The Real Scoop on Sugar

Today's Dietitian investigates the sugar debate.

According to the 1964 Walt Disney musical ***Mary Poppins***, just a spoonful of sugar helps the medicine go down. But while sugar may help the medicine go down, you don't hear anyone singing these praises anymore. Instead, many Americans and those in the healthcare community claim "Sugar is toxic." "Sugar causes obesity." "Sugar makes you fat."

For decades, both consumers and health experts have been pondering the potential negative health effects related to sugar consumption. The classic 1986 book ***Sugar Blues*** by William Dufty exploded onto the sugar-busting scene. People were shocked to read they were consuming, on average, 100 lbs of sugar per year.

By Sharon Palmer, RD

Fast forward to today, when Americans are consuming even more of the sweet stuff. According to the USDA, per capita consumption of caloric sweeteners, mainly sucrose and corn sugars, increased 39% between the 1950s and 2000 to an average of 152 lbs per year.[1] People are now eating an average of about 30 tsp of sugar per day, which contributes a whopping 476 kcal per day.[2] And along with the rise in sugar intake has come a growing sense of dread among the public over the potential health fallout. Findings from the International Food Information Council Foundation 2012 Food & Health Survey revealed consumers' attitudes about sugar and health. Consumers were asked which calorie sources (sugars, carbohydrates, fats, protein, or all sources) they believe are more responsible for

weight gain. Twenty percent said that calories from sugars are most responsible. While 62% believed a moderate amount can be part of a healthful diet and 61% said it's not necessary to completely eliminate sugar to lose weight, only 28% believed all sugars (including high-fructose corn syrup [HFCS], table sugar, and honey) are similar and used by the body in the same way. Fifty-one percent of Americans are trying to limit or avoid sugars when choosing foods and beverages, while 35% pay no attention to sugar content.[3]

Sugar Hits the Airwaves

What's fueling the public's sugar fears? "Consumers have been hearing for years the stories linking sugar to hyperactivity, diabetes, obesity, and other chronic diseases," says Jeannie Gazzaniga-Moloo, PhD, RD, a national spokesperson for the Academy of Nutrition and Dietetics (the Academy). "They've also heard reports disputing connections between sugar and all these conditions. I think many consumers are confused about sugar's role in disease development and management."

The volume on the sugar-health debate turned up a notch when a recent wave of media reports called on the opinions of Robert H. Lustig, MD, a professor of pediatrics in the division of endocrinology at the University of California, San Francisco, who's a leader in the antisugar movement. Lustig has spoken out at several recent nutrition conferences on the adverse health effects of sugar, including the Annual Nutrition & Health Conference and the Experimental Biology meeting.

Lustig reported at the Annual Nutrition & Health Conference in May 2011 that fructose intake, an egregious component in the Western diet, has doubled over the past 30 years from all its sources, including HFCS, sucrose, and juice. "The 'fructosification' of our food supply increases its palatability. Low-quality foods have high-fructose corn syrup added on purpose. It's used as a browning agent," Lustig said.

He reported that our growing dependence on fructose has fueled the obesity and type 2 diabetes epidemics and has led to increased energy intake, decreased resting energy expenditure, excess fat deposition, nonalcoholic fatty liver disease, insulin resistance, hyperglycemia, cardiovascular disease, and metabolic syndrome in humans.

Lustig has become a hit among mainstream audiences, thanks to his YouTube lecture "Sugar: The Bitter Truth," which has received more than 2.6 million hits to date. In April, ***60 Minutes*** aired a segment featuring Lustig as an expert on sugar and health. He reported that sugar is toxic and that it's to blame for the public health crisis more than any other food substance.[4]

One year earlier, Lustig was featured in a ***New York Times*** article titled "Is Sugar Toxic?" written by Gary Taubes, author of ***Good Calories, Bad Calories***, who shares similar views with Lustig. Sugar isn't just an empty calorie, Lustig says in the article; its effects on us are much more insidious. "It's a poison by itself," Lustig was quoted as saying. Taubes wrote:

> *Lustig's argument, however, is not about the consumption of empty calories—and biochemists have made the same case previously, though not so publicly. It is that sugar has unique characteristics, specifically in the way the human body metabolizes the fructose in it, that may make it singularly harmful if consumed in sufficient quantities.*[5]

Is Sugar Really Dangerous?

