Does Drinking Beverages with Added Sugars Increase the Risk of Overweight?

Overweight and obesity are health problems that affect a large number of people in the United States. To reduce body weight, a person must decrease the amount of calories he or she consumes while maintaining or increasing physical activity. The *Dietary Guidelines for Americans 2005*[1] indicates that the healthiest way to reduce caloric intake is to decrease one's consumption of added sugars, fats, and alcohol, all of which provide calories but few or no essential nutrients. One way for people to reduce their intake of added sugars and help manage their weight is to reduce the amount of sugar-sweetened beverages they drink.

This research brief explores the relationship between drinking beverages with added sugars and weight management.

An overview of the following topics is provided:

- Added sugar and the contribution of sugar-sweetened beverages to caloric intake.
- A research review of the science underlying the hypothesis that sugar-sweetened beverages are associated with body weight.
- Evaluations of interventions for reducing sugar-sweetened beverage intake.
- Contextual factors that might influence what we drink.
- Further research needs.
- Research to Practice: Suggestions for incorporating the research findings into our daily lives.

Added Sugar and the Contribution of Sugar-Sweetened Beverages to Caloric Intake

Added Sugars and Sugar-Sweetened Beverages in the American Diet

A large proportion of added sugar in the American diet comes from the consumption of sugar-sweetened beverages. Using nationally representative data, Guthrie and Morton[2] estimated that in 1994–1996, approximately one-third of added sugar intake came from regular (non-diet) carbonated soft drinks and 10% came from regular fruit drinks/ades and punches (not 100% juice). Soft drink intake has increased dramatically since the 1970s. One study[3] found that the percentage of youth who consumed any carbonated soft drinks (regular and low calorie) increased from 37% in 1977–1978 to 56% in 1994–1998, a 48% increase. Another study reported that among adults, consumption of carbonated soft drinks (regular and low calorie) and fruit drinks/ades (not 100% juice) increased by at least 100% between 1977–1978 and 1994–1995.[4] In 1996, Americans aged 2 years and older consumed 83 more calories of added sugar per day than they did in 1977.[5] Of these additional calories, 54 came from carbonated soft drinks (regular and low calorie) and 13 came from sugared fruit drinks.[5]

The consumption of sugar-sweetened beverages begins in early childhood and increases as children age. In 2002, the Feeding Infants and Toddlers Study (FITS) reported that 44% of toddlers aged 19–24 months old had consumed

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either fruit drinks/ades (38%) or carbonated soda (11%) at least once a day.[6] In 1994, almost 12% of preschoolers and 32% of school-aged children consumed 9 oz a day or more of carbonated soft drinks (regular and low calorie), while 22% of adolescents consumed 26 oz a day or more.[7] Few of these children drank diet carbonated soft drinks—in fact, only 5% of preschoolers, 11% of school-aged children, and 14% of adolescents.[7] Rampersaud et al.[8] showed that intake of carbonated soft drinks (regular and low calorie) increases as children grow older, with a dramatic rise occurring when they are around 8 years old .

Sugar-Sweetened Beverages and Caloric Intake

While beverages are a major source of added sugars in the American diet, the contribution of sugar-sweetened beverages to total caloric intake must also be considered. During 1999–2000, regular soft drinks and fruit drinks/ades contributed 7% of Americans' total caloric intake.[9] Among children and youth aged 6–17 years old, during 1994–1998, the highest percentage of caloric intake from soft drinks (regular and low calorie) occurred among 14– to 17–year-olds (males, 12% of caloric intake; females, 13%).[3]

In an analysis of the 1994 Continuing Survey of Food Intakes by Individuals (CSFII), caloric intake was positively associated with intake of non-diet carbonated soft drinks.[7] Using National Health and Nutrition Examination Survey (NHANES) III data collected from 1988 to 1994, Troiano et al.[10] found that overweight youth aged 2–19 years old consumed a higher proportion of their calories from carbonated soft drinks (regular and low calorie) than their non-overweight counterparts.

