No Sugars Added: How to Reduce Health Risks and Keep Life Sweet

Rachel K. Johnson, PhD, MPH, RD, FAHA
Bickford Green and Gold Professor of Nutrition
Professor of Pediatrics
The University of Vermont
THE GLOBAL SUGAR GLUT

Global sugar supply (in the form of sugar and sugar crops, excluding fruit and wine) expressed as calories per person per day, for the year 2007.
AHA Weighs in on Sugar

AHA Scientific Statement

Dietary Sugars Intake and Cardiovascular Health
A Scientific Statement From the American Heart Association

Rachel K. Johnson, PhD, MPH, RD, Chair; Lawrence J. Appel, MD, MPH, FAHA;
Michael Brands, PhD, FAHA; Barbara V. Howard, PhD, FAHA;
Michael Lefevre, PhD, FAHA; Robert H. Lustig, MD; Frank Sacks, MD, FAHA;
Lyn M. Steffen, PhD, MPH, RD, FAHA; Judith Wylie-Rosett, EdD, RD;
on behalf of the American Heart Association Nutrition Committee of the Council on Nutrition,
Physical Activity, and Metabolism and the Council on Epidemiology and Prevention

Abstract—High intakes of dietary sugars in the setting of a worldwide pandemic of obesity and cardiovascular disease have heightened concerns about the adverse effects of excessive consumption of sugars. In 2001 to 2004, the usual intake of added sugars for Americans was 22.2 teaspoons per day (355 calories per day). Between 1970 and 2005, average annual availability of sugars/added sugars increased by 19%, which added 76 calories to Americans’ average daily energy intake. Soft drinks and other sugar-sweetened beverages are the primary source of added sugars in Americans’ diets. Excessive consumption of sugars has been linked with several metabolic abnormalities and adverse health conditions, as well as shortfalls of essential nutrients. Although trial data are limited, evidence from observational studies indicates that a higher intake of soft drinks is associated with greater energy intake, higher body weight, and lower intake of essential nutrients. National survey data also indicate that excessive consumption of added sugars is contributing to overconsumption of discretionary calories by Americans. On the basis of the 2005 US Dietary Guidelines, intake of added sugars greatly exceeds discretionary calorie allowances, regardless of energy needs. In view of these considerations, the American Heart Association recommends reductions in the intake of added sugars. A prudent upper limit of intake is half of the discretionary calorie allowance, which for most American women is no more than 100 calories per day and for most American men is no more than 150 calories per day from added sugars. (Circulation. 2009;120:1011-1020.)
Why did AHA weigh in on added sugars?

• DGAC 2000 – no quantifiable recommendation
  – “Choose beverages and foods to *moderate* your intake of sugars.”

• DGAC 2005 – no quantifiable recommendation
  – “Choose and prepare foods and beverages with *little* added sugars or caloric sweeteners such as amounts in USDA Food Guide or DASH.”

• DGAC 2010 – no quantifiable recommendation
  - “*Reduce* the intake of calories from solid fats and added sugars. “
  - “Choose water instead of sugary drinks.”

• Consumers needed a number!
  – What do “*moderate*”, “*little*” and “*reduce*” mean?
“Sweet Surrender: Sugar Curbs Urged” - Wall Street Journal

- “The American Heart Association is taking aim at the nation's sweet tooth, urging consumers to significantly cut back on the amount of sugar they get from such foods as soft drinks, cookies and ice cream.”

- “In a scientific statement the organization says most women should limit their sugar intake to 100 calories, or about six teaspoons, a day; for men, the recommendation is 150 calories, or nine teaspoons.”
How much added sugar is America eating?

• Average intake all Americans
  – 320 calories/day
  – 20 teaspoons/day

• Men
  – 335 calories/day
  – 21 teaspoons/day

• Women
  – 239 calories/day
  – 15 teaspoons/day

• Source - Consumption of Added Sugars Among U.S. Adults, 2005–2010, CDC.
Source: ERS calculations based on USDA's 1977-78 Nationwide Food Consumption Survey (NFCS) data, 1989-91 and 1994-98 Continuing Survey of Food Intakes by Individuals (CSFII), and the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics 1999-2006 National Health and Nutrition Examination Survey (NHANES).
Soda Sizes

• [http://www.youtube.com/watch?v=Ish8NBunrQU](http://www.youtube.com/watch?v=Ish8NBunrQU)
Health Outcomes

- Weight gain/obesity
- Type 2 diabetes
- Cardiovascular disease
- Diet quality
Do SSBs promote obesity in children?

