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Literature Review

Policy review: Implication of tax on sugar-sweetened beverages for reducing obesity and improving heart health

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ABSTRACT

Objectives: This review aimed to review global consumption of sugar sweetened beverages and the extent to which this relates to the risks of obesity and cardiovascular disease. This review also aimed to assess evidence on the effectiveness of soda taxes in reducing the consumption of sugar sweetened beverages.
Methods: A literature review was performed on international rates of sugar sweetened beverage (SSB) consumption and associations between this and the risk of cardiovascular disease. An evaluation was also performed of evidence for operational results of these policies in several countries.
Results: The studies reviewed confirmed a consistent association between sugar sweetened beverage consumption and risk of cardiovascular disease and yet sugar sweetened beverage consumption has increased significantly worldwide. Review of published evidence suggests that taxing sugar sweetened beverages is an effective policy for reducing their consumption.
Conclusion: Based on the available evidence, an SSB tax is an effective policy in several countries. To expand and strengthen taxation policy for health-related indicators/outcomes, well-managed experimental studies of actual SSB taxation policies should be conducted and the tax system should be applied to each country considering the circumstances and with a package of effective interventions.

Introduction

Obesity and cardiovascular disease are major health problems globally. With regard to these health problems, issues about sugar sweetened beverages (SSBs) have been raised. SSBs include different kinds of drinks (i) fruit-juices, (ii) flavored milks, (iii) carbonated soft-drinks, and (iv) energy/sports drinks with added sugar. Over the past 30 years SSB consumption has increased globally [1]. Reports about SSB consumption and the risk of obesity and cardiovascular disease including hypertension, coronary heart disease, and stroke etc. have also been consistently presented [1–4].

In this regard, the American Heart Association recently released a statement suggesting a decrease in sugar intake [5]. Also, the World Health Organization (WHO) recommended imposing taxes on SSBs in 2017. They announced that a tax on sugary drinks that raised prices by 20% could lead to a reduction in consumption [6]. With the success of the tax on tobacco, many health experts strongly argued that the soda tax could help reduce the consumption of sugar sweetened beverages and thus the risk for obesity and heart health.

Starting with the United States in 2014 [7], several countries, including France, England, and Mexico, have already implemented a soda tax. However, despite the WHO's strong recommendation, many countries are postponing the introduction of soda tax legislation due to concerns over burdening consumers and the lobbying of production companies [8]. However, evidence presented from countries that already have sugar taxes [9–12], and the results of the association between SSB consumption and obesity, cardiovascular disease [1–4] show that a soda tax will be helpful in reducing these health problems.

Therefore, we would like to review the state of the global consumption of sugar sweetened beverages and how much they relate to the risks of obesity and cardiovascular disease as well as to establish the basis for the global spread of soda tax legislation. This study will review whether the soda tax has been effective in reducing the consumption of sugar sweetened beverages and the risk of obesity and cardiovascular disease.

The global state of sugar sweetened beverage (SSB) consumption

SSB consumption has increased significantly worldwide. In 2010, it was found that the global average intake of SSBs was 0.58 of an 8 oz. serving per day in adults. In young adults, aged 20–39,

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the consumption was about three times higher than that of the elderly over 60 [13]. The American Heart Association (AHA) set a daily allowance (RDA) of 24 g or 100 cal of sugar for women and 36 g or 150 cal for men [5]. Considering that other sugary foods are consumed, the current global state of SSB consumption can be seen as both not meeting RDA and being very high.

In the United States, SSB intakes increased by more than about 2.3 times from 3.9% of calories in the late 1970s to 9.2% calories in 2001 [14]. In 18 states of the U.S., 26.3% of adults consumed SSBs regularly more than once a day [15]. Also, during 2009–2010, adults consumed 151 kcal/day of SSBs. Moreover, according to the National Health and Nutrition Survey in Mexico, from 1999 to 2012, SSBs intake increased in all age groups from children to adults [16].

Annual per capita consumption of SSB is also very high in European countries including Norway (119.8 l/year), Belgium (102.9 l/year), the United Kingdom (96.5 l/year) and the Netherlands (96.1 l/year) [17].

