DIET DRINKS AND HEALTH

Nonnutritive sweeteners and cardiometabolic health: A systematic review and meta-analysis of randomized controlled trials and prospective cohort studies.


Key Question: What is the effect of regular consumption of nonnutritive sweeteners on long-term cardiometabolic health outcomes?

Key finding: Evidence from randomized controlled trials found no health benefits or harms from nonnutritive sweetener consumption while data from cohort studies found modest negative effects on BMI and cardiometabolic disease risk.

Implications: This review adds to evidence that nonnutritive sweeteners are not effective for improving cardiometabolic health, and may even worsen health; however, due to several significant limitations, it does not fully settle the debate about the healthfulness of diet drinks.
analyzed 37 studies looking at the association of regular consumption of nonnutritive sweeteners (NNS) with long-term cardiometabolic health outcomes including weight and obesity, type 2 diabetes, hypertension, and cardiovascular disease.

The review included 7 randomized controlled trials (RCTs) with a total of 1,003 participants and 30 prospective cohort studies involving a total of 405,907 individuals. Duration of RCTs ranged from 6 to 24 months and follow-up in cohort studies ranged from 1 to 38 years.

To establish temporality and avoid confounding by reverse causality (i.e. poor cardiometabolic health causes a person to choose diet drinks vs. consuming diet drinks causes poor metabolic health), the researchers only included observational studies that measured NNS intake and body composition at baseline, before changes in body composition and health were observed.

Pooled results from RCTs found no significant association between NNS consumption and changes in BMI or body composition. However, it’s worth noting that results differed by RCT duration – 2 longer term trials did show modest benefits in weight loss, while shorter term studies showed no benefit. In contrast, pooled results from observational studies found that regular NNS consumption was associated with modest but statistically significant increases in BMI and weight, and higher risk of metabolic syndrome, type 2 diabetes, and other cardiovascular diseases.

Limitations: While the evidence from the cohort studies is suggestive, such studies are generally limited by their inability to control for numerous potential confounders and their reliance on self-reported consumption, which may introduce bias. RCTs provide more reliable results because experimental variables are highly controlled, reducing risk of confounding. However, RCTs are generally limited by short duration and small number of participants. Additionally, most RCTs included in this review had a high risk of bias, and the dose, type, and source of NNS varied considerable between studies. Finally, this review does not distinguish different types of NNS, which could have differing health effects.

COMMUNICATIONS

Mass media campaign to reduce consumption of sugar-sweetened beverages in a rural area of the United States


Key Question: What impact does a mass media campaign have on sugary drink consumption?

Key Finding: After just 15-weeks of a mass media campaign, sales of sugary drinks dropped 3.4 percent compared to a control region, and respondents who recalled seeing campaign ads were more likely to recognize the health risks of sugary drinks.

Implications: A mass-media, counter-messaging campaign may be an effective strategy to reduce sugary drink consumption alone or in combination with other strategies such as taxes and warning labels.
axes, warning labels, and mass media campaigns have all been considered as strategies to reduce sugary drink consumption based on their efficacy at reducing tobacco use. This study from Farley and colleagues is one of the first to examine the impact of mass media campaigns on sugary drink consumption.

This intervention took place in a predominantly white, low-income, rural area in Appalachia with a high prevalence of sugary drink consumption. It consisted of a mass media campaign called “Live Sugarfreed” targeting young adults (18-29 years old) to raise their awareness of the personal health risks of sugary drinks. The messaging primarily focused on comparing the health risk of sugary drinks to tobacco.

Messages were disseminated for 15 weeks through television, radio and digital media such as YouTube, Hulu, Pandora radio, and Facebook. Additionally, local businesses and organizations were recruited to adopt Live Sugarfreed pledges and disseminate messages to their employees and members.

Evaluation of the campaign consisted of telephone surveys measuring recall and reaction to the campaign and self-reported purchase and consumption of sugary drinks, as well as data on sugary drink sales in the region. Telephone surveys were conducted immediately before and after the campaign. Sales data were collected for 26 weeks one year before the start of the campaign and for 26 weeks after the campaign started. They were compared to a control region in Virginia with similar demographics that was not exposed to any campaign messaging.

