cancer Institute method was used to estimate usual intake. Diet quality was defined according to the Alternate Healthy Eating Index-2010 (AHEI) and the Revised Brazilian Healthy Eating Index (BHEI-R). Adjusted odds ratios (aORs) with 95% CI for EBW, CA, and CVDR by diet quality index were tested by logistic regression models.

Results: The prevalence (of EBW, CA, and CVDR was 28.7% (95% CI: 21.7%, 35.7"), 6.5% (95% CI: 2.9%, 10.1%), and 18.8% (95% CI: 12.9%, 24.7%) in HSP, and 42.5% (95% CI: 37.5%, 47.5%), 12.6% (95% CI: 9.5%, 15.6%), and 17.2% (95% CI: 14.2%, 20.3%) in SOL-Youth. HSP participants with EBW (compared with normal bodyweight) had marginally lower (unhealthier) scores for whole grains and sugary beverages based on BHEI-R. SOL-Youth participants with EBW had lower scores of nuts and legumes based on AHEI, and sodium based on BHEI-R, but higher scores of whole grains and dairy according to BHEI-R. In HSP, BHEI-R was inversely associated with EBW (aOR: 0.87; 95% CI: 0.80, 0.95) and CVDR (aOR: 0.89; 95% CI: 0.80, 0.98) and AHEI was marginally associated with CA (aOR: 0.90; 95% CI: 0.79, 1.02). In SOL-Youth, AHEI was inversely associated with EBW (aOR: 0.93; 95% CI: 0.87, 0.99). No other associations were significant.

Conclusions: Healthier diet quality was associated with lower odds of EBW in Brazilian and US-Hispanic/Latino adolescents, and with lower CVDR in Brazilian adolescents, especially when measuring diet quality with indexes applicable to each population.

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Comparing the National Cancer Institute Method with the Multiple Source Method for Estimating Usual Intake of Nutrients in the Hispanic Community Health Study/Study of Latino Youth (P20-132)

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Objectives: The aim of this study was to compare the performance of the National Cancer Institute (NCI) method with that of the Multiple Source Method (MSM) for estimating usual energy and nutrient intakes of Hispanic/Latino adolescents.

Methods: Dietary data were obtained by two 24-h dietary recalls (24HR), initially in person and then by telephone, in 1453 individuals aged 8–16 y from the Hispanic Community Health Study/Study of Latino Youth (SOL-Youth), a population-based study of Hispanic/Latino adolescents living in the United States. The NCI method and the MSM were used to estimate usual intake of energy, macronutrients (total carbohydrate, protein, and total fat), ω-3 (n–3) fatty acids, cholesterol, minerals (calcium, iron, and potassium), vitamins (A, B-12, C, and D), added sugar, and caffeine. For both methods, the probability of consumption for these components was assumed to be 1, and the covariates in the usual intake models were age, sex, day of the week of the 24HR (weekend/weekday), self-perception about intake amounts (more compared with same or less than usual amount), and interview sequence of the 24HR (first or second). The distribution of the usual intake was estimated through the use of the 2-d mean, the MSM method, and the NCI method. The difference between the methods was compared in different percentiles of the distribution as well as the correlation between them. Data were analyzed with SAS version 9.3.

Results: For all components, except ω-3 fatty acids, MSM estimation was closer to the 2-d mean estimation than to the NCI estimation, but with lower SD than the mean. The NCI method presented the lowest SD values, except for caffeine, with higher values in the lowest percentiles and lower values in the higher percentiles. The correlation between the three methods was >0.85 for all the components ($P < 0.0001$), except for ω-3 (0.60 for NCI compared with mean, and 0.74 compared with MSM), and for caffeine (0.83 for NCI compared with mean).

Conclusions: Both MSM and NCI methods provided good estimates of the usual intake distribution with the use of 24HR, and they better represented the usual intake compared with the 2-day mean, correcting for measurement error and intra-individual variability. The smallest precision was observed in the extreme percentiles of the distribution, and for nutrients that are seldom consumed or have an asymmetric distribution.

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Health Department; National Council for Scientific and Technological Development—CNPQ; São Paulo Research Foundation—FAPESP.

Association of Fried Food Intake and Prediabetes and Diabetes Combined in the Filipino Women's Diet and Health Study (FiLWHEL) (P20–133)

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Objective: Fried food rich in saturated fatty acids and *trans*-fatty acids may promote insulin resistance, which plays an important role in the pathogenesis of type 2 diabetes. However, epidemiologic evidence about the association between fried food intake and type 2 diabetes is scarce. Therefore, we aimed to examine whether a higher intake of fried food was associated with increasing prevalence of type 2 diabetes among Filipino women married to Korean men.

Methods: The Filipino Women's Diet and Health Study (FiLWHEL) is a cohort of Filipino women married to Korean men in South Korea. The present study is a cross-sectional of 504 women with a median age of 33.6 y who were enrolled in 2014–2016. The American Diabetes Association diagnostic criteria was used to categorized prediabetes (fasting blood glucose (FBG): 110–125 mg/dL, or HbA1c: 5.7–6.4%) and diabetes (FBG: ≥126 mg/dL, or HbA1c: ≥6.5%). Fried food intake was determined through the use of 1-d 24-h recall. To assess the relation between fried food intake and the prevalence of prediabetes and diabetes combined, we used logistic regression analyses and adjusted for several potential confounders.

Results: The prevalence of prediabetes and diabetes combined in this population was 26.03%. Compared with consumers of nonfried food, the multivariate-adjusted odds ratio (ORs) and 95% CIs for the prevalence of prediabetes and diabetes combined were 0.81 (95% CI: 0.41, 1.59) for <100 g/d of fried food intake, 1.06 (95% CI: 0.57, 1.97) for 100–<300 g/d, and 1.93 (95% CI: 0.83, 4.46) for ≥300 g/d (P-trend = 0.06).

Conclusion: Our study suggests that Filipino women who consume large amounts of fried food are likely to have a higher prevalence of prediabetes and diabetes combined compared with nonfried food consumers.

Maternal Feeding Practices in Relation to Dietary Intakes and Body Mass Index in 5 Year Olds in a Multiethnic Asian Population (P20–134)

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Objective: The association between maternal feeding practices and dietary intakes and body mass index (BMI) of Asian preschoolers is little known. The aim of this study was to examine this relation in a multiethnic Asian cohort in Singapore (GUSTO).

Methods: Participants were mothers (n = 511) who completed the Comprehensive Feeding Practices Questionnaire and a semiquantitative food-frequency questionnaire when their children were 5 y old. The weight and heights of their children were measured.

Results: Compared with those in the low tertile, mothers in the high tertile of modelling healthy food intakes had children with higher intakes of vegetables (20.0 g/d; 95% CI: 11.6, 29.5 g/d) and whole grains (20.9 g/d; 95% CI: 9.67, 31.1 g/d) but lower intakes of sweet snacks (−10.1 g/d; 95% CI: −16.3, −4.94 g/d) and fast-foods (−5.84 g/d; 95% CI: −10.2, −1.48 g/d). Conversely, children of mothers in the high tertile for allowing child control (lack of parental control) had lower intakes of vegetables (−15.2 g/d; 95% CI: −26.6, −5.21 g/d) and whole grains (−13.6 g/d; 95% CI: −22.9, −5.27 g/d), but higher intakes of sweet snacks (13.7 g/d; 95% CI: 7.7, 19.8 g/d) and fast foods (6.63 g/d; 95% CI: 3.55, 9.72 g/d). In relation to BMI at 5 y, restrictive feeding was associated with higher BMI z scores (0.87 SD; 95% CI: 0.60, 1.13 SD)], whereas use of pressure to eat was associated with lower BMI z scores (−0.50 SD; 95% CI: −0.79, −0.21 SD).

Conclusions: Modelling healthy food intakes by mothers was the key feeding practice associated with higher intakes of healthy foods and lower intakes of discretionary foods. The converse was true for allowing child control. Only food restrictions for weight and use of pressure were associated with BMI z scores.

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Mercury and Selenium Relations in Umbilical Cord Blood and Placenta Indicate Maternal Consumption of Ocean Fish Diminishes Mercury Exposure Risks (P20-135)

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Objectives: Methylmercury (MeHg) has an extremely high binding affinity for selenium (Se), the nutrient required for synthesis of selenocysteine, the 21st genetically encoded amino acid. Since Se-dependent enzymes prevent oxidative damage in the brain, MeHg exposures that are high enough to impair their activities will result in brain damage and other signs of MeHg toxicity. The US FDA/EPA maternal seafood consumption advisory is based on outcomes of a study of a population in the Faroe Islands, where cord blood Hg:Se molar ratios that approached equimolar were associated with subtle adverse effects on subsequent cognitive abilities. However, that population ate pilot whale meat, one of the few foods that contain far more Hg than Se. Although ocean fish also contain Hg, they are far richer in dietary Se. This study assessed Hg and Se to establish Hg:Se molar ratios in cord blood and placentas from children of a maternal population exposed to MeHg through ocean fish consumption.

Methods: One hundred umbilical cord blood and placental tissue samples were collected following childbirth at the Kapiolani Medical Center (Honolulu, HI). These samples were shipped to the University of North Dakota for analysis of their Hg and Se contents and statistical assessments.

Results: Cord blood contained 25.7 ± 18.6 nmol Hg/kg and 1945.5 ± 359.4 nmol Se/kg (mean ± SD); Se:Hg molar ratio = 122:1. Placentas contained 32.2 ± 22.1 nmol Hg/kg and 3231.8 ± 416.7 nmol Se/kg; Se:Hg molar ratio = 169:1. The equation describing the relation between cord blood Se and Hg is: $y = 9.41x + 1.70$ ($P < 0.0001$). There was no relation between Hg and Se in placenta, but concentrations of both elements were significantly greater ($P < 0.01$) than in cord blood.

Conclusions: In contrast to the effects of eating pilot whale meat, the predominant source of Hg in the Faroes, cord blood Hg:Se did not approach, let alone exceed, a 1:1 molar ratio. Instead of higher Hg:Se ratios as Hg exposures increased, cord blood Se increased ~10 times faster, most likely because ocean fish generally contain far more Se than Hg. Therefore, ocean fish consumption is unlikely to be associated with adverse effects due to MeHg, perhaps explaining why it has been associated with 4–10 IQ point benefits in other studies.

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Supporting Images/Graphs

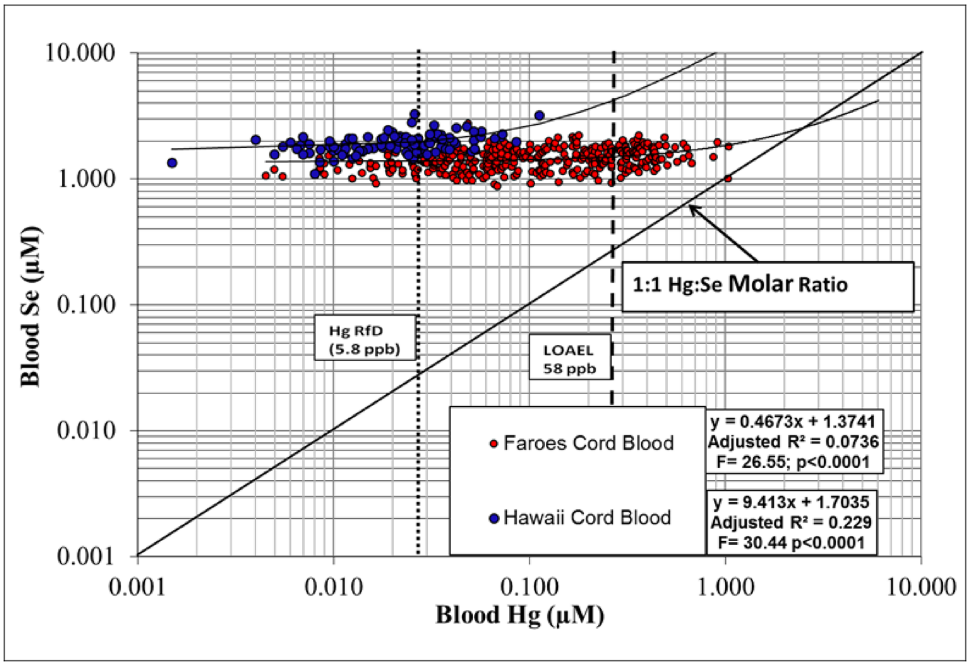

FIGURE P20-135-1 Hg and Se in cord blood from Hawaii compared with the Faroe Islands.

Epidemiology of Feeding Tubes in a Veterans Administration Amyotrophic Lateral Sclerosis Clinic (P20-136)

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Objectives: Amyotrophic lateral sclerosis (ALS) is a chronic, degenerative neurologic disease affecting the brain and spinal cord. Feeding tubes are used to maintain adequate nutrition in patients with dysphagia and upper extremity motor disabilities; these patients can also suffer from hypermetabolic states that may cause malnutrition. This study assessed the epidemiology of feeding tube placement and end-of-life care in patients with ALS.

Methods: A retrospective chart review was conducted of all patients who died between January 2010 and December 2015 who had received care from an ALS Clinic at a single US Veterans Administration (VA) Medical Center. Abstracted data included: date of feeding tube placement (when available), date of initiation of enteral nutrition, survival (from first ALS appointment), location of death, complications related to the tube or feedings, and use of hospice care. Statistics included chi-squared, *z* score, and Student's *t* test.

Results: Of the 139 patients who died with ALS, 88 (63.3%) had received a gastrostomy tube. Tube placement was more common among younger patients, e.g., <70 y of age. The mean/median time from initial ALS appointment to tube insertion was 247/145 d ($n = 72$). The mean/median survival after feeding tube placement was 352.5/258 d (range 4–2196). The patients with and without tubes did not differ significantly in survival from initial VA ALS Clinic appointment, location of death, or rate of use of hospice. See Figure 1. There were 7 deaths within 60 d after tube placement. Three patients received feeding tubes after enrollment in hospice.

Conclusions: This VA ALS Clinic had a higher rate of tube placement than reported previously. Use of a feeding tube does not appear affect decisions about enrollment in hospice or location of death. Lack of evidence of a survival benefit associated with use of feeding tubes in ALS in this and prior studies suggests their use should be better targeted to some subpopulation(s) of patients with ALS that future research might identify. Further study of quality of life among patients with ALS and a feeding tube may also be needed to justify widespread use of feeding tubes in this population.

Funding Sources

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Supporting Images/Graphs

	Total N = 139	With tube N=88	No tube N=51	p
% Male	97 %	97%	98%	
Mean/Median age at death	70.5/73	68	75	< 0.001
Mean/Median Survival after first ALS apt.	543/397	501/407	568/395	0.234
Location of death				$X^2 = 0.30$
% Home	61	64	57	
%Hospital	22	23	22	
% Nursing Home	15	11	22	
% Hospice House	1	2.3	0	

FIGURE P20-136-1 Demographics and outcomes in patients with feeding tubes compared with those without feeding tubes.

Intake of Red and Processed Meat And Liver Function Indices Among women with a History of Gestational Diabetes (P20-137)

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Objectives: Red and processed meat intake are known to be dietary risk factors for cardiometabolic diseases, but little is known about their associations with liver function. We aimed to examine associations of red and processed meat intake with liver function indices in a high-risk population of women with a history of gestational diabetes (GDM).

Methods: We included 550 women who had GDM-complicated pregnancies in the Danish National Birth Cohort (1996–2002), and were followed up 9–16 y later in the Diabetes & Women's Health Study (2012–2014). At follow-up, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and γ-glutamyltransferase (GGT) were measured from fasting blood samples. Derived liver function scores included hepatic steatosis index (HSI), fatty liver index (FLI), and nonalcoholic fatty liver disease liver fat score (NAFLD-LFS). Habitual dietary intake in the past year was assessed with a food-frequency questionnaire. We estimated adjusted relative risk (aRR) and 95% CI for elevated liver scores by quartiles of red and processed meat intake, adjusting for sociodemographics, physical activity, and other dietary factors.

Results: At follow-up, 54.0%, 43.5%, and 36.7% of women had elevated HSI (≥36), FLI (≥60), and NAFLD-LFS (> −0.64) respectively. Red meat intake was significantly and positively associated with HSI (adjusted β per g increase/d = 0.03, 95% CI: 0.01, 0.05) and FLI (adjusted β per g increase/d = 0.10, 95% CI: 0.01, 0.20). Compared with women in the lowest quartile (≤47.6 g/d) of red meat intake, women in the highest quartile (≥80.7 g/d) had an increased risk of elevated HSI (aRR = 1.49; 95% CI: 1.17, 1.89; *P*-trend = 0.002], elevated FLI (aRR = 1.43; 95% CI: 1.05, 1.94; *P*-trend = 0.01], and elevated NAFLD-LFS (aRR = 1.48;95% CI: 1.09, 2.01; *P*-trend = 0.01). No significant linear associations were observed between processed meat intake and liver function indices, yet compared to women in the lowest quartile (≤4.8 g/d) of processed meat intake, women in the highest quartile

(≥11.5 g/d) had an increased risk of elevated HSI (aRR = 1.32; 95% CI: 1.05, 1.67; *P*-trend = 0.06).

Conclusions: In a high-risk population of women with a history of GDM, greater red meat intake may be related to increased risk for liver dysfunction.

Funding Sources

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The Contribution of Diet to the Burden of Noncommunicable Diseases in Mexico: Findings from the Global Burden of Disease Study 2016 (P20-138)

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Objective: The aim of this study was to assess the diet-related burden of noncommunicable diseases (NCDs) in Mexico from 1990 to 2016 at a national and state level.

Methods: As part of the 2016 Global Burden of Disease, Injuries, and Risk Factors Study, a comparative risk assessment approach was used to quantify NCD mortality and disability-adjusted life years (DALY) related to 15 dietary risk factors (DRFs). Dietary exposure was estimated with the use of a Bayesian hierarchical meta-regression. The effect size of each diet-disease pair was obtained based on meta-analysis of prospective observational studies and randomized control trials. Using counterfactual scenarios, the attributable burden was computed by multiplying the risk and cause-specific population attributable fraction by cause-specific mortality.

Results: In 2016, DRFs were responsible for 87,742 deaths [95% uncertainty interval (UI): 70,928, 106,731] and 2.2 million DALY (95% UI: 1.7, 2.6 million) in Mexico, representing 17% and 10% of all NCD deaths and DALY, respectively. Of all diet-related deaths, 55% were in men, and 65%, 20%, 4%, and 3% were due to ischemic heart disease, diabetes, chronic kidney disease, and colon and rectum cancer, respectively. Most of diet-related DALY (80%) were due to ischemic heart disease and diabetes. Nearly 7 in every 10 diet-related deaths (68%) and DALY (73%) were explained by the low intake of nuts and seeds, and fruits and vegetables. The lowest estimated burden was associated with a low intake of whole grains, milk, and legumes. The states of Coahuila, Yucatan, Baja California Sur, and Sonora had the highest age-standardized death rates attributed to diet (≥114 deaths/100,000 persons), whereas the states of Tlaxcala, Aguascalientes, Nayarit, and Zacatecas had the lowest mortality due to diet (≤80 deaths/100,000 persons). In terms of DALY, Coahuila, Baja California Sur, and Sonora had the highest rates, whereas Tlaxcala, San Luis Potosi, and Sinaloa had the lowest rates. From 1990 to 2016, the diet-related NCD mortality and DALY rate remained unchanged; however, the number of NCD deaths and DALY attributed to diet doubled in these years.

Conclusions: Poor diet contributes to a substantial proportion of the health loss due to NCDs in Mexico. These results are useful to guide public health planning and inform strategies to improve the food environment and promote a healthy diet.

Funding Sources

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Diet Quality of Brazilian Adolescents: Results from the ERICA Study (P20-139)

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Objectives: This study aimed to assess dietary patterns of Brazilian adolescents by a food-based diet quality index, and to evaluate their compliance with international dietary guidelines.