Asian countries, including China, Vietnam, and Thailand, are currently major growth markets for the soft drink industry [18]. In South Korea, the prevalence of SSB consumption increased from 2001 to 2009. Among adolescents, young adults, adults and the elderly, the prevalence rate increased to 38%, 69%, 70%, and 50% from 31%, 66%, 63%, and 32%, respectively [19].

Associations between SSB consumption and the risk of obesity, cardiovascular disease

Recently, data from many studies is beginning to accumulate that could support the fact that high SSB daily intake may increase the risk of obesity and cardiovascular disease. There were some cases in which individual studies showed inconsistent results, but recently most results of systematic studies and meta-analysis have shown a link between SSB consumption and the risk of obesity, cardiovascular disease.

To examine the association between SSB consumption and weight gain, a large-scale cohort-based study was conducted. The group of women whose SSB intake increased to 1 or more drinks per day from 1 or fewer drinks per week showed the highest weight gain during the four years [20]. In the case of men, SSB consumption contributed to a higher prevalence of obesity [21]. Furthermore, children who drank SSBs once a day showed a positive association between weight gain and SSB consumption [22].

The cardiovascular disease dealt with in previous studies can be divided into three main categories. The first one is hypertension, the second one is coronary heart disease and the last one is stroke.

According to the recent systematic review and meta-analysis of six prospective cohort studies, there were positive association between SSB intake and the risk of hypertension. The Relative Risk (RR) of incident hypertension in the highest consumption of SSB group compared with the lowest consumption of SSB group was 1.12. Further, 1 serving/day intake of SSBs was positively associated with an 8% increased risk of hypertension [2]. Similarly, another meta-analysis of six studies also predicted an increased risk of incident hypertension for 1 serving/day intake of SSBs; the findings of a study on coronary heart disease (CHD) drew similar conclusions [4]. A recent meta-analysis of four studies found that higher consumption of SSBs is associated with an increased risk of CHD. The RR of incident CHD was 1.17 for 1 serving/day intake of SSBs [4]. Results from a meta-analysis of seven cohort studies showed a higher risk of stroke for increased SSB consumption [3].

The impact of a tax on SSB: focusing on reducing obesity and heart health outcomes

A nation's health policy is a very important factor affecting the health of the people of the country. Therefore, it is necessary to review how the implementation of a tax on SSBs as national policy affects the public's obesity and cardiovascular outcomes. This section tries to verify the effectiveness of sugar taxation policy in various countries and related studies. It will confirm a lesson learned from examples of voluntary or compulsory policies for substances, such as reducing sugar consumption.

A literature review of electronic databases (PubMed, CINAHL, and Google Scholar) was conducted in order to extract the current research evidence about the impact of a tax on SSBs. The search strategy included keyword terms and related text words, including 'sugar sweetened beverage', 'SSB', 'taxation', 'sugar tax', 'soda tax', and 'policy'. Documents published over the last decade were reviewed and the inclusion criteria were as follows: (i) peer-reviewed research; (ii) published from January 2008 to July 2018; (iii) written in English; and (iv) an examination of taxation for SSBs. If the articles did not meet these criteria, they were excluded from the study. The exclusion criteria were: (i) editorials, opinion pieces, or conference abstracts; (ii) non-English language papers; and (iii) not including obesity or heart health outcomes. The data collection period was from 8 to 14 July and 1 to 12 November 2018. The number of papers satisfying the inclusion criteria was 30. Of these, three review papers and 13 papers not covered by obesity and heart health outcomes were excluded. Finally, 14 papers were selected.

The studies that satisfied the above criteria are shown in Table 1. Table 1 summarizes the studies about SSB tax impacts on obesity and heart health. The results of the studies evaluating existing state-level sales tax rates are consistent. Mostly, the low state-level tax rates of the U.S. (3–5%) did not have a significant relation with SSB consumption or obesity [23–25]. Even if there is a significant relation, the impact is small in magnitude, as a 1 percentage point increase in SSB tax decreased BMI by 0.003 kg/m^2 [24].

