

Sugar-sweetened Beverages: What we know and what we can do - Improving the oral health of Californians

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Sugar-sweetened Beverages: What we know and what we can do - Improving the oral health of Californians

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Statement of Problem

Tooth decay is the most common chronic disease in children – five times more common than asthma or hay fever. According to the World Health Organization (WHO), dental disease is the most prevalent and preventable global non communicable disease (WHO, 2015). Dental disease has been linked to other poor health outcomes that include: anxiety, pain, poor school attendance and performance, as well as “social handicap” due to tooth loss (WHO, 2015).

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Introduction

Tooth decay or dental caries, more commonly referred to as cavities, is commonly categorized by either treated or untreated – meaning the decayed tooth has been filled or extracted by a dentist (treated) or visible tooth decay and infection is present (untreated). Across the nation, untreated tooth decay in the primary teeth (baby teeth) have been seen in over 14 percent of children aged two to eight years old according to a National Health and Nutrition Examination (CDC Morbidity and Mortality Weekly Report, 2017). Specifically, in California, 61 percent of third graders have experienced tooth decay, and nearly 22 percent of children have been reported to have untreated tooth decay according to California's Department of Public Health (CDPH) 2018-2019 California Smile Survey (Darsie, Conroy, & Kumar, 2021). Coincidentally, in California, results from the 2016-2017 California Health Interview Survey (CHIS) indicated that 42.4 percent of children aged two to 17

consume one or more sugar-sweetened beverages (SSB) per day (CHIS, 2015-2016).

Purpose

This paper focuses on research on the relationship of sugar-sweetened beverages (SSBs) and dental disease, especially among children. This paper is intended to summarize the literature findings about SSBs and dental disease – to include disease, caries, tooth decay and tooth loss (loss of 5 or more teeth), current recommendations to limit consumption of SSB, and to highlight statewide initiatives, policies and programs aimed at encouraging healthy drink options that have a favorable effect on overall oral health.

Background

Consumption of sugar, which includes SSBs, is one of the known causes of tooth decay and dental disease. Through research there have been associations identified between SSB consumption and dental disease throughout the lifespan from infancy to adolescence to adulthood. Even small amounts of SSBs have been shown to have lasting negative effects on oral health. According to the US

Dietary Guidelines, SSBs make up over half of the added sugar that American's consume daily (USDA, 2015-2016). Given this high prevalence on consumption and the relationship to dental disease, it is imperative that action is taken to reduce and eliminate consumption of SSBs across the nation.



SSBs make up over half of the added sugar that American's consume daily.

The Center for Disease Control (CDC) defines SSBs as “any liquids that are sweetened with various forms of added sugars like brown sugar, corn sweetener, corn syrup, dextrose, fructose, glucose, high-fructose corn syrup, honey lactose, malt syrup, maltose, molasses, raw sugar, and sucrose.” Given this definition, soft drinks, juice drinks, sports drinks, energy drinks, sweetened coffees/teas, flavored milk and vitamin added water all fall within the category of SSBs.

Consumption of foods (and drinks), especially sugars and carbohydrates, can alter and increase the bacteria found in the mouth and increase the likelihood of dental disease. The American Dental Association (ADA) explains that there is cavity causing bacteria already in the mouth, and when it is exposed to sugar consumed in the diet it can cause damage to the teeth. As the oral bacteria in dental plaque works to metabolize or breakdown sugar, acid is produced that will slowly dissolve the enamel of the teeth. Overtime, the tooth's enamel decays with the repeated acid exposure resulting in permanent damages such as cavities (ADA, 2014). The cavities created by the acid attacks continue to grow bigger as more of the tooth decays, and, if left untreated, can lead to further damages such as pain and infection. Further compounding the risk of disease is that SSBs are also known to be acidic by nature and the acidity can cause additional erosion to the teeth. Consuming sugar also elicits a reaction with the inflammatory and immune responses of the body which can also lead to disease (Dewhirst, 2016).

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Additional factors that can increase chances of developing dental disease include: frequency of drinking SSBs, susceptibility of an individual's tooth surfaces, daily oral hygiene practices, intrinsic properties affecting food clearance, fluoride availability, salivary flow and composition, and other factors related to a person's genetics (WSRO, 2011). Although saliva has many natural antibacterial, re-mineralizing, and pH balancing properties (The International Association for Dental Research, 2020) it is known to take roughly 20 minutes to restore pH after sugar is consumed. With frequent consumption, the saliva cannot act fast enough and can result in tooth decay.