Methods: Participants included 71,553 Brazilian adolescents (aged12–17 y) from the Study of Cardiovascular Risks in Adolescents (ERICA), a cross-sectional school-based multicenter survey, carried out from February 2013 to November 2014. Sociodemographic characteristics were assessed by self-administered questionnaire. Dietary intake was assessed by 24-h recall and a second one was collected randomly to correct the within-person variability. The National Cancer Institute method was applied to estimate the usual dietary intake of 10 food groups in order to determine the Diet Quality Index for Adolescents adapted for Brazilians (DQIA-BR) and its components: dietary quality, diversity, and equilibrium. The DQIA-BR total score ranges from −33% to 100%, and a higher score indicates higher diet quality and greater adherence to international dietary guidelines. The DQIA-BR distribution was analyzed according to sex, geographic area, and type of school.

Results: The DQIA-BRscores (mean ± SD) were 14.8 ± 6.1% for females and 19.0 ± 6.3% for males. All analyzed strata revealed low scores of DQIA-BR, whereas its components values were under half of their ideal scores. Median usual intakes were below recommendations for vegetables (∼45 g), fruits (∼30.5 g), milk products (∼175 g), and cheese groups (∼6.5 g), and also indicated overconsumption of meat group (∼185 g) and nonrecommended food groups (∼85 g of snacks and ∼600 mL of nonnutritive drinks). The highest and the lowest DQIA-BR mean scores were found in the north and the midwest regions of Brazil, respectively (17.0 ± 6.4% compared with 12.4 ± 6.2% for females; 20.7 ± 6.3% compared with 16.8 ± 6.3% for males). The lowest median usual intakes of the beans group were observed at private schools (92.7 g for females and 146.0 g for males). Both types of school showed relatively similar median usual intakes of food groups.

Conclusions: Our findings suggest that compliance with international dietary guidelines is inadequate, and the overall diet quality of

Brazilians adolescents needs urgent improvements, in all regions and for all socioeconomic backgrounds.

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Magnesium Dose, Hypertension, and Medication Status Determine Effectiveness of Oral Magnesium Therapy for High Blood Pressure: A Review of 48 Clinical Trials (P20-140)

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Objective: Oral magnesium (Mg) therapy for hypertension (HT) trials yield conflicting results. The aim of this study was to ascertain if Mg dose, HT status, and medication use explain these conflicts.

Methods: Trials from PubMed searches, merged with those from 6 meta-analyses and an FDA Qualified Health Claim Application, yielded 48 appropriate Mg for blood pressure (BP) studies. We classified each for statistically significant lowering of systolic blood pressure (SBP) and diastolic blood pressure (DBP), baseline HT status (140/90 mm Hg cutoff), medication use, and oral Mg dose. Studies were then tabulated by: *1*) hypertensive or normotensive status; *2*) antihypertensive medication use, treated (T) or untreated (UT); and *3*) ascending oral Mg dose.

Results: Hypertensive subjects, untreated (HT-UT), n = 18: at Mg doses <380 mg/d, no studies of HT-UT subjects showed statistically significant decreases in either DBP or SBP. Oral Mg doses at 384 to 486 mg/d decreased either DBP or SBP, but not both. However, all studies but one that used ≥600 mg/d Mg on HT-UT subjects showed significant reductions in both SBP and DBP. In the one HT-UT study showing no change in BP at 607 mg/d Mg, the authors deemed these subjects "Mg replete" as their dietary Mg was high. Hypertensive subjects, treated (HT-T), n = 12: in contrast to the HT-UT subjects, studies at all Mg doses (240–607 mg/d) in HT-T subjects showed statistically significant decreases in both SBP and DBP. Normotensive subjects, treated or untreated (NT): 16 of 18 studies on NT subjects, T or UT, showed no change in BP with Mg doses ranging from 250 to 600 mg/d. Subjects had low serum Mg in one NT study showing a decrease in BP at 632 mg/d, and the other NT study showing a BP decrease included borderline HT subjects.

Conclusions: Oral Mg does not lower BP in normomagnesemic NT subjects, even at high Mg doses. Oral Mg does lower BP of HT subjects who use anti-HT meds—at both low and high Mg doses. Only high Mg doses lower BP in nonmedicated HT subjects. Mg-replete subjects, even those with HT, do not show a decrease in BP with oral Mg therapy. This review shows that medication use, HT status, and Mg dose all reduce the effectiveness of oral Mg therapy for high BP. Combining data of HT-T subjects with NT and HT-UT at <600 mg Mg/d, or Mg-replete subjects, minimizes the beneficial effect of oral Mg therapy for HT.

Funding Sources

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Validation of a Short, Vegetarian Eating Patterns Questionnaire in Adventist Children and Adolescents in Latin America and the Caribbean: DANNIEL Study (P20-141)

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Objective: The aim of this study was to validate a short, qualitative questionnaire used in the DANNIEL study to assess the vegetarian eating patterns of Adventist children and adolescents in Latin America and the Caribbean.

Methods: This cross-sectional study included a sample of 4688 Seventh-Day Adventist children and adolescents aged 7–19 y from the DANNIEL study. The participants were from Mexico (40%), South America (34%), the Caribbean (21%), and Central America (5%). A 4-level Likert scale was designed in 3 languages (Spanish, English, and French), and used to qualitatively assess the weekly frequency of consumption of 17 foods and food groups, and 7 eating behaviors (24 items in total). We determined 5 factors that used a healthy vegetarian eating pattern as the criterion; 2 related to a healthy eating pattern (NUT = nutrient-dense food, HBE = healthy behaviors), and 3 with an unhealthy pattern (FSS = foods high in saturated fats, sodium and added sugars, SUG = foods high in added sugars and caffeine, UBE = unhealthy behaviors).

Results: Exploratory factor analysis resulted in an acceptable sample adjustment (KMO = 0.854) and a significant Bartlett's sphericity ($P < 0.05$). Both the criterion of own value and the drop contrast identify 5 factors (Table 1), which after being rotated orthogonally explain 44.15% of the total variance. All items report a factorial load >0.300. By factor, the items with a more dominant factorial load were consumption of fresh vegetables (0.693, NUT), having breakfast (0.784, HBE), consumption of meat (0.726, FSS), having sugary breakfast cereals for breakfast (0.669, SUG), and adding salt to finished and served dish (0.610, UBE). The general scale shows a reliability of 0.766 according to Cronbach's α. The stability of the factorial structure is acceptable, showing little exchange of items among the factors of unhealthy pattern.

Conclusions: It is considered that the instrument shows coherence with the theory and its indicators of validity and reliability are acceptable. It is a useful, self-administered, low-cost, and quick tool for evaluating, in a general way, the vegetarian eating patterns of Adventist children and adolescents in Latin America and the Caribbean.

Funding Sources

The DANNIEL Study and this specific project was funded by the Inter-American Division of the Seventh-Day Adventist Church, the Inter-American Health Food Company, amd the Department of Health Ministries of the General Conference of Seventh-Day Adventists.

Supporting Images/Graphs

	Component[b]				
	FSS	NUT	HBE	SUG	UBE
16 Consumption of meat (beef, chicken or fish)	**.726**	-.006	.044	.037	-.106
13 Consumption of fried food	**.671**	-.010	.023	.065	.147
17 Consumption of meat sausages (ham, sausage, bologna)	**.599**	-.025	-.070	.248	.094
22 Consumption of sweets, cookies, ice creams	.560	-.081	.168	-.014	**.354**
14 Consumption of cream or butter	**.542**	.119	.087	.089	.146
9 Consumption of soft drinks (soda)	**.499**	.004	-.152	.274	.191
12 Consumption of milk	**.391**	.238	.015	.262	-.172
7 Consumption of fresh vegetables salad	.031	**.693**	.139	-.126	-.075
8 Consumption of whole-grain bread	-.020	**.685**	-.027	.063	.032
5 Consumption of fresh fruit	.004	**.644**	.213	.126	-.083
15 Consumption of nuts or seed unsalted	-.124	**.613**	-.061	.135	.126
6 Consumption of legumes (beans, lentils, peas)	.136	**.548**	.290	-.150	-.141
18 Consumption of meat analogs (hamburger, sausage, etc.)	.077	**.519**	.010	.109	.211
1 Have breakfast	-.013	.044	**.784**	.096	-.015
24 Have three regular meals a day	.148	.152	**.685**	-.155	.030
2 Have breakfast with your family	-.125	.164	**.602**	.360	-.052
3 Have sugary breakfast cereals for breakfast	.090	.190	.127	**.669**	.048
4 Have sweet bread, pastries or muffins for breakfast	.213	.015	.113	**.588**	.176
11 Consumption of energy drinks (coffee, RedBull)	.223	-.048	-.096	**.526**	.100
21 Adding salt to finished and served dish	.080	.115	.065	.164	**.610**
20 Eating at fast food restaurants	.278	.131	-.085	.211	**.540**
23 Consumption of salty snacks like french fries	.429	.045	.015	.151	**.502**
10 Drink at least 8 glasses of water	.104	.285	.169	.197	**-.395**
19 Watch TV or use mobile devices when eating	.388	-.081	-.023	.010	**.390**

[a]Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 7 iterations.

[b]Healthy Eating Pattern: NUT = nutrient-dense food, HBE = healthy behaviors
Unhealthy Eating Pattern: FSS = foods high in saturated fats, sodium and added sugars, SUG = foods high in added sugars and caffeine, UBE = unhealthy behaviors.

TABLE P20-141-1 Rotated Component Matrix[a]

Total Carotenoid Intake Is Protective against Loss of Grip Strength over Time in Adults: The Framingham Offspring Study (P20-142)

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Rationale: Lower antioxidant serum levels but not intake has been linked with declines in lean mass or physical function in older adults. This could be because oxidative stress has been implicated as a central mechanism underlying decline in muscle with aging. Nevertheless, data on dietary antioxidants upon loss of muscle are still lacking.

Objective: The aim of this study was to determine the association of intake of vitamin C, vitamin E, and carotenoids with annualized change in grip strength in older adults from the Framingham Offspring study.

Methods: For this study, 2452 men and women completed a food-frequency questionnaire to determine the average intake of each antioxidant (vitamin C, vitamin E, and carotenoids, mg/d) at the index exam (1998–2001) and 2 prior exams (1995–1998 and 1991–1995). Carotenoid intake was calculated as the sum of intake of α-carotene, β-carotene, β-cryptoxanthin, lycopene, and lutein + zeaxanthin. Grip strength (kg) was measured with an adjustable Jamar isometric hand-held dynamometer (maximum of 3 readings of each hand) at the index exam and 2 follow-up exams (2005–2008 and 2011–2014). Annualized change in grip strength (kg/y) was calculated as [(follow-up grip strength−baseline grip strength)/baseline grip strength] × 100, divided by follow-up time in years. We used linear regression to calculate β coefficients and P values adjusting for confounders (see Table 1).

Results: Mean ± SD age was 61 ± 9 y (range 33–88 y). Median intakes were 208 mg/d (IQR: 132, 394 mg/d) for vitamin C, 27 mg/d (IQR: 7, 195 mg/d) for vitamin E, and 15 mg/d (IQR: 10, 21 mg/d) for carotenoids. Mean annualized change in grip strength was −0.4 ± 0.8 kg/y. In the combined sample of men and women, total carotenoid intake was protective against loss in grip strength over time ($P = 0.04$; Table1). However, intake of vitamin C and vitamin E were not associated with annualized change in grip strength ($P = 0.24$–0.29).

Conclusions: Total carotenoid intake was protective against loss of grip strength in this cohort of older men and women. These results are consistent with previously reported associations of plasma carotenoids with muscle strength in older men and women from the InCHIANTI study.

Funding Sources

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Supporting Images/Graphs

Antioxidant intake (mg/d)	Men and women (n=2,452)	
	β±SE[1]	P-value
Vitamin C	0.000077 ± 0.0001	0.24
Vitamin E	0.000122 ± 0.0001	0.29
Carotenoid	0.003 ± 0.002	0.04*

[1] Models adjusted for age, sex, height, BMI, physical activity, energy intake (residual method), current smoking, multivitamin supplement use and baseline grip strength. Antioxidant groups under study were adjusted for each other in the models; * P≤0.05.

TABLE P20-142-1 Association of antioxidant intake with annualized change in grip strength in men and women from Framingham Offspring Study.

Alcohol Consumption Trends in Spanish Adults (1987–2014): An Age-Period-Cohort Model (P20-143)

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Introduction: In Spain, alcohol consumption patterns are changing from a Mediterranean to a Northern Europe pattern, although the prevalence of high-risk drinkers has decreased in the last few decades. Therefore, it is of interest to study the independent effects of age, period, and cohort on the prevalence of low-risk and high-risk drinkers, and on the total volume of alcohol consumed in the Spanish adult population.

Methods: Data were taken from 9 surveys from the National Health Survey and from the European Health Survey of Spain from 1987 to 2014. The sample size was of 180,153 individuals aged ≥15 y. According to the average grams of pure ethanol consumed, participants were classified into low-risk drinkers (1–39 g/d in men, and 1–23 g/d in women), and high-risk drinkers (≥40 g/d in men, and ≥24 g/d in women). The volume of alcohol consumption was also measured.

Results: From 1987 to 2014, in both sexes, there was a decrease of alcohol consumption with age, an increase in the prevalence of low-risk drinkers across periods and cohorts, a drop in the prevalence of high-risk drinkers, as well as a decline in alcohol volume intake. High-risk drinkers prevalence peaked in cohorts born from the 1940s to the 1960s, whereas there was an increase in the prevalence of low-risk drinkers thereafter. A generational shift has been observed, due to the most recent cohorts born after the 1960s, who are low-risk drinking cohorts, with lower rates of alcohol consumption.

Conclusions: In Spain, since the cohorts born in the 1960s, there has been an increase in the prevalence of low-risk drinkers, whereas the prevalence of high-risk drinkers has declined, leading to an overall drop in the volume of alcohol consumed. Further studies should focus on studying trends of more complex Mediterranean patterns.

Funding Sources

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Differential Reporting Bias of Fruit and Vegetable Intake among Youth in a Randomized Controlled Behavioral Intervention Trial (P20-144)

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Objective: Intervention studies targeting diet quality typically rely on self-reported intake. However, intervention participation may influence dietary self-report, either by increasing social desirability bias (leading to greater misreporting) or by increasing attention to intake, thereby improving recall and portion estimation. Such differential reporting bias would impair estimates of treatment effect; however, few studies have tested this empirically. This study examined differential response bias by examining the relation of fruit and vegetable (FV) intake with serum carotenoids among youth with type 1 diabetes participating in a randomized controlled behavioral nutrition intervention trial targeting increased whole plant food intake.

Methods: Participants ($n = 136$) completed 3-d food records at baseline, 6, 12, and 18 mo, from which FV intake (servings/d) was calculated. Serum carotenoids were assessed at these visits with the use of an HPLC-based assay. Linear regression estimated associations of FV intake with serum carotenoids by treatment assignment, adjusting for glycemic control and sociodemographic characteristics. Multiplicative interaction terms tested the interaction of treatment assignment with FV intake on serum carotenoids for each visit and within each group over time.

Results: The association of FV intake with serum carotenoids was lower in the control than in the intervention group, with a significant interaction effect observed for baseline ($\beta = -0.49$, $P = 0.04$) and 6-mo ($\beta = -0.57$, $P = 0.03$) visits. However, the association of FV intake with serum carotenoids did not significantly differ over time for either group.

Conclusions: Although the stronger association of FV with carotenoids in the intervention group suggests differential reporting bias, indicating greater reporting accuracy among intervention participants, this difference was evident at baseline, and did not change significantly over time in either group. Thus, findings do not provide evidence for reactivity to the intervention in reporting of dietary intake.

Overweight and Obesity Rates among Adolescents in Tennessee Private Compared with Public Schools (P20-145)

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Objective: Although the incidence of overweight and obesity has been reported annually for public school students in middle Tennessee for a number of years, there is a lack of data on overweight and obesity in private school students. The aim of this study was to compare the prevalence of overweight and obesity in adolescents between private and public schools in middle Tennessee.

Methods: Electronic surveys covering nutrition knowledge, behavior, and nutrition education needs were used to gather information from middle school (aged 10–14 y) and high school (aged 14–18 y) students at a Nashville, TN private school. Anthropometric data was collected and used to generate body mass index (BMI) values. Using CDC BMI growth charts, the BMI-for-age percentiles were documented for each student. The BMI-for-age data from the private school students were compared with the data from the 2015–2016 report "Tennessee Public Schools: a summary of weight status data," collected and published by the Tennessee Department of Education. Specifically, the Williamson County public school data were used from the 2015–2016 summary due to a majority of the private school students residing in that county. Overweight and obesity were classified as $\geq$85th percentile on the BMI-for-age chart. The percentages of prevalence of overweight and obesity from the private school were compared with the percentages from public schools through the use of a chi-square statistical analysis with JMP Pro 13 software.

Results: The prevalence of overweight and obesity among public school students (middle school and high school combined) in Williamson County was 21.6%. The Tennessee private school combined overweight and obesity prevalence was 19.3% from a total of 176 middle school and high school students. The proportion of public school students overweight or obese was 0.216, whereas the figure for private school students was 0.193. The difference in proportions was not significant ($\chi^2 = 0.3124$, $P = 0.5762$.)

Conclusions: Private middle school and high school students have a similar prevalence of overweight and obesity as public school adolescents in Williamson County, Tennessee.

Funding Sources

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Creation of an Online Interface Facilitating Personalized Nutrition Interventions Based on Genomics, Metabolomics, Proteomics, and Microbiome Data through the Use of Datamining (P20-146)

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Objectives: Disclosing genetic and metabolomic information has been shown to increase compliance with dietary interventions (DIs), decreasing the risk of noncommunicable chronic disease. Personalized nutrition (PN) based on genomics and metabolomics is gaining increased attention. The objective of this project was to build an online interface to create PN actions based on genomic, metabolomic, proteomic, and microbiome measures for patients and care providers based on the use of the most recent information available.

Methods: We curated a database associating genetic single-nucleotide polymorphisms ($n > 100{,}000$), blood measures of metabolites ($n > 150$) and proteins ($n > 200$), and microbiome phylum data as well as adverse health conditions ($n > 100$) with DIs and dietary patterns, by employing datamining software (Ovid for Medline) on human studies alone. Each DI was linked to specific food categories and food items, respectively, through the use of the Canadian Nutrient File, to create specific PN actions. We developed machine learning algorithms, including an evidence-based confidence score, to rank DIs and food categories within and across multiple measures.

Results: To date, genetic polymorphisms, metabolites, and microbiome phyla have been included in the database as being associated with DIs. MTHFR 677CT and glucose are the polymorphism and metabolite, respectively, associated with the largest number of DIs ($n = 4$ and 9, respectively) and the highest confidence score. The Bacteroidetes-to-Firmicutes ratio was the microbiome measure with the highest confidence score and associated with $n = 1$ DI. Inflammatory bowel disease was the adverse health condition associated with the largest number of DIs ($n = 7$). Employing machine learning in a custom online interface ranked DIs according to their associations with multiple abnormal measures of metabolites, microbiome phyla, and genetic polymorphisms based on patients' own data; this process enables efficient determination of individualized DIs with the highest potential to benefit. The tracking app further facilitated translation of DIs into PN actions that can be easily recorded by patients through the use of a smartphone-based app to monitor and capture adherence longitudinally.

Conclusions: We created an online interface facilitating PN interventions, and will determine compliance and efficacy in a longitudinal study.

Funding Sources

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Walnut Consumption and Risk Factors for Cognitive Decline: Evidence Mapping (P20-147)

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Background: Walnuts contain a variety of nutrients and phytochemicals that have individually been related to cognitive function. Human intervention trials have found walnuts to provide protection against oxidative stress and inflammation, risk factors for cognitive decline.

Objective: The aim of this study was to summarize the data related to walnut intake and cognitive function in adults.

Methods: Data sources included MEDLINE, the Cochrane Central Register of Controlled Trials, and the Commonwealth Agricultural Bureau. Abstracts included were from 1946 through June 2017 that evaluated walnut intake with risk factor outcomes for cognitive decline. Outcomes of interest included oxidative stress, inflammation, cerebrovascular diseases (CeVD), blood lipids, hypertension,

diabetes, imaging for CeVD and cognition [cognitive testing, dementia, Alzheimer's disease, mild cognitive impairment (MCI)]. All study designs except case-report studies were included.

