Dietary Patterns

Eating School Meals Daily Is Associated with Healthier Dietary Intakes: The Healthy Communities Study


**Significance:** Students who eat school breakfast and lunch every day report modestly healthier dietary intakes than those who eat school meals less frequently.

**Background:** Research on the association between school meal consumption and overall dietary intake post-Healthy Hunger-Free Kids Act implementation is limited. **Objective:** This study examines the association between frequency of participating in the National School Lunch and School Breakfast Programs and children’s dietary intakes. **Design:** The Healthy Communities Study was a cross-sectional observational study conducted between 2013 and 2015. **Participants and Setting:** US children aged 4 to 15 years (n=5,106) were included. **Main Outcome Measures:** Dietary measures were assessed using the National Health and Nutrition Examination Survey Dietary Screener Questionnaire. Dietary intake included fruit and vegetables, fiber, whole grains, dairy, calcium, total added sugar, sugar-sweetened beverages, and energy-dense foods of minimal nutritional value. **Statistical Analysis:** Multivariate statistical models assessed associations between frequency of eating school breakfast or lunch (every day vs not every day) and dietary intake, adjusting for child- and community-level covariates. **Results:** Children who ate school breakfast every day compared with children who ate 0 to 4 days/wk, reported consuming more fruits and vegetables (0.1 cup/day, 95% CI: 0.01, 0.1), dietary fiber (0.4 g/day, 95% CI: 0.2, 0.7), whole grains (0.1 oz/day, 95% CI: 0.05, 0.1), dairy (0.1 cup/day, 95% CI: 0.05, 0.1), and calcium (34.5 mg/day, 95% CI: 19.1, 49.9). Children who ate school lunch every day, compared with those who ate less frequently, consumed more dairy (0.1 cup/day, 95% CI: 0.1, 0.2) and calcium (32.4 mg/day, 95% CI: 18.1, 46.6). No significant associations were observed between school meal consumption and energy-dense nutrient-poor foods or added sugars. **Conclusions:** Eating school breakfast and school lunch every day by US schoolchildren was associated with modestly healthier dietary intakes. These findings suggest potential nutritional benefits of regularly consuming school meals.

Lipids:

The Associations of Serum n-6 Polyunsaturated Fatty Acids With Serum C-Reactive Protein in Men: The Kuopio Ischaemic Heart Disease Risk Factor Study


**Significance:** This study shows a strong inverse association between serum n-6 polyunsaturated fatty acids and C-reactive protein, a key marker in inflammation.

**Background/Objectives:** There are concerns that high intake of n-6 polyunsaturated fatty acids (PUFA) may promote inflammation, because the end-product of n-6 PUFA metabolism, arachidonic acid, is a precursor for pro-inflammatory eicosanoids. Our aim was to investigate cross-sectional associations of the serum n-6 PUFAs, objective biomarkers for exposure, with serum high-sensitivity C-reactive protein (CRP), a key inflammation marker. **Subjects/Methods:** The study included 1287 generally healthy men aged 42-60 years from the population-based Kuopio Ischaemic Heart Disease Risk Factor Study, examined in 1984-1989. ANCOVA and logistic regression were used for analyses. **Results:** In the multivariable-adjusted analyses, both serum total n-6 PUFA and linoleic acid, the predominant n-6 PUFA, were associated with lower CRP. The mean CRP concentrations in quartiles of linoleic acid were 1.86, 1.51, 1.53, and 1.37 mg/L (P-trend = 0.001). The odds ratio for elevated CRP (>3 mg/L) in the highest vs. the lowest quartile was 0.47 (95% confidence interval (CI) 0.25-0.87, P-trend = 0.01). Arachidonic acid or the mainly endogenously produced n-6 PUFAs, gamma-linolenic acid and dihomo-gamma-linolenic acid, were not associated with higher CRP, either. Age, body mass index, or serum long-chain n-3 PUFA concentration did not modify the associations (P-interactions > 0.14). **Conclusions:** Serum n-6 PUFAs were not associated with increased inflammation in men. In contrast, the main n-6 PUFA linoleic acid had a strong inverse association with the key inflammation marker, CRP.