Sugars can be naturally present in foods, such as fructose in fruit or lactose in milk, or they may be added to food. Added sugars, also known as caloric sweeteners, are sugars and syrups that are added to foods at the table or during processing or preparation. Added sugars provide calories but few or no nutrients. Some of the names for added sugars are listed below:

- Brown sugar
- Corn sweetener
- Corn syrup
- Dextrose
- Fruit juice concentrates
- Glucose
- High-fructose corn syrup
- Honey
- Invert Sugar
- Lactose
- Maltose
- Malt syrup
- Molasses
- Raw sugar
- Sucrose
- Sugar
- Syrup

Research Review: Sugar-Sweetened Beverages and Increased Weight

Does drinking sugar-sweetened beverages cause weight gain? As with calories from other food sources, consumption of sugar-sweetened beverages will contribute to weight gain if a person's caloric intake exceeds the total number of calories required to maintain his or her current weight. The following studies examine whether people who consume sugar-sweetened beverages are at risk of consuming more total calories than they need, which can result in weight gain.

The studies included in this brief are all longitudinal, in that they investigated the association between sugar-sweetened beverages and body weight over time. Because cross-sectional studies examine relationships between variables at only one point in time, it is unknown whether beverage consumption preceded weight change or vice versa; for this reason, we did not include cross-sectional studies in this review. Because the types of beverages considered varied across the studies, in this brief, we use the same beverage descriptions used by the studies' authors. Furthermore, the authors used different methodologies, including study designs, intake measures, weight outcome variables, covariates, sample sizes, and lengths of follow-up, making comparisons among studies difficult. Despite these differences, five of seven observational studies[11–15] and four of four experimental studies[16–19] suggest an association between sugar-sweetened beverage intake and weight or body mass index (BMI). Although more studies need to be conducted in this area, these findings suggest that reducing the intake of sugar-sweetened beverages might be one strategy to help people manage their weight.

This review does not report on studies that examined the relationship between 100% juice intake and weight. Therefore, it excludes two related studies[20,21] that reported on the combined consumption of 100% juice and beverages with added sugars. This review also excluded an experimental study[22] that examined the relationship of supplemental foods and beverages containing added sugar compared to another group that received supplemental foods and beverages sweetened with artificial sweetener. These three excluded studies found a positive association between beverage consumption and weight.

Observational Studies

The seven observational studies followed a cohort of participants over time but did not attempt to change their beverage consumption behavior. Five of these studies found

a positive association between sugar-sweetened beverage consumption and increased weight or BMI. Of these five studies, one[12] followed adults and four[11,13–15] followed youth aged 8 years and older. These studies ranged in length from 19 months to 10 years. One study that did not show a positive association included younger participants, aged 2–5 years old, and a shorter time frame—data were collected on two visits between 6 and 12 months apart.[23] The other study[24] that did not find an association included children in grades 3–6 and collected data over 2 years.

Studies that found an association included the following:

- As part of a prospective study conducted from 1991–1999 (Nurses' Health Study II), Schulze et al.[12] collected self-reported weight and beverage intake information multiple times from 51,603 women. After adjusting for baseline and change in lifestyle variables—including age, postmenopausal hormone use, oral contraceptive use, physical activity, and various potential dietary confounders (caloric intake excluding soda)—weight gain and increases in BMI were highest among participants who increased their sugar-sweetened carbonated soft drink intake from ≤1 drink/week to ≥1 drink/day (P <0.001). Weight gain and increases in BMI were lowest among women who decreased their intake from ≥1 drink/day to ≤1 drink/week. Similarly, increased intake of fruit punch was associated with significantly greater weight gain than was decreased intake. Women who reported stable beverage consumption had no significant weight gain.

- A 10-year study of 2,379 black and white girls who were aged 9–10 years old at enrollment[11] directly measured and annually collected the girls' height and weight along with their beverage consumption. The sugar-sweetened beverages included soda (non-diet) and fruit drinks/ades (not 100% juice). Physical activity was not controlled for in this study. After adjusting for all other beverages consumed, study site, race, and total caloric intake, the authors found that non-diet soda intake had a very small but significant association with increased BMI (increased 0.01 BMI units for every 100 g of soda consumed).

- A 3-year longitudinal cohort study[14] that included more than 10,000 children aged 9–14 years old collected self-reported height and weight information and sugar-sweetened beverage intake annually for 3 years. Sugar-sweetened beverages were defined as soda, sweetened iced tea, and noncarbonated fruit drinks. While controlling for age, race, pubertal status, intake of other beverages, physical activity and inactivity, height, and previous BMI Z score, the researchers compared typical beverage intake over 1 year to height, weight, and BMI changes from 1 year to the previous year. They found that both boys and girls who increased their beverage consumption over 1 year had greater increases in BMI than those who did not. These increases were statistically significant for boys who consumed an additional one or two servings of sugar-sweetened beverages a day and for girls who consumed an additional two servings a day. When the authors adjusted for total energy intake, the estimated effects were diminished and were no longer significant, suggesting that the effect observed was mediated, at least in part, through increased total caloric intake.

