
ARTICLE REVIEW

Effectiveness of sugar sweetened beverages tax on health and healthcare costs: A systematic review

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ABSTRACT

Introduction	Taxing sugar-sweetened beverages (SSB) is one of many other best strategies to reduce consumption of SSB among populations. It is known that SSB consumption is the main contributor which cause obesity and further lead to non-communicable diseases. This study aimed to gather the evidence on the effectiveness of sugar-sweetened beverages tax implementation, in terms of health outcome and healthcare cost benefit.
Methods	A systematic review was done related to literature that reported about effectiveness of sugar-sweetened beverages tax implementation, in terms of health outcome and healthcare cost benefit. Four databases were used to identify the literature, namely PubMed, Cochrane, Scopus and Ovid and Medline. PRISMA flow checklist was used as a guide to search for the eligible articles.
Results	In total, there were sixteen eligible articles included in this systematic review. All studies are simulation studies. Results showed that both excise and ad valorem tax are effective to reduce healthcare costs and could avert diseases related to high sugar intake. Other than that, it is proven that implementing tax will gain favorable health outcome rather than do nothing. Better results seen when the tax is increased.
Conclusion	As a conclusion, SSB tax is proven as an effective public health intervention in terms of giving benefit to the health outcome and healthcare cost.
Keywords	Sugar - Sweetened beverages tax - Effectiveness- Health - Healthcare costs.

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INTRODUCTION

Non-communicable diseases (NCD) such as cardiovascular diseases, diabetes and cancers have become epidemics worldwide. Thirty-six million people died from NCD, and out of this, 14 million people died before the age of 70. Majority of these premature deaths occur in low-and middle-income countries. Most of it shared the same key risk factors such as tobacco use, unhealthy dietary intake, physical inactivity and alcohol abuse, which can be prevented.¹

NCD demanded extensive treatment and care as disability could occur due to the impairment or complications of the disease itself. This condition will have an impact on the household's socioeconomics and raise the direct or indirect cost associated to health.^{1, 2} Aside from that, premature deaths due to NCD result in loss of productivity and impact the economy of the country.³

Implementing health policy is one of many efforts that can be made to solve this problem. As an example, implementing unhealthy food and beverages tax, and subsidized healthy food, as shown by many developed countries.⁴⁻⁷

According to the World Health Organization (WHO), Sugar-Sweetened Beverages (SSB) is defined as any non-diet, non-alcoholic beverage items and beverage concentrates with added sugars, and is categorized into: regular soda, regular non-diet non-100% fruit juices or fruit drinks, non-diet sports and energy drinks and, non-diet non-milk based beverage concentrates, non-diet sugar sweetened coffee and tea products, and all others.⁸ It is well recognized that SSB are the

primary source of added sugars in individual diets, thus its consumption contributing to obesity, diabetes, and tooth caries.^{9, 10} Thus, WHO has recommended that free sugars intake should be limited to fewer than 10% of overall calorie intake in both adults and children due to its negative health consequences.⁸

Taxing SSB is one of many other best strategies to reduce consumption of SSB among populations, to ensure NCD in control.¹⁰ SSB taxes are seen as a cost-effective strategy that can aid in the reduction of diabetes, obesity, and tooth decay with evidence showing that 20% SSB tax can reduce population consumption by around 20%.¹¹

Realizing the importance of taxing SSB, therefore this study is conducted. The purpose of conducting this systematic review is to gather evidence on the effectiveness of sugar-sweetened beverages tax implementation, in terms of health outcome and healthcare cost benefit.

MATERIALS AND METHODS

A systematic review was done related to literature that reported about effectiveness of sugar-sweetened beverages tax implementation, in terms of health outcome and healthcare cost benefit. Four databases were used to identify the literature, namely PubMed, Cochrane, Scopus and Ovid and Medline. Articles that included the search terms related to the effectiveness of the SSB tax from the year 2010 until 2019 (ten years) were systematically searched. Keywords used for this search were as below:

“soft drink” OR “sugar-sweetened beverage*” OR “sugary drink*” OR “soda” OR “cola” OR “carbonated drink*”*
AND
“tax” OR “fiscal” OR “levy” OR “duty” OR “penalty”*
AND
“cost-effective” OR “medical cost*” OR “healthcare cost*”*

By using Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) checklist as a guide, eligible articles were searched.¹² Figure 1 shows the PRISMA checklist for this review. Records identified were assessed in terms of its relevance with the aim of this review. The studies were included in this review if: (a) reported on the effectiveness of sugar-sweetened beverages tax implementation, in terms of health outcome and healthcare cost benefit, (b) full article, and (c) published from the year 2010 till 2019. The exclusion criteria for this systematic review were: (a) studies that are not original article, including systematic review, meta-analysis, qualitative study and clinical trials, (b) study which was published not

in English language and (c) study which did not measure the required outcome.

