



REVIEW ARTICLE

The Impact of Sugar-Sweetened Beverage Taxes on Dental Well-being

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Abstract:

The World Health Organization (WHO) considered it as an effective strategy to reduce sugar consumption. The gradual intake of sugar-sweetened beverages (SSBs) has a significant public health concern, in relation to dental caries, obesity, and other non-communicable diseases (NCDs). Many countries have implemented taxes on sugar-sweetened beverages to reduce their consumption. This review deals with the dual benefits of sugar-sweetened beverages taxes one is by reducing the prevalence of dental diseases and the second by generating revenue for public health initiatives. Certain case studies from countries like Mexico, India, and UK, have shown positive impact of sugar-sweetened beverages taxes on both oral health and economic sustainability. There are some challenges like potential regressive effects and industry opposition, and some of the evidence has shown sugar-sweetened beverages taxes can greatly reduce sugar consumption, enhance public health outcomes, and decline healthcare costs. A few recommendations like allocating tax revenue to oral health education, implementing graduated tax rates based on sugar content, and launching awareness campaigns can help in improving the oral health status of the population. Globally, sugar-sweetened beverages taxes play a promising public health strategy to overcome the rising burden of oral diseases as well as other non-communicable diseases.

Keywords: Sugar-Sweetened Beverages, Dental Caries, Oral Health, Public Health

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Graphical Abstract

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| <p>Title : The Impact of Sugar-Sweetened Beverage Taxes on Dental Well-being Authors : Gaushini Ramuvel¹, Vinay Kumar Bhardwaj¹, Shailee Fotedar¹, Shelja Vashisth¹, Arun Singh Thakur¹, Atul Sankhyan¹, Aishwarya Rani Ravichandran² Affiliations : 1. Department of Public Health Dentistry, H.P Government Dental College, Shimla, Himachal Pradesh. 2. Jain Labs and Hospital, Madurai, Tamil Nadu.</p> | |
| <p>Background This narrative review aims to present evidence on the impact of sugar-sweetened beverage (SSB) taxes on oral health based on the available literature. This review evaluates the effectiveness of SSB taxation policies in various regions, thereby discusses importance of following sugar beverage taxes in reducing the consumption of sugar.</p> | |
| <p>Currently, there are 118 sugar-sweetened beverage (SSB) taxes which comprise 104 excise taxes, and 8 import taxes. There are 4 differential VAT and GST structures, and 2 provincial or regional sales taxes as well. Besides these taxes, there are 105 national sugar-sweetened beverage taxes across 103 countries and territories with 13 subnational taxes. In India, sugar-sweetened beverage (SSB) taxes are implemented as part of the Goods and Services Tax (GST) system. In India taxes on sugar beverages were part of the GST framework, which came into action in July 2017.</p> | <p>Recommendations: SSB tax allocation helps generate revenue to fund oral health education and provide greater access to underserved communities. By imposing a tax on sugar content naturally reduces the sugar level in beverages by the manufacturers themselves. The direct engagement of healthcare providers to will in the promotion of reduced sugar consumption through constant reinforcement of messages during each dental visit. The stakeholders, public health experts, policymakers, and community groups, can design and implement the tax.</p> |
|  <p>National Board of Examinations Journal of Medical Sciences</p> | <p>Conclusions: The strong law and policy system at the global level offer a substantial impact on the reduction of chronic diseases that associated with high sugar consumption.</p> |

Introduction

Sugar plays a major role in causing tooth decay, and it is necessary to reduce sugar intake in order to decrease the risk of cavities [1]. As a public health measure taxing sugar-sweetened beverages (SSBs) came into play which aimed to reduce the consumption of sugary drinks, which are a major concern towards dental caries and other health issues [2]. Sugar-sweetened beverages (SSBs) contain greater amount of added sugar. Drinks such as sodas, fruit, energy, sports, sweetened teas, and other beverages often contain added sugars. The greater amount of sugar content in these beverages influences significantly daily sugar intake leaving the individual at greater risk of exceeding daily recommended limits [3].