Lustig's views on sugar and health bring to light the crux of the sugar argument, raising the question, is there proof that the negative impact of sugar extends beyond its provision of empty calories?

"The concept that sugar is toxic simply has no credibility," says David M. Klurfeld, PhD, national program leader for the Human Nutrition USDA Agricultural Research Service, who edited a June 2009 ***Journal of Nutrition*** supplement "The State of the Science on Dietary Sweeteners Containing Fructose." "There's little doubt that Americans consume too much sugar, but we have no data to tell us how much is too much for any health endpoint we ask about."

Walter Willett, DrPH, MD, chair of the department of nutrition at the Harvard School of Public Health, says, "There are problems with sugar due to adverse metabolic effects, but the idea that fructose is dangerous—the science doesn't support this. To only focus on sugar as the problem, the science isn't there. There may be subtle metabolic differences in the body with fructose. Cutting back on sugar is an important part of a healthful diet, along with cutting back on refined starches and fruit juice, which have the same glycemic load as sugar."

The 2009 American Heart Association (AHA) Scientific Statement on Dietary Sugars Intake and Cardiovascular Health reported that excessive consumption of sugars has been linked with several metabolic abnormalities and adverse health conditions. Though the mechanisms are unclear, relative to other carbohydrate sources, sugar intake appears to be associated with increased triglyceride levels, a known risk factor for coronary heart disease, and some studies show that a higher consumption of high-sugar beverages and foods is associated with increased inflammation and oxidative stress, according to the AHA.

While acknowledging that obesity is a multifactorial condition, it's likely that Americans' recent history of weight gain must be related in part to increased intake of added sugars, even though research thus far has been insufficient to confirm a direct link, the AHA stated.[2]

Most everyone agrees that the increase in sugar intake has led to a sea of unwanted calories. The Dietary Guidelines for Americans report that added sugars are consumed in excessive amounts, resulting in a high intake of calories that offer little nutritional payback. However, the guidelines state that foods with added sugars are no more likely to contribute to weight gain than any other source of calories in an eating pattern that's within calorie limits.[6]

Joanne Slavin, PhD, RD, a professor in the department of food science and nutrition at the University of Minnesota who served on the 2010 Dietary Guidelines Advisory Committee, says, "There's no data that refined sugar or refined starch have different metabolic effects, except that fructose is a lower glycemic than glucose."

Kelly Brownell, PhD, a professor at Yale University and director of the Yale Rudd Center for Food Policy & Obesity, sums it up: "Sugar is a major issue, but it will take more science for us to know whether it promotes all of these metabolic effects. Sugar is certainly an important culprit in the obesity problem, but it's not the only one. Sugar is important for several reasons: It's added to the diet in large amounts; it makes things extremely palatable so that it pushes people to over consume it; and it's a major source of calories, especially from sugars added to beverages."

The Sugar Landscape

Consider that our early ancestors never knew the intensely sweet flavor of refined sugar; they knew only honey and fruit. Since early humans had to battle the bees for a taste of honey, the mild natural sweetness of sugar—which came packed with nutrients and fiber—defined our knowledge of sweetness.

"The brain didn't evolve to handle sugar and the amounts not found in nature," Brownell says. "Once it became processed and we started putting sugar in so many foods, the body doesn't know how to recognize it. When I go back to when I was a boy, the number of fast-food restaurants was much lower and the available size and containers for foods were much smaller. Sugar-sweetened beverages were reserved for special occasions, and they were in smaller bottles. Now they're huge, and there's sugar in so many foods now. The sugar landscape has changed in profound ways."