Most of the studies dealing with the impact of excise tax on health-related outcomes were modeling studies conducted in various countries including the U.S. [26–28], the United Kingdom [29], Ireland [30], Australia [31], Mexico [32], Germany [33], South Africa [34,35] and Colombia [36]. Studies assumed tax rates that are currently being implemented or proposed in their countries, such as 10%, 20%, or $0.01/ounce and so on.

All of the studies presented in Table 1 reported that the implementation of an excise tax is associated with a decrease in obesity rate based on reduced BMI and body weight. A 1.3% decrease in obesity and 0.9% decrease in overweight were reported in the UK [29]. In South Africa, it was reported that the effect of the SSB tax was related to the rate of obesity reduction in both genders [34]. In the United States, the BMI of the youth and adults decreased by 0.16 and 0.08 kg/m^2, respectively [85]. Australia [31], Germany [33] and Colombia [36] also reported significant decreases in BMI.

A tax on SSBs is also associated with a significant reduction in the incidence of cardiovascular disease such as stroke, myocardial infarction, and coronary heart disease. In Mexico an estimated 20,400 cases of cardiovascular disease will reduce from 2013 to 2022 [32], and in South Africa, a decrease of 100,000 stroke cases over the next 20 years [35]. It has been reported that in Australia, heart disease will decrease by 4400 cases and stroke by 1100 cases over 25 years [31]. Furthermore, most studies have shown that excise tax is associated with more than a 15% reduction in SSB consumption [27–29].

Table 1
Summary of the studies about the impact of SSB taxes on obesity and heart health.

	Health indicators	Reduction value	Consumption reduction rate	Tax description	Study type	Country	Authors (year)
Obesity	Obesity rate	0.7% (overweight) 1.3% (obese)	–	10% excise tax	Modelling study	Ireland	Briggs et al. (2013)a
		0.9% (overweight) 1.3% (obese)	15%	20% excise tax	Modelling study	UK	Briggs et al. (2013)b
		1.5%	15%	A penny/ounce excise tax	Modelling study	USA	Wang et al. (2012)
		3.8% (men) 2.4% (women)	–	20% excise tax	Modelling study	South Africa	Manyema et al. (2014)
		2.7% (men) 1.2% (women)	–	20% excise tax	Modelling study	Australia	Veerman et al. (2016)
		3% (overweight) 4% (obese)	–	20% excise tax	Modelling study	Germany	Schwendicke et al. (2017)
		1.5–4.9% (overweight) 1.1–2.4% (obese)	–	8%/16%/24%/32% excise tax	Modelling study	Columbia	Vecino-Ortiz et al. (2018)
		Not associated	Not associated	State-level sales tax rates 4.2%	Observational study	USA	Sturm et al. (2010)
	BMI	Not associated	–	State-level sales tax rates 4.25% (grocery store) 4.51% (vending machine)	Observational study	USA	Powell et al. (2009)
		0.003 kg/m^2	–	State-level sales tax rates 3.30–5.04%	Observational study	USA	Fletcher et al. (2010)
		0.16 kg/m^2 (youth) 0.08 kg/m^2 (adults)	20%	$0.01/ounce excise tax	Modelling study	USA	Long et al. (2015)
	Body weight	1.54–2.55 lb	–	20% excise tax	Modelling study	USA	Dharmasena et al. (2012)
		0.9 lb	15%	$0.01/ounce excise tax	Modelling study	USA	Wang et al. (2012)
Heart health	Stroke incident	100,000 (for 20 years)	–	20% excise tax	Modelling study	South Africa	Manyema et al. (2016)
		1100 (for 25 years)	–	20% excise tax	Modelling study	Australia	Veerman et al. (2016)
	Stroke & MI incident	20,400 (for 10 years)	–	10% excise tax	Modelling study	Mexico	Sanchez-Romero et al. (2016)
	Heart disease incident	4400 (for 25 years)	–	20% excise tax	Modelling study	Australia	Veerman et al. (2016)

BMI: body mass index, MI: myocardial infarction, SSB: sugar-sweetened beverage, USA: United States of America, UK: United Kingdom

Considerations for the implementation of an SSB tax

Many studies to date have reported that SSB taxation can have a positive impact on obesity and heart health outcomes. Despite these results, researchers also suggest that in-depth considerations are needed for the implementation of an SSB tax. In this section, we discuss the limitations of the papers mentioned above and some of the major issues related to the implementation of SSB taxes. This allows us to suggest points for consideration in implementing actual policies.

