The Associations Between Sugar-Sweetened Beverage Consumption and Children's Health: An Updated Review of the Literature

Healthy Eating Research
Building evidence to prevent childhood obesity

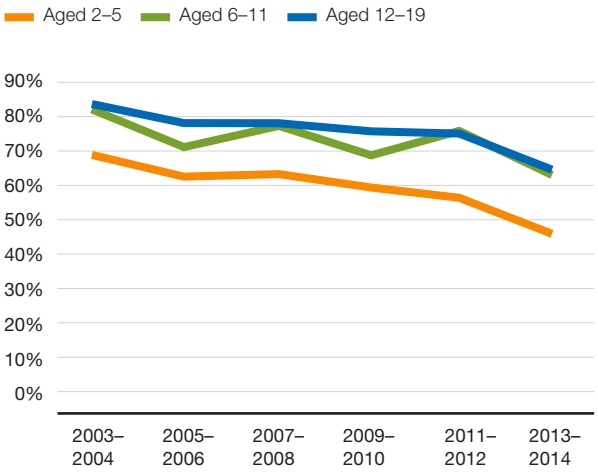
Issue Brief, February 2018

Introduction

Childhood obesity affects roughly one in six (13 million) children in the United States, disproportionately impacting children who are low-income and racial and ethnic minorities. From 1976 to 2016, the prevalence of childhood obesity has more than doubled in children aged 2 to 5 (from 5 percent to 13.9 percent), nearly tripled in children aged 6 to 11 (from 6.5 percent to 18.4 percent) and quadrupled in adolescents aged 12 to 19 (from 5 percent to 20.6 percent). Since 2003, obesity rates appear to be declining among children aged 2 to 5, remaining stable among children aged 6 to 11, and increasing among children aged 12 to 19. Given that obese children and youth are likely to remain so as adults, obesity and its adverse health consequences create a serious threat to children's current and future health.

Consumption of sugar-sweetened beverages (SSBs)—which include all drinks with added sugar, such as soda, fruit drinks, and sports drinks—is strongly linked to obesity and a number of other negative health consequences. In parallel with recent obesity trends, consumption of SSBs has begun to decline across all age groups, with much of the decline from 2003 to 2014 driven by a decrease in the percentage of young children aged 2 to 5 consuming SSBs.

Figure 1. Percentage of children/adolescents aged 2–19 who consumed at least one SSB on a given day from 2003-2014, by age group and year



Source: National Health and Nutrition Examination Survey, 2003-2014, author calculations.

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The decrease in SSB consumption from 2003 to 2014 was significant for all age groups of non-Hispanic white children, among non-Hispanic Black 12- to 19-year-olds and Mexican-American 2- to 5-year-olds and 12- to 19-year-olds. Consistent declines were observed in both low- and higher-income children. However, despite significant declines in per capita soda and fruit drink consumption over the past 15 years, calories from SSBs still represent a large portion of total daily calorie intake for children and adolescents.

This issue brief is based on an updated research review on this topic and examines the evidence on:

- the health impacts of SSBs on children's health (obesity, diabetes risk, dental caries, and caffeine-related effects);
- the health impact of replacing SSBs with other drinks (i.e., substitution of SSBs); and
- the role of taste preferences in SSB consumption patterns.

To examine the health impacts of SSBs, separate searches were conducted of leading online databases of scientific literature. Database searches also included reference lists of SSB literature reviews. All studies included had to be peer-reviewed articles examining the effects of SSBs on a specific health outcome, be limited to children and adolescents, and be published after January 1, 2007. Studies were excluded if they were not presenting new data, or were grey literature (i.e., non-academic or unpublished sources). This narrative review is meant to reflect the current state of evidence for SSBs and children's health and is not intended to be an exhaustive review of all available studies. For a list of all the articles included in the full review, as well as those that support the facts and figures in this issue brief, please see the full review available at *http://healthyeatingresearch.org*.

Key Research Results

- **Overweight and Obesity Risk:** The review found a strong, positive relationship between SSB consumption and overweight and obesity risk in children, meaning that increased consumption of SSBs was associated with higher risk of overweight or obesity. This was true for cross-sectional studies, which provide a snapshot of a single moment in time (15 of 19 found a positive association in all or some part of the study population), longitudinal studies, which track the same children over time (13 of 19 found a positive association in all or some part of the study population), and intervention studies, which randomly assign children to a "treatment" or "control" group and examine relative changes in SSB consumption before and after the intervention (3 of 3 found a positive association for at least one follow-up point).

- **Diabetes Risk:** All seven studies found a positive association between SSB consumption and insulin resistance, which is often a precursor to prediabetes and/or Type 2 diabetes. All six cross-sectional studies found a positive association in the whole or a subset of their study population. Only one longitudinal study was conducted to examine this association, and it also reported a positive association between SSB consumption and insulin resistance.

- **Dental Caries:** Twenty-three studies examined the relationship between SSB consumption and dental caries (cavities or tooth decay) among children and adolescents, with all but one study reporting a positive association in at least some part of the study population. Fifteen of the 16 cross-sectional studies and six of the six longitudinal studies found a positive association between SSB consumption and dental caries. One intervention study also found a positive association.