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In addition, key organizations including CDPH, CDC, WHO, American Association of Pediatric Dentistry (AAPD), International Association for Dental Research (IADR), Association of State and Territorial Dental Directors (ASTDD), among others, all support the avoidance of SSB consumption to reduce tooth decay as well as reduce other diseases including diabetes, obesity, and heart disease. Tooth decay is largely a preventable disease making it crucial to bring awareness to children and adults to reduce SSB consumption.

Methods

The literature review was conducted using Google Advanced search engine, in addition to a search conducted with CDPH library services that utilized PubMed, EBSCO, and other known reputable search engines. Key words that were searched for included: "sugar-sweetened beverages and tooth/dental decay/disease/caries/cavities". Research papers cited by key reputable governmental organizations were also utilized to find the most up to date information. A snowball approach was then used by researching articles of interest cited by sources found by methods prementioned.

Review of Articles

SSB Consumption and Dental Disease

In the United States, the prevalence of tooth decay and untreated tooth decay among children two to 19 was 46 percent and 13 percent respectively (Fleming & Afful, 2018). There has been a well-documented association between SSB consumption and tooth decay. Children with the highest intakes of SSBs were two to almost five times more likely to have severe early childhood caries compared to children who consumed the least amount of SSBs (Evans, et al., 2013). In adolescents, when assessing the dose response relationship between acidic beverage consumption and dental erosion, it was found that among those with a high daily consumption of acidic beverages, 48 percent had dental erosion compared with only 23 percent among those reporting a low

daily acidic beverage consumption (Sovik, Skudutyte-Rysstad, Tveit, & Sandvik, 2015).

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In a study done on third grade students in Georgia, SSB consumption was directly associated with tooth decay; for every additional serving of SSB consumed per day, tooth decay increased by 22 percent. Also, important to note in the study was that SSB consumption was reported higher in African Americans, those living in rural areas, those eligible for free/reduced lunch program and those who had mothers with tooth loss due to tooth decay (Wilder, Kaste, & Handler, 2015). In a study based on maternal recall, nearly 40 percent of six-year olds were reported to have had tooth decay. Children with tooth decay had an 83 percent higher odds to have been fed SSBs three or more times a week as an infant compared to children the same age who were never fed SSBs (Park, Lin, Onufrak, & Li, 2015).

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In a study of Australian adolescents, the odds of having an adverse oral health impact was most likely in those who drank from the diet soft drinks category. Although the effects of diet soda on tooth decay is not well documented, regardless of drink type consumed, a higher consumption rate of total SSBs was associated with higher odds of negative oral health outcomes. The study revealed that negative health outcomes were more prevalent than even unhealthy weight status in adolescents who consumed SSBs (Hardy, Bell, & Mahrshahi, 2018). The study suggests that more research needs to be done on prolonged exposure to other sugary foods as they may also influence negative oral health outcomes in conjunction with consumption of SSBs and warrants more research on the effects of artificial sweeteners on oral disease.

As with tooth decay, SSB consumption is also associated with tooth loss. The Behavioral Risk Factor Surveillance System (BRFSS) 2012 indicated that among young adults aged 18 to 30, those who consumed more than two SSBs per day were less likely to have all their permanent teeth compared to those who indicated not consuming any SSBs. The odds of losing up to five teeth were higher among SSB drinkers – even those consuming as little as less than one SSB per day (Kim, Park, & Lin, 2017). Similarly, among New South Wales Teenagers, those who did not consume SSBs had a lower mean decayed, missing or filled permanent teeth (DMFT) than those who consumed one or more SSB per day. The study found that there was an association between a higher frequency of tooth brushing and lower rates of SSB consumption.

Disparities in SSB Consumption and Tooth Decay

Gender, income, and race/ethnicity are all contributing factors for likelihood of consuming SSBs and having a higher prevalence of tooth decay. Boys are more likely to consume SSBs than girls, and children from lower income families are more likely to consume SSBs than more affluent families (CHIS, 2015-2016). In a study by Evans et al (2013), low-income young children aged two to six years old with severe childhood tooth decay consumed 3.2 to 4.8 oz of additional SSBs than children without tooth decay. In California specifically, African Americans (53%) and Hispanic/Latino (46%) consumed the most SSBs per day (CHIS, 2015-2016). Among the youth, Hispanics had the highest prevalence of tooth decay in the US; non-Hispanic Black youth had the highest prevalence when it came to untreated tooth decay (Fleming & Afful, 2018).