All the accepted studies were going through a few screening phases by title, abstract and full text content. Every eligible article identified was reviewed independently by two reviewers. Relevant information such as type of intervention (type of tax), health outcome and healthcare costs were extracted from the included studies.

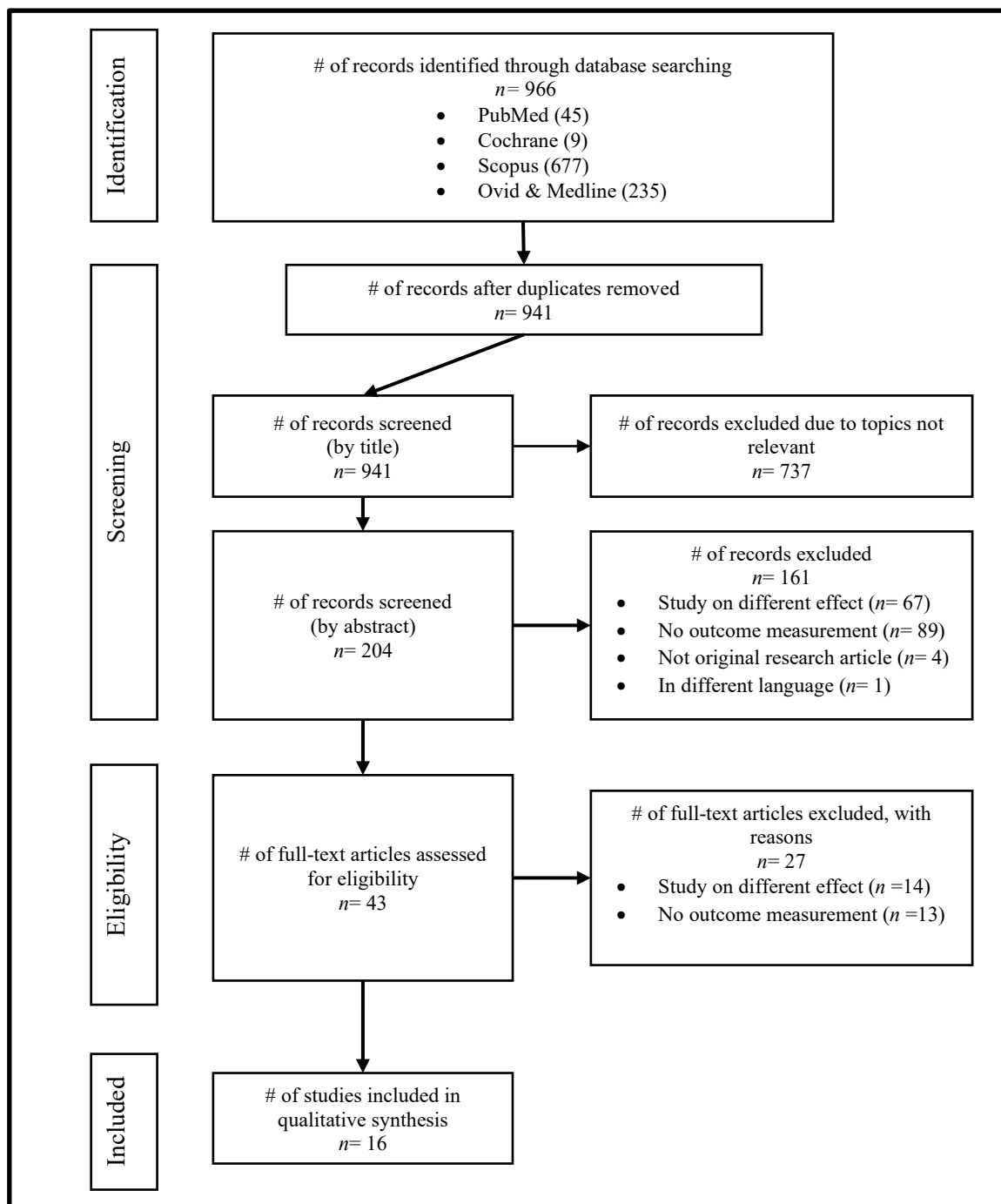


Figure 1 PRISMA checklist for article selection

RESULTS

Overall, 16 studies are accepted for review. Studies included fulfilling the aim of this study, which is focusing on health outcome and healthcare cost impact due to SSB tax implementation. While none of the study came from Asian countries, majority are from US (5), followed by Australia (4), South Africa (3), and each from Mexico, UK, Netherlands and Germany respectively. All of the included studies