- **Caffeine-Related Effects:** Eight cross-sectional studies examined the caffeine-related effects of SSBs, with seven focusing on energy drinks, and three analyzing the effects of other caffeinated SSBs such as colas. Not all studies examined the same caffeine-related outcomes, but the most commonly reported outcomes were: poor or reduced quality sleep, headaches, risk-seeking behavior and depressive symptoms. Three studies found evidence for an association between energy drink consumption and sleep-related issues and three found an association with increased headaches. Two studies reported an association between energy drink consumption and risk-taking behaviors (e.g., cigarette or drug use) and two studies found an association between energy drink consumption and stress, depressive symptoms, and suicidal ideation, plan, or attempt. One longitudinal study was conducted and found that energy drink consumption was associated with attention deficit/hyperactivity disorder inattention and hyperactivity. With respect to other caffeinated SSBs, one study found that both low and high consumption of cola were associated with lower stress, but found null associations with anxiety and depression. Another study found that high consumption of both cola and energy drinks was associated with headaches, stomach-aches, sleeping problems, and low appetite. An additional study found that insufficient sleep duration was associated with soda consumption.

- **Substitution:** A growing body of research broadly examined the health effects associated with substituting SSBs for artificially sweetened beverages, plain water, and milk among children and adolescents. While the results are limited by a small number of studies, two cross-sectional studies found an association between substitution of SSBs and lower caloric intake and two longitudinal studies found an association between substitution of SSBs and lower BMI, although the results varied by which beverage was being used for substitution. Four intervention studies have examined the effects of replacing SSBs on weight-related outcomes, such as Body Mass Index (BMI) and body composition, with the studies finding a mixture of positive and null results depending on outcome being examined and follow-up time.

- **Taste Preferences:** Early childhood (ages 0-5) is a critical period for the development of food preferences that will carry over into adulthood and have serious implications for health over the life course. No research has been conducted to assess the effect of SSB consumption during early childhood on taste preferences, with the literature instead examining sugar and sweetness more generally. The majority of research indicated that preference for sweetness is an inborn trait; however, emerging evidence supports limited exposure to sweetened foods as repeated exposures may result in an infant preferring that level of sweetness in the future.

Conclusions

Overall, SSB consumption has declined in the last 15 years. However, SSB consumption remains unacceptably high, particularly among low-income and racial and ethnic minorities, with many children still consuming more than the recommended amount set by the 2015–2020 Dietary Guidelines from the federal government. There is clear evidence that consumption of SSBs increases overweight and obesity risk and dental caries among children and adolescents, with emerging evidence linking SSB consumption to insulin resistance. The vast majority of the available literature suggests that reducing SSB consumption could help improve children's health by decreasing the risk for obesity and other negative health consequences. More research is needed related to substitution and taste preferences.

Policy Implications

For more than a decade, reducing SSB consumption has been the focus of many public health efforts. During this time, there has been progress in passing legislation, regulations, and ballot initiatives, which have been used to enact SSB taxes (that have passed in eight jurisdictions to date), remove SSBs from schools, limit total added sugars in beverages in schools, and require restaurants to substitute water or milk as the default beverage on kids' menu items in restaurants. There have also been voluntary actions by some large organizations to create healthy beverage defaults (i.e., Disney theme parks removed SSBs as a default on their children's menu and instead offers low-fat milk), increase the availability of healthy beverages (e.g., in hospitals, health systems, universities, and recreation centers), and remove SSBs from children's meals (e.g., McDonald's and Wendy's).

It is not possible to point to one area of policy progress in the public or private sectors as the key reason for the downward trend in SSB consumption among children. What is clear is that a continued focus on environmental changes to reduce SSB consumption, particularly those that alter the food and beverage environment in a permanent way (such as removing SSBs from schools) are generally considered to have a larger potential population effect, and more likely to be cost-effective and equitable when compared to approaches focused on individual behavior change (such as a onetime media campaign).

Going forward, more research is needed to both catalog the passage of new policies (in the public and private sector) that aim to reduce SSB consumption as well as the impact of these policies on children's SSB consumption and associated health outcomes. In addition to evaluating the impact of individual policies on SSB consumption and health outcomes, it will be important to understand the relative and collective impact of various SSB policies on reducing SSB consumption and the risk for adverse health outcomes, such as those explored in this brief, in order to effectively target resources and design future interventions.

There is also a need for new policies that aim to reduce SSB consumption in a few key areas where there has been limited policy progress to date. One is reducing children's exposure to marketing of SSBs, especially marketing approaches targeted to black and Hispanic children. Another is legislation that requires restaurants to remove SSBs from children's combination meals or change the default beverage on the children's menu to milk or water. To date, only a handful of municipalities have passed such statutes.

Suggested Citation

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About Healthy Eating Research

Healthy Eating Research (HER) is a national program of the Robert Wood Johnson Foundation. Technical assistance and direction are provided by Duke University under the direction of Mary Story PhD, RD, program director, and Megan Lott, MPH, RDN, deputy director. HER supports research to identify, analyze, and evaluate environmental and policy strategies that can promote healthy eating among children and prevent childhood obesity. Special emphasis is given to research projects that benefit children and adolescents and their families, especially in lower-income and racial and ethnic populations at highest risk for obesity. For more information, visit *www.healthyeatingresearch.org* or follow HER on Twitter at *@HEResearch.*

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