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2 OUT OF 5 Californian children (42%) consume one or more SSB daily.

Disparities that exist in a child's upbringing can also have an impact on SSB consumption. For example, in a study of 1333 US children, 81 percent of six-year old's reportedly consumed SSBs in the last 30 days. Of those six-year old's who consumed more than one SSB per day, they were more likely to have had at least one of these conditions: breastfed less than six months, had a mother who was

obese before pregnancy, had lower income, was less educated and was not married. The study also found that six-year-old children consuming more than one SSB per day were likely to be given SSBs during infancy and by ten to 12 months of age were likely to have consumed three or more SSBs per week (Park S. P., 2014).

Conclusion

According to the research, there is a well-documented association between SSB consumption and tooth decay. By limiting and eliminating SSB consumption, there could be many health benefits including reducing the risk of tooth decay, as well as other known diseases that are associated with intakes of added sugar. The effects of SSBs on oral health begins when they are consumed at a young age, even in small amounts, and the risk of tooth decay increases over time. Understanding the disparities that exist in SSB consumption and tooth decay is also paramount in identifying methods and procedures to reduce consumption rates across the state and nation.


Recommendations from Key Organizations

There are many oral health recommendations, guidelines, and evidence-based practices to reduce SSB consumption and improve oral health. First: Drink fluoridated water instead of SSBs. One of the greatest public health accomplishments of the 20th century is community water fluoridation. Drinking fluoridated water is the single most effective means of preventing tooth decay over a person's lifetime (US Department of Health and Human Services, 2000). International

experts recommend limiting SSBs in favor of drinking fluoridated water to reduce the risk for early childhood caries (The International Association for Dental Research, 2020). Fluoridated water is a great replacement beverage, as there is no added sugar and is void of calories. Although fluoride is an effective preventative measure, it alone does not completely prevent tooth decay. Tooth decay can still be present even in populations that are exposed to fluoride (WHO, 2015). It is critical to reduce remaining risk factors to protect against tooth decay even when exposed to the protective elements of fluoride by following key recommendations and guidelines as listed below.



Drinking fluoridated water is the single most effective means of preventing tooth decay over a person's lifetime.



The American Academy of Pediatrics (AAP) recommends avoidance of SSBs in infancy. They note that avoidance is especially important in the early years as it not only will decrease immediate tooth decay but will also likely contribute to decreased consumption and hence dental disease later in life (American Academy of Pediatrics, n.d.). The AAP suggests that babies drink either breastmilk or formula for the first 12 months of life. It is recommended to avoid feeding infants juice entirely, and if juice is introduced it should not be until six to nine months and should be in small quantities of four to six ounces. Feeding young children SSBs likely influences their decisions to consume SSBs throughout life, that in turn increases the risk for dental disease as well as other adverse health effects such as obesity and diabetes.

The 2015 World Health Organization (WHO) Guidelines make strong recommendations to reduce the intake of sugars to less than ten percent of total daily caloric intake throughout one's lifespan. Evidence has demonstrated that a higher rate of tooth decay is present in those consuming over ten percent of sugars in their daily diets as compared to those consuming less than ten percent (WHO, 2015). To put into perspective, in children, a daily consumption of less than ten percent from sugars equates to three teaspoons of sugar and a maximum of six teaspoons for adults. Just one can of soda has enough sugar in it to meet the sugar guidelines for children for not just one day, but for three days, and does not include any other sugar consumed in the daily diet. The WHO even goes a step further and makes conditional recommendations to further reduce sugar intake to less than five percent of daily caloric intake. To reduce sugar intake to below this recommendation is based on dose response relationships between not only sugar intake and tooth decay but also obesity. In summary, the recommendations indicate that reducing the intake of sugar, including SSBs, is key to combating dental disease as well as other known associated diseases.

Healthy People 2030 has identified a goal to “improve oral health by increasing access to oral health care, including preventative services”. This goal includes objectives such as: reducing the proportion of adults and children with tooth decay, increasing the proportion of people whose water systems have the recommended amount of fluoride, reducing the consumption of added sugars by people aged two years and over, and reducing the proportion of adults aged 45 years and over who have lost all their teeth (U.S. Department of Health and Human Services, 2021).

California Oral Health Plan Goals

The California Department of Public Health aims to reduce these oral health risks through resources and education to reduce consumption of SSBs. The overall goal of these programs is to educate Californians about healthy drink options, help identify drinks with added sugars, and to make the link between consumption of SSBs and associated health risks.