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Effects of Lipid Emulsion Particle Size on Satiety and Energy Intake: A Randomised Cross-Over Trial
Poppitt SD, Budgett SC, MacGibbon AK, Quek SY, Kindleysides S, Wiessing KR TP. *Eur J Clin Nutr.* 2018 Mar;72(3):349-357. doi: 10.1038/s41430-017-0016-7. [Article Link](https://doi.org/10.1038/s41430-017-0016-7)

**Significance:** While tube feeding studies suggest that some lipid emulsions may suppress appetite and food intake, this study found no effect of phospholipid emulsion particle size on satiety or eating behavior in lean men.

**Background/Objectives:** Emulsified lipids, with central lipid core surrounded by polar lipid ‘protective coat’, have been proposed to stimulate the ileal brake, alter appetite, food intake and aid weight control. In addition to lipid composition, emulsion particle size may contribute to efficacy with small droplets providing a larger surface area for gastrointestinal (GI) lipase action and larger droplets prolonging and delaying digestion in the GI tract. Tube feeding studies delivering emulsions directly into the small intestine show clear effects of smaller particle size on appetite and food intake, but evidence from oral feeding studies is sparse. The objective of this study was to determine the effects of lipid emulsion particle size on appetite response and food intake.

**Subjects/methods:** In a three-arm randomised cross-over, high-phospholipid (PL) dairy lipid emulsions or matched control were consumed at breakfast within a yoghurt smoothie: (i) large-particle size emulsion, LPE (diameter 0.759 µm, 10 g lipid emulsion, 190 g yoghurt), (ii) small-particle size emulsion, SPE (diameter 0.290 µm, 10 g lipid emulsion, 190 g yoghurt), (iii) control non-emulsion, NE (10 g non-emulsion lipid, 190 g yoghurt). Twenty male participants completed the study, where postprandial appetite response was rated using visual analogue scales (VAS) and ad libitum energy intake at a lunch meal measured 3 h later.

**Results:** There was a trend for LPE to suppress hunger (P = 0.08) and enhance fullness (P = 0.24) relative to both SPE and NE but not statistically significant, and no significant effect of either emulsion on food intake at the lunch meal (P > 0.05).

**Conclusions:** Altering particle size of a high-PL emulsion did not enhance satiety or alter eating behaviour in a group of lean men.

Carbohydrate:

**Metabolic Response to Amylose-Rich Wheat-Based Rusks in Overweight Individuals**

**Significance:** Amylose-rich flour may provide a more favorable postprandial metabolic response than conventional wheat flour.

**Background/Objectives:** The amylose-amylopectin ratio influences starch properties. A higher amylose content is associated with slower starch digestion thus reducing the postprandial plasma glucose response and improving the overall postprandial metabolism. So far, limited evidence is available on the metabolic effect of wheat-based foods rich in amylose. This randomised controlled study investigated the acute metabolic effects of amylose-rich wheat-based rusks in overweight subjects focusing on potential mechanisms.

**Subjects/methods:** Ten overweight subjects consumed in random order two test meals differing only in the carbohydrate source: rusks prepared with amylose-rich wheat flour (ARR) or conventional wheat flour (control). Blood samples were taken at fasting and over 4 h after the meal. Satiety and intestinal fermentation were evaluated by VAS and H2-breath test, respectively.

**Results:** ARR reduced plasma glucose response during the first two hours after the meal and the desire to eat, and increased breath hydrogen concentration at 4 h (p < 0.05 for all). Moreover, according to computational models, the ARR slightly reduced intestinal glucose absorption in the first hour after the meal and increased the overall postprandial insulin sensitivity.

