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Why a Sugar Sweetened Beverage Tax is no Silver Bullet to Reduce Obesity in Australia

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Abstract

Background: Much of the world's population is overweight and obese as a result of increased energy consumption and reduced energy expenditure. Approximately 2/3 of the Australian population is overweight or obese. It is thought that much of the excess energy intake in Australia is a result of the consumption of sugar sweetened beverages (SSB). Health officials and public health advocates in Australia recommend the introduction of a tax on SSB to reduce sugar consumption and therefore reduce overweight and obesity in Australia.

Aim: To examine the merit of implementing a tax on SSB in Australia to reduce overweight and obesity.

Methods: A review of available literature on the international experience of implementing SSB taxation; and a review of the implementation of similar taxes to reduce alcohol and tobacco consumption internationally and in Australia.

Results: Results internationally demonstrate a decrease in SSB consumption, but only a small decrease in overall energy consumed. As yet, there is no evidence that reduced SSB consumption leads to a reduction in the prevalence of overweight and obesity. Consumer behaviours such as brand loyalty, substitution for cheaper or generic brands, and substitution of other sources of energy (such as fruit juices) diminish SSB taxation effectiveness.

Conclusion: While introduction of a tax on SSB in Australia will likely reduce SSB consumption, other strategies such as sugar reduction in SSB through reformulation, restriction of sales, better information and education, and clear warning labels on packaging have also been shown to be effective to curb SSB consumption.

Keywords: Sugar; Beverage; Tax; Obesity

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Introduction

"*Sugar, rum, and tobacco, are commodities which are no where necessaries of life, which are become objects of almost universal consumption, and which are therefore extremely proper subjects of taxation.*" Smith A (1776) [1].

There is an enormous volume of literature concerning the taxation of sugar-sweetened beverages (SSB). Without question, much of the world's population is overweight and obese as a result of increased energy consumption and reduced energy expenditure. The high rates of overweight and obesity have implications for population health and health expenditure. Public health researchers and advocates contend that much of the population weight increase is due to increased consumption of free sugars - particularly from SSB - and that increasing prices of SSB through taxation will lead to decreased consumption and therefore lead to a decreasing prevalence of obesity. The supporting evidence however, is less clear.

The Worldwide Obesity Epidemic

Since 1980, the prevalence of overweight and obesity amongst the world's population has doubled [2] - and is now regularly termed the "obesity epidemic" [3,4]. Prior to the last century, overweight was an affliction of the wealthy; however, in recent decades this health issue has affected populations of lower socioeconomic status. The high prevalence of obesity was first identified in the most developed countries in the 1970s, followed by the middle-income countries, and is presently an issue of concern in developing nations. Although there are exceptions (such as Japan), overweight and obesity is prevalent in all nations worldwide regardless of developmental status [5,6]. The prevalence of overweight and obesity has been accelerating, with 2016 figures revealing 1.9 billion adults overweight and 650 million obese, representing 39% and 13% of the world's population respectively [7]. In Australia, two thirds (67.0%) of Australian adults were reported to be overweight or obese in 2017-2018; an increase from 63.4% in 2014-15 [8].

Obesity is of major health concern because it substantially increases the risk of associated diseases such as type 2 diabetes and several cancers; and is associated with comorbidities such as liver and kidney failure, hypertension, cardiovascular disease, and osteoarthritis; all of which have a deleterious effect on both life quality and life expectancy.

Obesity is associated with a reduction of 5 to 20 years in life expectancy, depending on the extent of obesity and associated comorbidities [7]. Treatment of obesity and related diseases and conditions is expensive. An analysis of 32 studies a decade ago by Withrow D, et al. (2011) [9], found estimated expenditure on obesity treatment accounted for between 0.7% and 2.8% of a country's total healthcare outlay; and projections for health costs of obesity in countries with higher prevalence such as the US are forecast to double every decade and reach up to 18% of total health expenditure by 2030 [10]. Public health promotion spending on obesity prevention strategies such as education and information, early interventions, promoting better nutrition and diet, and promoting physical activity have all increased, although remain a fraction of the expenditure on obesity-related healthcare [11]. Government regulation and policies such as restrictions on advertising and sales, and the taxation of unhealthy foods have also been implemented in many jurisdictions [12,13]. The overall aim of such prevention strategies is twofold: To increase physical activity and to improve food habits (to increase consumption of healthy food and decrease consumption of unhealthy or "junk" food).