are simulation studies which predict the future impact of SSB tax by using the specific country populations. Studies showed that both excise and ad valorem tax are effective to reduce healthcare costs and could avert diseases related to high sugar intake. Studies have proven that implementing tax will gain favorable health outcome rather than do nothing.¹³⁻¹⁵ Details of the included studies and its review are shown in Table 1 and Table 2.

Table 1 Characteristics of included studies, intervention and healthcare costs saved.

No.	Author/ year/ country	Study concept	Source of data	Type of fiscal policy/ Intervention	Intervention cost	(Net) Healthcare costs saved	Summary
1.	Basto-Abreu, A., et al./ 2019/ Mexico ¹⁶	Simulation study for 10 years (2014-2024) for Mexican population, 2-100 years' old	- the National Health & Nutrition Survey - projected population from National Population Council	Excise tax: 1 peso per liter SSB Excise tax: 2 pesos per liter SSB	24.15 million USD	91.62 million USD Cost saved per dollar invested: 3.98 USD 1:38.33 million USD Cost saved per dollar invested: 6.88 USD 7.92 USD per individual	The tax could improve quality of life and is projected to save future health care costs on its implementation. Increasing the current tax could lead to larger health benefits and future savings in health care costs. Cost-saving over a lifetime compared with doing nothing.
2.	Breeze, P., et al. / 2017/ UK ¹³	Simulation study for England population	Health Survey for England 2011	20% SSB tax (comparing with do-nothing)	NA		Reduce healthcare spending compared with doing nothing. Potentially large health benefits for the population and in reducing health sector spending on the NCD treatment Policy makers: consider long-term effectiveness of interventions that target young children, substantially reducing health care expenditures due to obesity
3.	Cobiac, L. J. and K. Tam/ 2017/ Australia ¹⁷	Simulation study for 2010 Australian population (age 5yo until dead or reached age 100 years old)	Australian Health Survey 2010	SSB Tax: AUD 0.47/L	20.24 million USD	257.6 million USD	
4.	Gortmaker, S. L., et al./ 2015/ US ¹⁸	Microsimulation model for US population from 2015 to 2025 -- impact on obesity	Census Bureau, American Community Survey, Behavioral Risk Factor Surveillance System, National Health and Nutrition Examination Surveys (NHANES), and National Survey of Children's Health	SSB excise tax	47.6 million USD	14.2 billion USD Cost saved per dollar invested: 30.78 USD	
5.	Jevdjevic, M., et al./ 2019/ Netherlands ¹⁹	Markov model for Dutch population, 6-79 years old - Study on impact on caries	Netherlands Statistics 2016	20% ad valorem tax	41.40 million USD	176.50 million USD	SSB taxation may substantially improve oral health and reduce the caries-related economic burden.