Results: Of 362 abstracts, 70 publications met the inclusion criteria; 23 in healthy populations, 45 in populations with risk factors for cognitive decline, and 2 studies that did not provide baseline health status information. Interventions/exposures included walnuts (58 studies, 82.9%), walnut oil (3 studies, 4.3%), and walnuts plus other nuts (10 studies, 14.3%). Risk factors assessed were serum lipids (52 studies, 74.3%), blood pressure (17 studies, 24.3%), inflammation (16 studies, 22.9%), diabetes or glucose response (15 studies, 21.4%), oxidative stress (11 studies, 15.7%), cognitive tests (3 studies, 4.3%), and brain imaging trial (1 study, 1.4%). There were no studies that evaluated clinical outcomes of dementia, Alzheimer's disease or MCI.

Conclusions: Evidence mapping found that most studies evaluating walnuts and risk factors for cognitive decline reported serum lipids, blood pressure, inflammation, diabetes/glucose response, or oxidative stress as the outcome. This suggests that there is sufficient research to warrant a systematic review/meta-analysis evaluating the role of walnuts and risk factors for cognitive decline. There was also sufficient research for meta-analysis on cognitive function.

Funding Sources
California Walnut Board.

Healthcare Costs and Savings Associated with Increased Adherence to Healthy Dietary Patterns Among Adults in the United States (P20-148)

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Exponent, Inc.

Objective: The aim of this study was to estimate the impact on healthcare costs associated with increased adherence to healthy eating patterns among US adults.

Methods: Recent moderate- to high-quality meta-analyses of health outcomes associated with increased adherence to diets measured by the Healthy Eating Index (HEI) or the Mediterranean-style diet (MED) scores were identified. The 2013–14 What We Eat in America (WWEIA) data provided estimates of adherence to HEI-2015 and MED. Risk estimates quantifying the association between dietary patterns and health outcomes were combined with the dietary pattern score increase under 2 adherence scenarios: *1*) increasing average HEI and MED scores by 20%; and *2*) increasing HEI and MED scores to achieve 80% of the maximum score. The resulting change in risk was combined with published data on annual healthcare and indirect costs, inflated to 2017 US dollars, to estimate cost. To address double counting, costs were adjusted to minimize potential overlap of comorbidities.

Results: Overall modelled cost savings were $25.7bn (range $11.6bn–$37.8bn) to $38.1bn (range $29.7bn–$46.8bn) based on a 20% increase in the MED and HEI-2015, respectively, resulting from reductions in cardiovascular disease (CVD), cancer, type 2 diabetes mellitus for both patterns, and including Alzheimer's disease and hip fractures for the MED. If diet quality of US adults were to improve to achieve 80% of the maximum HEI-2015 and MED score, cost savings were estimated at $66.9bn (range $51.9bn–$81.9bn) to $135bn (range $61.5bn–$200bn), respectively.

Conclusions: This is the first comprehensive study quantifying health care savings from health outcomes associated with 2 dietary patterns recommended as part of the 2015 Dietary Guidelines for Americans. Findings from this study suggest that increasing adherence to healthy dietary patterns among US adults could reduce costs, with billions of dollars in potential savings.

Funding Sources
National Dairy Council.

Carotenoid and Flavonoid Intakes Are Higher among Salad Reporters than Nonreporters: Results from What We Eat in America, NHANES 2007–2010 (P20-149)

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Objectives: The aim of this study was to determine associations between salad reporting status (reporter/nonreporter) and total daily intake of carotenoids (α-carotene, β-carotene, β-cryptoxanthin, lutein + zeaxanthin, and lycopene) and flavonoid classes (anthocyanidins, catechins, flavanones, flavones, flavonols, and isoflavones).

Methods: One day of dietary intake data from 10,998 adults aged $\geq$20 y participating in What We Eat in America, NHANES 2007–2010, was analyzed. Individuals who consumed raw vegetable–based salads on the intake day were designated as salad reporters. Adjusted estimates of carotenoids and flavonoids by salad reporting status were calculated via regression analyses. *t* tests determined differences between reporters and nonreporters.

Results: Salad was eaten by 21% of adults on the intake day. Among reporters, the contribution of salads to total daily intakes of carotenoids ranged from 12% (β-cryptoxanthin) to 60% (lutein + zeaxanthin); for flavonoids, they ranged from <1% (catechins) to 48% (flavones). Compared to nonreporters, salad reporters had higher intakes of α- and β-carotene and lutein + zeaxanthin ($P < 0.001$); in fact, intakes of β-carotene and lutein + zeaxanthin by reporters were more than double those by nonreporters. Intakes of most flavonoid classes were also higher among salad reporters than nonreporters: anthocyanidins were 69% higher; flavanones, 27%; flavones, 89%; flavonols, 31%; and isoflavones, 62%.

Conclusions: Not only is salad reporting associated with a higher intake of many of the carotenoids and flavonoid classes examined, but for some, namely α- and β-carotene, lutein + zeaxanthin, flavones, and flavonols, the magnitude of the observed differences is comparable to the contributions from salads. This demonstrates that, among adults, reporters' higher total daily intake of these carotenoids and flavonoids can be accounted for by their salad consumption. If these findings hold true within individuals in longer-term research, increasing salad intake seems likely to be an effective strategy for increasing intake of these beneficial bioactive compounds.

Funding Sources
ARS, USDA.

Food Sources of Fiber, Calcium, Vitamin E, iron, and Folate among Mexican School-Age Children (P20-150)

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Nestlé Research Center

Objective: Fiber, calcium, vitamin E, iron, and folate are the key nutrients inadequately consumed among Mexican school-age children. Food sources of these nutrients in Mexican children's diets are not well known and need to be investigated. Our aim is to describe the principal food sources of fiber, calcium, vitamin E, iron, and folate in the diets of 4- to 13-y-old Mexican children.

Methods: A nationally representative sample of 3980 Mexican school-age children 4–13 y old from the 2012 Encuesta Nacional de Salud y Nutrición (ENSANUT 2012) was used to examine food sources of selected nutrients. One 24-h recall was administered face-to-face with the child or their parent proxy. Stata Statistical Software was used to create data files, assign individual foods and beverages to food groups, and calculate the contribution of each food group to the overall intake of energy and nutrients. The weighted percentage contribution of each food group for all children was calculated. All estimates incorporated appropriate sample weights to produce nationally representative results.

Results: Tortillas (29%) and beans (10%) were the top food sources of fiber. Vegetables and fruits combined (13%) contributed as much as sweets and sweetened beverages combined (13%) of fiber intake. Top sources of calcium included dairy products such as cow's milk (18%), yogurt (5%), and sweetened beverages (11%). Food sources of vitamin E included sandwiches and tortas (13%), meats (9%), sweetened breads (7%), and eggs and egg dishes (6%). Meat contributed little to iron intake (5%); instead, tortillas, cereals (both ready-to-eat cereals and hot cereals), and sandwiches and tortas were the top sources of iron, contributing 28% of total daily iron.

Conclusions: Mostly traditional foods make up the core of the diet and present the key food sources of the examined nutrients. Sweets such as sweetened breads and sweetened beverages were also top contributors, thus explaining the inadequate fiber, calcium, vitamin E, iron, and folate intakes of Mexican school-age children.

Funding Sources

Nestlé Research Center (Nestec Ltd.)

Inadequate Vitamin D Status and Osteoporosis Are Associated with Lower Risk for Osteoarthritis in Korean Men: KNHANES 2009–2013 (P20-151)

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Objectives: Osteoarthritis (OA) is associated with vitamin D status and bone mass in white people, but the relation in Koreans is not known. Using a nationally representative database, we assessed the validity of awareness of OA and the relation between serum 25-hydroxyvitamin D [25(OH)D] and self-reported diagnosis of OA, radiographic OA, knee pain, and stiffness OA in Korean men and women. The association between osteoporosis and OA risk was also assessed in Korean older adults.

Methods: A total of 10,876 participants (≥50 y) of KNHANES (2009–2013) with complete data for serum 25(OH)D, self-reported diagnosis of OA or X-ray of knee and hip joints, and dual X-ray absorptiometry were analyzed by sex. Chi-square and multivariate logistic regression was performed to assess subject characteristics and odds ratio, respectively.

Results: The prevalence of radiographic OA (27.2% in men, 44.3% in women) was higher than that of self-reported diagnosis of OA (8.4% in men, 30.9% in women). Approximately 23% were not aware of their radiographic OA. Distribution of serum 25(OH)D differed between OA patients and healthy subjects, regardless of method used to to determine OA (self-report or X-ray) or sex. In men, low vitamin D (<12 ng/mL) was associated with a lower risk of radiographic OA (adjusted OR = 0.62, 95% CI: 0.43, 1.91) compared with those with higher vitamin D status (≥20 ng/mL) after adjustment for covariates (age, body mass index (BMI), survey year). No association between vitamin D status and OA risk was found in women. Serum 25(OH)D was not associated with the presence and level of pain or the presence and duration of joint stiffness in patients self-reporting OA in either sex. Men with osteoporosis had a 41% lower risk of OA after adjustment for age, BMI, income, and education (95% CI: 0.39, 0.88). When vitamin D status was included as a covariate, no association between osteoporosis and OA was found. Osteoporotic women had a 54% higher risk of OA before adjusting for covariates (95% CI: 1.10, 2.15). However, the association disappeared after adjustment for covariates.

Conclusions: Vitamin D–deficient or osteoporotic Korean men, but not women, have a lower risk of OA, but joint pain is not associated with vitamin D status. The association between OA and serum 25(OH)D or osteoporosis may differ by sex and race.

Funding Sources

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Development of a Food-Frequency Questionnaire for Korean Preschool Children (P20–152)

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Objective: The aim of this study was to document the data-based development of a food-frequency questionnaire (FFQ) for Korean preschool children.

Methods: Development of the FFQ was based on the data from 2766 preschool children aged between 1 and 5 y, who had completed 24-h dietary recalls in the 2009–2013 Korea National Health and Nutrition Examination Survey. For selection of items, we identified the food list based on the results of nutritional contribution and between-person variability for energy and 13 nutrients. Eighty-eight foods making >80% of total contribution to each nutrient, and with >80% of accumulated r^2 for each nutrient were selected. Dishes containing any of the 88 foods in the recipe were listed, and a total of 903 dishes were extracted. Among the 903 dishes, 438 dishes contributing >1% of total consumption for each food from the 88-item food list were selected, some of which were combined based on the nutrient content. Finally, 116 dish items were left. Frequency and portion size response choices for items were also determined.

Results: The final 116 dish items consisted of 15 Korean staple dishes, 8 breads, 14 soups and stews, 53 side dishes, 13 dairy products and beverages, and 13 fruits. The percentages of energy, protein, fat,

and carbohydrate consumption from the selected 116 items were 89.2%, 88.4%, 88.2%, and 89.4%, respectively. Nine frequency categories for dish items were included. Standard portion size was based on typical portion sizes for each item as reflected in the distribution of dietary data. In addition, when comparing the food portions of child with the standard portion size, subjects would be asked to select 1 of 3 response categories of less, similar, and more. If either less or more were selected, a percentage of the standard portion was recorded.

Conclusions: Dietary intake of Korean preschool children can be assessed with this new data-based FFQ. In addition, the new instrument can be used to identify nutritional needs of target groups for planning nutrition education and strategies to improve diet. Further studies are warranted to evaluate performance of the instrument.

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The Reproducibility of Taiwanese Online Food Frequency (P20-153)

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Objective: The purpose of this study was to test the reproducibility of an online food-frequency questionnaire (FFQ) for Taiwanese adults.

Methods: The study recruited 106 healthy adults (47 males, 59 females) aged 30–70 y, living in Taipei or New Taipei City area. In the FFQ, itemized frequency and portion size selections were used for all 92 food items, and each portion size was assisted with online food photos. Reproducibility was assessed by test-retest methodology by asking participants to complete the online FFQ on 2 occasions 1 mo apart.

Result: Reproducibility of the 2 online FFQs was moderate. Spearman correlations (median = 0.68) for repeated online FFQ ranged from 0.56 (polyunsaturated fatty acids) to 0.76 (vitamin E). Intraclass correlation coefficients (median = 0.77) ranged from 0.55 (polyunsaturated fatty acids) to 0.85 (vitamin E and calcium). The agreement of the 2 FFQs was high, with the median cross-classification into "exact agreement plus adjacent" being 89% for nutrients. The use of weight κ (median 0.51) indicated moderate agreement, ranging from 0.44 (vitamin A, monounsaturated fatty acids, and polyunsaturated fatty acids) to 0.68.

Conclusions: The results support the utility of the online FFQ as a reproducible tool for Taiwanese adult populations. We will further assess the validity of FFQ with 3-d 24-h recall.

Associations between Ready-to-Eat Cereal Intake and Nutrient Intake in Children 6 Months to 5 Years: Results from NHANES 2009–2014 (P20-154)

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General Mills, Inc.

Background: Investigating the association between key foods consumed by children in infancy and early childhood and health is important for informing upcoming dietary guidelines, US dietary policy, and public health. Ready-to-eat cereal (RTEC) is a common first food for infants and is commonly consumed by young children.

Objective: The aim of this study was to characterize the association between RTEC consumption and nutrient intakes in infants (6–24 mo) and preschool children (2–5 y).

Methods: Based on data from 3 cycles (2009–2010, 2011–2012, and 2013–2014) of NHANES, we classified infants (age 6–24 mo; n = 1160) and preschool children (age 2–5 y; $n = 2372$) as RTEC eaters or noneaters based on 1-d surrogate-completed 24-h dietary recalls. Study weights were applied based on survey methodology published by NHANES. Differences between RTEC eaters and noneaters for each age group were evaluated by t test with $P < 0.05$ considered significant.

Results: We found that 35% (n = 345) and 48% (n = 1146) of children 6–24 mo and 2–5 y, respectively, reported eating RTEC. RTEC eaters 6–24 mo old had higher (compared with noneaters) total daily energy intake as well as calcium, fiber, magnesium, potassium, protein, zinc, whole grains, vitamin E, and B vitamins, but they also had higher sodium and added sugar intake (all $P < 0.05$). RTEC eaters 2–5 y old had the same calorie intake as non-RTEC eaters but higher calcium, fiber, iron, magnesium, vitamin A, vitamin D, zinc, whole grains, and B vitamin intake (all $P < 0.05$). Sodium, added sugar, and saturated fat did not differ. Among RTEC eaters, RTEC contributed 50% of daily whole grain intake for children 6–24 mo old, and 44% of whole grain intake for children 2–5 y old. In addition, RTEC was an important source of iron and B vitamins. RTEC and milk together provided 33% of vitamin D intake, and 18% of daily calcium intake in children 2–5 y old who consumed RTEC. Lastly, there was no significant difference in body mass index z score for RTEC eaters and noneaters for children 2–5 y old.

Conclusion: RTEC is a popular source of important nutrients and whole grains for infants and young children. There is no evidence that RTEC intake is associated with a detrimental effect on body weight.

Funding Sources

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Sources of Total and Added Sugar Intake in the Diet for Ready-to-Eat Cereal Eaters and Noneaters: Results from NHANES 2013–2014 (P20-155)

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Background: Ready-to-eat cereal (RTEC) is a popular breakfast food that is an important source of whole grains and nutrients; despite this, RTEC is frequently criticized for containing added sugar. However, the contribution of RTEC to total and added sugar intake in the diets of children and adults has not been fully characterized.

Objective: The aim of this study was to characterize top sources of total and added sugar in the diets of US children ($n = 1540$), teens ($n = 992$), adults ($n = 5076$), and total population ($n = 7967$) for RTEC eaters and noneaters through the use of NHANES 2013–2014 data. Dietary intake was based on 1-d 24-h recall. Appropriate study weights were applied and differences between RTEC eaters and noneaters for each age group were evaluated by t test, with $P < 0.05$ being considered significant.

Results: RTEC eaters ≥2 y ($n = 1917$) consumed similar amounts of added sugar as non-RTEC eaters (71 g compared with 74 g, $P = 0.28$) but comsumed more total sugar (119 g compared with 110 g, $P = 0.02$). Neither added sugar nor total sugar intake differed between RTEC eaters and noneaters for children and teens. RTEC contributed 4% (3 g) and 3% (3 g) of added and total sugar intake for the total population ≥2 y. Among children, the contribution of RTEC to added sugar intake was 6% (4 g) and for total sugar was 4% (5 g). Added sugar intake did not differ between RTEC eaters and noneaters and this was due in part to decreased intake of added sugar from soft drinks (13 g compared with 20 g, $P = 0.0003$). For the total population, the overall top 5 food categories contributing to added sugar intake were soft drinks (26% of added sugar intake), grain-based desserts (14%), candy and sweets (14%), other beverages (8%), and milk products (excluding yogurt) (7%). RTEC eaters consumed a greater percentage of their total and added sugar at breakfast (25% and 20%, respectively) than non-RTEC eaters (19% and 16%, respectively) but this was compensated for by RTEC eaters consuming proportionally less total and added sugar at snacks and dinner than non-RTEC eaters.

Conclusions: Added sugar intake did not differ between RTEC eaters and noneaters. RTEC eaters compensated for the added sugar contribution of RTEC by consuming less added sugar from other sources, particularly from soft drinks.

Funding Sources

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User Challenges and Opportunities in Implementing the INDDEX24 Mobile Dietary Assessment Platform in Burkina Faso and Viet Nam (P20-156)

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Objectives: This study assessed user challenges and opportunities in implementing a tablet-based method for collecting dietary data in Burkina Faso and Viet Nam. INDDEX24 is comprised of a mobile app to conduct interviewer-administered multiple-pass 24-h dietary recalls (24HR) synchronized to a web app to manage context-specific input databases: food list, food composition table, tag list, and portion conversion factors. The International Dietary Data Expansion (INDDEX) Project is developing the platform to increase the availability, access, and use of dietary and food consumption data globally.

Methods: 24HRs performed with the INDDEX24 version1 mobile app were conducted with adult men and women in rural and urban Burkina Faso ($n = 60$) and Viet Nam ($n = 60$), through the use of context-specific input files prepared by local partners prior to the survey. Feedback from respondents and enumerators was collected after each interview through the use of structured enumerator questionnaires, respondent cognitive debriefs, and enumerator focus groups. The platform was demonstrated for national and global technical experts and feedback sought through focus group discussions.

Results: Participant feedback was supportive of the mobile app for data collection, and highlighted the intuitive app structure. Recommended refinements included improving operating speed to shorten lag between questions and ensuring more complete food and tag lists. Enumerators reported issues with portion size estimation aids and other inputs, including missing foods in the photo atlas, mismatched portion sizes to standard measurements, and difficulty estimating the total amount of a mixed dish after preparation.

Conclusions: The INDDEX24 version 1 mobile app structure holds promise for 24HR surveys across diverse contexts. Ensuring that context-specific inputs are comprehensive and complete before the survey is a challenge regardless of the data collection platform, but is a critical step in the success of any 24HR. The INDDEX24 web app, under development, is envisioned to be a cumulative repository of input data that can, eventually, dramatically reduce the input preparation burden. Results from this study will be used to develop an improved INDDEX24 version 2.

Funding Sources

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Trends in Dietary Fat and Fatty Acid Intakes and Chronic Health Conditions among Korean Adults, a 9-year Profile from 2007 through 2015 (P20–157)

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Objectives: This study investigated trends in intakes of fat and fatty acids and prevalence of chronic health conditions among Korean adults with the use of data from the Korean National Health and Nutrition Examination Survey (KNHANES) for 9 y from 2007 through 2015.