- A 10-year longitudinal study of growth and development examined 196 girls from pre-adolescence (aged 8–12-years-old) to adolescence (until 4 years after menarche),[13] and annually measured their height and weight and collected food frequency data. After adjusting the model for age at menarche, parental overweight, and servings of fruit and vegetables, the researchers found a positive, longitudinal relationship between the percentage of calories from soda and BMI Z scores, but not with bioelectrical impedance analysis (used to calculate percent body fat and lean body mass). Girls in the third and fourth quartiles of percentage calories from soda had BMI Z scores ~0.17 units higher on average than girls in the first quartile. When the data were stratified by menarcheal status, the researchers found that this relationship remained significant only among postmenarcheal girls.

- A 19-month study[15] of 548 ethnically diverse school children in grades 6 and 7 showed that change in consumption of sugar-sweetened drinks was associated with overweight. Height and weight were directly measured and beverages included in this study were soda (non-diet), sweetened fruit drink (not 100% juice), and sweetened iced tea (non-diet). After adjusting for baseline anthropometrics, demographics, dietary factors, physical activity, and television-viewing variables, the researchers found no statistically significant increase in weight associated with baseline beverage consumption. In contrast, the study showed a significant association with change in beverage consumption: the risk of becoming overweight for these children increased 1.4 times for each additional sugar-sweetened beverage consumed daily. When controlling for total energy intake, this risk increased to 1.6.

Two earlier research reviews in this series—*Can Eating Fruits and Vegetables Help People to Manage Their Weight?* and *Do Increased Portion Sizes Affect How Much We Eat?*— present the published research on two promising weight-control strategies: increasing consumption of fruits and vegetables and reducing portion sizes.

Studies that did not find an association included the following:

- In a 6- to 12-month study of 1,345 children, aged 2–5 years old, who were participating in the North Dakota Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), Newby et al.[23] examined the association between changes in weight and BMI and intakes of fruit drinks and soda (non-diet). Height and weight were directly measured. The analysis controlled for age, sex, energy intake, baseline BMI, change in height, birth weight, and other sociodemographic variables, but not physical activity. Baseline intake of fruit drinks or sodas (average total < 3.5 fluid oz daily) and changes in intake of these beverages were not significantly associated with weight change or BMI. The results did not vary when total energy intake was removed from the model.

- In a 2-year study,[24] 166 (of approximately 830 eligible) primarily white students in grades 3–5 were measured at baseline and again 2 years later. Researchers examined beverage intake and total caloric intake using one 24-hour food recall collected at baseline and another 2 years later. These data were used to examine predictors of BMI Z score at year 2. Height and weight were directly measured. The sugar-sweetened beverages included regular soda, HI-C, sports drinks, Kool-Aid, fruit-flavored drinks, ice tea, and hot chocolate. Physical activity data were not collected. No relationship was found between sugar-sweetened beverage intake at baseline, change, or follow-up

and BMI Z score; however, two unusual findings were reported. Total caloric intake decreased significantly between baseline and follow-up, and a positive association was noted between diet soda intake and BMI Z score at follow-up (controlling for baseline BMI Z score), which explained ~3.5% of the variance.

Experimental Studies

Four studies of adults used an experimental[16–19] design to assess the effects of sugar-sweetened beverage consumption on weight. Height and weight were directly measured in all four studies. In the studies by Tordoff and Alleva[19] and DiMeglio and Mattes,[17] the participants were unaware of the true purpose of the studies. They received the experimental beverages and foods and were instructed to consume them everyday along with their normal diets and according to their preferred schedules. Both studies found a positive association between sugar-sweetened beverage consumption and increased body weight. The other two studies included a home-based environmental and behavioral change intervention[16] and a school-based curriculum intervention.[18] Participants in these studies reduced their intake of sugar-sweetened beverages, and a decrease in weight occurred among some groups.[16–18]

- In a 9-week study, Tordoff and Alleva[19] examined the influence of consuming the following for a period of 3 weeks each: sugar-sweetened soda, artificially sweetened soda, or no beverage supplement. The 30 normal weight men and women were required to consume four bottles (1135g/day) of the soda daily during the soda conditions. The authors found that sugar-sweetened soda significantly increased body weight in both men and women and artificially sweetened soda produced a significant decrease in body weight in men only. This study suggests that consuming sugar-sweetened beverages can increase weight and that artificially sweetened soda may facilitate weight management.