The Fructose Story

Fueling the sugar debate is consumers' confusion over the effects of HFCS, which has received the lion's share of public scrutiny on the sugar front, even to the point where consumers often consider cane sugar to be healthful in comparison. However, most nutrition experts consider all added sugars, such as HFCS, table sugar, and honey, to be similar in their effects.

The problem with HFCS is that it's so pervasive in our food system. The intake of HFCS increased by more than 1,000% between 1970 and 1990, far exceeding the changes in intake of any other food or food group in American diets. HFCS now represents more than 40% of the caloric sweeteners added to foods and beverages and is the sole caloric sweetener in soft drinks.[7]

Many consumers mistakenly believe that HFCS, a corn-derived sweetener commonly used in food and beverage processing, is pure fructose when in fact it's 42% to 53% glucose and 42% to 55% fructose, depending on the type, making it similar in composition to table sugar, which is one-half glucose and one-half fructose. HFCS is produced from corn syrup, nearly all glucose, which undergoes enzymatic processing to increase the fructose content and is then mixed with glucose.[2]

According to the AHA, studies suggest that excessive fructose consumption may play a role in insulin resistance, obesity, hypertension, dyslipidemia, and type 2 diabetes in humans.[2] In a University of California, Davis, review on fructose and metabolism, researchers reported that the hepatic metabolism of fructose favors lipogenesis, which may contribute to hyperlipidemia and obesity.[8]

"Fructose clearly is metabolized differently from glucose," Klurfeld explains. "Fructose is metabolized primarily in the liver, and there are both advantages and disadvantages to that. The advantage is that eating fructose doesn't raise blood glucose or insulin levels, both of which, when elevated above the normal range, are thought to contribute to a variety of diseases ranging from heart disease to obesity to several forms of cancer or even the normal aging process. The disadvantage is that when fructose is metabolized in the liver, it's used preferentially to make fats. However, since fructose is almost never eaten by itself and is usually in approximately equal amounts with glucose, neither of the above conditions predominates."

Glycemic Response

What about the impact of sugar on glycemic response and insulin secretion? It's not unusual for nutrition professionals to counsel patients to avoid added sugars because of their effects on blood glucose. Increasingly, health professionals are recognizing the usefulness of the glycemic index (GI) to educate

clients on the quality of carbohydrates and their impact on glycemic response. The American Diabetes Association reports that the type of carbohydrate does have an effect on blood glucose, thus the GI may be helpful in fine-tuning blood glucose management.[9]

Indeed, some studies have found that low-GI diets can reduce the risk of heart disease, inflammatory diseases,[10,11] and type 2 diabetes.[12] Consuming low-GI carbs also may delay hunger and reduce subsequent energy intake compared with higher-GI carbs.[13] And some research has found weight-loss benefits with low-GI diets.[14] However, not all studies have found such promising results, and investigators stress that more research is needed.

Does a low-GI diet protect against insulin resistance? After all, insulin resistance is associated with several health problems, such as type 2 diabetes, obesity, high blood pressure, heart disease, and stroke. The Insulin Resistance Atherosclerosis Study (IRAS) showed a lack of association between GI, glycemic load, and carbohydrate intake and measures of insulin sensitivity, insulin secretion, and adiposity.[15] The strongest link to insulin resistance remains excess weight and lack of physical activity.[16]

It's important to consider that the effects of a food's GI may be muddled with other factors. The benefits seen with low-GI diets may be related to fiber and other components found naturally in whole grains, fruits, and vegetables.[17] In addition to sugar, many carbohydrate-containing foods such as refined grains, cereals, and breads rank high on the GI. The view that sucrose consumption results in higher blood glucose levels than starch is a common misperception. Indeed, cooked starch, such as bread, rice, and potatoes, evokes glucose responses similar to glucose.[2]

"The glycemic response is greatest for glucose, not fructose," Slavin says. "So sugar causes less glycemic response than glucose or starch. Therefore HFCS, which is usually 55% fructose, has the lowest glycemic response compared to sucrose with 50% fructose or starch with 100% glucose."