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6.	Lal, A., et al./2017/ Australia ²⁰	Markov model: for Australian population age 2-100 years old modelled for lifetime	Australian Health Survey 2011-12	20% SSB tax	123.19 million USD	1784.99 million USD	Taxation may reduce healthcare spending in long terms
7.	Long, M., et al./2019/ Maine, US ²¹	Microsimulation for Maine population: 2017-2027	Maine population in 2015 and interviews with stakeholders	Excise SSB tax of 0.01 USD/oz	4.35 million USD	78.3 million USD	Policy was estimated to be cost-saving approaches to preventing obesity.
8.	Long, M., et al./2015/ US ²²	Simulation study using cohort model 2015-2025	Baseline cohort of the U.S. population (41 year of age) in 2015.	Excise SSB tax of 0.01 USD/oz	<ul style="list-style-type: none"> 51 million USD 1st year 430 million USD over 10 years 	23.6 billion USD Cost saved per dollar invested: 55 USD	Over 10 years, the policy would reduce healthcare expenditures and increase healthy life expectancy.
9.	Manyema, M., et al./2015/ South Africa ¹⁴	Markov model: simulated for 20 years - study on impact on T2DM	2012 SA National Health and Nutrition Examination Survey	20% SSB tax vs without tax	NA	USD 860 million	20% SSB tax would reduce the number of incident and prevalence of T2DM
10.	Manyema, M., et al./2016/ South Africa ²³	Simulation for 20 years - study on impact on stroke	2012 South African National Health and Nutrition Examination Survey	20 % SSB tax	NA	400 million USD	This farsighted approach may have a direct impact on obesity and on reducing associated NCDs such as stroke.
11.	Nomaguchi, T., et al./2017/ Australia ²⁴	Markov model	Australian Bureau of Statistics, National Health Survey (NHS), and other studies	20% SSB tax	NA	391 million USD	Hypothetical 20% tax on SSBs leads to potential economic benefits
12.	Schwendicke, F., et al./2016/ Germany ¹⁵	Microsimulation study —study on impact on caries	2015 German population aged 14 to 79 years old	20% SSB sales tax vs 0% tax	NA	88.8 million USD	Taxation could reduce caries cases, and treatment costs.
13.	Sowa, P. M., et al./2019/ Australia ²⁵	Cohort model over 10years	Australian Bureau of Statistics (ABS) & Australian Health Survey (AHS)	20% ad valorem tax	NA	599.4 million USD	20% SSB tax result in reductions in tooth decay and cost savings in dental care
14.	Stacey, N., et al./2018/ South Africa ²⁶	Using Monte-Carlo simulation- over 30 years period.	South Africa Statistics	10% SSB tax	NA	NA	328.8 million USD increases in annual revenues
				20% SSB tax	NA	NA	521.04 million USD increases in annual revenues

15.	Wang, Y. C., et al./ 2012/ US ²⁷	Simulation using Coronary Heart Disease Model -over the period 2010–20	Population age 25-64 years old from National Health and Nutrition Examination Survey for the period 2003–06	Penny-Per-Ounce Tax (0.01 USD/oz) on Sugar-Sweetened Beverages	NA	NA	567.84 million USD increases in annual revenues 13 billion USD in annual tax revenue, a modest tax on SSB could reduce the adverse health and cost burdens of obesity, diabetes, and CVD
16.	Wilde, P., et al./ 2019/ US ²⁸	Microsimulation from CVD PREDICT Model -- CVD for US adults aged 35 to 85 years	Adult consumers from National Health and Nutrition Examination Survey (NHANES) 2005 through 2012 cycles	Excise SSB tax of 0.01 USD/oz	1.84 billion USD	45 billion USD	Incremental cost effectiveness ratio (ICER): cost-saving 270 USD per person

Table 2 Fiscal policy outcome on health impact/ benefit.

No.	Author/ year/ country	Type of fiscal policy/ Intervention	Outcome (Health impact/ benefit)							Note	
			DALYs averted	Life-years gained	QALYs gained	Obesity	DM	Disease prevented CVD	Stroke		Others
1.	Basto-Abreu, A., et al./ 2019/ Mexico ¹⁶	Excise tax: 1 peso per liter SSB Excise tax: 2 pesos per liter SSB	5,840	918	55,300	239,900 obesity cases prevented (0.21%) 476,400 obesity cases prevented (0.41%)	DM cases prevented: 61,340 DM cases prevented: 107,300	IHD cases prevented: 4,380 IHD cases prevented: 7,840	Stroke cases prevented: 3,990 Stroke cases prevented: 6,860	- -	Discounted at 3 percent annually Discounted at 3 percent annually
2.	Breeze, P., et al./ 2017/ UK ¹³	20% SSB tax (comparing with do-nothing)	NA	324 per 5 million simulated individuals	1,495 per 5 million simulated individuals	NA	Reduction of DM cases: 18 per 5 million simulated individuals NA	Reduction of CVD cases: 30 events per 5 million simulated individuals NA	NA	-	QALYs discounted for 1.5%
3.	Cobiac, L. J. and K. Tam/ 2017/ Australia ¹⁷	SSB Tax: AUD 0.47/l	5840	NA	NA	NA	NA	NA	NA	-	-
4.	Gortmaker, S. L., et al./ 2015/ US ¹⁸	SSB excise tax	NA	NA	NA	575,936 childhood obesity cases prevented	NA	NA	NA	-	-
5.	Jevdjevic, M., et al./ 2019/ Netherlands ¹⁹	20% ad valorem tax	NA	NA	NA	NA	NA	NA	NA	• 2.13 caries-free tooth years per person • Prevent 1,030,163 caries lesions in population	Future costs were discounted at 4%, and future health effects were discounted at 1.5% Discounted at 3% annually
6.	Lal, A., et al./ 2017/ Australia ²⁰	20% SSB tax	NA	• Total years of life saved	NA	NA	NA	NA	NA	-	NA