The campaign cost a total of $207 thousand and delivered about 27 million video, audio, and static impressions. More than half of survey participants recalled seeing a campaign ad. Those who recalled the ads were more likely to agree that sugary drinks cause weight gain and increase risk of heart disease and cancer. There was a small but statistically significant drop of 3.4 percent in per capita sales of sugary drinks, driven primarily by a 4.1 percent drop in soda sales, relative to the comparison region.
Dietary quality changes in response to a sugar-sweetened beverage-reduction intervention: Results from the Talking Health randomized controlled clinical trial


**Key Question:** Can behavioral interventions targeting physical activity or beverage choice lead to improvements in overall diet?

**Key Finding:** People participating in an intervention to reduce sugary drink consumption showed decreased total energy intake and improvements in overall diet score, while those participating in a physical activity intervention did not show significant dietary changes.

**Implications:** Results of this study suggest that when people reduce sugary drink intake, they do not replace beverages with other junk foods. It also suggests that interventions focusing on sugary drinks can be a gateway to other spontaneous dietary improvements.

Interventions such as sugary drink taxes have been shown to reduce sugary drink consumption, which presumably would result in lower intake of added sugars and total calories. However, it is not yet known if people replace sugary drink calories with other foods and beverages. In this study, Hedrick and colleagues used data from the Talking Health randomized controlled trial to see if an intervention focused on beverage choice resulted in improvements in overall diet, compared to a physical activity intervention.

The Talking Health study was a 6-month behavioral intervention with two different trial arms, one focused on reducing sugary drink consumption (SIPsmartER) and the other on increasing physical activity (MoveMore). A total of 292 people participated (149 in the SIPsmartER group and 143 in the MoveMore group). The interventions included small-group education classes and individualized phone calls. Dietary intake data was collected through three 24-hour dietary recalls before and after the intervention, and diet quality was scored based on the Healthy Eating Index (HEI).

Not surprisingly, SIPsmartER participants showed greater improvements in sugary drink consumption than MoveMore participants. Sugary drink consumption dropped from 978 mL to 612 mL per day among SIPsmartER participants. Total energy intake decreased from 1975 calories to 1690 calories, and added sugar intake decreased from 108 grams to 73 grams in the SIPsmartER group as well, suggesting that beverage calories and sugar were not replaced with calories or sugar from other foods.

In addition to greater improvements in beverage, sugar, and energy consumption, SIPsmarER participants also showed improvements in vegetable consumption, trans fat intake, and overall HEI score compared to the MoveMore group, suggesting that sugary drinks may be a promising gateway to other dietary changes.

**Limitations:**
Biometric health indicators such as weight, BMI, cholesterol, or blood sugar would help determine which intervention had a greater impact on overall health. The study relied on self-reported dietary intake data, which is prone to bias. Study participants were predominantly female (81 percent) and Caucasian (93 percent), so results may not be generalizable to the wider population. The study lasted only 6 months, so it is not known if beverage and dietary changes were sustained long term.
calories to 1690 calories, and added sugar intake decreased from 108 grams to 73 grams in the SIPsmartER group as well, suggesting that beverage calories and sugar were not replaced with calories or sugar from other foods.

In addition to greater improvements in beverage, sugar, and energy consumption, SIPsmartER participants also showed improvements in vegetable consumption, trans fat intake, and overall HEI score compared to the MoveMore group, suggesting that sugary drinks may be a promising gateway to other dietary changes.

**Limitations:** Biometric health indicators such as weight, BMI, cholesterol, or blood sugar would help determine which intervention had a greater impact on overall health. The study relied on self-reported dietary intake data, which is prone to bias. Study participants were predominantly female (81 percent) and Caucasian (93 percent), so results may not be generalizable to the wider population. The study lasted only 6 months, so it is not known if beverage and dietary changes were sustained long term.

**POLICY IMPACT**

Reducing US cardiovascular disease burden and disparities through national and targeted dietary policies: A modeling study. P


**Key Question:** Among a set of promising national level nutrition policies, which would have the greatest impact on cardiovascular disease (CVD) mortality and disparities in the United States?