The World Health Organization (WHO) recognized that sugar-sweetened beverages are responsible for non-communicable diseases (NCDs) such as obesity, type 2 diabetes, and cardiovascular diseases [4]. The WHO has given a recommendation on sugar-sweetened

beverage taxes which suggests that by increasing the cost of sugar sweetened beverages, it will lead to reduction in the purchase and decreases its consumption. The ultimate aim is to make sugar-sweetened beverages less affordable and encourage each individual to make healthier choices followed by improving overall health outcomes [5]. The role of dietary carbohydrates is to initiate and progress the dental caries. Caries are found to have a stronger association with the frequency of sugar intake than the amount of sugar ingestion [6]. The Australian Institute of Health and Welfare (AIHW) reported that children aged between 2 and 3 years receive 8% of their daily energy intake from free sugars. Recently it was seen that the majority of this sugar intake is dealt with sugar-sweetened beverages [7]. It is evident that there is a linear dose-response relationship between sugar and dental caries, and the World Health Organization (WHO) has recommended the reduction of free sugar intake up to <5% of the total energy intake. Approximately 25 g

of sugar and 20 g of sugar can be consumed by an adult and children respectively [4].

The consumption of sugar-sweetened beverages (SSBs) has become a major public health concern due to its direct impact on various health issues, like dental caries and non-communicable diseases (NCDs) like obesity, diabetes, and cardiovascular disease. The global market is fully loaded with sugary drinks which greatly impact one's oral and overall health. Due to this many countries have given fiscal policies, specifically dealing with taxes on SSBs, as it acts as a strategic approach to decreasing the consumption of sugar-sweetened beverages and helps in reducing the health risks.

Taxing sugar-sweetened beverages not only helps to reduce the prevalence of dental diseases but also greatly acts as an economic tool to influence consumer behavior. It will help them by providing long-term health benefits. The revenues generated from these taxes can be used wisely in public health initiatives which will further enhance positive impact on both general and oral health. This review provides insight into the dual benefits of sugar-sweetened beverage taxes by examining both the economic advantages and its role in improving dental health. The existing literature has shown how sugar-sweetened beverage taxes can act as a powerful instrument in fighting against noncommunicable diseases.

There is a variety of approaches to implementing sugar-sweetened beverage taxes in order to bring changes in the consumer's behavior towards their oral health needs. Currently, there are 118 sugar-sweetened beverage (SSB) taxes which comprise 104 excise taxes, and 8 import taxes. There are 4 differential VAT and GST structures, and 2 provincial or

regional sales taxes as well. Besides these taxes, there are 105 national sugar-sweetened beverage taxes across 103 countries and territories with 13 subnational taxes. Due to public health concerns, there is a global commitment to implement sugar-sweetened beverage taxes to curb the consumption of sugary drinks [8]. In the year 2016, the WHO initiated the taxing law by increasing the tax on sugary drinks by 20% as a strategy to decrease sugar consumption [1]. Over 57% of excise taxes on sugar-sweetened beverages are specific taxes, which means they are levied as fixed amounts based on measurements in liters or grams of sugar consumption. Ad valorem taxes comprise 35% which deals with a percentage of the product's value. The remaining 9% are mixed taxes [8].

The majority of the excise taxing systems are seen in North America, Europe, and Central Asia, followed by East Asia the Pacific, and South Asia. Middle East and North Africa, Latin America and the Caribbean, and sub-Saharan Africa follow an Ad valorem taxing policy. High-income countries use specific taxes, while low- and middle-income countries mostly use ad valorem or mixed taxes. There are only three countries like Cook Islands, Mauritius, and South Africa which follow purely sugar-specific excise taxes. Both Poland and Sri Lanka use sugar- and volume-specific taxes. Ecuador's mixed taxing system is a combination of ad valorem and sugar-specific components which deals with applying different costs based on sugar content and product type concerned.