Specifically, CDPH's California Oral Health Plan ([California Department of Public Health Oral Health Program, 2018](#)) identifies five key goals for improving oral health and achieving oral health equity for all Californians. The first of the five goals aligns well with the need to reduce SSB consumption as its focus is to "Improve the oral health of Californians by addressing determinants of health and promote healthy habits and population-based prevention interventions to attain healthier status in communities". As part of this goal, strategies to address the determinants of oral health were identified and include:


- Provide dental health professions with protocol and tools to screen for relevant social determinates of health and link patients to community resources to mitigate their oral disease risk factors.
- Provide dental health professionals with a protocol and tools to screen, counsel, refer, and follow up with patients who are affected by common risk factors for chronic disease...including consumption of soda and other sugar-sweetened beverages.
- Identify and promote community-clinical linkage programs such as school-based/linked dental sealant for oral disease prevention and early treatment management through community engagement.

Each of these identified strategies can have a significant impact reducing the consumption of SSBs across California to reduce the occurrences of oral health disease in the state.

Discussion

Although the need to reduce SSB consumption is still very relevant to improving oral health, promising evidence suggest that consumption rates of SSBs are on the decline across all age ranges (Marriott, Hung, Malek, & Newman, 2019). Additional evidence also suggests a decline in tooth decay and untreated tooth decay among children (Fleming & Afful, 2018) (Darsie, Conroy, & Kumar, 2021) indicating that we are making progress and can make additional impact by further reducing SSBs. Much work is still needed, especially in communities of color, where, for example, the marketing of SSBs remains disproportionately high in Black and Hispanic communities (UConn Rudd Center for Food Policy & Obesity, 2020).

Evidence suggests a decline in dental caries, and untreated tooth decay among children indicating that we are making progress!



Community campaigns, portion size reduction and positive educational messaging are all approaches that can be successful in reducing SSB consumption (Marriott, Hung, Malek, & Newman, 2019).

Healthy habits such as brushing two times a day with fluoride toothpaste can also have a large impact by keeping the teeth and mouth clean. Consuming higher amounts of SSBs was found to be correlated with lower frequency of brushing and associated with having teeth extracted or filled (Skinner, Byun, Blinkhorn, & Johnson, 2015).

In addition to community awareness campaigns, improved oral health for children can be achieved through increased health messaging regarding SSBs from physicians, dentists, and other healthcare providers. Discussions are ongoing about the role of dentists in reducing SSB consumption rates to help children with weight management. The dental office may be a prime setting to offer SSB reduction strategies. In a survey sent out to pediatric dentists and pediatric dental residents in 2006, "96 percent of the parents and other caregivers thought the dental offices as a good place to get information on healthy eating and exercise". Encouragingly, 94 percent of the respondents also indicated that they offer information or other interventions to patients on the risk of consuming SSBs. Dentists agreed that they should help children reduce SSB consumption and most also expressed a willingness to discuss reduction of SSB strategies with parents. The findings suggest that "oral health professionals, because of their frequent contact with child patients and their educational

foundation to address nutritional habits, are in a prime position to screen for weight related risk factors of SSB consumption and promote health weight in children” (Wright & Casamassimo, 2017). Reducing SSB consumption with nutrition counseling and education in the dental setting may not only help with tooth decay and tooth loss but also with weight management.

Additionally, policies can be implemented to limit SSB consumption at the school, state, and national levels (Wilder, Kaste, & Handler, 2015). Using a cost-effectiveness analysis model, implementing a \$0.02/ounce state excise tax on sugary drinks in California is projected to save \$39.5 million in tooth decay treatment costs alone over ten years (Gouck, et al., 2021). Parent education and counseling, as it relates to reducing SSB consumption, could help reduce the prevalence of severe early tooth decay (Evans, et al., 2013). The State of Alaska’s Health and Human Services developed a great intervention “[When Sugar is Not So Sweet: A brief guide to explaining how sugary dinks can harm your teeth.](#)” This serves as an excellent intervention model highlighting the risk of SSBs and offering simple graphics and easy to follow steps to reducing SSB consumption. The intervention has been adapted and adopted for use in the State of California.



It is recommended to eliminate sugary beverages (soda, energy drinks, chocolate milk, smoothies and fruit punch or juice) and replace with healthier options such as: water, unsweetened tea, milk, plain sparkling water, or diluted juice. If you still can’t resist the sugary beverage(s), the ADA recommends:

- *Drink don’t sip.*
 - *Fluoride is your friend.*
 - *Brush and clean between your teeth.*
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