Intervention trials

• 224 overweight and obese adolescents randomly assigned to experimental and control groups.

• Experimental group (n=110) received a one-year intervention.
  — home deliveries of bottled water and diet drinks for one year.
  — encouraged to avoid sugary drinks.

Sugar-sweetened beverages (SSBs) and weight gain

Teens who eliminated SSBs gained 4 lbs less on average than their peers.

**YEAR 1: Intervention**
- Intervention group virtually eliminated SSBs

**YEAR 2: No intervention**
- Intervention group’s SSB consumption began to go up

Control group continued drinking SSBs both years.
Do SSBs promote obesity?

**Intervention trials**

- 641 normal weight Dutch school children ages 4-11
- Randomly assigned to
  - receive 8 oz/day of sugar-free beverage OR
  - receive 8 oz/day of 104 calorie SSB in an identical can.

Results

- Over 18 months the children in the sugar-free group gained an average of 13.9 pounds.

- Those drinking SSBs gained 16.2 pounds.

- “We found that masked replacement of a sugar containing beverage with a sugar-free beverage significantly reduced weight gain and body fat gain in healthy children. Children in the US consume on average almost three times as many calories from sugar-sweetened beverages as the amount provided in our trial. We speculate that decreased consumption of such beverages might reduce the high prevalence of overweight in these children.”

— Janne C. de Ruyter, M. Sc., University Amsterdam
Sugar Sweetened Beverages (SSBs) and Obesity - A Systematic Literature Review

- All lines of evidence consistently support the conclusion that the consumption of SSBs has contributed to the obesity epidemic.
- It is estimated that SSBs account for at least **ONE-FIFTH** of the weight gained between 1977 and 2007 in the US population.

Relationship between SSB consumption and risk of developing Type 2 Diabetes

P<0.001 for trend

Sugar-sweetened soft drink consumption

- <1/mo
- 1-4/mo
- 2-6/wk
- >=1/d

Malik V S et al. Circulation. 2010;121:1356-1364
SSBs and Cardiovascular Disease
Blood Pressure

• In the Framingham Heart Study, consumption of $\geq 1$ soft drink/day significantly increased the odds of developing high blood pressure.
Sugar-Sweetened Beverages and Hypertension

- INTERMAP
  - International Study of Macro/Micronutrients and Blood Pressure
  - N=2,696, ages 40-59
  - 4, 24 hr diet recalls
  - 8 BP readings and 2, 24 hr urine collections
- SSB intake >1 serving/day associated with higher BP
- Recommend intakes of SSBs, sugars and salt be substantially reduced.
Dyslipidemia

• US adults (n = 6113) from NHANES 1999-2006
• A mean of 15.8% of consumed calories were from added sugars.
• Significant correlations between dietary added sugars and blood lipid levels among US adults.
Multivariable-Adjusted Mean HDL-C Levels by Level of Added Sugar Intake Among US Adults, NHANES 1999-2006

Multivariable-Adjusted Geometric Mean Triglyceride Levels by Level of Added Sugar Intake Among US Adults, NHANES 1999-2006