Factors in Obesity

Obesity is both a simple disease and a complex disease. Obesity is simple in that if kilojoules consumed are greater than kilojoules expended, an energy imbalance occurs and the excess energy is stored in the body. Over a long period, the stored energy (predominantly stored as fat) becomes substantial and leads to overweight and obesity. Evolutionally, the storage of energy is a survival mechanism, with humans and their ancestors able to store energy during periods of plenty, and then draw on those stores during periods of famine. Very few people today live in true famine, with food supply currently 20% higher than what is needed on a global scale [14]. Obesity is also complex, in that there are many complicating factors to the simple energy consumption *versus* energy expenditure equation. Factors such as social or emotional overeating [15], genetics, prescribed medication, employment status, shift work, sedentary employment or recreation [16], food marketing and availability [17], socio-economic status [18], recreational drug use, government policies, and others are all contributors to overweight and obesity [7].

Just as obesity is both simple and complex, the role of sugar is likewise both simple and complex. "Sugar" includes the simple sugars - monosaccharides - of glucose (produced by breaking down carbohydrates and stored in the body as glycogen to fuel the aerobic system); fructose (naturally occurring in honey, fruit and berries; but not processed as efficiently as glucose so is more readily stored as fat); and galactose (found in dairy products and is broken down in the body to form glucose). Complex sugars are disaccharides - two monosaccharides joined together - the most common of which is sucrose (a glucose module and a fructose module bonded together and most commonly extracted from sugar cane and sugar beets). Sucrose is broken down in the human body to glucose and fructose [19]. While sugars occur naturally in many foods regularly consumed and provide a source of energy to muscles and the brain, many processed food products contain added sugars in high volumes. WHO (2015) [20], recommends that free (or added) sugars should comprise less than 10% of total energy intake (around 50g / day), and that less than 5% is preferred. Research from Europe reveals that up 31% of dietary energy is provided by free sugars, with up to one third provided by SSB [21]. The type of sugar contained in SSB varies by country and region, with products in the US in particular containing a higher proportion of fructose as High Fructose Corn Syrup (HFCS) – than others with higher proportions of sucrose [22]. The Australian Bureau of Statistics reports that Australians consume an average of 60g of free sugar per day, with over half (52%) from SSB [23].

Alternatives to sugar such as artificial sweeteners, rare sugars, and stevia (*stevia rebaudiana*) are available. Artificial sweeteners include chemicals such as Acesulfame, Aspartame, Saccharine, and Sucralose; and have a sweet taste many times more intense than sugar but with low energy content. Artificial sweeteners are a good sugar substitute in SSB, but don't have the same physical characteristics, so are less useful in foodstuffs [24]. Although there were early concerns linking artificial sweeteners to bladder and other cancers, studies now show no evidence of a link and have determined the risk to be negligible [25]. Rare sugars are monosaccharides which taste and have properties similar to sucrose, but with a much lower energy content. Rare sugars are infrequently produced in nature and must be chemically induced through fermentation or enzymatic processes; but have great potential as future sugar substitutes for the food and beverage industry [26]. A third alternative, stevia, is made from the leaves of a plant native to South America, and possesses similar properties to sucrose [27]. In line with community expectations, consumer choice, and regulations, SSB manufacturers have reduced the sugar content of their products and have continued to introduce a greater range of sugar-free alternatives using sugar substitutes [28]. An ongoing concern of all sugar substitutes however, is that while they reduce the energy content of the foods and drinks in which they are contained, they do not provide complete appetite satiation, and consumption of other foods and beverages is often undertaken to make up the perceived energy deficit [29,30].