Taxation policy

In **North America**, Mexico introduced a tax of 1 peso per liter on SSBs in 2014, reducing consumption [9,10].

South American countries include Ecuador, which implemented a 0.18 USD per liter tax in 2016, and Chile, which imposed an 18% tax on sugary drinks in 2014 [11,12]. Brazil has some state-level taxes but lacks a national policy, while Colombia proposed a tax in 2016, with some local jurisdictions adopting similar measures [13,14]. In **Australia**, a 20% SSB tax was implemented and it was found that there was a reduction in tooth decay and also saved the cost in dental care [15]. In **Europe**, Estonia introduced a tiered tax on sugary drinks based on sugar content in 2018. Norway increased existing taxes on sugary products, including beverages. Hungary's "public health product tax," effective since 2011, covers sugary drinks [16]. France established a tax on sugary beverages in 2012, later adjusting it to include artificial sweeteners [17]. Finland's tax, effective since 2011, varies by product, and Romania proposed a sugar tax in 2019 [18]. Ireland launched a sugar tax in 2018, with rates depending on sugar content, while Portugal and Belgium also introduced taxes on sugary drinks [19].

Middle Eastern countries with SSB taxes include Egypt, which implemented a tax in 2016, Saudi Arabia, which introduced a 50% tax on sugary drinks and a 100% tax on energy drinks in 2017, and the UAE, which also imposed a 50% tax on sugary drinks and a 100% tax on energy drinks in 2017 [20]. Concerning **Asia**, ever since 2017 India has followed a 28% Goods and Services Tax on sugary drinks [21]. In the year 2017, Thailand implemented a sugar tax by increasing costs based on sugar content [22]. The Philippines also introduced a sugar-sweetened beverage tax in 2018, by imposing varied rates on sugary drinks based on their caloric and non-caloric

sweeteners [23]. In Sri Lanka, the sugar-sweetened beverage taxes were introduced in 2017 by considering a rate of LKR 12 per liter or 50 cents per gram of sugar in the product. It underwent four revisions and the recent revision to the policy came into force by October 2020 which fixed the rate to be LKR 12 per litre or 30 cents per gram of sugar for beverages with more than 4 g per 100 ml [24].

Mauritius introduced a sugar tax in the year 2013. The taxing policy deals with a charge of ZAR2.21 cents for every gram of sugar exceeding 4 g per 100 mL. South Africa's National Treasury has mentioned that the resulting taxes are to be 10% as per the calculation of ZAR 11.45 per liter and sugar content to be 10.6g per 100m [25]. Both Dominica and Barbados introduced a tax on sugar-sweetened beverages in 2015. Barbados implemented a 10% tax on sugary beverages in order to reduce the prevalence of obesity [26].

The UK government introduced sugar-sweetened beverage taxes in the year 2016. It mainly focused on reducing sugar consumption by implementing a levy on the soft drinks industry [27]. There was a two-tier taxing system in the year 2018 which mainly dealt with reformulating the content of sugary drinks by the manufacturers rather than directly transferring the whole burden over the consumers. For soft drinks with more than 8 grams of sugar content per 100 milliliters, the tax rate was fixed at £0.24 per liter, while those containing between 5 and 8 grams of sugar per 100 milliliters were fixed at a tax amount of £0.18 per liter. But the drinks with less than 5 grams of sugar per 100 milliliters were exempted from the levy. A few beverages like 100% fruit juices, powdered drink mixes, milk, and milk-based beverages were exempted from taxation despite their

sugar content. Due to reformulation efforts, the United Kingdom Soft Drinks Industry Levy (SDIL) greatly showed a reduction in the sugar content of soft drinks which majorly influenced the amount of sugar purchased [28]. Rogers NT et al. investigated whether the Soft Drinks Industry Levy (SDIL), announced in March 2016 and implemented in April 2018, was linked to changes in the incidence rates of hospital admissions for tooth extractions due to caries in children, 22 months after the SDIL's implementation. There was a 12.1% reduction in hospital admissions for tooth extractions due to caries in children aged 0-18 years. Specifically, reductions of 28.6% were seen in children aged 0-4 years and 5.5% in those aged 5-9 years, with no change in older children. These reductions were consistent across most areas, regardless of deprivation. The UK SDIL was linked to a decrease in the incidence rates of childhood hospital admissions for tooth extractions due to caries [29].

