

SUGAR-SWEETENED BEVERAGES, MILK INTAKE, AND OBESITY IN CHILDREN AND ADOLESCENTS

In this issue of *The Journal*, Striegel-Moore et al¹ provide data from a prospective study of more than 2300 9-year-old girls followed for 10 years. This study raises 2 important questions:

1. Does the intake of sugar-sweetened beverages displace the consumption of milk, a key source of dietary calcium for children and adolescents?
2. Do sugar-sweetened beverages, such as soda and sugar-added juices, cause obesity?

In their study, absolute quantities of milk consumed decreased by 25% and sugar-sweetened beverage consumption increased almost 3-fold over a 10-year period. Soda consumption, but not the consumption of other beverages, predicted the greatest increase in body mass index (BMI). Because changes in BMI rather than incident obesity were measured, the authors are appropriately careful not to ascribe obesity to increased soda consumption. Soda consumption was also associated with a statistically significant decrease in calcium intake. Because milk provides an important source of calcium in the diets of children and adolescents, the decline in girls' milk consumption at a time when bone mineral deposition may predispose to eventual osteoporosis is a major concern.

Several studies have indicated that in children and adolescents, sugar-sweetened beverage consumption as a percentage of total caloric intake has increased and milk consumption has decreased over the last 20 years.^{2,3} The same studies found that sugar-sweetened beverages accounted for 5% to 10% of caloric intake among children age 2 to 16 years. Although a reciprocal relationship between milk and sugar-sweetened beverage intake often exists,^{1,4,5} these studies do not irrefutably demonstrate that increased sugar-sweetened beverage consumption leads to decreased milk consumption. However, 1 study demonstrated that when a small sample of 6- to 13-year-old children at a 4- to 8-week summer day camp were offered both milk and fruit-flavored sugar-sweetened beverages, the children's milk consumption was significantly lower when they consumed more than 16 oz/day of sugar-sweetened beverages compared to when they consumed no sugar-sweetened beverages.⁶

With respect to the relationship of sugar-sweetened beverage consumption and excessive weight gain, the evidence that an association is causal depends on several characteristics. The criteria include statistically significant associations, specificity, consistency, a temporal relationship, a dose-response

effect, and biological plausibility.⁷ As shown in the [Table](#), the longitudinal observational studies that have examined the relationship of sugar-sweetened beverages to various measures of obesity meet many of these criteria.^{1,8-11} These studies used variable measures of sugar-sweetened beverages, such as soda and 10% fruit juice. Various weight-related measures were used as outcome measures, including changes in BMI, BMI z-score, percentage of body fat, and prevalence of obesity. The relationship of sugar-sweetened beverage consumption to excessive weight gain was generally statistically significant, but the effect sometimes varied across groups within the same study. In those studies that controlled for other variables likely to influence weight gain, the associations were specific for sugar-sweetened beverage consumption.^{8,10} Sugar-sweetened beverage consumption preceded the effect on the weight-related measures. A dose-response effect was found in several of the studies.^{1,8,9} A logical mechanism exists that can explain this association. Consumption of excess calories can produce weight gain. The high fructose content of sugar-sweetened beverages may promote hepatic lipogenesis, and the reduced insulinogenic response may decrease the inhibitory effects of these sugar-sweetened beverages on food intake.¹² In addition, significant weight gain may occur when carbohydrates are consumed as liquids rather than as solids.¹³

The potential contributions of sugar-sweetened beverages to weight gain are supported by the results of several controlled clinical trials in adults. Adults fed almost 1135 g/day of high-fructose corn syrup-sweetened beverages gained weight; when they were fed the same amount of beverages with an artificial sweetener, men, but not women, lost weight.¹⁴ In a study of overweight adults fed supplements of 152 g/day of either sucrose or artificial sweeteners, predominantly in the form of beverages, those who

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The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control.

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Table. Observational studies of the relationship of sugar-sweetened beverage consumption and weight change in children and adolescents