Added Sugar Intake and Cardiovascular Diseases Mortality Among US Adults


<table>
<thead>
<tr>
<th>Subgroup</th>
<th>No. of Participants (Deaths)</th>
<th>Adjusted HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;60</td>
<td>8835 (144)</td>
<td>1.67 (0.78-3.58)</td>
</tr>
<tr>
<td>≥60</td>
<td>2898 (687)</td>
<td>1.83 (1.01-3.31)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5639 (434)</td>
<td>1.34 (0.60-3.00)</td>
</tr>
<tr>
<td>Female</td>
<td>6094 (397)</td>
<td>2.95 (1.48-5.91)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>4802 (494)</td>
<td>2.67 (1.48-4.80)</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>3233 (187)</td>
<td>0.71 (0.44-1.15)</td>
</tr>
<tr>
<td>Mexican American</td>
<td>3217 (134)</td>
<td>1.76 (0.49-6.39)</td>
</tr>
<tr>
<td>Education, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;12</td>
<td>4318 (455)</td>
<td>2.29 (1.49-3.50)</td>
</tr>
<tr>
<td>≥12</td>
<td>7415 (376)</td>
<td>1.67 (0.67-4.18)</td>
</tr>
<tr>
<td>Healthy Eating Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥Top 50%</td>
<td>5673 (457)</td>
<td>2.96 (1.15-7.63)</td>
</tr>
<tr>
<td>&lt;Top 50%</td>
<td>6060 (374)</td>
<td>1.80 (1.05-3.07)</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>4407 (287)</td>
<td>2.12 (0.63-7.18)</td>
</tr>
<tr>
<td>Low</td>
<td>7326 (544)</td>
<td>1.54 (0.93-2.53)</td>
</tr>
<tr>
<td>Body mass index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25</td>
<td>4697 (320)</td>
<td>1.55 (0.56-4.34)</td>
</tr>
<tr>
<td>≥25</td>
<td>7036 (511)</td>
<td>2.23 (1.40-3.55)</td>
</tr>
</tbody>
</table>
Added Sugar Intake and Cardiovascular Diseases Mortality Among US Adults

• Conclusions and Relevance
  – Most US adults consume more added sugar than is recommended for a healthy diet.
  – The researchers observed a significant relationship between added sugars consumption and increased risk for CVD mortality.

Sugar and heart disease

http://www.youtube.com/watch?v=TM3oWoby
VA4
Mechanism

• We don’t compensate for liquid calories by eating fewer calories from solid food
• Sugar in a liquid form is less filling than in solid...
SSBs may lead to weight gain as a result of incomplete compensation for liquid calories at subsequent meals, resulting in positive energy balance.

Malik V S et al. Circulation. 2010;121:1356-1364
Diet Quality
Nutrient Density
Diet Quality

• High intakes of added sugars associated with lower intakes of calcium, fiber, micronutrients, other protective compounds
Key messages

- Maintain calorie balance over time to achieve and sustain a healthy weight.
- Focus on consuming nutrient-dense foods and beverages.
- Drink water instead of sugary drinks.
Does High-Fructose Corn Syrup Harm Health?

- Effects on lipid metabolism
  - High intakes of fructose associated with fat accumulation in the blood and liver.
### Types of Nonnutritive Sweeteners

<table>
<thead>
<tr>
<th>Name</th>
<th>Times sweeter than sucrose</th>
<th>ADI(^1) and EDI(^2)</th>
<th>Use in foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luo han guo extract</td>
<td>150-300</td>
<td>ADI: None determined EDI: 6.8 mg/kg BW(^3)</td>
<td>GRAS(^4). Intended for use as a tabletop sweetener, a food ingredient, and a component of other sweetener blends.</td>
</tr>
<tr>
<td>Stevia</td>
<td>250</td>
<td>ADI: (determined by JECFA(^5)) 4 mg/kg BW EDI: 1.3-3.4 mg/kg BW</td>
<td>GRAS. Intended for use as a sweetener in a variety of food products such as cereals, energy bars, and beverages and as a tabletop sweetener.</td>
</tr>
<tr>
<td>Sucralose</td>
<td>600</td>
<td>ADI: 5 mg/kg BW EDI: 0.1-2.0 mg/kg BW</td>
<td>General use; heat stable for cooking and baking.</td>
</tr>
<tr>
<td>Acesulfame K</td>
<td>200</td>
<td>ADI: 15 mg/kg BW EDI: 0.2-1.7 mg/kg BW</td>
<td>Approved for general use, except in meat and poultry. Combines well with other NNS; stable at baking temperatures.</td>
</tr>
<tr>
<td>Aspartame</td>
<td>160-220</td>
<td>ADI: 50 mg/kg BW EDI: 0.2-4.1 mg/kg BW</td>
<td>Approved for general use. Degrades during heating. Unstable/breaks down at low pH.</td>
</tr>
<tr>
<td>Neotame</td>
<td>7,000-13,000</td>
<td>ADI: 18 mg/kg BW EDI: 0.05-0.17 mg/kg BW</td>
<td>Approved for general use, except in meat and poultry. To date, little used in food processing.</td>
</tr>
<tr>
<td>Saccharin</td>
<td>300</td>
<td>ADI: Prior sanctioned food ingredient; no ADI determined EDI: 0.1-2 mg/kg BW</td>
<td>Limited to &lt;12 mg/fl oz in beverages, 20 mg/serving in individual packages, or 30 mg/serving in processed foods.</td>
</tr>
</tbody>
</table>