Methods: A total of 47,749 adults (20,024 men and 27,725 women) aged ≥19 y were selected from the 2007–2015 KNHANES data. Dietary data were obtained by a 24-h recall. Intakes of total fat and fatty acids, including saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), n–3 (ω-3) fatty acids (n–3 FAs), and n–6 FAs were calculated based on the Food Composition Table and presented in grams and proportion of energy intake (%E) across 3 survey periods (2007–2009, 2010–2012, and 2013–2015) by sex and age groups. Information on chronic health conditions was obtained from the published data in the Korea Health Statistics 2015. Chronic health conditions included obesity, hypercholesterolemia, and hypertriglyceridemia, and were suggested as age-standardized prevalence from 1998 through 2015 by sex. Intakes of fat and fatty acids were compared across the survey periods by multiple linear regression after adjustment for covariates.

Results: The prevalence of obesity, hypercholesterolemia, and hypertriglyceridemia among Korean adults was 26.0%, 10.0%, and 10.2% in 1998, and 33.2%, 17.9%, and 16.8% in 2015, respectively. From 2007 to 2015, intakes of energy and total fat steadily increased, whereas carbohydrate intake decreased in both sexes. All sex and age groups

showed significant increases in SFA intake: from 11.8 g (5.0%E) to 14.0 g (5.5%E) in men and from 7.8 g (4.5%E) to 10.0 g (5.2%E) in women. PUFA intake increased from 8.7 to 10.7 g, as did the proportion of energy from PUFAs from 4.2% to 4.7%. PUFA intake significantly increased in all sex and age groups except for young adults aged 19–29 y. n–6 FA intake increased in most sex and age groups, whereas n–3 FA intake significantly increased in adults aged ≥50 y.

Conclusions: These findings suggest that total fat and FA intakes in Korean adults have been increasing along with the high prevalence of chronic diseases. This work provides helpful information for development of preventive strategies of diet-related illness.

Funding Sources

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Health, Lifestyle, and Environmental Characteristics of College Vegetarians (P20-158)

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Objectives: The aim of this study was to examine the health and lifestyle characteristics of vegetarian college students in comparison with their nonvegetarian peers, and to explore the environmental conditions associated with adherence to vegetarian and nonvegetarian diets.

Methods: Data were obtained from a baseline survey completed in the fall of 2016 as part of the Get Fruved study. Vegetarians and nonvegetarians were compared based on demographic variables, body mass index (BMI), blood pressure, waist circumference, and scores on the eating attitudes (EAT-26), physical activity (IPAQ), stress (PSS-14), sleep quality (PSQI), fruit/vegetable consumption (NCI FVS), fat consumption (NCI Fat), and campus environment perceptions (CEPS) scales.

Results: Of the total sample of 1155 students, 1118 students (96.8%) from 8 regionally dispersed US universities answered the vegetarian screening question and were included in the subsequent analysis. The prevalence of vegetarianism was 6.2%. Vegetarians had higher odds of being female (OR = 2.62; 95% CI 1.35, 5.08; $P = 0.003$) but were no more likely to be of low affluence. Vegetarians had significantly lower mean BMI (23.1 compared with 24.5 kg/m^2, $P < 0.01$), systolic blood pressure (104.2 compared with 109.5 mm Hg, $P < 0.01$), waist circumference (75.6 compared with 79.5 cm, $P < 0.01$), and consumed fewer calories from fat (29.0% compared with 29.6%, $P < 0.01$). Vegetarians also had higher fruit/vegetable consumption (3.6 compared with 2.4 cup equivalents, $P < 0.01$) and perceived stress scores (27.0 compared with 25.1, $P = 0.03$). No significant differences were observed in diastolic blood pressure ($P = 0.08$), physical activity ($P = 0.26$), sleep quality ($P = 0.69$), disordered eating behaviors ($P = 0.09$), or any of the CEPS subscale scores.

Conclusions: The observed differences between vegetarian and nonvegetarian students in measures of physical health do not appear to be related to differences in lifestyle or campus environment. These results may be of use when developing interventions to improve college students' health and wellbeing, especially in light of the increased prevalence of diet-related diseases in this population.

Funding Sources

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Portion Size Reporting in Dietary Intake Interviews: What We Eat in America, NHANES 2011–2014 (P20-159)

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USDA, ARS, BHNRC, FSRG

Objective: The aim of this study was to compare the use of portion size estimation tools by food and demographic characteristics in What We Eat in America (WWEIA), NHANES.

Methods: USDA's Automated Multiple-Pass Method (AMPM) collects 24-h dietary recalls for the WWEIA, NHANES. The AMPM provides a comprehensive set of portion-size estimation tools for respondents to use to report the amount of the foods/beverages they consumed. This analysis used WWEIA, NHANES 2011–2012 and 2013–2014, day 1 and day 2 dietary data. The study population was 14,161 individuals, aged ≥2 y (excluding breastfed children) with 2 d of complete and reliable intakes. The portion-size estimation tools available in AMPM were organized into 4 groups: portion descriptions, food models, household measures, and liquid and weight measures. Portion descriptions include common food sizes such as item, small, medium, regular, large, and package sizes. USDA Food Models include 2- and 3-dimensional models of serving dishes such as glasses and bowls. Household measures are cups, teaspoons, and tablespoons. Liquid and weight measures include measures such as fluid ounce, liter, and weight ounce. Day 1 interviews are conducted in person based on 3-dimensional models. Day 2 interviews are done by phone based on the 2-dimensional food model booklet.

Results: Overall, the most commonly used portion size estimation tools were portion descriptions, which were used for 45% of the foods/beverages reported; food models were used for 29%, household measures for 17%, and liquid and weight measures for 9%. This pattern was the same for the day 1 and day 2 interviews and for men and women. When looking at foods and beverages separately, portion descriptions were used for 60% of the foods reported but only for 16% of the beverages. This is a sharp contrast to the use of food models, which were used for 47% of the beverages reported, but only 20% of the foods.

Conclusions: This study demonstrates the importance of portion descriptions in reporting the amounts of foods consumed, and the contrasting importance of food models to report the amounts of beverages.

Funding Sources

ARS, USDA.

The Impact of FDA's Updated Nutrient Daily Values on the Nutrition Rich Food (NRF) Index (P20–160)

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Herbalife Nutrition

Objectives: The daily values (DVs) for a number of nutrients have been updated by the FDA in its new nutrition labeling regulation in 2016. As the DVs are used in calculating the Nutrition Rich Food (NRF) index scores, which are commonly used to estimate the nutrient density of foods and dietary quality, the objective of this study was to examine the impact of changes in DVs on the calculation of the NRF index for major food groups and their nutrient density.

Methods: The 9 major USDA food groups (Milk and Milk Products; Meat, Poultry, Fish, and Mixtures; Eggs; Legumes, Nuts, and Seeds; Grain Products; Fruits; Vegetables, Fats, Oils, and Salad Dressings; and Sugar, Sweets, and Beverages) were each represented by the 10 most frequently consumed items by NHANES 2013–14 participants aged $\geq$2 y. Each food's nutrient density was evaluated with the use of the NRF9.3 algorithm, through the use of the old and the new DVs. Paired *t* test was performed to compare the NRF index scores. A priori α level was set as $P \leq 0.05$ for statistical significance.

Results: Calculated NRF index scores were found to be statistically lower with new DVs than old DVs among the most frequently consumed food items in 6 groups: Milk and Milk Products ($P = 0.004$), Meat, Fish, Poultry, and Mixtures ($P = 0.004$), Legumes, Nuts, and Seeds ($P = 0.029$), Grain Products ($P = 0.004$), Fruits ($P = 0.008$), and Sugar, Sweets, and Beverages ($P = 0.031$). No significant changes were found for the food items in the vegetable group ($P = 0.244$). The use of new DVs also resulted in a significant increase in calculated NRF index scores relative to those that used old DVs in the food items in the groups of Eggs ($P < 0.001$), and Fat, Oils, and Salad Dressings ($P = 0.029$).

Conclusions: The changes to the DVs were found to have a significant impact on the NRF index scores for many of the frequently consumed food items in major food groups other than vegetables. Although the impact on the NRF index of each food item may not affect the NRF index of the food group as a whole, the NRF index and other nutrient density scores should be updated constantly to reflect current regulations. Further study is needed to determine if such difference can affect the determination of the nutrition density and dietary quality of different dietary patterns.

Funding Sources

None.

Parental Distress Is Associated with Child Stunting in Indonesia: Results from the Indonesia National Health Survey 2013 (P20-161)

Kun A Susiloretni,[1] Emily Smith,[2] Suparmi Suparmi,[3] Siswanto A Wilopo,[4] and Anuraj H Shankar[1]

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Background: Stunting, an indicator of restricted linear growth, has become a primary measure of childhood undernutrition due to its persistent high prevalence globally, and its importance for health and development. Although the etiology is recognized to be complex, most analyses have focused on biomedical determinants, with limited attention paid to social factors affecting care and nurturing in the home.

Objectives: The aims of this study were to identify whether parental psychological distress is related to linear growth and stunting, document the associated risk factors, and examine the relation between parental distress and behavioral risk factors for stunting.

Design: We used data from the Indonesia National Health Survey 2013, including 54,261 households. Multivariate linear, logistic, and multilevel multinomial logistic regression, through the use of survey weights, were used to assess the relation between parental distress, as assessed by the WHO Self Reporting Questionnaire (SRQ20), with height-for-age *z* score (HAZ), stunting, and behavioral risk factors for stunting.

Results: Maternal, paternal, and parental distress (i.e., both maternal and paternal distress) were associated with reduced linear growth of the children by 0.09, 0.15, and 0.24 *z* scores, respectively. Maternal and paternal distress increased the risk of mild stunting (HAZ < -1) by 34% (RR 1.34; 95% CI: 1.16, 1.54; $P = 0.000$) and 35% (RR 1.35; 95% CI: 1.21, 1.51; $P = 0.000$), and the risk of moderate stunting (HAZ < -2) by 26% (RR 1.26; 95% CI: 1.11, 1.42; $P = 0.000$) and 29% (RR 1.29; 95% CI: 1.11, 1.50; $P = 0.001$), respectively, and parental stress increased the risk of moderate stunting by 47% (RR 1.47; 95% CI: 1.14, 1.90; $P = 0.003$). Risk factors for childhood stunting included infectious disease, nutritional, physiological, behavioral, and social factors. Parental distress was also related to several other behavioral risk factors associated with child stunting.

Conclusions: Parental psychological distress is associated with reduced linear growth and with increases in behavioral risk factors associated with stunting. These data highlight the complex etiology of stunting, and suggest promotion of mental and behavioral health programs for parents would promote child growth and development.

Funding Sources

The Higher Education Network Ring Initiative (HENRI).

Supporting Images/Graphs

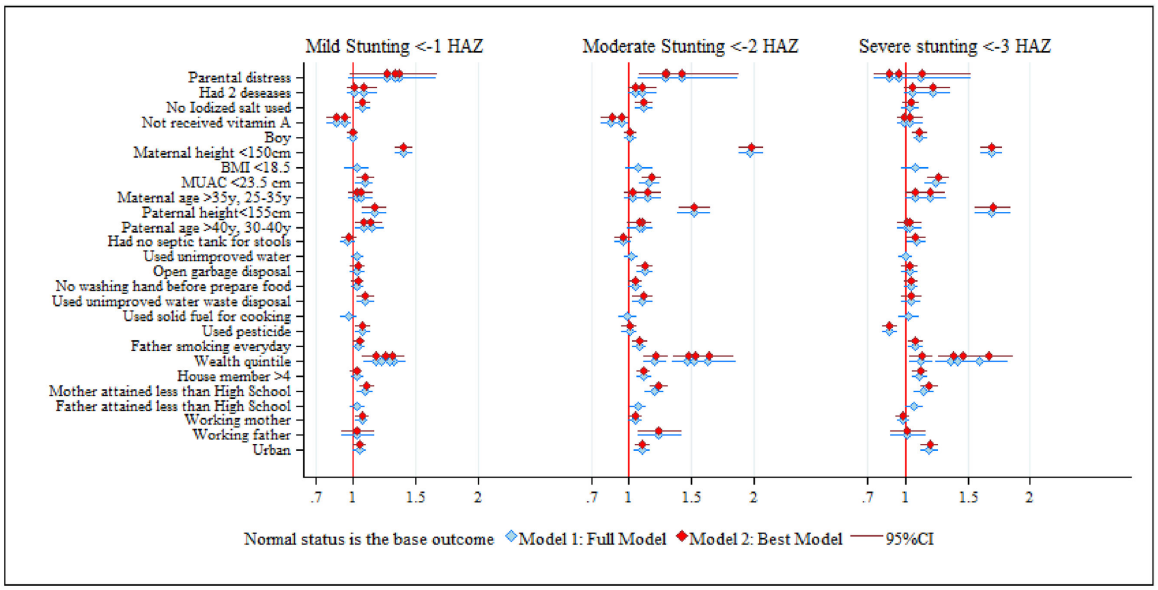

FIGURE P20-161-1 Relative risk ratio of parental distress and other covariates for stunting on children age 6–59 mo.

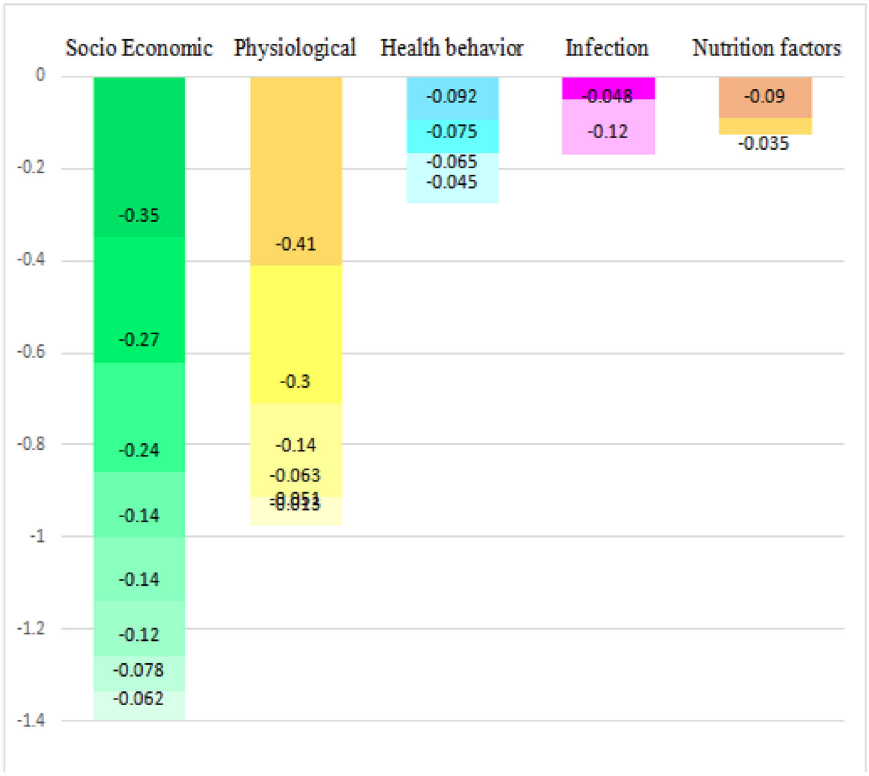

FIGURE P20-161-2 *z* score loss (β coefficient) according to stunting risk factors.

Associations between Consumption of Specific Food Groups and Hemoglobin Level among Rural Ethiopian Children (P20-162)

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Objective: Although it is known that low dietary diversity is among the causes of low hemoglobin levels in young children, evidence linking consumption of specific food groups to hemoglobin level is limited in low-resource settings. The objective of this study was to examine evidence for associations between hemoglobin level, as an indicator of anemia, and consumption of specific food groups among children in rural Ethiopia, where dietary diversity is low.

Methods: Children (n = 372) aged 6–36 mo from poultry-producing rural households participating in the Agriculture to Nutrition (ATONU) project were included in this cross-sectional study. Food consumption over the preceding 24 h and 7 d was assessed with the use of a food-frequency questionnaire. Hemoglobin level was measured in capillary blood with a HemoCue machine. Generalized linear models were used to evaluate the associations between consumption of specific food groups and hemoglobin level in children.

Results: Child food consumption patterns over the preceding 24 h and 7 d revealed high levels of staples (grains, roots, and tubers) (86% and 89%) and low to moderate animal source foods, including meat (4% and 7%), eggs (13% and 26%), and dairy (41% and 47%). Consumption of specific food groups varied across different age groups of children. More than half (56%) of the children had low hemoglobin levels (<11 g/dL). After controlling for confounders, consumption of staples in the preceding 7 d, but not 24 h, was associated with decreased hemoglobin level ($\beta = -0.65$ g/dL; 95% CI: −1.22, −0.10 g/dL). There were no significant associations between consumption of other food groups and hemoglobin level.

Conclusions: Diets based primarily on staple foods, possibly due to lack of other food sources, were associated with decreased hemoglobin levels in children.

Funding Sources

Bill & Melinda Gates Foundation.

Dairy Product Consumption and Colorectal Cancer Risk in the United States (P20-163)

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Objectives: Current evidence suggests an inverse association between total dairy product consumption and colorectal cancer risk; however, evidence on associations with dairy products by fat content or fermentation is limited. We conducted a prospective analysis of associations between dairy consumption and colorectal cancer risk with the use of data from the Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial (PLCO) cohort.

Methods: Prediagnostic dairy product consumption was assessed through a validated diet history questionnaire. Incident colorectal cancer was ascertained through the study's screening visits, local cancer registries, or self-reports. Only pathologically verified cases were included in the analysis. A multivariate Cox regression model was used to estimate HRs and 95% CIs for associations between quartiles of dairy product consumption and colorectal cancer risk, adjusting for colorectal cancer risk factors and trial arm.

Results: Among 101,677 participants (aged 54–83 y), 1033 colorectal cancer cases accrued during the follow-up (median = 12.5 y). Total dairy consumption was inversely associated with colorectal cancer risk (HR = 0.77; 95% CI: 0.65, 0.92 comparing the highest with the lowest quartile; P-trend < 0.01). When dairy consumption was grouped by fat content, an inverse association was observed for low-fat dairy consumption (HR = 0.76; 95% CI: 0.64, 0.90; P-trend < 0.01), but not for high-fat dairy consumption (HR = 0.96; 95% CI: 0.80, 1.14; P-trend = 0.47). Furthermore, fermented dairy consumption was inversely associated with colorectal cancer risk (HR = 0.78; 95% CI: 0.64, 0.94; P-trend < 0.01), but there was no association with nonfermented dairy consumption (HR = 0.87; 95% CI: 0.73–1.03; P-trend = 0.14).

Conclusions: Our findings support a protective effect of dairy product consumption, especially low-fat and fermented dairy products, on colorectal cancer.

Funding Sources

This study was funded by the Oregon Health & Science University/Oregon State University Cancer Prevention and Control Initiative.

Regional Variations in Women's Anemia Prevalence in India: The Role of Cereals (P20-164)

Tinku Thomas,[1] Jithin Varghese,[2] Sumathi Swaminathan,[2] Nivya George,[2] Santu Ghosh,[1] and Anura Kurpad[1]

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Objectives: The National Family Health Survey of India (NFHS) 2015–2016 reports 53% prevalence of anemia in women of reproductive age (WRA). The problem has been perceived to be due to iron intake. As the burden of anemia is high, most interventions aim at universal coverage. This study examined regional variations in anemia prevalence, iron intake, and its attribution to cereal intake among WRA.

Methods: District aggregate data on food intake from an expenditure survey (NSS-Round 68), prevalence of anemia parsed from NFHS 4 district reports, and individual anemia status from District Level Household Survey (DLHS) 4 were used. The dietary nutrient and food group intake at consumer unit level and district level average were computed from NSS-Round 68. Multiple linear regression analyses of anemia prevalence and multilevel logistic regression analysis of individual anemia status in WRA were performed, the latter on household-level triangulated data between DLHS 4 and NSS-Round 68. All analyses were performed in R software, and $P < 0.05$ was considered statistically significant.