Sample	n	Independent Variable	Outcome Measure	Finding*
9 to 10-year-old girls; 10-year follow-up ¹	2371	Soda consumption	BMI	Positive relationship between increase in soda consumption and increase in BMI ($P < .05$).
11 to 12-year-old middle-school children; 19-month follow-up ⁸	548	Sugar-sweetened drink consumption	Obesity (BMI and triceps skinfold \geq 85th percentile)	Baseline sugar-sweetened drink consumption ($P < .02$) and change in consumption ($P < .03$) associated with change in BMI; change in consumption associated with incident obesity ($P < .02$).
9 to 14-year-old children; 2-year follow-up ⁹	11,000	Sugar-added beverage consumption	BMI	Baseline and increased sugar-added beverage consumption significantly associated with weight gain in boys ($P = .012$). Baseline consumption of 1 daily, but not 2 or 3 servings gained significantly more BMI ($P = .02$) than nondrinkers. No significant effect of change in sugar-added beverage consumption in girls.
2- and 3-year-old children ¹⁰	10,904	Sweet drink consumption	Overweight (BMI \geq 95th percentile)	Higher sweet drink consumption at baseline significantly associated with incidence of overweight among children with BMI 85th to $<$ 95th percentile, and retention of overweight among children with BMI \geq 95th percentile.
9- to 10-year-old girls; 7-year follow-up ¹¹	132	Soda consumption	BMI z-score and % body fat	Calories from soda related to BMI z-score ($P < .001$) but not to % body fat.

*Studies are adjusted for variables that vary from study to study.

received sucrose gained weight, whereas those who received artificial sweetener lost weight.¹⁵

The observational studies in children and adolescents include several limitations that preclude a definitive conclusion that sugar-sweetened beverages cause excessive weight gain. As individuals gain weight, their energy requirements increase.¹⁶ Therefore, the increased caloric requirement associated with increased BMI may account for the greater intake of calories and sugar-sweetened beverages. However, this relationship does not account for the relationship between baseline sugar-sweetened beverage consumption and weight gain. Although the relationship has been reasonably consistent across studies, the number of studies is small.

An alternative approach to longitudinal studies is to examine the association between reduced consumption of sugar-sweetened beverages on obesity or the prevention of excessive weight gain. A group-randomized, controlled, school-based intervention aimed at reducing students' consumption of sweetened and unsweetened carbonated beverages appeared to reduce the prevalence of overweight, but not of obesity, in 7- to 11 year-old children.¹⁷ However, it was not clear whether decreased soda intake mediated the shifts in overweight that occurred.¹⁸ Randomized trials demonstrating that reduced consumption of sugar-sweetened beverages reduces the incidence or increases the remission of obesity would substantially augment the existing studies and provide firmer evidence that interventions designed to limit sugar-

sweetened beverage consumption provide a sound intervention for weight control in children and adolescents.

As stated in a recent report from the Institute of Medicine,¹⁹ the severity of the obesity epidemic mandates that we not wait for the best possible evidence regarding the prevention of childhood obesity; we must act on the best available evidence. The article by Striegel-Moore et al¹ and the Institute of Medicine report¹⁹ suggest that reduced consumption of high-calorie, nutrient-poor beverages may help reduce or prevent childhood obesity. The ubiquity, low cost, and taste appeal of sugar-sweetened beverages present challenges for health care providers and families who believe that children's intake of sugar-sweetened beverages should be controlled to prevent excessive weight gain or reduce weight as necessary. As with any program aiming to effect changes in nutrition or physical activity, several behavioral strategies should be used, including changing the environment, setting goals, reinforcing the behavioral target, and monitoring the outcome.²⁰ For most families, the first step is to limit access at home. In addition, for older children, the frequency with which sugar-sweetened beverages can be consumed both within and outside the home should be discussed and limits suggested. For all children, consumption of sugar-sweetened beverages should be monitored and successful efforts to decrease consumption rewarded.²⁰ Schools, faith-based organizations, community groups, and other entities serving youth should institute changes that support reduced consumption of sugar-

sweetened beverages. Finally, the efforts recommended here should be considered in the context of other strategies to achieve and maintain normal weight, including providing nutritional selections consistent with the dietary guidelines and increasing physical activity. Reduced intake of sugar-sweetened beverages alone may not be sufficient to control excessive weight gain in individuals or populations.

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LOST IN TRANSLATION? PEDIATRIC PREVENTIVE CARE AND LANGUAGE BARRIERS

There are 47 million people in the United States who speak a language other than English at home; equivalent to almost 1 in 5 Americans. In 2003, 19% of school-age children spoke a language other than English at home, almost triple the number of that reported in 1979.² Almost 1/2 of all Americans³ and U.S. schoolchildren² who speak a non-English language at home are limited in English proficiency (LEP), defined as having a self-rated ability to speak English less than "very well."

LEP Limited English proficiency
SCHIP State Children's Health Insurance Program

Studies document that language barriers can have numerous detrimental consequences for children's health, including suboptimal health status, impaired access to medical care, lower likelihood of having a usual source of care, increased risk of intubation in pa-

See related article, p. 254.

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