\(^1\)ADI=acceptable daily intake  
\(^2\)EDI=estimated daily intake  
\(^3\)BW=body weight.  
\(^4\)GRAS=generally recognized as safe.  
\(^5\)JECFA=Joint Expert Committee on Food Additives

Reference:  


Sucralose aided weight management using a “small change” approach

A family intervention study evaluating small changes that included elimination of 100 calories/day by replacing sugar with sucralose found:

• Sucralose was acceptable to parents and children.

• Paired with 2,000 steps/day, this small-changes approach to lifestyle modification was effective in helping to reduce excessive weight gain in children who were overweight or at risk for overweight.

Non-nutritive sweeteners: A potentially useful option – with caveats

“Substituting non-nutritive sweeteners for sugars added to foods and beverages may help people reach and maintain a healthy body weight – as long as the substitution doesn’t lead to eating additional calories later as compensation.”

Recent research on non-nutritive sweeteners
Suez et al. *Nature* Published online 17 September 2014

- Mouse model
- Saccharin, aspartame and sucralose caused significant changes to the microorganisms in the gut, causing the animals to develop glucose intolerance — a condition that can lead to diabetes.
Human arm of the study

- The researchers followed *seven* people given a high dose of saccharin—5 milligrams per kilogram of body weight, the FDA’s maximum acceptable daily intake—on *six* consecutive days.

- Four of the subjects began showing signs of glucose intolerance.
  
  – Suez et al. *Nature* Published online 17 September 2014
Author’s comment

• “We are the first to admit that the human arm in the study has only preliminary results on a small subset of individuals.”
  – Eran Segal, one of the Nature study authors.
“It would be a mistake to conclude that diet sodas are worse than sugary drinks, and no diet-soda drinker should interpret the new study as license to switch to regular soda. The risks of type 2 diabetes and weight gain far out-weigh the new concerns about artificial sweeteners.”

– Center for Science in the Public Interest, September 17, 2014.
Policy solutions to reduce intakes of sugary drinks

- Schools
- Healthy workplaces
- Portion size controls
- SSB Taxes
Healthy, Hunger-Free Kids Act of 2010

Wellness Guidelines in Schools

• “Competitive food” regulations in place fall 2014
  – Calorie, fat, sugar and sodium limits have to be met on almost every food and beverage sold during the school day

• Advertising of sugary drinks and junk food on school grounds phased out

• In VT, foods sold at fundraisers (bake sales) need to meet nutrition guidelines

• No restrictions on foods brought from home
Healthy Workplaces

• Boston
  – Phased out the sale, advertising, and promotion of sugary beverages on City-owned property.

• New York City
  – Ad campaigns
Portion Size Control

16 oz  32 oz  44 oz  52 oz  64 oz

48 Teaspoons Sugar
New York City Soda Size Ban

• http://www.youtube.com/watch?v=eDPTiiP4vT7I
Sugar-sweetened Beverage Taxes

“A tax on sugar-sweetened beverages such as sodas, energy drinks, sweet teas, and sports drinks would reduce obesity in adolescents more than other policies, such as exercise or an advertising ban, and would also generate significant revenue for additional obesity prevention activities.”

Proposed SSB Tax in Vermont

Impact of SSB tax in Mexico

• First quarter of 2014 compared to first quarter of 2013
  – 10 percent decline in purchases of taxed beverages
  – 7 percent increase in purchases of untaxed beverages
• diet sodas, sparkling and still plain water, 100% juices, flavored water with non-caloric sweeteners.
Fed Up Trailer

- [http://www.youtube.com/watch?v=aCUbvOwWfWM](http://www.youtube.com/watch?v=aCUbvOwWfWM)
Questions?

STOP. RETHINK YOUR DRINK. GO ON GREEN.

Red - Drink Rarely, If At All
- Regular sodas
- Energy or sports drinks
- Fruit drinks

Yellow - Drink Occasionally
- Diet soda
- Low-calorie, low-sugar drinks
- 100% juice

Green - Drink Plenty
- Water
- Seltzer water
- Skim or 1% milk