**Conclusions:** Rusks made with amylose-rich flour could be useful for improving postprandial glucose metabolism and reduce the desire to eat, thus possibly contributing to the prevention and treatment of overweight/obesity, impaired glucose tolerance or diabetes.

Dietary Carbohydrates: A Review of International Recommendations and the Methods Used to Derive Them
Buyken AE, Mela DJ, Dussort P, Johnson IT, Macdonald IA, Stowell JD, Brouns FJPH. *Eur J Clin Nutr.* 2018 Mar 13. doi: 10.1038/s41430-017-0035-4. [Article Link](https://doi.org/10.1038/s41430-017-0035-4)

**Significance:** This article reviews recently published dietary carbohydrate recommendations from 13 authorities.

**Background/Objectives:** Renewed dietary recommendations for carbohydrates have recently been published by various international health authorities. The present work (1) reviews the methods and processes (systematic approach/review, inclusion of public consultation) used to identify, select and grade the evidence underpinning the recommendations, particularly for total carbohydrate (CHO), fibre and sugar consumption, and (2) examines the extent to which variation in the methods and processes applied relates to any differences in the final recommendations.

**Subjects/methods:** A search of WHO, US, Canada, Australia and
European sources identified 19 documents from 13 authorities with the desired detailed information. Processes and methods applied to derive recommendations were compiled and compared. Results: (1) A relatively high total CHO and fibre intake and limited intake of (added or free) sugars are generally recommended. (2) Even where recommendations are similar, the specific justifications for quantitative/qualitative recommendations differ across authorities. (3) Differences in recommendations mainly arise from differences in the underlying definitions of CHO exposure and classifications, the degree to which specific CHO-providing foods and food components were considered, and the choice and number of health outcomes selected. (4) Differences in the selection of source material, time frames or data aggregation and grading methods appeared to have minor influence. Conclusions: Despite general consistency, apparent differences among the recommendations of different authorities would likely be minimized by: (1) More explicit quantitative justifications for numerical recommendations and communication of uncertainty, and (2) greater international harmonization, particularly in the underlying definitions of exposures and range of relevant nutrition-related outcomes.

The Direct and Indirect Associations of Usual Free Sugar Intake on BMI Z-Scores of Australian Children and Adolescents


Significance: Free sugar intake was not associated with BMI z-score in a cohort of Australian children and adolescents.

This cross-sectional analysis aimed to assess the association between free sugar consumption and the BMI z-score of Australian children and adolescents. Data from the 2007 Australian National Children’s Nutrition and Physical Activity Survey were analyzed. Structural equation modeling was used to assess the direct association between usual free sugar intake and age-and-sex-specific BMI z-score, and the indirect association mediated via energy overconsumption. Weak and statistically non-significant associations were found for the direct (BMI z-score $\beta = -0.02$ per 10% change in energy intake from free sugar, $p = 0.705$) and indirect pathways (BMI z-score $\beta = -0.04$ per 10% change in energy intake from free sugar, $p = 0.705$). We concluded that free sugar intake was not associated with BMI z-score in this cohort. Instead of focusing on a single energy source in the diet, improving the quality of the whole diet may be a better approach in tackling childhood obesity.

Sugar-Sweetened Beverages:

Effect of High Milk and Sugar-Sweetened and Non-Caloric Soft Drink Intake on Insulin Sensitivity After 6 Months in Overweight and Obese Adults: A Randomized Controlled Trial


Significance: No difference in insulin sensitivity was observed following 6 months of water, milk, sugar-sweetened soft drink, or non-caloric soft drink consumption (1 L per day) in overweight and obese adults.