- In a small study[17] of 15 adults, participants consumed 450 kcal/day of either soda (liquid) or jelly bean (solid) supplements for 4 weeks followed by a 4-week wash-out period. This regiment was then followed by a second 4-week period in which the participants consumed either the soda or jelly beans that had not been consumed during the first 4-week period. The supplement intake patterns varied by the form of the food (i.e., liquid vs. solid). Participants reported consuming jelly beans as a snack more often than soda (82% vs. 45%, respectively), and they reported consuming soda more often than jelly beans (49% vs. 9%, respectively) when eating a meal. When consuming the jelly beans, energy intake from other foods and beverages was significantly lower than at baseline. However, energy intake from other foods and beverages did not decrease when the participants drank the soda supplement; in fact, total daily energy intake increased in an amount exceeding the supplement. The participants' body weight and BMI increased significantly only during the soda supplement phase.

- In a 25-week intervention study that included 103 adolescents aged 13 to 18 years old, Ebbeling et al.[16] implemented a home-based intervention that included an environmental component to reduce access to sugar-sweetened beverages (soft drinks, juice drinks <100% juice, punches, lemonades, iced teas, and sports drinks) as well as provided behavioral counseling. Non-caloric beverages were sent to the participants' households, and the participants received monthly telephone counseling to help them reduce their intake of sugar-sweetened beverages (additional details of this study are described in the next section). Adolescents in the upper baseline BMI tertile experienced a significant net BMI change of -0.75 $\pm$ 0.34 kg/m^2 compared to the control group. No significant differences were noted in the net BMI changes among adolescents in the lower baseline BMI groups. Additionally, a greater effect occurred among adolescents with higher baseline consumption of sugar-sweetened beverages. On average, for every one less serving per day of sugar-sweetened beverages, BMI decreased by 0.26 kg/m^2.

- In a year-long school curriculum intervention conducted in England with 644 children aged 7–11 years old,[18] participants received four 1-hour sessions, one in each of four academic terms. The curriculum focused on reducing intake of "fizzy" drinks and promoting a healthy diet (additional details of this study are described in the next section). At 12 months, overweight and obesity increased in the control group by 7.5% and decreased in the intervention group by 0.2%. Note that this study was criticized in an editorial[25] as having important conceptual and methodological limitations, such as lack of a mediational analysis showing changes in beverage intake linked to changes in weight, and raised questions about whether such a brief and low-intensity intervention could affect a change in prevalence of overweight.

Evaluations of Intervention Studies for Reducing Intake of Sugar-Sweetened Beverages

If consuming sugar-sweetened beverages can lead to increased weight, then what do we know about the effectiveness of interventions to decrease the consumption of these types of beverages? In this section, we report on the results of six evaluations[16,18,26–30] of interventions to reduce intake of sugar-sweetened beverages. These interventions included changes in home and school environments, behavioral counseling, a school-based curriculum, a day camp, a family-based intervention, and an after-school program. In four of six studies, participants significantly decreased their intake of sugar-sweetened beverages after participating in the interventions.

- During 2003–2004, Ebbeling et al.[16] implemented a home-based intervention that included environmental and behavioral counseling components to reduce access to and intake of sugar-sweetened beverages. This 25-week intervention included 103 adolescents aged 13 to 18 years old who reported consuming at least one serving of a sugar-sweetened beverage per day. The intervention provided home delivery of non-caloric beverages selected by the household along with monthly telephone counseling to help participants reduce their consumption of sugar-sweetened beverages. Participants received four beverage servings per day, and each additional household member received two beverage servings per day.

While intervention participants were instructed to consume the intervention beverages and to not consume sugar-sweetened beverages, the control group participants were instructed to maintain their normal beverage intake throughout the intervention period. The consumption of sugar-sweetened beverages was significantly reduced by 82% in the intervention group compared to baseline but remained the same in the control group. In addition, the intervention resulted in reduced BMI among intervention participants in the upper-baseline BMI tertile (see the Experimental Studies section for more details).