**Key Finding:** A national policy to subsidize the cost of fruits and vegetables (F&Vs) by 10 percent would have the greatest impact, preventing or postponing over 150,000 CVD deaths by 2030. Subsidies combined with a national mass media campaign and 10 percent tax on sugary drinks would prevent or postpone 230,000 CVD deaths and reduce CVD disparities by 6 percent.

**Implications:** This modelling study provides evidence suggesting national-level nutrition policies may improve public health and reduce health disparities.

Poor diet is a leading cause of CVD in America. National-level policies to encourage F&V consumption and discourage sugary drink intake could prevent CVD deaths. Pearson-Stuttard and colleagues aimed to quantify the impact of such policies through a rigorous modelling study.

The researchers focused on four policy options: 1) a national subsidy to reduce the price of F&V by 10 percent, 2) a targeted subsidy to reduce the price of F&V by 30 percent for Supplemental Nutrition Assistance Program (SNAP) participants, 3) a tax to increase the price of sugary drinks by 10 percent, and 4) a national mass media campaign to encourage F&V consumption and discourage sugary drink consumption. They modelled each policy alone and
combined to determine how many CVD deaths would be prevented or postponed over 15 years, and what impact the policies would have on CVD disparities.

A national 10 percent F&V subsidy would have the greatest impact, preventing or postponing over 150,000 CVD deaths by 2030. The targeted 30 percent F&V subsidy, 10 percent sugary drink tax, and mass media campaign would prevent or postpone 31,000, 35,100, and 25,800 CVD deaths, respectively. The targeted 30 percent F&V subsidy for SNAP participants would be twice as effective as the national 10 percent subsidy at reducing socioeconomic CVD disparities. A national 10% SSB tax would also reduce disparities, but to a lesser degree. Combining all policies would be more effective than any policy alone, preventing or postponing approximately 230,000 deaths and reducing disparities by about 6 percent.

**Limitations:** This study did not model cost-effectiveness of the policies. While subsidies were most effective, securing funding for such a policy could be challenging. Combining F&V subsidies with a sugary drink tax could be a cost-effective strategy since taxes could generate revenue to fund subsidies. The researchers only modelled the direct impact of the policies on CVD mortality and did not look at the potential impact on other diseases or mediating risk factors for CVD such as obesity or diabetes. The sugary drink tax model uses a conservative price elasticity estimate – this study assumed that a 10 percent price increase would yield a 7 percent decrease in consumption, while most other models assume a 12 percent decline in consumption per 10 percent price increase. Additionally, current best practice recommends that a tax should increase the price of sugary drinks by at least 20 percent to achieve the desired public health impact (this study modelled a 10 percent price increase).

**SUGARY DRINK TAXES**

**The impact on productivity of a hypothetical tax on sugar-sweetened beverages.**


**Key Question:** Can the potential health benefits of a sugary drink tax lead to economic gains in worker productivity?

**Key Finding:** A 20 percent sugary drinks tax could reduce the number of employees with obesity by 317,000 over the lifetime of the 2010 Australian population. As a result, the Australian economy would benefit from productivity gains worth AU$751 million in the paid work sector (1 AU$ = 0.80US$).

**Implications:** This study extends beyond previous work modeling the effect of a sugary drink tax on BMI to demonstrate the potential economic benefits of improved population health.

The potential public health benefits of sugary drink taxes have been well established by modelling studies in numerous populations. Many models have also looked at the potential health care cost savings resulting from reductions in diseases related to
overweight and obesity. Nomaguchi and colleagues used a similar modelling approach to estimate potential gains in productivity due to a healthier workforce.

The researchers used the predicted change in BMI from a previous model developed by Veerman et al to estimate the subsequent reduction in the incidence, prevalence, and mortality of obesity-related diseases, such as diabetes, heart disease, and certain cancers. They then estimated the potential productivity gains due to reductions in obesity-related mortality and absenteeism in the paid workforce, as well as the unpaid sector (i.e. volunteerism, housework, etc).