Background/Objectives: Milk contributes with saturated fat, but randomized controlled trials (RCT) on the effects of dairy on the risk of type 2 diabetes (T2D) where dairy is given as whole foods are scarce. The objective of our study was to investigate the long-term effects of semi-skimmed milk on insulin sensitivity and further to compare milk with sugar-sweetened soft drinks (SSSD). Subjects/methods: A secondary analysis of a 6-month RCT with 60 overweight and obese subjects randomly assigned to 1 L/d of either milk (1.5 g fat/100 mL), SSSD, non-calorie soft drink (NCSD), or water was conducted. Insulin sensitivity was evaluated by oral glucose tolerance test (OGTT) and plasma free fatty acids. Second, fasting blood lipids, blood pressure, and concentration of plasminogen activator inhibitor-1 were assessed. Results: There were no differences between milk, SSSD, NCSD, and water on insulin sensitivity assessed by OGTT (Matsuda Index, fasting, and area under the curve glucose, insulin and homeostasis model assessment values). SSSD increased total cholesterol compared to NCSD ($P = 0.007$), and triacylglycerol compared to NCSD and water ($P = 0.045$ and 0.045, respectively). None of the other parameters differed significantly between the groups. Conclusions: In conclusion, there were no differences in effect between intake of milk, SSSD, NCSD, and water (1 L/d) for 6-month on risk markers of T2D in overweight and obese adults. As a secondary analysis, these results need confirmation in future studies.
Fluid Consumption Pattern and Hydration Among 8-14 Years-Old Children
Mar;72(3):420-427. doi: 10.1038/s41430-017-0012-y. Article Link

**Significance:** A water- and milk-based drinking pattern is associated with better hydration in children, while regular soda and other drinks are associated with inferior hydration.

**Background/Objectives:** Children consume various fluids to meet dietary water intake needs. However, the contribution of different fluid types on hydration is unclear. The purpose of this study was to develop fluid intake patterns and examine their association with hydration, as indicated by 24-h urine osmolality. **Subjects/methods:** Two hundred ten (105 girls) healthy children (height: 1.49 ± 0.13 m, weight: 43.4 ± 12.6 kg, body fat: 25.2 ± 7.8%) recorded their fluid intake for two consecutive days, and collected their urine for 24-h during the 2nd day, while conducting their normal daily activities. Urine samples were analyzed for specific gravity and osmolality. Factor analysis with principal components method was applied to extract dietary patterns from six fluid groups. Linear regression analysis evaluated the associations between the extracted dietary patterns and hydration based on 24-h urine osmolality. **Results:** The analysis revealed the following six components: 1, characterized by consumption of milk and fresh juice, but not packaged juice; 2, by regular soda and other drinks, but not water; 3, by fresh juice and other drinks; 4, by packaged juice, but not regular soda; 5, by water and milk; and 6, by fresh juice. Component 5 was negatively correlated with urine osmolality (P = 0.001) indicating better hydration, whereas component 2 was positively correlated with urine osmolality (P = 0.001). **Conclusions:** A drinking pattern based on water and milk was associated with better hydration, as indicated by lower urine osmolality, whereas drinking regular soda and other drinks but not water was associated with inferior hydration.

Cardiovascular Disease:
The Role of Inorganic Nitrate and Nitrite in Cardiovascular Disease Risk Factors: A Systematic Review and Meta-Analysis of Human Evidence

**Significance:** This meta-analysis found that consumption of inorganic nitrite (found in beetroot and spinach) reduces several cardiovascular disease risk factors.