- The authors of another study[29,30] reported on environmental changes that reduced consumption of sugar-sweetened soda among high school students. The 4-year intervention study, which was conducted without a control group, was designed to enhance the students' knowledge of diabetes, increase their physical activity and their fruit and vegetable intake, and reduce their sugar-sweetened soft drink consumption. At the study's outset, sugar-free beverages were not available in school vending machines. During intervention years 1 and 2, sugar-free beverages were added, and in years 3 and 4, only sugar-free beverages were available. In the first analysis published, sugar-sweetened beverage intake was significantly reduced from more than 80% of all beverages consumed to less than 50% consumed among most students between intervention years 1 and 3 (P <0.05).[29] In the second analysis published, the researchers found no evidence that students were bringing sugared soft drinks to school, and parents reported that it became acceptable for teens to consume water and diet soft drinks (30). The authors of the study estimated that the environmental changes reduced intake of sugared-sweetened soft drinks by ~4.8 oz/day/student.[30]

- Another study[18] conducted in England with 644 children aged 7–11 years old used a school-based curriculum to prevent overweight and obesity. The curriculum focused on water consumption, reduced intake of all "fizzy" soft drinks, and a healthy diet. The intervention group received four sessions, one in each of four academic terms. The strategies included promoting water consumption, demonstrations of the effect of carbonated soda on tooth enamel, a music competition, art activities, and a classroom quiz based on a popular television game. The authors reported that mean carbonated drink (sweetened and unsweetened) intake was reduced over 3 days (2 weekdays and 1 weekend) by 0.6 glasses/3 days in the intervention group and increased by 0.2 glasses/3 days in the control group. They also reported a decreased prevalence of overweight in the intervention group (see the Experimental Studies section for more details).

Baranowski et al.,[26] Beech et al.,[27] and Story et al.[28] reported on the results of the Girls health Enrichment Multi-site Studies (GEMS), which funded researchers at multiple sites to develop and pilot test the feasibility of intervention strategies, including reduced intake of sweetened beverages, to prevent excess weight gain among 8- to 10-year-old African American girls. Each site independently developed a 12-week intervention and used a randomized controlled trial design, including a comparison group, in order to evaluate the pilot interventions with a small sample of girls.

- Baranowski et al.[26] developed a 4-week summer day camp for 19 girls that integrated normal camp activities and intervention strategies, followed by an 8-week Internet intervention targeting both the girls and their parents. The 16 girls in the control arm attended a different 4-week day camp where they only engaged in normal camp activities, and they also participated with their parents in an Internet intervention on general health once a month. The authors found no significant differences between the number of servings of sweetened beverages consumed among the girls in the intervention arm (2.9 servings/day) and the girls in the control arm (3.6 servings/day).

- Beech et al.[27] conducted a three-arm intervention study that compared two active, culturally tailored, family-based interventions centered on healthy nutrition and increasing physical activity. One arm included 21 girls in a child-focused intervention; a second arm included 21 parents in a parent-focused intervention. The control arm centered on increasing self-esteem among 18 children and did not include information on nutrition or physical activity. The authors reported a statistically significant 34.1% decrease in servings of sweetened beverages among the girls in the two active intervention arms combined compared to the control arm.

- In the third GEMS intervention study, Story et al.[28] developed an after-school intervention in which 26 girls participated in club meetings twice a week for 1 hour after school, along with a family component. The 28 girls in the control arm participated in a club that met less frequently than the intervention arm and focused on positive self-esteem and cultural enrichment. The authors found no significant differences between the number of servings of sweetened beverages consumed among girls in the intervention arm (1.1 servings/day) and girls in the control arm (0.9 servings/day). In addition, no significant differences were found in the availability of sweetened beverages in the intervention and control households.

These six studies represent the limited number of published evaluations of interventions designed to reduce sugar-sweetened beverage intake. When planning interventions to change a particular behavior, such as sugar-sweetened beverage consumption, it is important to understand the everyday experiences and environments that shape the participants' decision-making processes regarding the behavior. Some of the factors that should be considered in the context of sugar-sweetened beverage consumption are examined in the next section.

Exploring the Context of Beverage Consumption

To develop and successfully implement effective interventions, one needs to explore the context in which beverage intake occurs, including environmental and behavioral factors as well as knowledge, attitudes, and experiences associated with beverage consumption. While many everyday experiences potentially influence beverage consumption patterns, this section examines the following

topics: the role of advertising, portion size, restaurant food consumption and soft drink intake, sources of beverages for youth, sugar-sweetened beverages and schools, and youth perceptions of and experiences with sugar-sweetened beverages. The available literature varies tremendously, with multiple sources examining issues specific to youth and schools and almost no literature that is specific to adults, work sites, homes, or other community institutions.