One of the most serious consequences of obesity is the development of type 2 diabetes. In short, type 2 diabetes results in an inability to produce or respond to insulin and glucose in the blood system cannot be effectively delivered to the cells of the body. It is largely preventable and most often associated with lifestyle factors such as insufficient physical activity, an unhealthy diet, obesity, and tobacco smoking. Ongoing treatment is required to manage the disease and comorbidities such as heart disease, kidney disease, and other diseases of the circulatory system. There are many studies that provide a link between the high consumption of added sugars in SSB - kilojoules which are easy to consume - and the development of obesity and type 2 diabetes [31,32]; however there is some debate on the scale of impact a reduction in SSB consumption would have on the prevalence of overweight and obesity.

Taxing Sugar

As has been noted in the UK [33], continental Europe [21], the US [34,35], Australia [36], and many other countries [37-40], much of the daily energy consumed by the population comes from sugar, of which SSB represent a high proportion. While sugar and SSB consumption has started to decline in highly-developed countries, the prevalence of obesity has continued to rise. First identified in Australia, and known as the Australian Paradox [41], further studies have found sugar consumption, including from SSB, has slowly decreased in developed countries [42-46], even amongst adolescents and young adults - normally the biggest consumers [47,48]; however, the prevalence of obesity has continued to rise. Free sugar and SSB consumption continue to increase in low- and middle-income countries in line with the increase in population weight [49,50].

There is a growing call by health officials and public health advocates within Australia to implement a sugar tax - particularly a tax on SSB - to moderate sugar consumption and by extension, reduce the prevalence of overweight and obesity [51-54]. Modelling conducted by

proponents of an Australian SSB tax of either a 20% excise tax or 20% sales tax (see below) estimate various reductions in SSB consumption of 0.6 L/month [55], of 17 g sugar/day [56], or by 11.52% [57]. Modelling also estimates a reduced consumption of SSB could lead to reductions in weight of the average consumer of 0.29 kg/year and up to 1.49 kg/year for the heaviest consumers [58]; which could result in lowering the prevalence of obesity by up to 2% [56]. Modelling by Duckett S, et al. (2016) [59], based on a 40 c/100g sugar excise tax (see below) estimated a reduction in consumption of SSB by up to 10 L/year. All models estimated the tax revenue from the proposed SSB taxes in Australia to be between $400M and $640M per year.

A tax on SSB can be implemented in a number of ways, as has been done so in various jurisdictions around the world. An excise tax (sometimes termed excise duty) is an indirect tax applied at the point of manufacture or importation rather than the point of sale [60]. Excise taxes are typically applied to goods with an inelastic demand such as alcohol, tobacco, and fuel; or to non-essential luxury goods such as imported cars. Excise taxes can be applied on a specific or volumetric rate (such as $0.20/litre or 1 cent/g of added sugar), or on an *ad valorum* basis, where the tax collected is based on a percentage of the value or recommended retail price. An indirect public health advantage of excise taxes applied at a volumetric rate is that manufactures have an incentive to reduce the sugar content of their products to reduce the tax paid while maintaining retail pricing [61,62].

A sales tax is an indirect tax which is applied at either the point of sale (a true sales tax), or as in the case of a Value Added Tax (VAT) or Goods and Services Tax (GST), is levied at each stage of the production process. Sales taxes are typically *ad valorum* taxes, in which the tax is proportional to the price of the product rather than the volume of the good or service. Sales taxes are often argued to be *regressive* taxes; as low-income households typically contribute a higher proportion of their total income in sales taxes than higher income households - assuming purchase of the same goods [63]. Both excise taxes and sales taxes have the same effect as ultimately it is the final consumer who suffers the majority of the burden of the tax regardless of at which stage the tax is applied.