**Context:** Depleted nitric oxide levels in the human body play a major role in cardiovascular disease pathogenesis. Inorganic nitrate/nitrite (rich dietary sources include beetroot and spinach) can act as a nitric oxide donor because nitrate/nitrite can be metabolized to produce nitric oxide. **Objective:** This review and meta-analysis sought to investigate the role of inorganic nitrate/nitrite in preventing or treating cardiovascular disease risk factors in humans. **Data Sources:** Electronic databases, including Medline, Embase, Cumulative Index to Nursing and Allied Health Literature, Cochrane, and Scopus, were searched. **Data Extraction:** Experimental trials examining the effect of oral inorganic nitrate/nitrite intake on cardiovascular disease risk factors were included for systematic analysis. **Results:** Thirty-four studies were included for qualitative synthesis, 23 of which were eligible for meta-analysis. Included studies measured the following outcomes: blood pressure, endothelial function, arterial stiffness, platelet aggregation, and/or blood lipids. Inorganic nitrate intake was found to significantly reduce resting blood pressure (systolic blood pressure: −4.80 mmHg, P < 0.0001; diastolic blood pressure: −1.74 mmHg, P = 0.001), improve endothelial function (flow-mediated dilatation: 0.59%, P < 0.0001), reduce arterial stiffness (pulse wave velocity: −0.23 m/s, P < 0.0001; augmentation index: −2.1%, P = 0.05), and reduce platelet aggregation by 18.9% (P < 0.0001). **Conclusions:** Inorganic nitrate consumption represents a simple strategy for targeting cardiovascular disease risk factors. Future studies investigating the long-term effects of inorganic nitrate on cardiovascular disease outcomes are warranted.

Micronutrients:
Body Size modifies the Relationship Between Maternal Serum 25-Hydroxyvitamin D Concentrations and Gestational Diabetes in High-Risk Women

**Significance:** Serum 25(OH)D concentration is associated with incidence of gestational diabetes in women with a first-trimester BMI of ≥35 kg/m².

Obesity increases the risk of low 25-hydroxyvitamin D (25(OH)D) concentrations and gestational diabetes (GDM). We explored whether the association between GDM and change in 25(OH)D concentrations measured in the first (7–18 wk) and second (20–27 wk) trimesters of pregnancy is dependent on maternal BMI. The study was a prospective study of 219 women with BMI of ≥30 kg/
m², a history of GDM, or both. The participants were stratified by first-trimester BMI: BMI of <25.0, 25.0–29.9, 30.0–34.9, and ≥35 kg/m². In the BMI group ≥35 kg/m², those who did not develop GDM during the follow-up showed higher increase in serum 25(OH)D concentrations compared with women who developed GDM (43.2 vs. 11.5%; P < 0.001). No associations between 25(OH)D concentrations and GDM were observed in other BMI groups. These findings give an important aspect of the role of maternal body size in the association between vitamin D and GDM in high-risk women.

**Obesity:**

**The Effect of Weight Change Over a 2-Year Period on Inflammatory Status in Postmenopausal Women**


**Significance:** In postmenopausal women, modest weight loss improves inflammatory biomarkers while modest weight gain is associated with a pro-inflammatory state.

**Background/Objectives:** Body fat distribution has been shown to be a predictor of adhesion molecule and inflammatory marker expression albeit the effect of modest weight change on concentrations of adhesion molecules and inflammatory markers in postmenopausal women are not fully understood. The primary aim was to investigate the effects of weight change on adhesion molecules and inflammatory markers over 24 months in postmenopausal women. **Subjects/methods:** Body composition was assessed in 254 healthy postmenopausal women using dual-energy X-ray absorptiometry (DXA). Adhesion molecules and inflammatory markers were analysed by multiplex ELISA. Participants weight gain/loss at 24 months was defined as any value that was either above/below the weight value recorded at baseline. **Results:** Postmenopausal women with an average weight loss of 3% had significantly decreased leptin concentrations by 18% at 24 months (P < 0.01). A 4% increase in body weight or a 9% increase in FMI significantly increased intercellular adhesion molecule-1 (ICAM-1), tumour necrosis factor-α (TNF-α) and leptin concentrations in postmenopausal women at 24 months (P < 0.01). **Conclusions:** Modest weight loss in postmenopausal women has a lowering effect on leptin concentrations over 24 months which may improve inflammatory status whilst modest weight gain increases ICAM-1, leptin and TNF-α, markers which are associated with a pro-inflammatory state and vascular complications.