Advertising and Marketing of Sugar-Sweetened Beverages

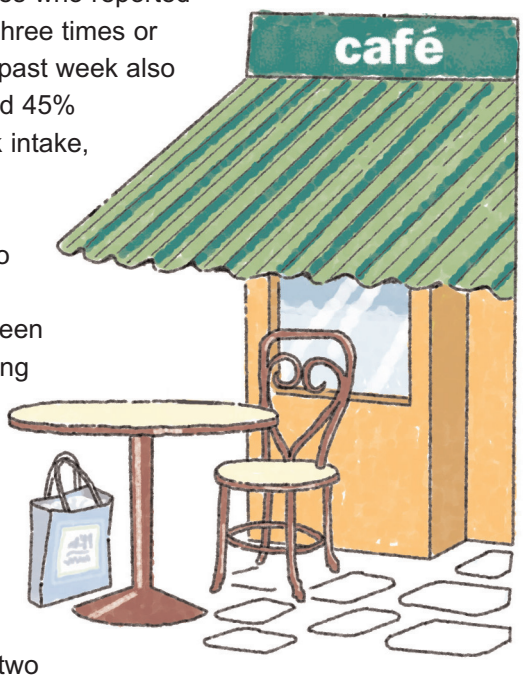
When trying to understand the factors that might influence sugar-sweetened beverage intake and preferences, it is important to consider the possible effects of advertising and marketing. Every year, beverage companies spend millions of dollars to promote the purchase and consumption of sugar-sweetened beverages through multiple media, including intensive television advertising, sales promotions, Web sites, games, and product placement agreements.[31] Gallo reported that in 1997, soft drink and bottled water manufacturers spent $702 million on advertising,[32] not including the additional funds spent on marketing. Much of the promotion focuses on children, because of their increased spending power, purchasing influence, and future as adult consumers.[31–33] A 2006 report from the Institute of Medicine (IOM) concluded that intensive advertising to children and youth influences child preferences and their requests for high calorie and low-nutrient-dense foods and beverages.[34] Health experts from the IOM[34] and from a World Health Organization/ Food and Agriculture Organization (WHO/ FAO)[35] consultation reviewed the literature and concluded that the heavy marketing of energy-dense, micro-nutrient poor foods, including sugar-sweetened beverages, is associated with adiposity, but that the available evidence does not prove that advertising and marketing cause overweight. These reports raise the question of whether interventions should include a focus on media literacy and/or limiting advertising and marketing, particularly to youth.

Portion Sizes of Soft Drinks

Portion sizes of many foods have increased since the 1970s.[36] Between 1977 and 1996, the size of the average soft drink consumed increased significantly from 13.1 fl oz to 19.9 fl oz (144 calories to 193 calories, respectively).[37] Serving sizes as defined by the U.S. Department of Agriculture (USDA) are often smaller than the current sizes of marketplace portions.[38] A 20-oz bottle of caffeinated cola contains 2.5 servings equaling 227 calories,[39] and a 64-oz caffeinated cola sold at convenience stores contains more than 700 calories,[39] which is a significant proportion of the daily caloric requirement for an adult or child. Flood et al. (in press) found that when beverage portion size was increased by 50%, men increased their caloric intake from the beverage by 26% and women increased their caloric intake by 10%. Limiting portion sizes could decrease the amount and calories of sugar-sweetened beverages consumed.

Soft Drink Intake and Restaurants

French et al.[40] reported that the Project EAT (Eating Among Teens) study among more than 4,000 students in 31 secondary schools found a positive association between eating at fast food restaurants and increased intake of soft drinks. Compared to students who reported not eating at a fast food restaurant during the past week, males and females who reported eating fast food three times or more during the past week also reported 42% and 45% greater soft drink intake, respectively. Another study of adult women also found a positive association between frequency of eating at fast food restaurants and soft drink intake.[41] It is unknown whether the teenagers and women in these two studies acquired the soft drinks at the restaurants. More research is needed to understand these dietary patterns and the relationship between soft drink intake and eating at restaurants.