Alcohol and Tobacco Taxes

One of the principles aims of excise or specific-product sales taxes is to reduce consumer consumption by making the product more expensive to purchase - a Pigouvian tax intended to distort the free market [64,65]. This tactic has also been employed to reduce the consumption of alcohol and tobacco in many countries around the world [66-70]. Alcohol and tobacco are products which are considered to have inelastic demand - that is, increases in price have a relatively small effect on the quantity demanded. Although it is a fundamental law of economics that the quantity demanded of a product is inversely proportional to the price [71]; certain classes of products such as those with an inelastic demand or *Veblen goods* [72] do not ascribe to the standard economic laws. As such, excise taxes on goods with inelastic demand can raise significant revenue for governments, and at a lower political cost than other alternatives. Some opponents of excise or "sin taxes" also argue that governments have perverse incentives to maintain the taxation revenue at the expense of their citizens' health - a conflict of interest [73,74]. Even relatively large increases in excise taxes on inelastic goods have little effect on government revenue - a Laffer curve that is strongly skewed to the right [75].

Studies into the effect of tobacco excise taxes have found that increasing cigarette prices (for example through increasing excise tax) results in a decrease in consumption, although not to the expected effect due to inelastic demand. Research across a range of countries worldwide demonstrates the inelasticity of tobacco consumption [67,76, and 77], with one recent international study finding an aggregate change of 10% in price led to only a 2% decrease in consumption [78]. Tobacco consumers change their behaviours to reduce the impact of price increases. Consumers try to minimise the effect of price increases without affecting consumption through strategies such as consuming higher-nicotine products, switching to lower-cost or generic brands, or buying from lower-tax regions [79,80]. Hyland A, et al. (2005) [79], also identified that taxation increases disproportionally affect lower income consumers and those with higher daily consumption rates - consumers with the highest inelasticity of demand.

Excise taxes have been the primary means internationally to increase alcohol prices and curb consumption; however, the rates and form of taxation used varies greatly internationally, and often varies between categories of alcohol such as wine, spirits, and beer [81]. Public health policy directed at reducing alcohol consumption also includes reductions in harm from alcohol-related behaviours such as drink-driving, risky behaviours, and domestic violence [66,82]. Increasing the cost of alcohol through taxation results in a decreased consumption [13], however the elasticity varies considerably between lighter and heavier consumers [83], and the availability of substitutes such as alcohol category, lower quality alcohol, and other drugs such as marijuana - particularly in jurisdictions in which marijuana has been legalised or decriminalised [84].

Australia has experienced similar increases in tobacco excise taxes and similar reductions in the consumption of tobacco to other countries. The Australian government commenced a program of significant tobacco taxation reform in 2001, with an ever-increasing excise tax on tobacco which is applied volumetrically in Australia. Over the period 2001 to 2017, the excise charged by kilogram of tobacco increased by a little over 300%. Unsurprisingly, tobacco consumption fell during the same period, with the overall smoking prevalence in Australia falling from 22.6% to 12.8%. Investigation by Wilkinson AL, et al. (2019) [85], noted the smallest decreases in smoking prevalence were amongst the lowest income quintile. Increased excise tax was not the only factor in the reduction of smoking prevalence - a range of law reforms introduced over the same period saw smoke-free workplaces and restaurants, further restrictions on tobacco advertising, plain packaging legislation, government expenditure on smoking cessation and campaigns, and government subsidy of nicotine replacement therapies [86,87].

Alcohol taxation in Australia is quite complex, with up to 16 different excise rates applied volumetrically; based on alcohol category, alcoholic strength, point of purchase, and container size [88]. Comparatively, spirits are taxed heavily in Australia, while draught beer is lightly taxed. Tax on wine is based on the wholesale price - with the result that excise has minimal impact on the retail price of cheap domestic cask wine [88] - which is favoured by those in the lowest income quartile. Alcohol consumption in Australia has been declining since 2007, particularly among young Australians [89]; with a range of governmental policies including taxation, restrictions on advertising and sales, restrictions on alcohol content available at major events, and the introduction of alcohol-free and safe drinking precincts contributing to the reduction [90]. Substitution of alcoholic products however, remains a behavioural concern. Concerned at high youth and adolescent consumption of ready-to-drink pre-mixed sweetened spirits (known as "alcopops"), the Australian government increased

excise on this category of alcohol by 70% in 2008. While consumption of alcopops among young Australians declined, there was little change against the overall and already decreasing aggregate consumption of alcohol, and there was a clear substitution of consumption towards alcoholic ciders [91].