7.	Long, M., et al./2019/ Maine, US ²¹	Excise SSB tax of \$0.01/oz	NA	3560	10,400 obesity cases prevented	NA	NA	NA	NA	QALYs discounted at 3% annually	
8.	Long, M., et al./2015/ US ²²	Excise SSB tax of \$0.01/oz	101,000	871,000	NA	NA	NA	NA	NA	Costs and health gains were discounted at 3% annually	
9.	Manyena, M., et al./ 2015/ South Africa ¹⁴	20% SSB tax vs without tax	374,000 DALYs averted (attributed to T2DM)	NA	NA	T2DM cases reduced: 108,000	NA	NA	NA	-	
10.	Manyena, M., et al./ 2016/ South Africa ²³	20 % SSB tax	550,000 DALYs averted (attributed to stroke)	NA	NA	NA	NA	Stroke cases reduced: 85,000	NA	-	
11.	Nomaguchi, T., et al./ 2017/ Australia ²⁴	20% SSB tax	NA	NA	437,000 obesity cases reduced (1.96%)	NA	NA	NA	NA	Discount rate at 3%	
12.	Schwendicke, F., et al./ 2016/ Germany ¹⁵	20% SSB sales tax vs 0% tax	NA	NA	NA	NA	NA	NA	NA	Costs and revenues were discounted at 3% per annum	
13.	Sowa, P. M., et al./ 2019/ Australia ²⁵	20% ad valorem tax	NA	NA	NA	NA	NA	NA	NA	Discount rate at 5%	
14.		10% SSB tax 20% SSB tax	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	Reduction of 750,000 caries cases in population 3.89 million decayed-missing-filled teeth (units) averted	- -

over
lifetime:
111,700
• 175,300
HALYs
gained

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<p>Stacey, N., et al./ 2018/ South Africa ²⁶</p>	<p>NA</p>	<p>953 158</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>	<p>Stroke cases reduction: 8,000</p>	<p>NA</p>	<p>-</p>	<p>-</p>
<p>15. Wang, Y. C., et al./ 2012/ US ²⁷</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>	<p>867,000 obesity cases reduced (1.5%)</p>	<p>2,377,000 DM-person years with 2.6% DM cases reduced</p>	<p>NA</p>	<p>NA</p>	<p>MI cases reduction: 4,494</p>	<p>Stroke cases reduction: 60 million</p>	<p>NA</p>	<p>-</p>	<p>-</p>
<p>16. Wilde, P., et al./ 2019/ US ²⁸</p>	<p>NA</p>	<p>NA</p>	<p>3,400,000 (0.0201 per person)</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>	<p>MI cases reduction: 4,494</p>	<p>Stroke cases reduction: 60 million</p>	<p>NA</p>	<p>Discounted at 3%</p>	<p>-</p>

Quality of the articles were assessed using the Newcastle-Ottawa Quality Assessment Scale tool which has been adapted for observational studies.

All the articles are of a good quality (refer Table 3). Therefore, all 16 articles were included in the review.

Table 3 Newcastle-Ottawa Quality Assessment Scale

Study	Selection			Comparability		Assessment of the outcome	Outcome	Statistical test	Quality score
	Representativeness of the sample	Sample size	Non-respondents	Ascertainment of the exposure (risk factor)	The study controls for the most important factor				
Basto-Abreu, A., et al. 2019	Participants were representative of Mexican population as the data was from national survey *	Not justified	No description on characteristics of respondents	Outcome estimates using DISMOD II **	Yes *	No	**	Cohort simulation model explained well. uncertainty and sensitivity analyses as well *	Good quality
Breeze, P., et al. 2017	Participants were representative of England population as the data was from the national survey*	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by developing Microsimulation model **	Yes *	No	**	Model, uncertainty and sensitivity analyses as well explained well *	Good quality
Cobiac, L. J. and K. Tam 2017	Participants were representative of Australian population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by modelling **	Yes *	No	**	Model and sensitivity analyses as well explained well *	Good quality
Gortmaker, S. L., et al. 2015	Participants were representative of US population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by developing Microsimulation model **	Yes *	No	**	Model, uncertainty and sensitivity analyses as well explained well *	Good quality
Jevdjevic, M., et al. 2019	Participants were representative of Dutch population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by using Markov model **	Yes *	No	**	Markov transitional model, sensitivity and scenario analyses was explained well *	Good quality
Lai, A., et al. 2017	Participants were representative of Australian population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by using Markov cohort model **	Yes *	No	**	Markov cohort model and sensitivity analyses as well explained well *	Good quality