Results: The median prevalence of anemia was 52% (Q1: 43; Q3: 60). Iron intake was variable across the districts (mean: 14 mg/d, range 5–33 mg/d). Anaemia prevalence was poorly correlated with iron intake at district level ($r = 0.13$). For the predominantly wheat-eating

northwestern part of India, 55% of dietary iron came from wheat, and median iron intake was high at 17 mg/d (Q1: 15; Q3: 19), although the bioavailability of iron from wheat could range from 5% to 11% (in iron-deficient individuals). An interaction effect of wheat and milk intake was observed such that anemia prevalence was associated with milk intake ($\beta = 7.86$, $P < 0.001$). For eastern and southern coastal regions, rice was a major source of iron (10 mg/dy). Despite the increased intake of iron in the wheat-eating districts, anemia prevalence was high compared with that in the rice-eating districts (56 compared with 50). This association of cereal intake with anemia was confirmed at the individual level through the use of triangulated data.

Conclusions: Iron intake is variable across India based on the cereal consumed by region. Dietary and environmental factors affect the variability of anemia in India, and a small fraction of it is attributable to iron intake. This analysis questions the appropriateness of the universal coverage of iron-based interventions for India.

Funding Sources
Society for Applied Studies, New Delhi.

Association of Milk Consumption and vitamin D Status in the US Population: NHANES 2001–2010 (P20–165)

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Objectives: Vitamin D deficiency increases the risk of rickets in children, and the risk of osteomalacia and osteoporosis in adults. Additionally, vitamin D modulates cell growth, and neuromuscular and immune function. The 2015 Dietary Guidelines for Americans (DGA) identified vitamin D as a nutrient of public health concern. Therefore, DGA encourages higher intake of food sources of vitamin D, such as milk. Accordingly, the objectives of this study were to determine the association of milk consumption and vitamin D status in the US population, and to examine if milk consumers have better vitamin D status than nonconsumers.

Methods: Data from NHANES 2001–2010 were used to perform the current work. Day 1 dietary data were used with exclusions for unreliable data, age <2 y, pregnant or lactating females, missing serum vitamin D data, missing poverty income ratio (PIR), or missing body mass index (BMI). Separate analyses were conducted for the following age groups (gender combined): 2–8, 9–18, ≥19, and ≥71 y. Covariates used in all linear and logistic regressions were: age, gender, ethnicity, PIR, and BMI or BMI *z* score when the population being analyzed was <19 y. SAS 9.2 and SUDAAN 11 were used for all calculations. NHANES survey weights, strata, and primary sampling units were used in all analyses. Significance was set at $P < 0.01$. Milk consumption was determined as the sum of whole, reduced-fat, low-fat and nonfat milks.

Results: Mean milk intake for gender-combined children and adults were as follows: 1.71 cup eq for 2–8 y ($n = 4061$); 1.77 cup eq for 9–18 y ($n = 8700$); 1.37 cup eq for ≥19 y ($n = 20{,}911$); and 1.12 cup eq for ≥71 y ($n = 3454$). Milk consumption was associated with a significantly higher probability of achieving recommended serum vitamin D (>50 nmol/L) concentrations among all age groups (ORs: 1.42, 1.31, 1.31, and 1.35, respectively). Likewise, there was significant linear association between milk consumption and serum vitamin D status among all age groups. Subjects with milk consumption >2 cup eq (2–8 y), >1.99 cup eq (9–18 y), >1.44 cup eq (≥19 y), and >1.2 cup eq (≥71 y) had significantly higher serum vitamin D levels than nonconsumers ($P < 0.0001$).

Conclusions: The results from this study show that increasing milk intake may be an effective strategy to improve the vitamin D status of the US population, reinforcing DGA recommendations.

Funding Sources
National Dairy Council.

Examining Differences in School Hour and School Day Dietary Quality among Canadian Children between 2004 and 2015 (P20-166)

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Background: Since 2004, all Canadian provinces have created policies about what types of foods schools should offer. Nevertheless, little is known about how children's dietary quality on school days has changed over the last decade, or whether dietary outcomes differ by province.

Objectives: This study had the following aims: *1*) to evaluate changes in Canadian children's dietary quality during school hours and on school days between 2004 and 2015; and *2*) to examine whether changes in school hour diet quality were moderated by sociodemographic characteristics, such as sex, age, ethnicity, province of residence, parental education, and food security status.

Methods: Nationally representative 24-h dietary recall data for Canadian children aged 6–17 y were obtained from the 2004 ($n = 4827$) and 2015 ($n = 2447$) Canadian Community Health Surveys. Dietary quality for the full school day was measured based on the Canadian Healthy Eating Index (HEI), a score based on 11 dietary components that examines the totality of foods and beverages consumed and compliance with national dietary recommendations. Multivariable regression models compared differences in HEI scores for the whole school day, and for school hours alone through the use of an adapted school hour HEI (S-HEI). Interaction terms tested the moderating effects of sociodemographic variables on changes in school hour diet quality between 2004 and 2015.

Results: S-HEI scores rose from 51.2 to 57.3 points (maximum = 100) from 2004 to 2015 ($P < 0.001$). S-HEI subscores for grains, total vegetables and fruit, whole fruit, dark green and orange vegetables, milk, and meat products improved over time ($P < 0.001$) but remained well below recommendations, and subscores for whole grains declined ($P < 0.001$). A decrease in the percentage energy from minimally nutritious foods accounted for 43% of the improvement in S-HEI scores. Whole-day HEI scores also improved (60.4 to 64.5 points, $P < 0.001$) from 2004 to 2015. All provinces saw improvements in school hour dietary quality over time, but some provinces saw slightly smaller gains than others (*P*-value for the overall interaction = 0.055). No other sociodemographic variables significantly moderated changes in S-HEI scores.

Conclusions: The average self-reported dietary quality of Canadian children during school hours and on school days improved modestly from 2004 to 2015, but remains below national dietary recommendations.

Funding Sources

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Association between Vitamin D Status and Oral Inflammation in Postmenopausal Women: The Buffalo OsteoPerio Study (P20-167)

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Objectives: Vitamin D is hypothesized to prevent periodontal disease through its immune modulatory mechanisms and its role in calcium homeostasis. Few studies have investigated the association of vitamin D status and local oral inflammation. Our objective was to examine the cross-sectional association between vitamin D status and biomarkers of oral inflammation among postmenopausal women.

Methods: We analyzed data from 710 postmenopausal women who participated in the baseline Buffalo Osteoporosis and Periodontal Disease (OsteoPerio) Study (1997–2000), an ancillary study to the Women's Health Initiative (WHI) Observational Study. Multivariable linear regression was used to examine the association between plasma 25-hydroxyvitamin D [25(OH)D] concentrations and markers of oral inflammation in saliva [matrix metalloprotinease-8 (MMP-8), monocyte-chemoattractant protein-1 (MPC-1), tumor necrosis factor-α (TNF-α), and C-reactive protein (CRP)], assessed through the use of multiplex immunoassays. Salivary proteins were log transformed for normality. Censored data methods were used for concentrations above and below the limits of detection. Multivariable models were adjusted for potential confounders.

Results: We found that 35% of women had deficient or inadequate vitamin D status [25(OH)D $<$ 50 nmol/L]. After adjustment for age, race, hormone use, frequency of brushing, and days since last dental visit, a significant inverse association was observed between 25(OH)D and CRP (7.3% lower CRP per 10nmol/L; 95% CI: 1.8, 12.5, $P = 0.01$). Further adjustment for body mass index, waist circumference, and recreational physical activity, strong predictors of 25(OH)D, attenuated this association (-3.3%; 95% CI: -8.7, 2.6; $P = 0.271$). Similar inverse associations with 25(OH)D were observed for MMP-8, MCP-1, and TNF-α; however, they were not statistically significant.

Conclusion: Vitamin D may be associated with markers of oral inflammation. The roles of adiposity and physical activity need to be further understood.

Diet-Related Prevention Research Funded by the US National Institutes of Health from 2012 to 2017 (P20-168)

Ashley J Vargas, Jennifer Villani, and Sheri D Schully

National Institutes of Health

Objectives: The aim of this study was to describe the landscape of diet-related prevention research proposed by investigators who were awarded US National Institutes of Health (NIH) grants. To our knowledge, this is the largest effort ever undertaken to describe funded diet-related prevention research in humans.

Methods: We characterized $>$9000 representative research grants awarded by NIH that were chosen through the use of a novel machine-learning algorithm trained to predict prevention research in humans. Teams of 3 public health professionals read and coded each grant based on titles, abstracts, and public health relevance statements. Each grant was coded for the type of prevention research, health condition foci, study designs, and whether diet was an outcome or exposure for any research aim. The coded results were extrapolated to describe the entirety of the diet-related prevention research funded by the NIH during fiscal years 2012–2017.

Results: The study of diet was observed to be commonly proposed by NIH grantees who planned to conduct disease prevention research in humans during fiscal years 2012–2017. The most common health conditions focused on in these diet-related grants were obesity, heart disease, and cancer. The aims of these grants were most often observational in nature, but randomized clinical trials were also a common study design proposed by the investigators. Of the few grants developing novel methods for dietary assessment, most focused on biomarkers of food/nutrient intake as opposed to making use of new technology (e.g., cameras, wearables) to improve capture of dietary intake.

Conclusions: NIH Is the largest funder of biomedical research in the world, and frequently invests in diet-related research. As expected, the aims of these diet-related grants were more often hypothesis generating (observational) in nature than testing a dietary intervention. Few grants proposed methods for improving dietary assessment, which is the largest limitation for diet research. Next steps include examining the alignment of the proposed research in these grants with notable gaps in evidence for nutrition- and diet-related policy, and research to determine where needs still exist.

Funding Sources

National Institutes of Health, Office of the Director, Office of Disease Prevention supported this work in full.

Development of a Dashboard Simulating India's Nutrition Scenario and Potential of Fortification Interventions (P20–169)

Jithin Sam Varghese,[1] Rutuja Chhajed,[1] Sumathi Swaminathan,[1] Tinku Thomas,[2] Vinod Kamat,[3] and Anura Kurpad[1]

[1]St John's Research Institute, India; [2]St John's Medical College and Hospital, India; and [3]Tata Trusts, India

Objective: The aim of this study was to develop an interactive and intuitive web dashboard that would assist government stakeholders and researchers to understand the Indian nutrition scenario in terms of supply-demand (agricultural produce-food intake), health outcomes, and optimum levels of priority nutrients for fortifying foods.

Methods: Publicly available datasets on crop production and health outcomes were extracted and preprocessed. A commercial dataset on consumer food expenditure (National Sample Survey, Round 68 Sch.1.0) was purchased from the Ministry of Statistics and Programme Implementation. The food expenditure was translated into food and nutrient intake through the use of Indian Food Composition Tables 2017, USDA SR 28, and proprietary recipe databases. Distribution of food intake within a household was calculated based on age- and gender-specific consumer units. The fortification simulation algorithms were developed based on the IOM Dietary Reference Intakes to assess

risk of both inadequacy as well as adverse effects for any nutrient, level, and vehicle combination. The application was prototyped in Shiny by RStudio, and later scaled with the use of Javascript and PHP with MySQL as the database.

Results: The dashboard presents data for production of 61 crops, 151 foods, 14 nutrients, and 90 indicators relevant for health and nutrition. The Fortification Simulation tab provides functionalities to modify the fortificant level and coverage of interventions for up to 3 fortification vehicles simultaneously. The EAR cut-point method and the probability approach to assess risk of deficient intakes were successfully implemented in R 3.3.3. The fortification simulation algorithm was effectively translated from R to PHP. The algorithm estimates that risk of iron inadequacy in men would decrease from 64.7% to 1.3% in India, whereas the risk of adverse events would increase from 0.005% to 24.4%, with the mandatory fortification of rice, wheat and salt at 3, 3, and 100 mg/100 g of food consumed.

Conclusions: An integrated dashboard of the state of Indian nutrition is now available to inform policy. This is the first application of its kind which uses food expenditure data tailored to a developing country context, and uses the entire distribution of intakes. The dashboard will be refined further to include other datasets associated with understanding the nutrition situation in India.

Funding Sources

Tata Trusts.

Supporting Images/Graphs

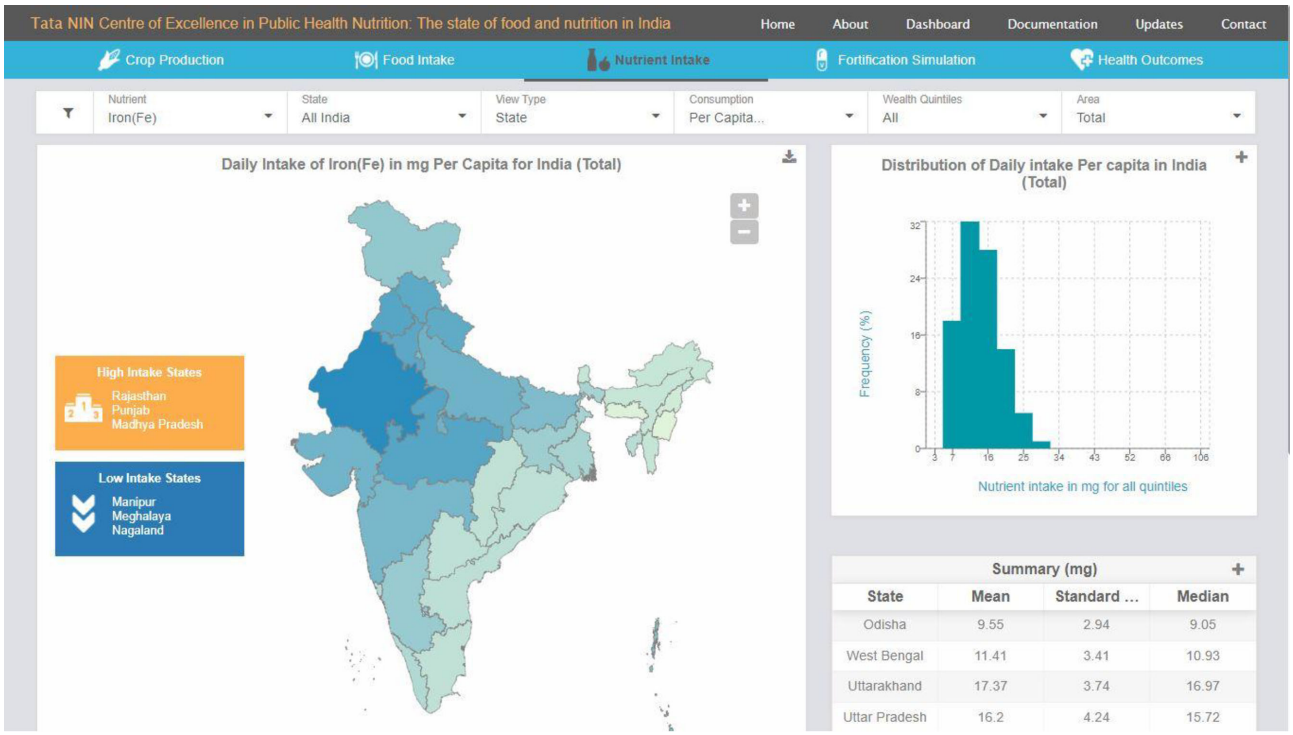

FIGURE P20-169-1 Nutrient intake tab.

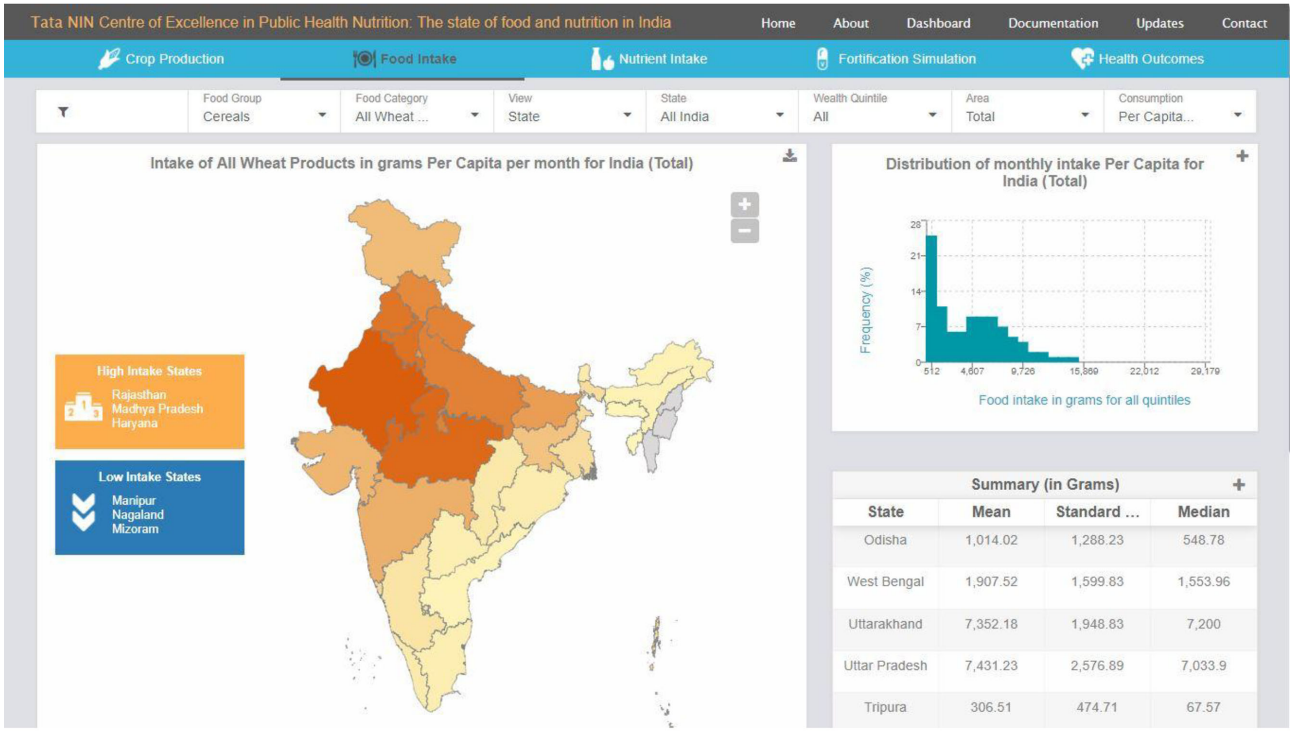

FIGURE P20-169-2 Food intake tab.

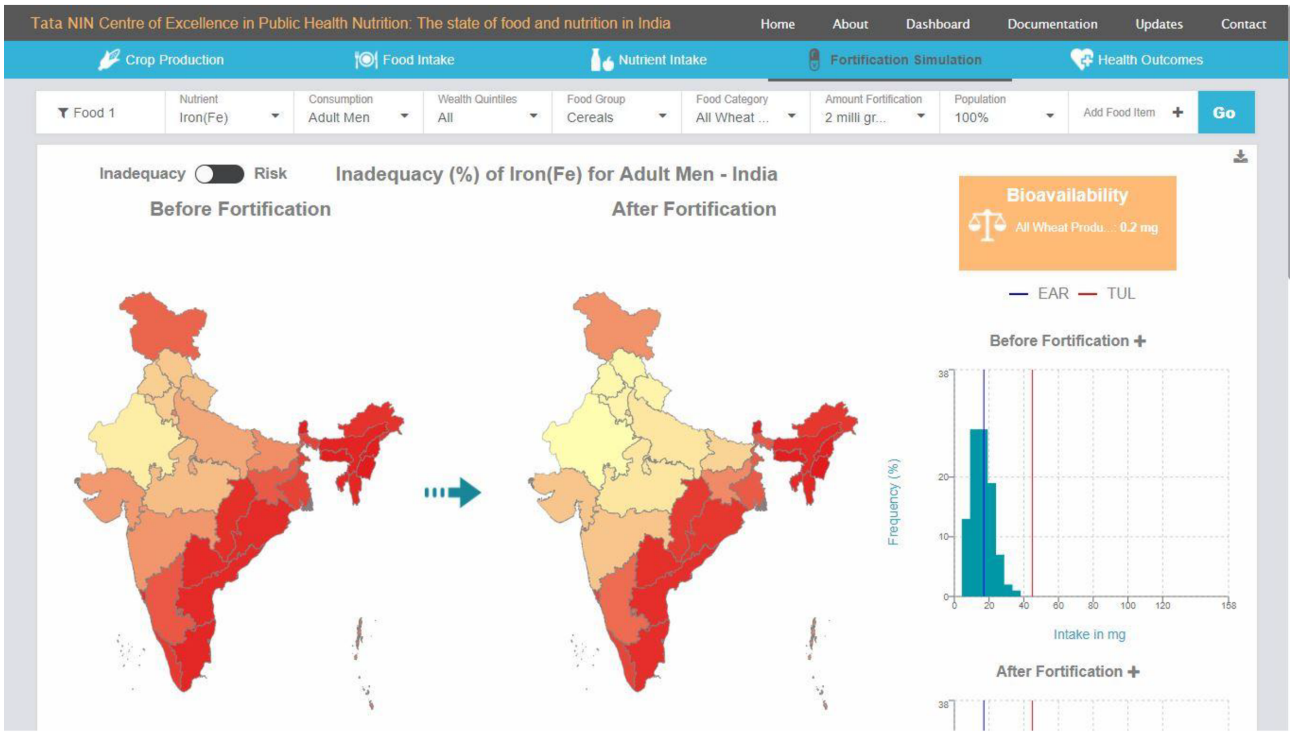

FIGURE P20-169-3 Fortification simulation tab.