Sugar Sweetened Beverage Taxes - The International Experience

Globally, over 45 jurisdictions (countries, states, and local governmental areas) have implemented a tax on SSB to reduce consumption and assist in obesity reduction. While several small Pacific Ocean nations such as Fiji, Samoa, and Tonga were the first to introduce SSB taxes between 2002 and 2008, the first major jurisdiction to do so was Mexico (population: over 120 million people), which implemented a 1 peso per litre excise SSB tax in 2014. This resulted in a decrease of 7.3% per capita sales of SSB in the first two years after introduction [92]. Later in 2014, the US city of Berkeley, California launched a 1 cent per ounce excise on SSB, from which Falbe J, et al. (2016) [93], reported a 21% decrease in SSB consumption in low-income neighbourhoods four months after implementation. Other major US cities such as Philadelphia, San Francisco, and Seattle followed suite [94,95]. Chile introduced a two-tiered SSB tax in 2014, and an investigation of the effect of the taxes found that purchases of SSB fell by 3.4% by volume and 4.0% by energy content [96]. Somewhat counter-intuitively, the investigation also revealed that the decrease was greatest in high-income households. The UAE and Saudi Arabia both introduced valoric sales taxes of 50% on soft drinks and 100% on energy drinks in 2017 - and while sales of SSB continued to rise in Saudi Arabia, the rate of increase was reduced by 57% [97].

SSB taxes have since been introduced in parts of Europe (Republic of Ireland, the UK, France, Belgium, Estonia, Portugal, Latvia and Norway), Africa (Morocco and South Africa), Asia (Thailand, Brunei, the Philippines, India, and Malaysia), and the Americas (Bermuda, Barbados, Panama, Ecuador, Peru, and local jurisdictions in the US) [98]. As these are relatively recently introduced, the effects of the taxes are yet to be quantified. In many of the jurisdictions, the taxation of SSB is only one strategy undertaken to reduce consumption, with others including restricting the convenient availability of SSB in vending machines [99,100]; restricting advertising and promotion [101,102]; restricting the maximum portion size permitted for sale [103]; and more explicit product labelling [104].

Effectiveness of Sugar Sweetened Beverage Taxes

There is strong evidence that the world-wide trend of an increase in population weight and obesity is driven largely by an increase in energy consumed rather than by a decrease in energy expended [105]. Hill JO, et al. (2003) [106], calculated that reducing energy consumption by as little as 4 to 5% per day could prevent weight gain in the majority of the population. SSB taxation supporters contend that reducing SSB consumption will reduce energy consumption, which in turn will result in weight loss and a reduction in the prevalence of obesity and its associated negative health consequences. However, as previously stated, obesity is a complex disease.

Proponents of SSB taxes point to the successful implementation of taxes in various jurisdictions which have demonstrated a reduction in consumption of SSB, such as in Mexico and Chile [92,96]; however, SSB taxes have been introduced in many other countries and regions based on modelling rather than direct empirical evidence, and empirical results are not yet available. Longitudinal studies of SSB purchases pre- and post-tax conducted in Philadelphia by both Lawman HG, et al. (2020) [107], and Zhong Y, et al. (2020) [108], found the impact of the tax on general consumption of SSB was only small, indicating inelastic demand similar to that of tobacco and alcohol, with brand loyalty a potential factor [109].