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Author(s) and Year	Participants were representative of population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by developing Microsimulation model **	Yes *	No	Record linkage. **	The simulation model was explained well *	Good quality
Long, M., et al. 2019	Participants were representative of Maine population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by developing Microsimulation model **	Yes *	No	**	The simulation model was explained well *	Good quality
Long, M., et al. 2015	Participants were representative of US population as the data was from the national survey *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by using cohort model **	Yes *	No	**	Cohort model and sensitivity analyses was explained well *	Good quality
Manyena, M., et al. 2015	Participants were representative of South African population as the data was from the national survey *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by modelling **	Yes *	No	**	Modelling and sensitivity analyses was explained well *	Good quality
Manyena, M., et al. 2016	Participants were representative of South African population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by modelling **	Yes *	No	**	Modelling and sensitivity analyses was explained well *	Good quality
Nomaguchi, T., et al. 2017	Participants were representative of Australian population as the data was from national survey *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by using Markov model **	Yes *	No	**	Markov model and sensitivity analyses was explained well *	Good quality
Schwendicke, F., et al. 2016	Participants were representative of Germany population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by developing Microsimulation model **	Yes *	No	**	The micro simulation model was explained well *	Good quality
Sowa, P. M., et al. 2019	Participants were representative of Australian population as the data was from national survey *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by using cohort model **	Yes *	No	**	Cohort model, sensitivity and scenario analyses was explained well *	Good quality
Stacey, N., et al. 2018	Participants were representative of South African population *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by modelling **	Yes *	No	**	Modelling and scenario modelled was explained well *	Good quality
Wang, Y. C., et al. 2012	Participants were representative of US population as the data was from national survey *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by simulation using Coronary Heart Disease Policy Model **	Yes *	No	**	Coronary Heart Disease Policy Model and sensitivity analyses was explained well *	Good quality
Wilde, P., et al. 2019	Participants were representative of US population as the data was from national survey *	Justified and satisfactory *	No description on characteristics of respondents	Outcome estimates by using validated microsimulation model (CVD PREDICT)	Yes *	No	**	CVD PREDICT Model and sensitivity analyses was explained well *	Good quality

Good quality: 3 or 4 stars (F) in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome domain; Fair quality: 2 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome domain; Poor quality: 0 or 1 star in selection domain OR 0 stars in comparability domain OR 0 or 1 stars in outcome/exposure domain.

DISCUSSIONS

This review assessed the efficacy of the application of SSB tax, specifically in relation to their impact on health outcomes and the potential benefits in terms of healthcare costs. The effectiveness of the SSB tax in terms of health outcomes and healthcare cost benefits was evaluated using key outcomes such as disability-adjusted life years (DALYs), quality-adjusted life years (QALYs), life-years gained, projected number of people with noncommunicable diseases avoided, and estimated long-term healthcare cost savings. All 16 research articles chosen for qualitative synthesis for this review were simulation studies from a variety of backgrounds and nations, with national data utilized to run the simulation.

Numerous studies have found that consuming SSB has a detrimental effect on health, required prolonged care and treatment and may result in disability and consequently affected healthcare expenses.²⁹⁻³² In order to combat this issue, public health policy such as SSB tax was proposed as implementation of the policy was aimed to increase good behaviours by enhancing the nutritional intake while simultaneously decreasing those that are harmful to one's health.^{11, 33, 34} Almost all studies proved that SSB tax can save healthcare costs by increasing the population's quality of life, as implementation of the tax was projected to reduce future healthcare expenditure in long terms.^{13-25, 27, 28} According to a study that used a proportionate multi-state life table-based Markov model to predict the effects of SSB taxing on health and economic outcomes, SSB taxation is a potentially cost-effective policy tool for reducing obesity and related chronic illnesses.³⁵ This is similar with other literatures.³⁶⁻⁴⁰