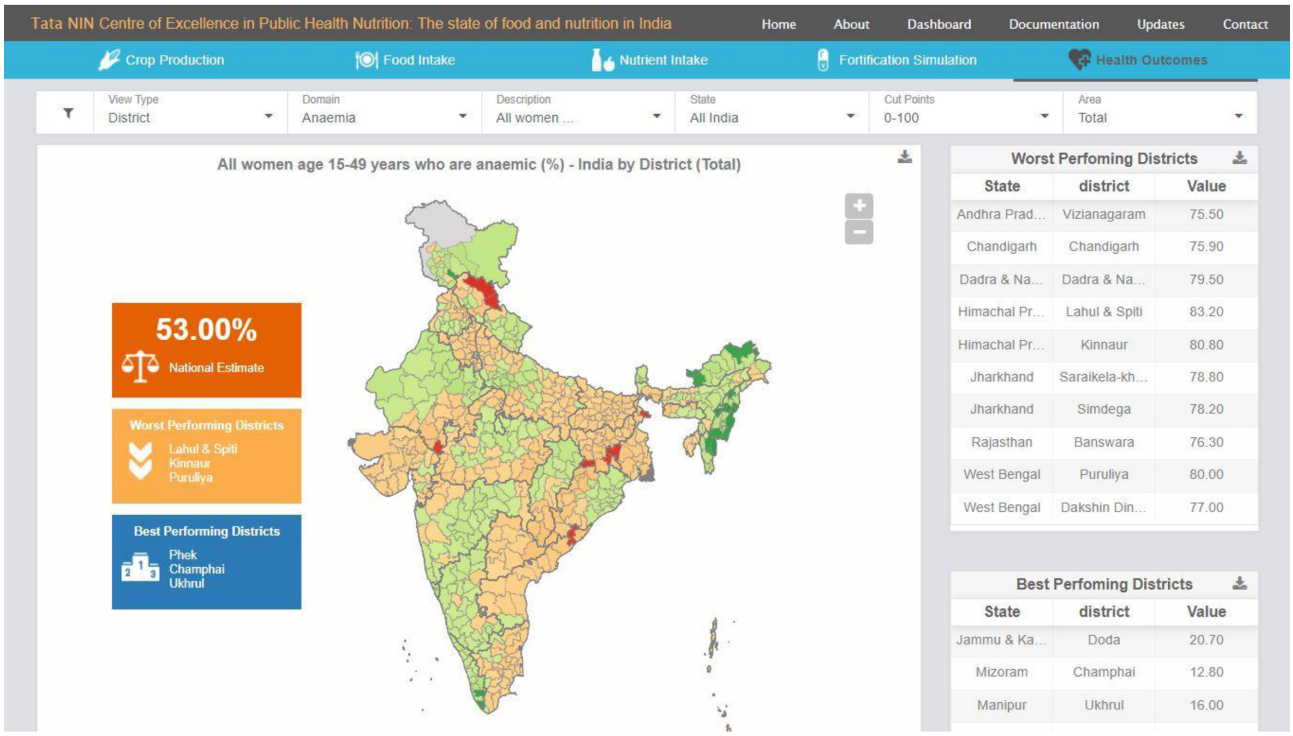

FIGURE P20-169-4 Health outcomes tab.

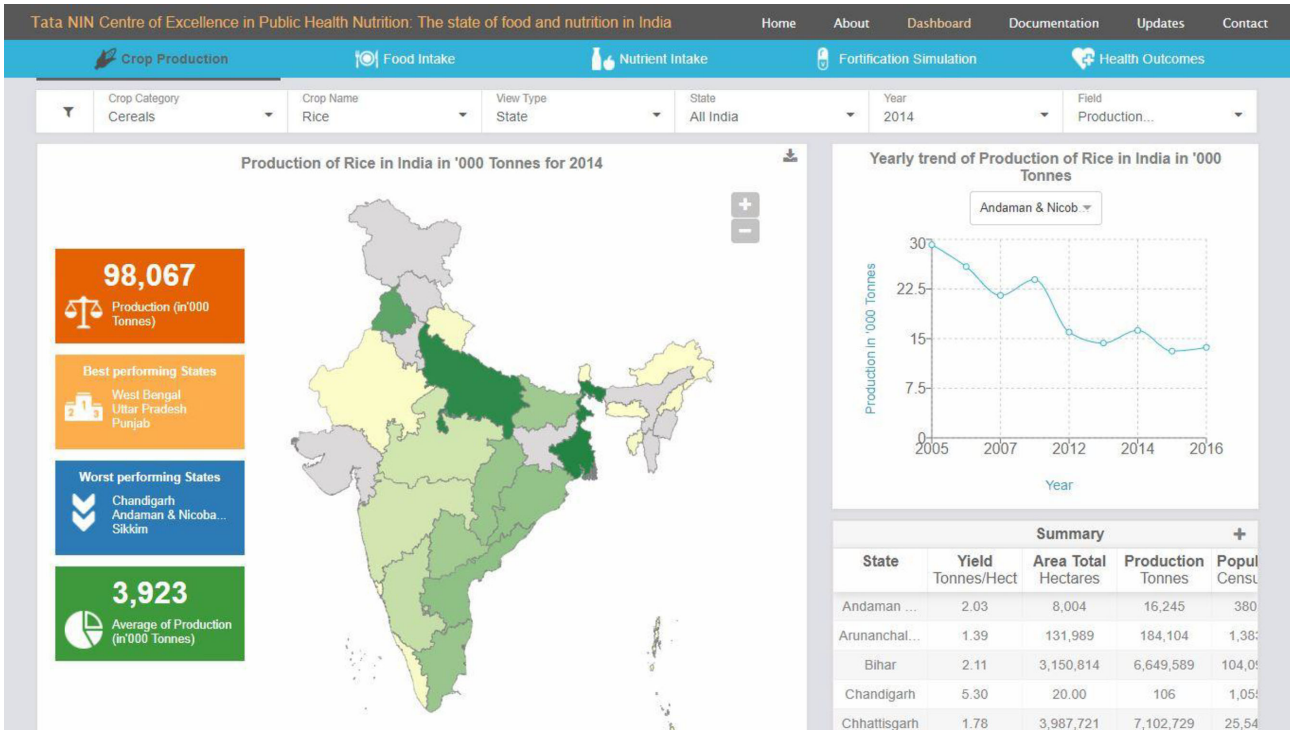

FIGURE P20-169-5 Crop production tab.

Polyphenols from Açaí (*Euterpe oleracea*) and Rooibos (*Aspalathus linearis*) Mitigate the Growth of *Plasmodium* Parasites In Vivo and In Vitro (P20-170)

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Objectives: The aim of this study was to evaluate the antimalarial activity of açaí (*Euterpe oleracea*) and rooibos (*Aspalathus linearis*) polyphenols in in vitro *Plasmodium falciparum* (*Pf)* cultures and in *Plasmodium chabaudi chabaudi (Pc)*–infected mice.

Methods: Sorbitol-synchronized cultures of *Pf* HB3 (chloroquine-sensitive) and Dd2 (chloroquine-resistant) at 1% parasitemia and 2% hematocrit were seeded into 96-well plates, and incubated with açaí (total phenolics, anthocyanins, nonanthocyanic phenolics) and rooibos (total extract) polyphenols [up to 30 mg/L gallic acid equivalents (GAE)] for 48 h. Negative and positive (untreated and 28 nM chloroquine, respectively) controls were included. DNA content was compared by measuring fluorescence with PicoGreen. For in vivo experiments, groups of 5 female C57BL/6JUnib mice (5–7 wk old, 20 ± 3 g) were infected with 10^6 *Pc* AS-sens-infected erythrocytes. Animals were treated via gavage with acai total phenolics at 7.5–20 mg GAE · kg^{-1} · d^{-1} for 10 d. Parasitemia was assessed on day 7 (peak of *Plasmodium* induction) in Giemsa-stained blood smears.

Results: Açaí total phenolics and anthocyanins did not decrease the parasitemia of *Pf* in vitro, whereas açaí nonanthocyanic phenolics exerted antimalarial activity at 10 and 20 mg/L GAE, where culture DNA content was decreased by 38.3%. Rooibos total extract showed in vitro antimalarial activity at concentrations as low as 5 mg/L GAE, where parasitemia was decreased by up to 70.4% in HB3 and 68.1% in Dd2 *Pf*. In vivo, açaí total phenolics significantly decreased parasitemia on day 7 after infection by 62.2 and 77.5% (at 15 and 20 mg GAE · kg^{-1} · d^{-1}, respectively).

Conclusions: Açaí phenolics exert in vitro and in vivo antimalarial activity. Phenolics in rooibos extract also showed antimalarial activity. Further in vitro/in vivo investigations and mechanistic studies are needed to investigate involved mechanisms.

Funding Sources

Texas A&M AgriLife Research Insect Vector Disease grant program.

Cognitive Processes of Respondents in Tablet-Based 24-Hour Dietary Recalls in Burkina Faso and Viet Nam (P20-171)

Sarah Wafa,[1] Winnie Bell,[1] Jennifer Coates,[1] Jerome Some,[1] Brooke Colaiezzi,[1] Cathleen Prata,[1] Zachary Gersten,[1] Ha Thi Phuong Do,[2] and Beatrice L Rogers[1]

[1]Tufts University, MA; and [2]National Institute of Nutrition, Viet Nam

Objective: This research explored respondents' cognitive processes during a tablet-based, interviewer-administered 24-h dietary recall (24HR) in Burkina Faso and Viet Nam, focusing on how respondents recall their previous day's diet. The results elucidate which aspects of the 24HR are challenging to report accurately and why. This information could help improve the accuracy of dietary surveys in low- and middle-income countries (LMICs).

Methods: Cognitive debriefings were conducted with 120 respondents aged 18–65 y in Burkina Faso and Viet Nam after administration of a tablet-based 24HR. Respondents were equally divided between men and women and rural and urban areas in both countries. In Burkina Faso, where eating from a common pot is prevalent, a member of the study team visited the household a day in advance to drop off a standard bowl and plate. Debriefings were recorded, transcribed, and translated. Data analysis used an inductive, thematic analysis methodology, identifying and describing ideas within data to generate themes.

Results: Respondents had no difficulty with the tablet-based administration of the 24HR; the tablet was not distracting. Most believed they were able to remember what they ate, but said it was easier to remember what they ate at home than outside. Respondents found portion size estimation aids (PSEAs) helpful in estimating quantities consumed. Among the PSEAs, most preferred photos. In Burkina Faso, estimating quantities consumed from a common pot was a challenge. The previsit in Burkina Faso helped respondents recall the foods and quantities consumed. Most respondents said the previsit did not affect their food consumption. However, the researcher's request to use a standard plate and bowl before the recall confused some respondents, who thought they were being asked to consume a portion equal to that of the size of the dining utensils.

Conclusion: The cognitive debriefing of respondents demonstrated the acceptability of the use of a tablet to conduct an interviewer-administered 24HR. While respondents generally felt confident in their ability to recall foods consumed the previous day with the aids that the researchers had introduced, further work to validate the accuracy of recalls in rural and urban LMIC settings is warranted.

Funding Sources

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Diet Intake of Nutrients and Risk of Cervical Intraepithelial Neoplasia in a Chinese Population-Based Study (P20–172)

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Objectives: Dietary nutrients play a significant role in carcinogenesis. However, few studies have been conducted to evaluate the association of dietary nutrients and the risk of cervical intraepithelial neoplasia (CIN) and cervical cancer among community-based Chinese women.

Methods: We performed a cross-sectional analysis of baseline data in a total of 40,000 local resident women (married, and aged 19–65 y) in an area with a high incidence of cervical cancer (Shanxi Province, China). Multivariable logistic regressions were modeled to evaluate the relation of dietary factors with CIN risk. Epidemiologic survey, cervical cytologic examination, human papilloma virus (HPV) test and vaginal pH test were used to assess these women; and a food-frequency

questionnaire (FFQ) was used to retrospectively investigate dietary ingredient intake.

Results: Dietary folate after multiple adjustments was negatively associated with CIN II+ risk (OR: 1.57; 95% CI: 1.04, 2.35). Dietary vitamin B-6 was associated with CIN II+ risk (OR: 1.64; 95% CI: 1.09, 2.48); vitamin C was associated with CIN II+ risk (OR: 1.57; 95% CI: 1.03, 2.37); niacin was associated with CIN II+ risk (OR: 1.68; 95% CI: 1.11, 2.55); vitamin K was significantly associated with CIN II+ risk, albeit displaying a reverse U-shaped relation.

Conclusion: Dietary nutrients associated with the risk of CIN supported the hypothesis that the nutrition shortage of the dietary folate, vitamin B-6, vitamin C, niacin, and vitamin K affected CIN II+ risk in an area with a high incidence of cervical cancer in China. Diet and nutrition factors should be added to risk stratification when counseling women about the risk of carcinogenesis.

Funding Sources

Early warning model for the development of cervical intraepithelial neoplasia and multicenter study on the optimization of treatment strategies. Chinese Clinical Trial Register (ChiCTR), ChiCTR-ROC-15006479.

Supporting Images/Graphs

Characteristics[a]	Without CIN	CIN I	CIN II+	Total
No. of participants	1,503 (65.2)	564 (24.5)	237 (10.3)	2,304(100.0)
Age (years)				
< 30	36 (1.6)	19 (0.8)	3 (0.1)	58 (2.5)
30-39	180 (7.8)	63 (2.7)	41 (1.8)	284 (12.3)
40-49	441 (19.1)	175 (7.6)	95 (4.1)	711 (30.9)
50-59	666 (28.9)	231 (10.0)	73 (3.2)	970 (42.1)
> 60	180 (7.8)	76 (3.3)	25 (1.1)	281 (12.2)
Education years				
0-6	309 (13.4)	117 (5.1)	46 (2.0)	472 (20.5)
7-9	630 (27.3)	239 (10.4)	127 (5.5)	996 (43.2)
> 9	564 (24.5)	208 (9.0)	64 (2.8)	836 (36.3)
Annual family salary				
< 10,000	173 (7.5)	65 (2.8)	24 (1.0)	262 (11.4)
10,000-30,000	738 (32.0)	255 (11.1)	126 (5.5)	1119 (48.6)
> 30,000	592 (25.7)	244 (10.6)	87 (3.8)	923 (40.1)
Smoker	29 (1.3)	12 (0.5)	8 (0.3)	49 (2.1)
Menopause status	803 (34.9)	293 (12.7)	78 (3.4)	1174 (51.0)
High-risk HPV				
Positive	429 (18.6)	168 (7.3)	158 (6.9)	755 (32.8)
Negative	1074 (46.6)	396 (17.2)	79 (3.4)	1549 (67.2)
Age at Menarche	15.1±2.1	15.0±2.3	14.6±1.9	15.0±2.1
<13	181 (7.9)	93 (4.0)	34 (1.5)	308 (13.4)
13-<15	466 (20.2)	180 (7.8)	93 (4.0)	739 (32.1)
15-<17	452 (19.6)	133 (5.8)	69 (3.0)	654 (28.4)
>17	404 (17.5)	158 (6.9)	41 (1.8)	603 (26.2)
IUD use	735 (31.9)	231 (10.0)	115 (5.0)	1081 (46.9)
Years of IUD use				
<10,	1037 (45.0)	426 (18.5)	169 (7.3)	1632 (70.8)
≥10	466 (20.2)	138 (6.0)	68 (3.0)	672 (29.2)
SCJ visibility				
fully visualized	382 (16.6)	185 (8.0)	79 (3.4)	646 (28.0)
not fully visualized	1121 (48.7)	379 (16.4)	158 (6.9)	1658 (72.0)
Vaginal PH				
<5	939 (40.8)	342 (14.8)	175 (7.6)	1456 (63.2)
≥5	564 (24.5)	222 (9.6)	62 (2.7)	848 (36.8)
Had Gynecologic surgery	255 (11.1)	107 (4.6)	35 (1.5)	397 (17.2)

FIGURE P20-172-1 Characteristics of participants with cervical histologic examination among 2304 women in the study ($n = 2304$).

Had vaginitis	82 (3.6)	38 (1.6)	20 (0.9)	140 (6.1)
Sexual behavior in menstrual period	39 (1.7)	9 (0.4)	8 (0.3)	56 (2.4)
Folate (μg/day)	382.8 (298.8-727.2)	383.4 (300.3-804.8)	358.9 (283.8-836.5)	381.0
Vitamin B1 (mg/day)	1.5(1.1-2.7)	1.4(1.2-2.9)	1.3(1.1-2.6)	1.5
Vitamin B2 (mg/day)	1.4(1.1-2.7)	1.4(1.1-2.8)	1.3(1.0-2.8)	1.4
Vitamin B6 (mg/day)	2.1(1.7-3.8)	2.1(1.7-4.0)	1.9(1.6-4.2)	2.1
Vitamin C (mg/day)	62.9 (45.8-135.9)	63.8 (47.6-143.3)	59.4 (43.2-148.2)	62.8
Vitamin E (mg/day)	8.6(4.2-21.8)	9.0(4.9-21.5)	8.8(5.4-21.7)	8.8
Vitamin K (μg/day)	201.2 (127.0-519.4)	197.1 (134.1-569.4)	187.2 (127.7-560.6)	198.2
Niacin (mg/day)	22.0(18.1-42.5)	21.7(17.8-43.3)	21.3(17.5-42.5)	21.9
Dietary fiber (g/day)	34.8(27.5-62.8)	34.4(27.5-65.8)	32.1(26.0-62.4)	34.5

HPV: Human Papillomavirus; Vaginal PH: Vaginal potential of hydrogen; CIN: Cervical intraepithelial neoplasia; IUD: Intrauterine device; SCJ: Squamous-columnar junction

[a]: Data were presented as Median with range (Q1-Q4) or n (%).

FIGURE P20-172-2 Characteristics of participants with cervical histologic examination among 2304 women in the study (n = 2304).