It is questionable whether a reduction in the consumption of SSB will result in a reduction in the prevalence of obesity or at least a reduction in population weight. While supporters of SSB taxes point to correlations between high levels of SSB consumption and obesity [110], there are also other correlated dietary and lifestyle factors. A unidirectional correlation does not necessarily mean than the correlation is true in reverse - that reducing levels of SSB consumption will lead to decreases in bodyweight. Empirical evidence of efficacy is reported as generally small [48,111], with consumer behavioural changes too small to have any meaningful effect on population weight [108,112], and which will likely take years to see significant results across the population. There is evidence that restriction of SSB can result in some weight loss amongst those in the heaviest proportion of the population [113], however restriction of SSB may be more effective in reducing the prevalence of obesity rather than reducing the weight of those already overweight or obese [110]. It must also be kept in mind that sugar consumption is declining in Australia and other developed nations; while obesity prevalence continues to climb [42-44].

Another impediment in achieving the weight loss through reduced consumption of SSB is the body's own compensation for lost energy through substitution with other energy sources. The availability of similar beverages containing artificial sweeteners provides a near-zero-energy substitution for many consumers, however as discussed previously, there are concerns that artificial sweeteners and sugar substitutes do not provide appetite satiety, and other foodstuffs are consumed to make up the perceived deficit [29,30, and 110]. A review by De La Hunty A, et al. (2006) [114], found that for beverages sweetened with Aspartame, approximately one-third of the energy loss is compensated through other food and beverage consumption in the short term. Other studies have shown compensation towards fruit juices [110,115], which although appear to most people to be a healthy alternative to SSB, contain considerable energy content and are sweetened primarily with fructose - which has a greater tendency to be stored as fat when consumed in isolation rather than a part of the sucrose disaccharide [116-118].

Arguments against SSB taxation include resentment against further taxation and resistance to government interference in free choice [109], and that the ability to tax … "should not be used as a mechanism for government to attempt to bring about social change in a free society" [119]. Supporters of an Australian SSB tax claim that between $400M and $642M could be collected annually, and suggest that such revenue could be spent on health programs, such as subsidising healthy food [54,56,57]. It is naive at best to imagine that the revenue collected from SSB taxation would be efficiently applied to the subsidisation of healthy food, and there is scant evidence of the effectiveness of such subsidies [120,121]. Clearly taxation is not the only method to reduce sugar consumption from SSB; and selection and consumption of SSB has been shown experimentally to lessen through reducing convenience of availability, restricting advertising and promotion, restricting portion sizes, and overt warning labels on packaging [99-104,122,123]. In jurisdictions in which excise-based SSB have been introduced such as the UK, South Africa, and Mexico; reductions in population sugar intake has also resulted from product reformulation, as manufacturers attempt to minimise the tax paid [28,62].

Conclusion

The high prevalence of overweight and obesity in Australia continues to be an issue of concern for the health of the population. Overweight and obesity result from increased energy consumption and decreased energy expenditure. Much of the excess energy consumption is derived from free or excess sugars, of which SSB are a significant source. As has been the case with alcohol and tobacco consumption, introducing taxation on SSB through excise or sales taxes is proposed to artificially increase the price, leading to a decrease in purchase and consumption, and a decrease in the prevalence of obesity. However international experience has shown that although increased SSB prices lead to decreased consumption, the effect is small, and has little effect on population weight. There is however, some evidence that SSB taxation may be more effective in reducing the prevalence of obesity rather than reducing the weight of those already overweight or obese. As with alcohol and tobacco, consumers are likely change their behaviour to minimise the effect of price increases through strategies such as substitution with lower-cost or generic brands, or through consumption of other products such as fructose-sweetened fruit juices. Based on international experience, in an environment of SSB taxation, manufacturers are also likely to reduce the sugar content of their beverages through substitution of sugar with alternative sweeteners, and in fact are already doing so. Strategies such as restriction of sales, improved information and education, and clear warning labels on packaging have also been shown to be effective to curb SSB consumption. Introduction of SSB taxation in Australia is a policy with a worthy goal, however an SSB tax alone is certainly no silver bullet to reduce obesity in Australia.

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Declarations of Interest

The Author declares that there is no conflict of interest.

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