BMJ

BMJ 2013;346:e8077 doi: 10.1136/bmj.e8077 (Published 15 January 2013)

EDITORIALS

Science souring on sugar

Accumulating evidence points towards a role for sugar and other refined carbohydrates in the development of overweight

Walter C Willett *professor and chair*[1], David S Ludwig *professor of pediatrics*[2]

[1]Department of Nutrition, Harvard School of Public Health, Boston, MA 02115, USA; [2]New Balance Foundation Obesity Prevention Center, Boston Children's Hospital, Boston

Sugar—most importantly sucrose (table sugar) and high fructose corn syrup—has long been thought to have adverse health effects, such as contributing to dental caries, overweight, diabetes, and heart disease. A linked feature (doi;10.1136/bmj.e7800) comments on the 40th anniversary of the publication of the popular book—*Pure, White and Deadly*—written by the British physiologist John Yudkin, which claimed that high sugar consumption was associated with heart disease.[1 2]

The association between sugar and poor health has remained contentious over the past few decades. This is partly because of weaknesses in the data (Yudkin's conclusions were largely based on comparisons of sugar intake and disease rates among different populations, which is generally considered a weak form of evidence) and because powerful economic interests are invested in the production and sale of sugar based products. The tension between industry and scientists can be illustrated by a 2003 recommendation from the World Health Organization that sugar intake be limited to 10% of energy intake,[3] which was heavily attacked by the sugar industry and many governments, but was ultimately sustained. Because WHO plans to update its recommendations, a systematic review of the literature on the association between sugar consumption and body weight was commissioned, the findings of which are presented in the linked paper by Te Morenga and colleagues (doi:10.1136/bmj.e7492).[4]

Te Morenga and colleagues limited their analysis to prospective studies and randomized trials that examined freely consumed sugar—they excluded studies in which weight loss was emphasized. Both types of studies supported an adverse effect of sugar on body weight in adults. Randomized trials of children were limited by the low number, size, challenges of blinding, and adherence to assigned diets, but the findings of prospective studies supported an adverse effect of high sugar consumption on body weight. A broader review of studies that included trials where sugar was restricted provides further evidence to support Te Morenga and colleagues' conclusions.[5] This evidence includes two recent randomized trials in children,[6 7] one of which was the first double blinded study in which an artificially sweetened drink was used as control.

Although the finding that sugar is adversely associated with adiposity is important, recommendations on sugar intake should take all its health effects into account. Consumption of sugar, and carbohydrates in general, raises postprandial plasma glucose and adversely affects manifestations of the metabolic syndrome—for example, it increases concentrations of insulin and triglycerides and reduces concentrations of high density lipoprotein cholesterol.[8] Not surprisingly, given these metabolic effects, the consumption of sugar sweetened drinks has been associated with an increased risk of type 2 diabetes and coronary artery disease.[9 10]

Te Morenga and colleagues' results suggest that sugar increases body weight mainly by promoting overconsumption of energy (although the effects of sugar on body fatness independent of changes in weight could not be assessed). This, and other evidence in the broader literature, suggests that sugar intake should be limited, but questions remain. What is a desirable limit? No clear threshold exists for the many adverse effects of sugar intake; in general the association seems to be roughly linear, which makes a limit somewhat arbitrary. Current intake of added sugar in the United States and United Kingdom is about 15% of total energy. Thus a limit of 10% could be viewed as a realistic practical goal. In contrast, the American Heart Association suggests a limit of about 5% of energy,[11] which would be more consistent with a goal for optimal health.

What mechanisms underlie the effects of sugar on weight, and what is the relative importance of sugar in liquid versus solid form? As Te Morenga and colleagues noted, many of the studies they identified examined the role of sugar sweetened drinks. Sugar in this form does not induce satiety to the same degree as it does in solid form, which makes overconsumption easier. Because of this, and the large amounts of sugar consumed in drinks, reducing the intake of sugar sweetened drinks is a high priority. Overconsumption of sugar is surely, in part, due to sweetness itself, and food technologists exploit this fact to encourage greater consumption of their products. This results in a food supply that is permeated by a high level of sweetness, which may promote behaviors akin to addiction.[12]

walter.willett@channing.harvard.edu

What are the relative roles of glucose and fructose? Popular attention has focused on high fructose corn syrup as a specific danger, but its composition is almost identical to that of sucrose (half glucose and half fructose). Although fructose is metabolized by different pathways from glucose, both seem to have adverse effects, and there is no good evidence that replacement of fructose with glucose would be beneficial. Furthermore, many starchy foods, particularly highly processed grains and potato products, have a high glycemic index, raising blood glucose and insulin more rapidly than an equivalent amount of sucrose.[13] Unfortunately, the 2003 WHO report disregarded evidence suggesting that refined grain and potato products have metabolic effects comparable to those of sugar. In contrast to added sugar, sugars occurring in the form of whole fruit have generally not been associated with weight gain, perhaps because of their relatively low glycemic index and high amounts of accompanying fiber.

What actions are needed? Efforts to reduce sugar intake are appropriate, but they should form part of a broader effort to improve the quality of carbohydrates, which would include reducing intakes of refined grain products and potatoes. Action should be taken at many levels, including educational programs, improvements in foods and drinks provided in schools and worksites, and supplemental nutrition programs for people with low incomes. Reducing the amount of sugar consumed in drinks deserves special attention because of the strength of the evidence and the ease with which excessive sugar is consumed in this form. Policy approaches, such as imposing taxes on sugar laden drinks,[14] are useful, as are restrictions on advertising to children and limits on serving sizes, as have been tried in New York.[15] Healthcare providers could play an important role by routinely asking about consumption of sugar sweetened drinks as well as tobacco and alcohol use, by setting a good example, and by assuming leadership in public efforts to limit sugar as a source of harm.

Competing interests: Both authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Provenance and peer review: Commissioned; not externally peer reviewed.

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Cite this as: *BMJ* 2013;346:e8077