	Q1	Q2	Q3	Q4	P for trend
Folate					
Median per day intake, μg	297	381	488	764	
No. of cases	132	147	139	146	
Model 1[1]	0.92(0.70-1.21)	1.01(0.77-1.33)	0.92(0.70-1.21)	1.00(reference)	0.828
Model 2[2]	0.96(0.72-1.26)	1.04(0.79-1.37)	0.92(0.70-1.21)	1.00(reference)	0.837
Model 3[3]	0.95(0.71-1.26)	1.04(0.79-1.38)	0.92(0.69-1.21)	1.00(reference)	0.799
Vitamin B1					
Median intake, mg per day	1.1	1.4	1.9	2.7	
No. of cases	134	157	132	141	
Model 1[1]	0.96(0.73-1.27)	1.20(0.92-1.57)	0.88(0.67-1.15)	1.00 (reference)	0.140
Model 2[2]	1.01(0.77-1.34)	1.21(0.92-1.59)	0.88(0.67-1.16)	1.00 (reference)	0.148
Model 3[3]	1.03(0.78-1.37)	1.23(0.94-1.62)	0.87(0.66-1.15)	1.00 (reference)	0.101
Vitamin B2					
Median intake, mg per day	1.1	1.4	1.8	2.7	
No. of cases	123	148	157	136	
Model 1[1]	0.88(0.66-1.16)	1.10(0.84-1.45)	1.14(0.87-1.50)	1.00 (reference)	0.240
Model 2[2]	0.92(0.69-1.22)	1.12(0.85-1.48)	1.15(0.87-1.51)	1.00 (reference)	0.350
Model 3[3]	0.90(0.68-1.21)	1.11(0.84-1.48)	1.15(0.87-1.51)	1.00 (reference)	0.323
Vitamin B6					
Median intake, mg per day	1.7	2.1	2.6	3.9	
No. of cases	144	146	131	143	
Model 1[1]	1.04(0.79-1.36)	0.99(0.76-1.30)	0.90(0.69-1.19)	1.00 (reference)	0.787
Model 2[2]	1.10(0.83-1.44)	1.05(0.79-1.38)	0.90(0.68-1.18)	1.00 (reference)	0.526
Model 3[3]	1.10(0.83-1.45)	1.04(0.79-1.37)	0.91(0.69-1.20)	1.00 (reference)	0.604
Vitamin C					
Median intake, mg per day	46.0	62.8	86.9	138.9	
No. of cases	124	149	145	146	
Model 1[1]	0.85(0.65-1.13)	1.05(0.81-1.38)	1.01(0.77-1.33)	1.00 (reference)	0.463
Model 2[2]	0.89(0.67-1.19)	1.10(0.84-1.44)	1.05(0.80-1.37)	1.00 (reference)	0.521
Model 3[3]	0.86(0.65-1.15)	1.09(0.83-1.44)	1.05(0.80-1.38)	1.00 (reference)	0.403
Vitamin E					
Median intake, mg per day	4.4	8.8	10.8	21.7	
No. of cases	131	135	151	147	
Model 1[1]	0.82(0.63-1.09)	0.86(0.65-1.13)	1.08(0.83-1.42)	1.00 (reference)	0.174
Model 2[2]	0.84(0.64-1.11)	0.86(0.65-1.14)	1.10(0.84-1.44)	1.00 (reference)	0.177
Model 3[3]	0.85(0.64-1.13)	0.86(0.64-1.13)	1.13(0.86-1.48)	1.00 (reference)	0.142

FIGURE P20-172-3 ORs and 95% CIs for quintiles of dietary multivitamin intake with cervical intraepithelial neoplasia (grade I) risk among 2304 women in the study.

	Quintile				
	Q1	**Q2**	**Q3**	**Q4**	**P for trend**
Folate					
Median intake, μg per day	297	381	488	764	
No. of cases	75	57	49	56	
Model 1[1]	1.36(0.93-1.98)	1.02(0.69-1.52)	0.84(0.56-1.27)	1.00 (reference)	0.097
Model 2[2]	1.45(0.99-2.12)	1.06(0.71-1.60)	0.86(0.57-1.30)	1.00 (reference)	0.059
Model 3[3]	1.57(1.04-2.35)	1.17(0.77-1.78)	0.96(0.62-1.48)	1.00 (reference)	0.072
Vitamin B1					
Median intake, mg per day	1.1	1.4	1.9	2.7	
No. of cases	72	72	35	58	
Model 1[1]	1.26(0.86-1.82)	1.34(0.92-1.95)	0.57(0.36-0.88)	1.00 (reference)	0.001
Model 2[2]	1.29(0.88-1.89)	1.30(0.89-1.91)	0.54(0.35-0.85)	1.00 (reference)	0.000
Model 3[3]	1.48(0.98-2.24)	1.31(0.87-1.97)	0.58(0.36-0.93)	1.00 (reference)	0.000
Vitamin B2					
Median intake, mg per day	1.1	1.4	1.8	2.7	
No. of cases	62	63	51	61	
Model 1[1]	0.99(0.67-1.44)	1.05(0.72-1.53)	0.82(0.56-1.23)	1.00 (reference)	0.680
Model 2[2]	1.06(0.72-1.57)	1.09(0.74-1.61)	0.88(0.58-1.32)	1.00 (reference)	0.737
Model 3[3]	1.21(0.80-1.83)	1.10(0.73-1.66)	0.95(0.62-1.46)	1.00 (reference)	0.692
Vitamin B6					
Median intake, mg per day	1.7	2.1	2.6	3.9	
No. of cases	69	65	47	56	
Model 1[1]	1.27(0.87-1.86)	1.13(0.77-1.66)	0.83(0.55-1.25)	1.00 (reference)	0.181
Model 2[2]	1.39(0.94-2.05)	1.21(0.81-1.79)	0.86(0.57-1.31)	1.00 (reference)	0.097
Model 3[3]	1.64(1.09-2.48)	1.35(0.89-2.05)	0.95(0.61-1.46)	1.00 (reference)	0.031
Vitamin C					
Median intake, mg per day	46.0	62.8	86.9	138.9	
No. of cases	73	56	57	51	
Model 1[1]	1.44(0.98-2.11)	1.13(0.76-1.70)	1.14(0.76-1.71)	1.00 (reference)	0.295
Model 2[2]	1.54(1.03-2.28)	1.14(0.76-1.73)	1.15(0.76-1.73)	1.00 (reference)	0.165
Model 3[3]	1.57(1.03-2.37)	1.16(0.75-1.78)	1.12(0.73-1.72)	1.00 (reference)	0.159
Vitamin E					

FIGURE P20-172-4 ORs and 95% CIs for quintiles of dietary multivitamin intake with cervical intraepithelial neoplasia (grade II+) risk among 2304 women in the study.

Median intake,mg per day	4.4	8.8	10.8	21.7	
No. of cases	50	67	59	61	
Model 1[1]	0.76(0.51-1.13)	1.03(0.71-1.50)	1.02(0.69-1.50)	1.00 (reference)	0.397
Model 2[2]	0.89(0.59-1.34)	1.06(0.71-1.56)	1.10(0.74-1.62)	1.00 (reference)	0.758
Model 3[3]	0.92(0.60-1.41)	1.24(0.82-1.87)	1.11(0.73-1.66)	1.00 (reference)	0.539
Vitamin K					
Median intake, μg per day	133.0	194.0	285.0	534.0	
No. of cases	61	71	51	54	
Model 1[1]	1.10(0.75-1.63)	1.40(0.99-2.12)	0.93(0.62-1.40)	1.00 (reference)	0.110
Model 2[2]	1.14(0.76-1.71)	1.53(1.04-2.26)	0.96(0.63-1.45)	1.00 (reference)	0.075
Model 3[3]	1.31(0.86-2.02)	1.68(1.11-2.54)	1.20(0.78-1.86)	1.00 (reference)	0.093
Niacin					
Median intake,mg per day	17.7	21.6	27.9	42.8	
No. of cases	68	60	54	55	
Model 1[1]	1.30(0.89-1.91)	1.10(0.74-1.63)	0.96(0.64-1.43)	1.00 (reference)	0.401
Model 2[2]	1.40(0.95-2.08)	1.13(0.76-1.69)	0.92(0.61-1.39)	1.00 (reference)	0.173
Model 3[3]	1.68(1.11-2.55)	1.35(0.88-2.06)	1.05(0.68-1.62)	1.00 (reference)	0.049
Dietary Fiber					
Median intake, g per day	27.4	34.5	43.7	63.2	
No. of cases	68	64	49	56	
Model 1[1]	1.23(0.84-1.81)	1.18(0.80-1.73)	0.84(0.56-1.26)	1.00 (reference)	0.216
Model 2[2]	1.30(0.88-1.93)	1.19(0.80-1.77)	0.82(0.54-1.24)	1.00 (reference)	0.121
Model 3[3]	1.48(0.97-2.24)	1.21(0.79-1.85)	0.92(0.60-1.42)	1.00 (reference)	0.128

Abbreviations: CIN= cervical intraepithelial neoplasia; CI= confidence interval.
Model 1[1]: odds ratios unadjusted;
Model 2[2]: odds ratios adjusted for education years; annual family salary; smoker; age at menarche; menopause status;
Model 3[3]: additionally odds ratios adjusted for age; high-risk HPV; IUD use; years of IUD use; SCJ visibility; vaginal PH; Sexual behavior in menstrual period; had gynecologic surgery; had vaginitis.

FIGURE P20-172-5 ORs and 95% CIs for quintiles of dietary multivitamin intake with cervical intraepithelial neoplasia (grade II+) risk among 2304 women in the study.

The Association between Cow's Milk-Fat Percentage and Non-High-Density Lipoprotein Cholesterol during Early Childhood (P20-173)

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Objectives: The primary objective of this study was to determine the association between cow's milk-fat and non-high-density lipoprotein (HDL) cholesterol, a marker of cardiovascular disease (CVD) risk, during early childhood. The secondary objective was to determine whether this association was mediated by the volume of cow's milk consumed.

Methods: A longitudinal study in 2- to 8-y-old children was conducted through The Applied Research Group for Kids (TARGet Kids!), a practice-based research network in Toronto, Canada. Generalized estimating equations were used to examine the relation between parent-reported cow's milk-fat percentage intake and serum non-HDL cholesterol levels as well as incident high non-HDL cholesterol ($\geq$145 mg/dL), adjusting for covariates including age, sex, body mass index *z* score, duration of breastfeeding, mother's ethnicity, and parental history of CVD. Bootstrap resampling (10,000 repetitions) was used to assess whether cow's milk volume mediated the association between cow's milk-fat percentage and non-HDL cholesterol.

Results: Among 2890 children, 156 (5.4%) had high non-HDL cholesterol. Each percentage point increase in cow's milk-fat percentage was associated with a 1.35 mg/dL (95% CI: 0.62, 2.09 mg/dL; $P < 0.001$) and 0.97 mg/dL (95% CI: 0.19, 1.70 mg/dL; $P = 0.01$) increase in non-HDL cholesterol, unadjusted and adjusted for covariates, respectively. Cow's milk-fat percentage was not associated with greater odds of incident high non-HDL cholesterol, unadjusted (OR: 1.10; 95% CI: 0.95, 1.26) and adjusted (OR: 1.04; 95% CI: 0.89, 1.21) for covariates. In the mediation analysis, volume of cow's milk partially mediated the association between cow's milk-fat percentage and non-HDL cholesterol, accounting for 28% of the relation ($P < 0.001$).

Conclusions: Consumption of higher-fat cow's milk was associated with a small increase in non-HDL cholesterol concentration but not greater odds of incident high non-HDL cholesterol. These findings suggest that consuming higher-fat cow's milk may contribute minimally

to cardiovascular risk in children. Further research is needed to assess these findings in relation to other CVD risk factors during early childhood.

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Effects of Branched-Chain Amino Acids on Glucose Metabolism in Obese, Prediabetic Men and Women (P20-174)

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Objectives: Recent studies have shown that there is an increased circulation of branched-chain amino acids (BCAAs) in obese individuals, and this is associated with impaired glucose metabolism. However, it is not known if supplementation with additional BCAAs will further impair glucose metabolism. The purpose of this pilot study was to determine the effects of BCAA supplementation on body weight, body composition, and glucose metabolism in obese, prediabetic individuals.

Methods: This is a randomized, crossover study with 12 obese individuals with prediabetes. Participants ($n = 12$) were randomly assigned to daily supplement with 20 g BCAA or protein low in BCAA control (i.e., 4 g BCAA) for 4 wk, then switched to the other group for 4 wk after a 2-wk washout. Subjects were asked to maintain consistent consumption of calorie and protein for the duration of the study. During each visit, body weight, and body composition were recorded, and an oral glucose tolerance test (OGTT) was performed. Collected blood samples were used to measure glucose, insulin, biomarkers such as nerve growth factor (NGF), tumor necrosis factor-α (TNF-α), interleukin (IL)-6, IL-8, and monocyte chemoattractant protein (MCP-1).

Results: There were no significant changes in body weight, body fat, and muscle mass after 4-wk supplementation of BCAA compared with control. Serum glucose response to OGTT was evaluated by area under the curve (AUC: 0, 30, 60, 90 and 120 min). Compared with control, BCAA supplementation showed a trend to normalize the serum glucose response during OGTT ($P = 0.055$). Although not significant, the serum levels of NGF, which is associated with insulin resistance, tend to have a larger decrease by BCAA supplementation compared with control (BCAA: $-29.85 \pm 9.98\%$, compared with control: $-9.63 \pm 8.84\%$, $P = 0.078$). In addition, serum cytokines such as TNF-α, IL-6, IL-8, and MCP-1 were also not significantly different between BCAA supplementation and control.

Conclusion: Together, our data suggested that BCAA supplementation did not impair insulin resistance in obese, prediabetic subjects. Further larger studies are needed to confirm the results seen in the present study.

Funding Sources

Department of Medicine, UCLA Center for Human Nutrition.

Validity of a Semiquantitative Food-Frequency Questionnaire in Japan (P20-175)

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Objective: The aim of this study was to validate a 167-food item semiquantitative food-frequency questionnaire (FFQ) intended to be used to measure the effects of nutrition intervention programs and policies in Japan.

Method: We developed the FFQ as a tool to be able to assess habitual nutrient intakes of residents in Japan. The FFQ was administered twice to 131 participants in Nagasaki Prefecture at an interval of ∼1 y (2013–2014). Twelve 24-h recalls, which served as our comparison method for each subject, were collected during the study period at ∼4-wk intervals and on the same day of the week. Diet information by the 24-h recall was reviewed each time by a registered dietitian through interview, telephone, or fax. Food items for the food list for the questionnaire were chosen focusing on nutrients associated with lifestyle-related diseases and based on information from public health nutritionists nationwide and in the study areas. The nutrient intakes were computed from the 2015 Japanese standard tables of food composition. To evaluate the validity of the FFQ we calculated Pearson's coefficients by use of nutrient density measures. After obtaining of the mean nutrient intakes from the two FFQs and the twelve 24-h recalls, we calculated the percentage of energy intake for protein, carbohydrate, and specific types of fat. For folate we calculated μg/1000 kcal.

Results: Preliminary analyses show that correlation coefficients between the intakes of nutrients measured by the 2 methods are 0.55 ($P < 0.0001$) for protein, 0.45($P < 0.0001$) for carbohydrate, 0.54 ($P < 0.0001$) for total fat, 0.60 ($P < 0.0001$) for saturated fat, 0.49 ($P < 0.0001$) for monounsaturated fat, 0.43 ($P < 0.0001$) for polyunsaturated fat, 0.18 ($P < 0.036$) for cholesterol, and 0.51 ($P < 0.0001$) for folate. Statistical analyses were conducted with SAS.

Conclusions: We found reasonable correlations between the intakes of nutrients measured by the 2 methods. Further analyses are needed to fully evaluate the performance of this FFQ.

Funding Sources

University of Nagasaki President Education Research Funds 2014, 2015, and 2016.

Racial Differences in Seafood, and EPA and DHA ω-3 Fatty Acid Consumption in US Childbearing-Age Women (P20-176)

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Background: The Dietary Guidelines for Americans (DGA 2015–2020) recommend that the general population consume ∼8 ounces (227 g) of a variety of seafood weekly [providing ∼250 mg eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) ω-3 (n–3) fatty acids per day] for heart health, and that pregnant and lactating women consume at least 8 ounces of various seafood weekly that are sources of DHA for infant health. According to a Pew Research report,

the US Asian population grew with the fastest rate among the major racial/ethnic categories. However, the intake of seafood, and EPA and DHA among the US Asian population is limited.

Objective: The present study was conducted to determine and compare the consumption of seafood, and EPA and DHA among the Asian childbearing-age women with other racial/ethnic groups.

Methods: Childbearing-age women 15–44 y from NHANES 2011–2014 were included.

Results: The mean ± SE intakes of seafood were higher among the Asian childbearing-age women ($n = 397$; 1.11 ± 0.15 oz eq/d), followed by non-Hispanic black ($n = 695$; 0.82 ± 0.13 oz eq/d), Hispanics (Mexican Americans and other Hispanics combined; $n = 741$; 0.47 ± 0.06 oz eq/d), and non-Hispanic white ($n = 983$; 0.34 ± 0.04 oz eq/d). The mean intakes of EPA and DHA from foods alone were significantly higher among the Asian childbearing-age women (147.22 ± 24.22 mg/d) than among the other racial/ethnic groups, followed by non-Hispanic black (95.11 ± 13.01 mg/d), Hispanics (62.32 ± 6.19 mg/d), and non-Hispanic white (54.56 ± 6.13 mg/d). The mean intakes of EPA and DHA from combined foods and dietary supplements were also significantly higher among the Asian childbearing-age women (183.12 ± 22.76 mg/d) than among the other groups, followed by non-Hispanic black (107.12 ± 13.24mg/d), non-Hispanic white (82.08 ± 6.52 mg/d), and Hispanics (80.81 ± 7.61 mg/d).

Conclusions: These results suggest that Asian childbearing-age women consumed more seafood, and EPA and DHA than other racial/ethnic groups, but many childbearing-age women among racial/ethnic groups in the United States still consume less than the DGA 2015–2020 recommendation.

Funding Sources

This study is supported by the Nature's Bounty Co. The dietary data analysis was conducted by Nutrition Impact LLC.

Fatty- and Lean-Fresh Red Meat Intakes Are Differentially Associated with Blood Pressure among Chinese Adults (P20-177)

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National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention

Objectives: Observational studies have linked higher intakes of red meat to higher blood pressure; however, studies on the different roles of fatty and lean red meat intake are limited. We assessed in this study the longitudinal associations between fatty- and lean-fresh red meat (FRM) intake and blood pressure among Chinese adults.

Methods: Our data are from 16,059 adults aged 18–65 y in the China Health and Nutrition Survey from 1991 to 2011. We assessed intakes of fatty-FRM (≥10 g fat/100 g) and lean-FRM (<10 g fat/100 g) with three 24-h dietary recalls.

Results: Multilevel mixed-effect regressions showed that men had a significant systolic blood pressure (SBP) decrease of 0.73 mm Hg (95% CI: −1.37, −0.09 mm Hg) only in the first quartile of lean-FRM intake compared with nonconsumers, and a diastolic blood pressure (DBP) increase of 0.48 mm Hg (95% CI: 0.09, 0.87 mm Hg, $P = 0.03$) in the top quartile of fatty-FRM intake, after adjustment for all potential confounders. In contrast, women showed a significant SBP decrease of 1.03 mm Hg (95% CI: −1.66, −0.39 mm Hg) in the third quartile of lean-FRM intake, and a DBP decrease of 0.58 mm Hg (95% CI: −1.02, −0.14 mm Hg) only for the bottom quartile of lean-FRM intake. Fatty- and lean-FRM intakes were not significantly related to elevated blood pressure risk in men and women.

Conclusions: Greater intake of fatty-FRM was associated with higher DBP in Chinese men, whereas lean-FRM had favorable effects on SBP and DBP in women. Further research is required to elicit the potential mechanism on gender-specific differential association of fatty- compared with lean-FRM with blood pressure.

Potato Consumption and Risk of Hypertension: Results from China Health and Nutrition Survey (CHNS) cohort study 1989–2011 (P20-178)

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Objectives: The Chinese government has promoted potatoes as a major staple food. It is not clear what effects potato, a potassium-rich food that elicits high glycemic responses after consumption, has on hypertension. In this study, we aimed to investigate the association between potato consumption and hypertension risk among Chinese people.

Methods: A total of 11,763 adults (≥20 y old) who were free of hypertension at baseline were enrolled from the China Health and Nutrition Survey (CHNS) Cohort study for 1989–2011. Individuals with aged <20 y, identified to be pregnant, and previously diagnosed with hypertension, cancer, infarction, apoplexy, and diabetes at baseline survey were excluded. Cox proportional hazards regression models were used to estimate the associations after adjusting for potential confounders.