Over the lifetime of the 2010 adult Australian population, a 20 percent sugary drink tax could reduce the number of workers with obesity by 317,000 people. This would translate into AUS$751 million worth of productivity gains in the paid workforce, and AUS$1172 million in the unpaid sector. Combined with healthcare cost savings, the potential economic gain is equal to AUS$5,375 over the lifetime of each person whose obesity is prevented or cured by a sugary drink tax.

**Limitations:** Like all modelling studies, this study relies on many assumptions that each have its own limitations. In particular, the association between obesity and productivity was drawn from self-reported cross-sectional data which is prone to bias and other limitations. The model also predicts outcomes over a long time-frame and assumes that all model parameters remain stable into the future. The researchers only looked at health effects mediated by obesity and did not include direct health effects of sugary drinks or those mediated by overweight. Finally, the model only looked at the adult population and did not include children. While the study provides a novel perspective on a new potential benefit of a sugary drink tax, the actual numbers should be interpreted with caution.

Modelled health benefits of a sugar-sweetened beverage tax across different socioeconomic groups in Australia: A cost-effectiveness and equity analysis.


**Key question:** Do health benefits of sugary drink taxes effect socioeconomic groups differently?

**Key finding:** Households in the two lowest socioeconomic quintiles would accrue about half of the total health gains of a 20 percent tax on sugary drinks. The most disadvantaged quintile would pay only slightly more in taxes each year than the least disadvantaged quintile.

**Implications:** This study counters the argument that sugary drink taxes are regressive by showing that low-income communities will accrue significantly greater health benefits from taxes than higher-income groups, while paying only slightly more in taxes.

One of the most common arguments against sugary drink taxes is that they are regressive because the tax burden for low income families is a greater proportion of their income relative to higher-earning families. However, tax supporters argue that low-income
families stand to benefit the most from the long-term health benefits of taxes, making it a progressive policy. Lal and colleagues set out to examine this argument further by modelling the difference in health impact of taxes by socioeconomic level.

Like the study above by Nomaguchi and colleagues, the researches modelled the health effects and healthcare cost savings of a 20 percent sugary drink tax over the lifetime of the 2010 Australian population. The researchers also divided the population into five quintiles based on socioeconomic position (SEP), and compared the effect of the tax on each quintile.

The 20 percent sugary drink tax is estimated to save 175,300 health-adjusted life years (i.e. years lived in full health) and save over AUS$1.7 billion in health care costs. Lower SEP households would benefit disproportionately from the health gains, with the lowest two quintiles accruing about half of the health benefits. Lower SEP households did pay a higher percentage of their annual grocery dollars on the tax than higher SEP households, but the absolute amounts were small – AUS$35.40 or 0.5 percent for the lowest quintile vs. AUS$31.60 or 0.3 percent for the highest quintile.

**Limitations:** This study suffers from many of the same limitations as the study by Nomaguchi and colleagues regarding limitations of model parameters. This model also only looked at health effects mediated by obesity, so likely underestimates potential health benefits. Additionally, results for each quintile had very wide confidence intervals, and in most cases the difference between quintiles was not statistically significant. The model does not capture all tax impacts on equity, such as selective investment of tax revenues in low SEP communities or reductions in absenteeism and disability.

New data from Mexico sheds new light on the impact of the sugary drink tax. For this study, Colchero and colleagues used data from the National Income and Expenditure Survey from 2008 to 2014 and found a 6.3 percent decline in sugary drink purchases overall and a 10.3 percent decline among low-income households in 2014 (the first year of the tax). These numbers are similar to results from their previous study that used Nielson Homescan Data.

This study also found a significant increase in bottled water purchases (+16.2 percent) that was higher in low-income households (+21.7 percent) compared to high-income (+9.6 percent). Additionally, sugary drink consumption dropped more in urban households (-6.9 percent) than rural households (-3.9 percent), and among households with adults and children (-11.0 percent) than adult-only households (-2.4 percent).

Overall, this new study confirms that sugary drink consumption dropped significantly in Mexico one year after implementing a national sugary drink tax. and consumption has dropped most in low-income households, where sugar-related diseases like diabetes and obesity are most prevalent. The difference in rural vs. urban outcomes indicates that rural areas may need more outreach when implementing taxes.