First, the studies about the effects of SSB taxation on obesity and cardiac outcomes were mostly observational studies [23–36]. Thus, the impacts of SSB taxes validated in these studies may include uncontrolled confounders that are present in the real world. It is possible that factors unrelated to the taxes or other interventions may affect health outcomes. Moreover, the modeling studies estimated the effects of SSB taxes on the basis of several assumptions and cohort study data, which not only means that they were tested empirically but also that they have limitations because of not considering real-world dynamics. Modeling studies based on price elasticity could estimate the impacts to be larger than the actual effects of taxes. Therefore, considering real-world dynamics in the specific context of each region and controlling confounders are necessary for establishing the internal and external validity of such research. To expand and strengthen the basis of evidence for evaluating tax policy on health, well-managed experimental studies of actual SSB taxation policies should be conducted.

Second, because the specific contexts of each country are different, the impact of a tax would also differ. In this regard, Jou (2012) noted three points that could differentiate the effect of a sugar tax: population obesity prevalence, soft drink consumption level, and baseline tax rates [37]. If the existing obesity prevalence is high or gradually increases, and if the current SSB consumption is already high, the effect of policies can be significant. Further, if the existing SSB tax rate is already high, it is difficult for the tax to have a positive effect on consumption levels or health outcomes. These considerations could be useful in determining whether to enforce taxes in each country.

Third, considering the regressive nature of an SSB tax is also one of the important aspects of policymaking. These concerns stem from the fact that low-income populations might have to pay a large portion of their income towards increased taxes [38], which could deepen the inequality between social economic classes. However, a systematic study has shown that taxation provides a similar weight benefit to all strata and SSB taxes are regressive only to a very small extent; further, even the lower SEP (Socioeconomic Position) group had more weight benefit [39]. Thus, lower SEP groups may be able to get health benefits and reduce medical expenditure through taxation. Further, the revenue will be used as welfare costs for lower SEP groups. In order to implement policies stably, it is necessary to consider the regressive nature of an SSB tax, and research about its cost-effectiveness for different SEP groups should be conducted. Such careful consideration could help to reach a social consensus on SSB taxation.

Finally, it is necessary to consider whether SSB taxation is an effective policy for achieving better outcomes for obesity and heart health. When establishing health policies for obesity and heart health at the national level, it is possible to prepare targeted measures for vulnerable/at-risk groups. The prohibition of TV commercials and conducting school- or community-based preventive education programs may be easier and more appropriate than taxation. Although many studies have shown that an SSB tax has a positive effect on health outcomes, it does not solve all of the problems associated with obesity and cardiovascular health. Policies should be implemented with a package of effective intervention programs.

Conclusion

The reviewed studies indicate a consistent link between SSB consumption and the risk of cardiovascular disease, and yet, SSB consumption has increased significantly worldwide. To solve this problem, several countries have already implemented a soda tax imposition. The research discussed in this review suggests that taxing SSBs is an effective policy for reducing obesity and heart health. However, to expand and strengthen the basis of evidence for evaluating tax policy on health, well-managed experimental studies of actual SSB taxation policies should be conducted. Moreover, because the specific contexts of each country are different, the impact of tax would also differ. Therefore, SSB tax systems will have to be adjusted to each country's circumstances. Further, taxes alone will not solve the obesity epidemic in the world, and they should be implemented along with a package of effective interventions, for example, the prohibition of TV commercials and school- or community-based preventive education programs or diet education related to calories, and so on. As with other policies, continuing to assess their effectiveness is far more important than only implementing them.

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Competing interests

None declared.

Ethical approval

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