Results: During an average 11.3 y of follow-up, 4033 incident cases of hypertension were recorded. People who consumed increased amounts of total potatoes, stir-fried potatoes, and non-stir-fried potatoes had enhanced risks of hypertension (P-trend = 0.0063, 0.0473, and 0.0001, respectively). Multivariable HRs for increased consumption of total potatoes were 1.401 (95% CI: 1.289, 1.523), 1.192 (95% CI: 1.094, 1.300), and 1.110 (95% CI: 1.008, 1.222) compared with nonconsumers. Higher consumers were inclined to have lower risk of hypertension when excluding the nonconsumers of total potatoes or stir-fried potatoes (both P-trend < 0.0001). In addition, a positive association of sweet potato intake with hypertension risk was only found in urban residents (P-trend = 0.0264). Our results showed that potato consumption was prospectively associated with developing hypertension in the Chinese population.

Conclusions: Here we first report the association between potato consumption and the incidence of hypertension nationwide in the Chinese population. As urbanization along with a transition to Western-style diets continues, more consideration should be given before potato consumption is promoted in China.

Funding Sources

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Association of Individual Saturated Fatty Acid Intake with Total Mortality in a Nationwide Prospective Cohort Study (P20-179)

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Objectives: It is currently unknown whether dietary intake of saturated fatty acids (SFAs) is associated with total mortality in the Chinese population. We aimed to evaluate the association between individual SFA intake and total mortality in Chinese.

Methods: We analyzed data of 14,383 participants from between 1989 and 2009 from the China Health and Nutrition Survey (CHNS). Cumulative averages of SFA intake were calculated based on 3-d 24-h recalls in each survey year. Multivariate Cox proportional hazard regression models were used to evaluate HRs and 95% CIs.

Results: During a median of 14 y of follow-up, 1011 deaths were documented. In men, the relation between total SFAs (TSFAs) and even-chain SFAs with total mortality appeared U-shaped, with the lowest HR in the third quartile ($HR_{Q3\ vs\ Q1}$: 0.58; 95% CI: 0.43, 0.80) for TSFAs and 0.57 (95% CI: 0.42, 0.79) for even-chain SFAs). In contrast, higher even-chain SFA intake was associated with an increased risk of death in women ($HR_{Q4\ vs\ Q1}$: 1.75; 95% CI: 1.05, 2.91; *P*-trend = 0.03). Notably, total mortality was inversely associated with the intake of odd-chain SFAs in men ($HR_{Q4\ vs\ Q1}$: 0.62; 95% CI: 0.46, 0.83; *P*-trend = 0.01) and women ($HR_{Q4\ vs\ Q1}$: 0.54; 95% CI: 0.38, 0.77; *P*-trend < 0.001). Furthermore, intake of medium-chain SFAs was related to a lower total mortality in men ($HR_{Q4\ vs\ Q1}$: 0.6495% CI: 0.44, 0.93; *P*-trend = 0.06). An increased total mortality was observed in men when replacing unsaturated fatty acids with even-chain SFAs, especially palmitic acid (16:0) and stearic acid (18:0).

Conclusions: Moderate TSFA intake may reduce total mortality in men. High even-chain SFA intake may increase total mortality in women, whereas odd-chain SFA intake is associated with a lower total mortality in both genders. Our findings provide epidemiologic evidence for improving dietary guidelines for Chinese.

Funding Sources

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Supporting Images/Graphs

Multivariate-adjusted hazard ratios for associations between total SFAs and subtypes of total SFAs intake and total mortality in Chinese men (n=6,495) and women (n=7,888)[1]

Types of SFAs	Men (n=6,495)					Women (n=7,888)				
	Quartiles of SFAs intake (g/day)				*P*-trend[2]	Quartiles of SFAs intake (g/day)				*P*-trend[2]
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4	
Total SFAs										
SFAs intake, g/day median (range)	6.89 (<9.97)	13.13 (9.97-15.94)	19.19 (15.94-23.12)	29.97 (≥23.12)		5.59 (<8.20)	10.71 (8.20-13.17)	15.85 (13.17-19.13)	24.85 (≥19.13)	
deaths, *n* (%)	194 (11.95)	138 (8.50)	91 (5.60)	141 (8.68)		138 (7.00)	98 (4.97)	96 (4.87)	115 (5.83)	
person-years	25,044	24,079	25,326	25,938		28,009	26,974	28,473	30,661	
Age-adjusted model[3]	1.00	0.77 (0.62, 0.96)	0.45 (0.35, 0.57)	0.77 (0.62, 0.96)	0.003	1.00	0.74 (0.57, 0.95)	0.74 (0.57, 0.96)	0.81 (0.63, 1.04)	0.18
Multivariate-adjusted model[4]	1.00	0.90 (0.70, 1.14)	0.58 (0.43, 0.80)	1.01 (0.65, 1.55)	0.61	1.00	0.96 (0.72, 1.28)	1.12 (0.80, 1.59)	1.64 (0.99, 2.72)	0.06
0dd-chain SFAs										
SFAs intake, mg/day median (range)	60 (<80)	110 (80-150)	190 (150-270)	400 (≥270)		40 (<70)	90 (70-120)	160 (120-220)	350 (≥220)	
deaths, *n* (%)	208 (12.81)	140 (8.62)	110 (6.78)	106 (6.53)		160 (8.11)	114 (5.78)	103 (5.22)	70 (3.55)	
person-years	25,188	24,888	25,457	24,854		27,727	27,871	29,554	28,965	
Age- adjusted model[3]	1.00	0.68 (0.55, 0.84)	0.52 (0.41, 0.65)	0.53 (0.42, 0.68)	<0.001	1.00	0.77 (0.60, 0.98)	0.60 (0.47, 0.77)	0.47 (0.36, 0.63)	<0.001
Multivariate-adjusted model[5]	1.00	0.73 (0.58, 0.92)	0.59 (0.45, 0.76)	0.62 (0.46, 0.83)	0.01	1.00	0.83 (0.65, 1.07)	0.68 (0.51, 0.90)	0.54 (0.38, 0.77)	<0.001
Even-chain SFAs										
SFAs intake, g/day median (range)	6.79 (<9.82)	12.93 (9.82-15.73)	18.91 (15.73-22.88)	29.62 (≥22.88)		5.47 (<8.05)	10.55 (8.05-12.96)	15.63 (12.96-18.89)	24.60 (≥18.89)	
deaths, *n* (%)	195 (12.01)	137 (8.44)	90 (5.54)	142 (8.75)		137 (6.95)	98 (4.97)	96 (4.87)	116 (5.88)	
person-years	24,990	24,041	25,426	25,930		27,981	26,962	28,489	30,685	
Age-adjusted model[3]	1.00	0.77 (0.62, 0.96)	0.44 (0.34, 0.57)	0.78 (0.62, 0.96)	<0.001	1.00	0.74 (0.58, 0.95)	0.76 (0.58, 0.98)	0.82 (0.64, 1.05)	0.24
Multivariate-adjusted model[6]	1.00	0.91 (0.71, 1.15)	0.57 (0.42, 0.79)	1.02 (0.66, 1.56)	0.62	1.00	0.99 (0.74, 1.32)	1.18 (0.84, 1.67)	1.75 (1.05, 2.91)	0.03

FIGURE P20-179-1 Multivariate-adjusted HRs for associations between total saturated fatty acids and subtypes of total saturated fatty acid intake and total mortality in Chinese.

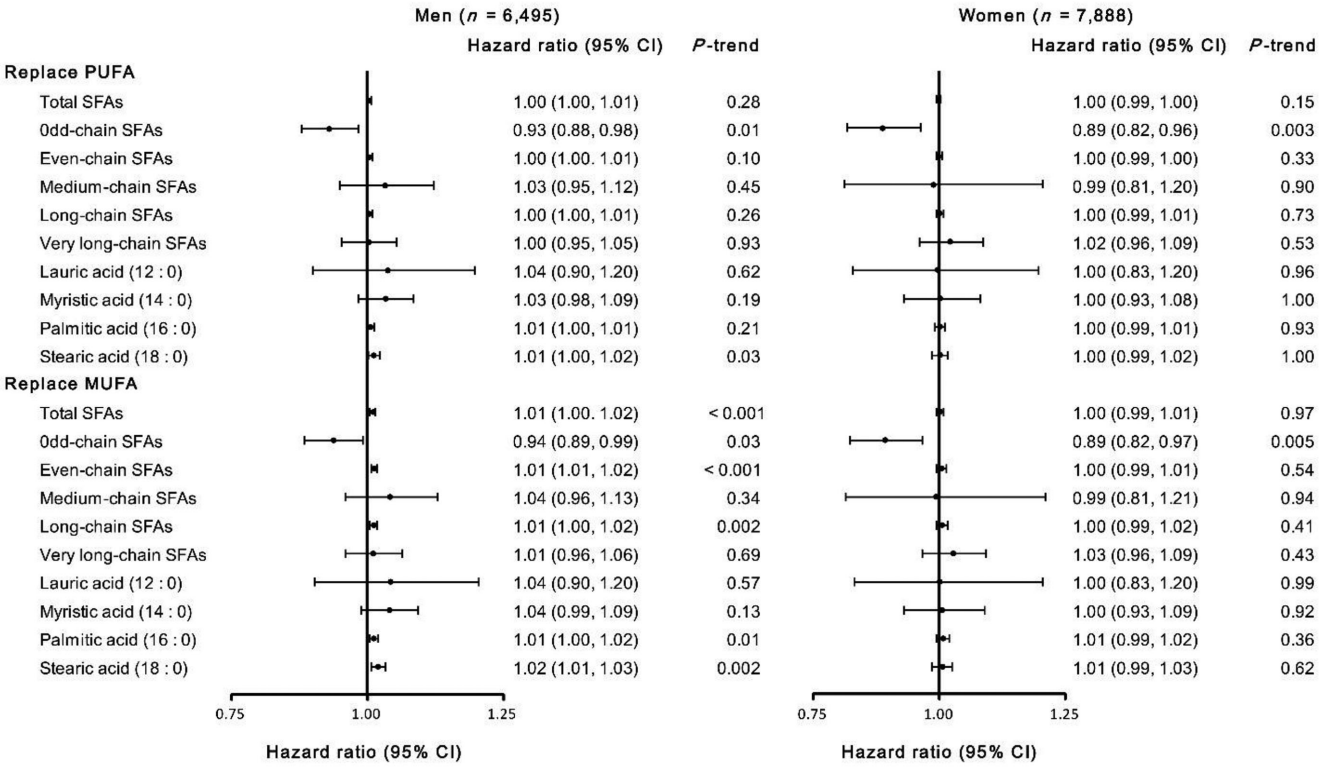

FIGURE P20-179-2 Multivariate-adjusted HRs (95% CI) of total mortality by replacing 100 mg of polyunsaturated fatty acid or monounsaturated fatty acids with an equal amount of saturated fatty acids.

WIC Works: Food Package Revisions Neutralize Differences in Dietary Intake between Participants and Nonparticipants (P20-180)

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Objective: The aim of this study was to assess the impact of the 2009 Special Supplemental Nutrition Program for Women Infants and Children (WIC) food package revisions on food and nutrient intake in a nationally representative sample of US children and women.

Methods: Data from children aged 2–5 y and females aged ≥12 y of age who participated in the 2005–2008 and 2011–2014 cycles of NHANES were used for this study. Information regarding WIC utilization and dietary intake were collected by NHANES. Dietary data was collected through the use of 24-h recall; diets for children <6 y were reported as proxy via the guardian. All data were analyzed by multivariable linear regression with SAS 9.4 survey procedures to account for the unequal sampling probability and the complex survey design of NHANES.

Results: Prior to the WIC package change, children in households receiving WIC benefits had lower reported intake of red and orange vegetables excluding tomatoes ($P = 0.014$), higher intake of starchy vegetables ($P = 0.032$) and fruit juice ($P = 0.0029$), as well as less calcium ($P = 0.028$), less zinc ($P = 0.035$), and more potassium ($P = 0.023$) than nonparticipants. After the policy change, these discrepancies in the diets of WIC and non-WIC children were not observed, with the exception of fruit juice, which remained significantly higher among WIC participants ($P = 0.016$). Additionally, children in WIC households had greater reported intake of legumes ($P = 0.008$), whole grains ($P = 0.031$), and vitamin C ($P = 0.0066$) than nonparticipants in NHANES cycles after the food package revisions. Women living in households receiving WIC benefits reported fewer servings of dark green vegetables ($P = 0.029$) and cheese ($P = 0.0069$) than women in non-WIC households. In the years following the WIC package change, these differences had dissipated, but women in WIC households reported consumption of fewer servings of whole fruit ($P = 0.037$) than nonparticipants.

Conclusions: These findings indicate that the WIC food package revisions neutralized differences in dietary intake between WIC and non-WIC households. The mostly positive influence of the cost-neutral WIC policy change on dietary intake of WIC participants suggests that population-level interventions in WIC are effective.

Women's Dietary Diversity in Kenya and Zambia (P20-181)

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Objectives: The aim of this study was to assess women's dietary diversity scores (WDDS) in Kenya and Zambia, and to assess the distribution of WDDS by different geographic settlement (urban/rural) in Zambia.

Methods: 500 households were randomly selected in both countries and the female head of household (HH) was interviewed by a trained enumerator to assess household food consumption and WDD through the use of standard questionnaires from FAO and USAID. Selection was

based on previous participation in development projects. In Zambia, the study was conducted in rural (53.4% rural: Chipata, Choongwe, and Chilanga) and urban (Kafue and Lusaka) regions. The sample was stratified in tertiles of WDDS by urban or rural living area and a chi-square test was performed to assess the correlation between WDDS and those geographical settlements. Ethical approval was provided by the Rutgers University Institutional Review Board and the Zambian National Ethics Board.

Results: In Kenya and Zambia, 82.5% and 77.0%, respectively, of respondents' dietary diversity scores (DDS) were within the third highest tertile. A majority of HH in Zambia and Kenya reported having a primary school education (54.7% and 53.7%, respectively), whereas 49.7% of Zambian and 46.6% of Kenyan spouses reported a primary school education. Those with a primary education, 45.1% and 45.4% in Zambia and Kenya, respectively, reported a DD within the third highest tertile. The second highest reported education level was junior high (24.9% Zambia and 20.7% Kenya) with a majority of the respondents within this education level reporting a DD within the third highest tertile. Within Zambia, 96.6% of individuals surveyed who reside in the rural areas fall within the third highest tertile for WDDS. In urban areas, 54.9% of the individuals scored in the third highest tertile, and 41.6% scored in the middle tertile of WDDS. There was a significant association between urban and rural WDDS ($P2 = 252.7462$).

Conclusions: The reported WDDS was high in Kenya and Zambia, and there was no correlation with educational status. Based on the data presented, women in rural areas have a more diverse diet than women in urban areas. The results of this study are preliminary and additional variables are required to better assess the relation between education and WDD in rural and urban areas of sub-Saharan Africa.

Funding Sources

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Supporting Images/Graphs

Dietary Diversity Tertile	% of individuals in Kenya	% of individuals in Zambia
1st	1.6	2.4
2nd	15.9	20.6
3rd	82.5	77.0

FIGURE P20-181-1

		Kenya		Zambia	
Survey Sample Size		n = 504		n = 500	
		mean	**range**	**mean**	**range**
Head of Household Age		51.09 +/- .88	49.35 - 52.84	44.76 +/- 0.72	43.34 to 46.18
		Percentage		**Percentage**	
Head of Household gender					
	Female	0.20		13.20	
	Male	59.44		59.80	
	Unknown	40.35		27.00	
Head of Household Education level					
	Primary	54.76		50.00	
	Junior High	13.10		22.80	
	Senior High	20.40		12.00	
	University	4.60		5.60	
	Masters	0.40		0.80	
	PhD	0.20		0.20	
	Unknown/Not answer	6.54		8.60	
Spouse Educational Level					
	Primary	49.70		46.60	
	Junior High	13.12		12.60	
	Senior High	13.32		4.80	
	High School	1.59		2.80	
	University	0.20		0.40	
	Unknown/Not answered	22.07		32.80	

FIGURE P20-181-2

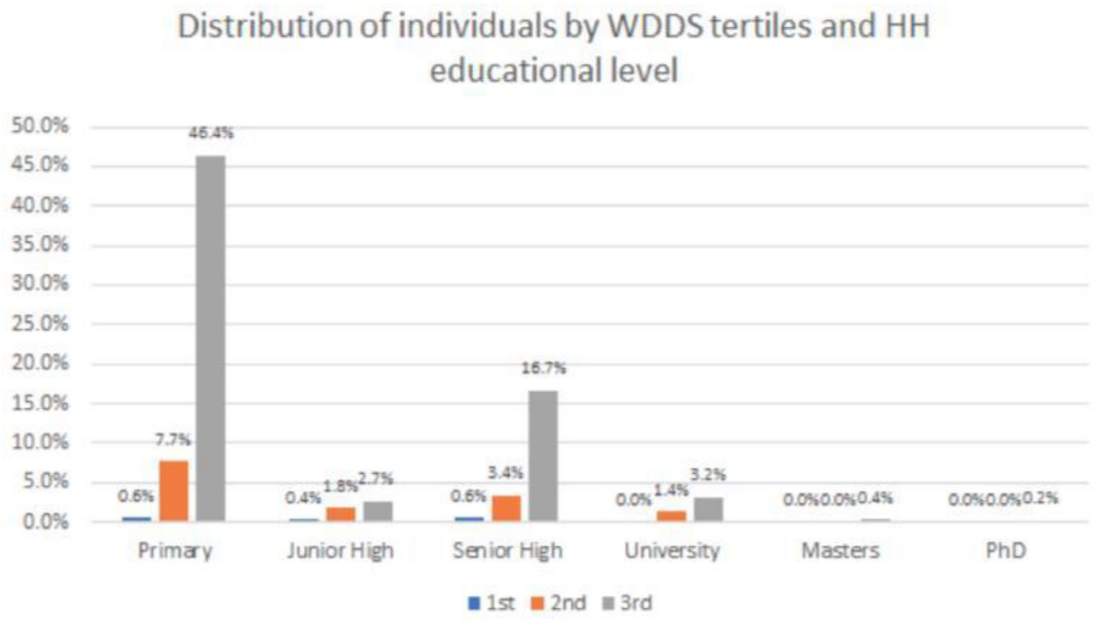

FIGURE P20-181-3

Kenya

Dietary Diversity Score	Kenyan Frequency	Zambian Frequency
1	1	3
2	1	2
3	6	7
4	14	17
5	26	39
6	40	47
7	59	73
8	116	102
9	241	210
Total	504	500

FIGURE P20-181-4

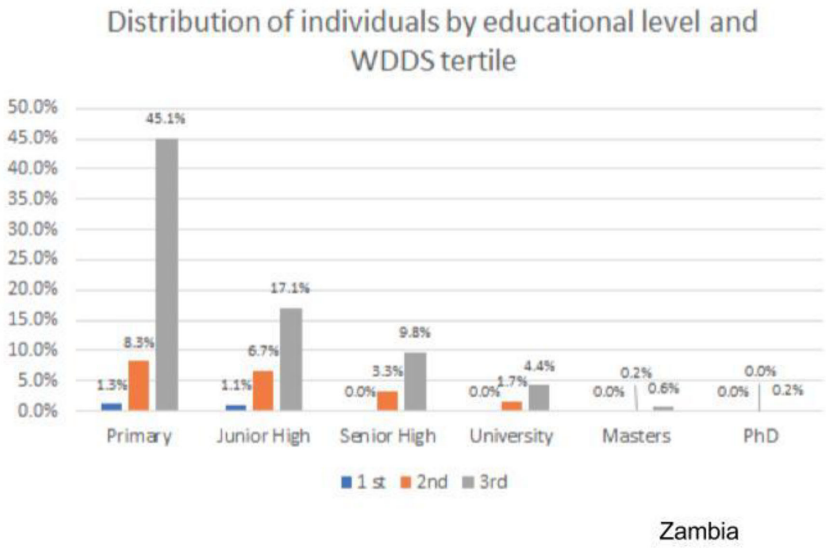

FIGURE P20-181-5