Sugar-Sweetened Beverages and Youth
Sources of beverages

While restaurants, fast food outlets, and vending machines frequently promote and sell carbonated soft drinks, data from the National Food Consumption Survey (NFCS) 1977–78, and the CSFII 1994–1996 and 1998 show that the home is where most children and youth aged 6–17 years old obtained carbonated soft drinks (regular and low calorie). During 1977–1978, 26% of youth obtained soft drinks from home; by 1994–1998, this increased to 34%.[3] During 1994–1998, 49% of the share of all soft drinks

consumed were obtained at home, 22% were obtained in restaurants, 4% from vending machines, 3% from school cafeterias, and 22% from other sources.[3] In recent years, considerable energy has focused on reducing access to and consumption of sugar-sweetened beverages in schools. This information suggests that the home environment and restaurants should also be targeted.

Schools

In recent years, efforts to limit the availability and sale of sugar-sweetened beverages in schools have ranged from legislation affecting all schools in a particular state to changes in a single school setting. While the majority of these types of beverages are obtained elsewhere, they are also widely available in schools for youth to purchase. The 2000 School Health Policy and Program Study (SHPPS) reported that 43% of elementary schools, 74% of middle/junior high schools, and 98% of senior high schools have a vending machine, school store, canteen, or snack bar. Among these, 58% of elementary, 84% of middle/junior high, and 94% of high schools sell sugar-sweetened beverages.[42] Availability in schools was shown to be associated with beverage intake in a cross-sectional study of 157 primary and secondary schools in Belgium-Flanders; students were significantly more likely to consume sugar-sweetened soft drinks every day if they were available in schools.[43] Another study among 1,088 high school students from 20 schools in Minnesota found that vending machine soft drink purchases were significantly lower in schools where the machines were turned off at lunch time compared to those that did not limit the hours of operation.[44]

Cross-sectional studies of attitudes toward the school food environment show that both parents and teachers support the concept of schools providing mostly or only healthy options and limiting or eliminating low-nutrient options, such as soft drinks and candy, particularly in elementary schools.[45,46] Despite this positive finding, other information suggests that barriers still exist. One focus group study with parents of high school students found that parents were not aware of sugar-sweetened beverage availability or beverage contracts at the schools, and that they were more concerned about student use of illicit drugs, alcohol, and smoking.[47] Concern about potential loss of school revenue is a key barrier to removing sugar-sweetened beverages from schools.[48] In 2003-2004, the General Accounting Office (GAO)[48] estimated that 29% of high schools earned more than $125,000 from the sale of competitive foods. Most decisions about the sale of competitive foods are made at the local level, often on a case-by-case basis.[48,49] Local champions often catalyze the movement to change policies, but limited data are available to explore how changes in policies actually affect school revenue.[48]

In May 2006, the nation's largest beverage producers announced that they would voluntarily agree to encourage bottlers to stop nearly all sugar-sweetened soft drink sales to public schools.[50] The industry proposes phasing in these changes into all public schools by 2010.[50] Because these changes are voluntary, their effectiveness in changing the availability of sugar-sweetened soft drinks in schools needs to be evaluated.

Perceptions and Experiences

While teachers and other school personnel, parents, and beverage vendors play a role in the availability and consumption of sugar-sweetened beverages for youth at schools, understanding how youth perceive and experience sugar-sweetened beverages provides insight into the decision-making processes that go into selecting a beverage. A focus group study[51] with adolescents found that they might not realize the nutrient content and composition of soft drinks and other beverages. Adolescents reported that they consumed sports drinks, energy drinks, and high-protein milk formulas for various reasons, including the idea that these drinks provided improved immunity, prevented illness, produced better health, and "created energy." The adolescents did not know that the "energy" found in "energy drinks" was the result of caffeine and a stimulant effect as well as from calories.

In another study, a cross-sectional mail-in survey distributed nationally via a children's educational magazine examined predictors of soft drink intake among children aged 8–13 years old.[52] The results showed that the strongest predictor was a strong taste preference for soft drinks in a model that included variables for availability in the home and school, intake by parents and friends, and strong preference for the taste of water and milk. In addition, parental intake and access to soft drinks in the home were also strongly associated with child intake. When designing interventions to reduce intake, understanding perceived attributes of the beverages and the role of taste preference in beverage selection by youth could be important.

In summary, understanding the context of everyday consumption will help those who are designing interventions to plan appropriate and relevant strategies and gauge the feasibility of the proposed strategies. Because sugar-sweetened beverages are widely consumed by youth and adults, it is important to consider the multiple incentives and barriers to reducing intake in any given context.