At the Annual Nutrition & Health Conference, Lustig said, "Fructose induces insulin resistance." But Klurfeld says that while it was once thought that high sugar intake promotes insulin resistance, this was disproven. "If someone consumed nothing but glucose in large amounts, this might occur, but since we consume a mixture of sugars, it doesn't happen. In fact, fructose doesn't require insulin for its metabolism," Klurfeld says.

According to a review published by a researcher at the Diabetes and Vascular Research Centre in the United Kingdom, animal studies have consistently shown the effect of high-sucrose and high-fructose diets in decreasing insulin sensitivity, but studies in humans have produced conflicting results, with limited evidence demonstrating a negative effect on insulin sensitivity at higher intakes of fructose or sucrose (generally greater than 30% of daily calories from sucrose and greater than 15% of daily energy from fructose). However, observational studies in humans haven't shown a link between sucrose consumption and insulin sensitivity. The differences in the pattern of postprandial responses between fructose and sucrose may offer a possible explanation for the conflicting results on insulin sensitivity.[18]

The IRAS study also found no association between sucrose intake and insulin sensitivity.[19] But a study of 16 overweight Latina adolescent females who completed a 12-week modified carbohydrate intervention found that greater reductions in added sugar intake showed significantly greater improvements in insulin secretion following a modified carbohydrate nutrition intervention.[20] And sugar-sweetened beverage intake was linked with hepatic insulin resistance in the Framingham Offspring Study.[21]

The Sugary Beverage Conundrum

While researchers may be cautious about the evidence linking sugar to obesity and other health concerns, they seem more clear on the relationship between sugar-sweetened beverages and health. "Sugar in beverages is a problem for several reasons," Brownell says. "One, [sugar-sweetened beverages] are the greatest source of added sugars in the diet. Two, they're completely empty calories. Three, they're very heavily promoted. Four, the body doesn't seem to recognize calories very well when they're delivered in liquids; you don't feel as full. Five, it's possible that sugar triggers an addictive process in the brain."

Between 1970 and 2000, per person daily consumption of caloric soft drinks increased 70%, from 7.8 to 13.2 oz.[2] Carbonated sodas provided 22% of the refined and added sugars in the 2000 American food supply compared with 16% in 1970.[1,2]

Several studies have linked sugar-sweetened beverage intake with higher energy intake, greater body weight, health problems, and poor nutrition.[2] People don't compensate as well for calories in beverages, compared to calories in solid food, which may impact weight control.[22] A California study found that adults who drink one or more sodas every day are 27% more likely to be overweight or obese than those who don't drink soda.[23] And women who regularly consume sugar-sweetened beverages were shown to have a higher risk of coronary heart disease.[24]

Best Expert Advice

It seems there are more questions than answers when it comes to the role of sugar in human health. "The science of food and health is young," Gazzaniga-Moloo says, "Our bodies are complicated machines, and the fuel we feed it and how it's metabolized by the body is unique to each individual. It's complicated science with few definitive, concrete answers at this point."

The AHA guidelines on sugar call for a prudent upper limit intake of one-half of the discretionary calorie allowance, which for most American women is no more than 100 kcal/day and for most American men no more than 150 kcal/day from added

sugars.[2] Both Brownell and Gazzaniga-Moloo recommend using these guidelines for educating the public.

Foods and beverages that are high in added sugars and low in nutrients can displace nutrient-rich foods in the diet so that it becomes difficult for people to meet the recommended intake for macronutrients and micronutrients. In fact, the Dietary Guidelines state that a diet with no more than 5% to 15% of calories from solid fats and added sugars can meet the USDA food pattern designed to meet nutritional needs within calorie limits. Thus, they advise limiting the amount of added sugars when cooking or eating, and consuming fewer and smaller portions of foods and beverages that contain them.[6]

"The best—and most boring—advice is variety and moderation in sugar intake and everything else," Klurfeld says. "The key to defining how much sugar to consume is to balance calories in with calories expended. Since most Americans do very little physically, the only options are to eat less or move more, and more activity increases and helps maintain muscle mass, which is associated with better health."

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