Sugar beverage taxes in India

India, the largest consumer of sugar globally, was also the top producer in 2021, with 27.2 million tons. The average global sugar consumption is 22 kg per person per year, but an average Indian consumes 25 kg per year, including regular sugar, sugar from SSBs, and traditional sources like jaggery [30]. India's per capita sugar consumption has significantly increased, rising from 22 grams per day in 2000 to 55.3 grams per day in 2010 [31]. In India, sugar-sweetened beverage (SSB) taxes are implemented as part of the Goods and Services Tax (GST) system. In India taxes on sugar beverages were part of the GST framework, which came into action in July 2017. This GST system followed different tax rates for various goods and services

which were fixed by the Ministry of Finance, Government of India. The rate of 8% was fixed for sugar-sweetened beverages and any beverages with added sugars [32]. Deciding and fixing taxes on sugary drinks was a public health strategy to combat the increased consumption of sugary drinks. Combining these taxing systems with public education on healthy diets and better access to nutritious foods can help encourage the knowledge and understanding of the public in relation to oral health. A study by Gupta A et al. assessed the impact of a 20% price increase on sugar and sugar-sweetened beverages (SSBs) in India. This was a decision analytical model that dealt with predicting the price hike that could prevent an average of 1.32 carious teeth per person over a lifetime and significantly help in prevention of 28 million tooth-loss incidents and cuts down ₹3116.32 billion which are spent in dental treatment. There can be a reduction of up to 0.86% in caries incidence with a similar increase in the sugar-sweetened beverage taxes. This study has suggested that increasing the cost of sugar-sweetened beverage taxes can help reduce caries incidence and further reduce the treatment costs spent on dental disease [33]. There are states like Kerala where they introduced a 'Fat Tax' to deal with the increased incidence of obesity and lifestyle-related health issues. This taxing policy aimed to implement a tax on foods that are high in sugar and fat, such as fast foods and processed snacks, which are often linked to unhealthy weight gain and an increased risk of non-communicable diseases (NCDs). In 2016, the Kerala government imposed a Fat Tax to create awareness among the public with policy-driven intervention in order to reduce the prevalence of obesity. The tax was on items such as burgers, pizzas,

doughnuts, and junk food sold in branded restaurants where the taxing policy levied at a fixed rate of 14.5%. The notion behind this strategic approach was decreasing the consumption of nutrient-less and high-caloric foods which greatly offer unnecessary public health burden [30].

Discussion

The World Health Organization in the year 2018 identifies SSBs as major drivers of NCDs due to their high sugar content and lack of nutritional benefits. Sugar-sweetened beverages contribute empty calories thereby providing no energy and offering no health benefits. This characteristic has made them a focal point for both researchers and policymakers [4]. Food labeling, marketing restrictions, and SSB taxes are commonly commended public policies to reduce sugar consumption [34]. The global rise in sugar consumption poses a threat to oral health and requires policy solutions. Ample evidence exists for SSB taxes to counteract this trend, but the oral health community should realize that other factors are at play than evidence-based arguments for oral health alone [35]. Sugar-sweetened beverages (SSBs), including carbonated soft drinks, energy drinks, sports drinks, electrolyte drinks, cordials, and fruit or vegetable drinks with added sugars, are among the largest sources of free sugars in the diets of children and adults [36]. The sugar-sweetened beverage taxes aimed to reduce the increased consumption of sugary drinks by setting high costs over these beverages thereby leading to less intake of sugary drinks. Both economic and public health challenges are addressed by imposing sugar-sweetened beverage taxes. These taxing policies aimed to decrease the incidence of dental caries and other health-related events.