Research Gaps

The research shows a generally positive association between sugar-sweetened beverages and weight; however, many important, relevant issues still need to be clarified through additional studies. Some of the issues that should be explored in future research include the following:

- *The long-term effects of sugar-sweetened, diet, and low-calorie beverages on weight management, food intake, satiety, and hunger for both adults and children.*
- *The evaluation of interventions targeting reduction in sugar-sweetened beverage intake among all ages and in various settings, especially the home.* Evaluations are needed that target multiple levels of the social-ecologic model, particularly environmental and policy strategies. Evaluation designs that measure outcomes related to beverage intake, caloric intake, weight, and effects on revenue are needed.
- *The context in which sugar-sweetened beverage selection and intake occurs for adults and youth, particularly in homes, work sites, child care, community institutions, and other places where people spend time.* Research should explore the influence of advertising and marketing on intake and overweight; the influence of portion sizes on caloric intake and weight; the available sources for adults and youth; how availability influences intake; the relationship between eating out and beverage intake; and how the home, school, work site, and child care contexts inhibit or encourage intake.
- *People's perceptions of and experiences with sugar-sweetened beverages and the decision-making processes that people go through in selecting what beverages to consume.* It is important to consider how this varies by characteristics, such as age, sex, race/ethnicity, socioeconomic status, education, and location.

Research to Practice: What Does This Mean for Those Who Want to Lose or Maintain Weight?

We know that the key to weight management is balancing calories consumed with calories expended through physical activity. However, this research review suggests that people do not compensate for the calories they consume from beverages by reducing their caloric intake from other sources. People can reduce their caloric intake by reducing their consumption of caloric beverages or by substituting lower-calorie beverages for sugar-sweetened beverages. Practitioners can counsel their patients or clients to use the following strategies to reduce their calorie intake from beverages.

Create Supportive Environments

Work with others to change their beverage environment—whether in the home, work site, house of worship, community center, school, or any place that people spend time. People who want to change their beverage environment can

- Ensure that water and low-calorie versions of sugar-sweetened beverages are available.
- Make water and low-calorie beverages the easy choice by providing people with their preferred low-calorie beverage options.
- Eliminate access to sugar-sweetened beverages.

Replace Sugar-Sweetened Beverages with Water or Low-Calorie Beverages

Water, whether consumed in the beverages we drink or in the foods that we eat, is essential for life and good health. Because it has zero calories, drinking water instead of a sugar-sweetened beverage is one way to limit caloric intake for weight management. Carbonated water is also calorie free, as long as caloric flavors/sugars have not been added. People who want to reduce their caloric intake from beverages should be encouraged to do the following:

- When thirsty, think water first instead of caloric beverages.
- When eating out, order water with meals instead of caloric beverages—water is usually free.
- When eating at home, serve water or low-calorie beverages with meals.
- Don't "stock the fridge" with sugar-sweetened beverages. Instead, keep a jug or bottles of cold water in the refrigerator.
- For a quick, easy, and inexpensive thirst-quencher, carry a water bottle and refill it throughout the day instead of drinking sugar-sweetened beverages.

Not everyone likes the taste of plain water. Here are some suggestions for other low-calorie options:

- Make water more exciting by drinking carbonated water or adding slices of lemon, lime, watermelon, or cucumber, which add flavor with few calories.
- Add a splash of 100% juice to plain sparkling water for a refreshing, low-calorie drink.
- Choose "diet" beverages sweetened with artificial sweeteners instead of sugar-sweetened drinks.

People should also be encouraged to be role models for their friends and family by choosing healthy, low-calorie beverages.

Choose Appropriate Portion Sizes

People trying to cut down on calories need to be aware of the large portion sizes common to many beverages. A 20 oz bottle of regular cola contains 2.5 servings of 8 oz each, which adds up to 250 calories and 67.5 grams of sugar (>16 teaspoons) in one bottle. Practitioners should encourage people to use the following strategies to be aware of and reduce portion sizes:

- Always check the Nutrition Facts label and be aware of the calories in one can or bottle of a beverage.
- When you do opt for a sugar-sweetened beverage, go for the small size. Some companies are now selling 8 oz. cans and bottles of soda, which contain about 100 calories.
- If you want to drink a large portion of a beverage, choose water or a beverage with zero calories.

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