SSB consumption is influenced by its price, therefore establishing taxes can be an effective means of reducing SSB consumption.^{41, 42} As shown in the included studies, the higher the tax price, the higher the impact on averting undesirable health outcomes.^{16, 26} This is consistent with findings from other studies, showing that SSB tax could contribute in reduction of morbidity and mortality.^{43, 44} Reduction in morbidity and mortality was made feasible by implementing SSB tax, since the taxation strategy may reduce SSB intake, by making SSB less available to the population through price increases.^{11, 45}

All studies showed the evidence of tax effectiveness. Studies have shown that the effectiveness impact will be bigger, if SSB tax is combined with other intervention such as: eliminating tax subsidy of TV advertising to children,⁴⁶ and healthy food subsidy.⁴⁷ The study in Mexico showed that the tax on SSB was associated with reductions in purchases of taxed beverages and increases in purchases of untaxed beverages such as plain water, which means the population shifted to

cheaper option available.⁴⁸ Aside from that, SSB taxes may motivate manufacturers to reformulate to maintain their profit margin, resulting in SSB with less sugar formulation and thus leading to healthier life.^{11, 49} For example, the implementation of SSB tax in Berkeley demonstrates in an alarming 21% decrease in SSB consumption and a 63% increase in plain water consumption as a result of the population adopting a healthier lifestyle.⁵⁰

Stacey et al. showed that implementing higher tax can increase the tax revenue.²⁶ Health taxes have the ability to provide steady, consistent revenue in the short to medium term while also lowering long-term health expenses.¹¹ Tax revenue gain is beneficial in a way that it can be used for health promotion to the public and can also be used in investment, such as to support research and development to minimize the cost of producing sugar-free beverages.^{9, 51, 52} Individually or in conjunction with other policies, SSB taxes may generate revenue and encourage healthier dietary intake.⁵³

Even though there are consistent evidence showing health policy can improve dietary pattern of the population,^{9, 47} SSB tax is not easy to implement, as proper measures had to be taken into consideration. Challenges faced by governments especially from beverages industry which opposed the idea actively⁵⁴ need to be taken care appropriately. Other than that, government might also need to consider that the SSB tax which will be implemented throughout the country could benefit across the socio-economic groups in the population, as much evidence have shown that tax is mostly affecting children and adolescent, and low-socio-economic population.^{6, 55-61} This concern may look regressive, affecting low-income taxpayers more severely than high-income ones. However, this is countered by the health advantages and lower health-care expenses, resulting in a progressive net impact.¹¹

The successful implementation of SSB tax in a country was facilitated by the government's keen focus on taxing, considering both fiscal and health considerations. Additionally, the effective collaboration between the health and finance sectors, together with efficient effort with local and international sources, played a crucial role in the acceptance of the tax.⁶² Hence, the presence of strong political backing for sugar-sweetened beverage (SSB) taxes has been recognized as a crucial determinant in guaranteeing the effective execution of SSB tax policies as mentioned in various literatures.⁶³⁻⁶⁵

Strength of the study

This paper gathers credible evidence regarding the efficacy of SSB tax implementation in terms of the health outcomes and healthcare cost benefits, based on search from multiple databases. The quality of

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the studies in this review was evaluated, and it was determined that every study was in good quality. Thus, findings from this study could guide and provide evidence to the policy maker to consider implementing SSB tax for the benefit of the populations.

Limitations

All studies used projection of the impact, which might not be totally accurate if adopted in real situation. However, considering it is a modelling based on real population, it can be used as a guide to estimate the effectiveness of SSB tax in terms of healthcare costs and health outcome.

Other limitation in this review is that, type of tax and the optimal standard of SSB tax could not be determined to ensure optimal benefit to the population. Different countries will have different population background, which cannot be generalized worldwide.

CONCLUSION

Various evidence has shown that SSB tax could reduce morbidity and mortality due to NCD in the population by changing the population's behavior towards consumption of healthier beverages. Following this, future healthcare costs which are needed to treat NCD could be saved. As a conclusion, SSB tax is proven as an effective public health intervention in terms of giving benefit to the health outcome and healthcare cost.

RECOMMENDATIONS

Implementation of SSB tax, either excise taxes or ad valorem taxes are proven effective at lowering healthcare costs which could prevent diseases associated with excessive sugar consumption. Thus, policy makers were recommended to consider imposing the SSB tax in order to increase the population's well-being by enhancing their quality of life, as evidenced by the research.

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Competing Interests

None declared.

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