Arora A. et al. conducted a longitudinal study where they assessed the influence of sugar-sweetened beverages in Australian children from birth to age 3 years and found both early life and socioeconomic factors greatly influence the outcomes. They used data from the Healthy Smiles Healthy Kids Birth cohort which had the details of 934 mother-infant pairs. Two different SSB intake trajectories were observed which comprised high and low trajectories. The consumption of sugar-sweetened beverages increased for both groups between 4 months and 2 years and then it got stabilized. Households with three more children, low-education mothers, and those who were residing in socioeconomically disadvantaged areas were found to report high consumption of sugar-sweetened beverages with a rate of 25%. Early intervention to limit sugar-sweetened beverage consumption can help in improving children's nutrition. Socioeconomic factors show a strong correlation in shaping the intake pattern of sugar-sweetened beverages [37]. The sugar-sweetened beverage taxes alter the food intake pattern at individual, family, and community levels. By making people less inclined towards sugar-sweetened beverages it helps to create a healthier environment. This strategy of policy approach not only addresses the immediate health concerns associated with SSBs but also promotes public health and prevents the long-term economic burdens associated with oral health disease.

Economic benefits

1. By imposing sugar-sweetened beverage taxes it aids in generating sufficient economy for the government. Such revenue generated through sugar-sweetened beverage

- taxes can help in planning, initiating, and executing oral health programs. It will help in offering subsidies for healthier food and drink.
2. It can help in lowering the incidence of dental caries and other health-related issues. It will also reduce the burden on the healthcare system which sufficiently leads to save the cost of dental treatment.
 3. It helps to improve the overall oral health-related quality of life. Good oral health offers less discomfort improves productivity and lessens frequent absenteeism in schools and the workplace.

Challenges

1. The sugar-sweetened beverage taxes affect lower-income individuals due to its disproportionate distribution. However, the health benefits and amount generated through SSB taxes surpass all these challenges.
2. The industrial sector often discouraged the concept of SSB taxes because it led to unemployment at a wider scale. Certain pieces of evidence have also mentioned that these SSB taxes created economic downfall.
3. By implementing SSB taxes enhances the knowledge of individuals towards healthy diets, and encourages increased access to affordable healthy foods and drinks.

Recommendation

1. Allocation of SSB tax helps to generate revenue to fund oral health education and provide greater access to underserved communities.
2. By imposing a tax on sugar content naturally reduces the sugar level in

beverages by the manufacturers themselves.

3. Through educational programmes creates awareness about the direct link between sugar consumption and oral disease.
4. The direct engagement of healthcare providers to will in the promotion of reduced sugar consumption through constant reinforcement of messages during each dental visit.
5. The stakeholders, public health experts, policymakers, and community groups, can design and implement the tax.

Conclusion

The Global SSB tax has facilitated the guidance on effective SSB taxation principles. Sugar beverage taxes offer a promising public health plan to overcome the increasing burden of oral health. By reducing the consumption of high-sugar drinks these SSB taxes can provide valuable insight on the causes of dental caries, gum disease, and other health-related issues. The success of the SSB tax was directly associated with societal norms around sugar consumption. The strong law and policy system at the global level offer a substantial impact on the reduction of chronic diseases that associated with high sugar consumption. The revenue generated through SSB tax should used wisely over preventive care and health education. In order to create a healthier future the SSB taxing policy should be followed with great responsibility.

Author's Contribution

GR: Conceptualisation, Literature Search, Writing – Original Draft. **VKB:** Supervision, Validation, Writing – reviewing and editing. **SF:**

Conceptualisation, Literature Search, Writing- reviewing and editing. **SV:** Conceptualisation, Literature Search, Writing – reviewing and editing. **ASTL:** Supervision, Validation, Writing – reviewing and editing. **AS:** Writing – reviewing and editing. **ARR:** Conceptualisation, Literature Search, Writing – Original Draft

Conflicts of interest

The authors declares that they do not have conflict of interest.

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