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Tax on sugar-sweetened beverages: Perspectives from the field of nutrition

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Background: A tax on sugar sweetened beverages (SSBs) was implemented from the 1st of April 2018 to address overweight and obesity (o/o) and resultant non-communicable diseases (NCDs) in South Africa (SA). The tax has potentially far-reaching consequences for consumers as well as industrial and agriculture sectors.

Objectives: This review focuses on: (i) the most recent international and national recommendations on intakes of added sugars; (ii) contributing factors to o/o; (iii) the ethics of the tax; (iv) international experiences with similar taxes; and (v) expected advantages and disadvantages.

Methods: The relevant recent literature is used for a review and discussion of the tax on SSBs in the SA context.

Results: The mean intake of added sugars in SA exceeds recommendations. Both o/o and non-communicable diseases are problems in SA. A SA study demonstrated the relationship between SSBs and overweight. However, it is uncertain if the intended tax on SSBs, as a Pigovian tax, will have benefits for poorer segments of the population. Possible advantages include additional income generated by the State, lower expenditure on SSBs and medical cost savings because of lower prevalence of o/o. The major concern is about potential job losses.

Conclusions: O/o is the result of complex, multifactorial and transdisciplinary factors and therefore needs multisectoral and transdisciplinary interventions, of which taxation is but one. The proposed tax seems ethically sound but there is little evidence that it will reach the proposed aims in SA. It is recommended that the government addresses the expected job losses because of the tax and that implementation and consequence of the tax are monitored and evaluated.

Introduction

Since April 1, 2018, a tax of 2.1 cents per gram of sugar has been charged in South Africa (SA) on all sugar-sweetened beverages (SSBs) that exceed 4 g sugar/100 ml. The levy is in accordance with the Rates and Monetary Amounts and Amendment of Revenue Laws Act, 2017 (National Treasury 2016b). The purpose of this tax is to decrease the consumption of SSBs and thus of added sugars, in an attempt to reduce overweight and obesity and the consequent non-communicable diseases (NCDs) in SA (Economics Tax Analysis Chief Directorate 2016). The tax also forms part of the Department of Health's comprehensive strategy to address overweight and obesity.

Weight gain is a major risk factor for NCDs such as coronary heart disease, hypertension, stroke, type 2 diabetes mellitus, and some cancers. These diseases are major public health challenges in SA (Joubert et al. 2007). Sugar intake, especially in the form of SSBs, contributes to overweight and also tooth decay in children and adults (Brownell et al. 2009; Pan and Hu 2011; World Health Organization 2015a). Prevention of weight gain and NCDs through a reduced sugar intake, may reduce the burden on SAs public health services, such that the sugar tax may result in both health and financial benefits.

The tax was welcomed by several institutions (ADSA 2016; South African NCDs Alliance 2016), but has also been criticised by the producers of sugar (South African Sugar Association 2016) as well as the marketers of SSBs (BEVSA 2016). The focus of the criticism is that, in a sugar-producing country such as South Africa, the tax will lead to job losses and that there is not enough evidence the tax will have the desired outcomes and impact. The research organisation TIPS (Trade and Industrial Policy Strategies), which facilitates policy development amongst other things, argues that the possible loss of job opportunities suggested by some critics is exaggerated, and data have been incorrectly interpreted (Trade and Industrial Policy Strategies [TIPS] 2016).

In this review you will find brief explanations of the most recent dietary recommendations regarding added sugars as well as the intake of these sugars in SA. Obesity and overweight are then discussed, recognising obesity as a multifactorial problem requiring multi- and transdisciplinary interventions. This leads to a discussion of the ethics of the tax, the arguments for government intervention in dietary recommendations through taxes, international experiences with similar taxes, as well as the expected advantages and disadvantages of the tax. Finally, some recommendations are given on further steps to be taken.

International and South African guidelines for sugar intake

In 2015, the World Health Organization (WHO) published updated dietary guidelines on sugar intake to combat overweight and tooth decay (World Health Organization 2015a). A set process was followed (World Health Organization 2014) to ensure that recommendations were based on the best available scientific evidence.

The WHO guidelines on sugar intake (WHO 2015) are as follows:

- The WHO recommends a reduced intake of added sugar over the total life cycle (strong recommendation*).
- In both adults and children, the WHO recommends that added sugars should not be more than 10% of the total energy intake**.
- The WHO recommends a further reduction of added sugar intake to less than 5% of total energy (conditional recommendation***).

* *Strong recommendation means that when one adheres to the recommendation, the desired or beneficial consequences are greater than any possible adverse effects and that the recommendation can be accepted as a policy in most situations.*

** *Total energy intake is the sum of all daily intakes of calories/kilojoules of food and drink #.*

*** *Conditional recommendation means that there is less certainty about the balance between the benefits and the possible disadvantages of implementing the recommendation. This means that substantive debate is needed between all stakeholders before such a recommendation becomes part of policy and implementation can be accepted.*

The South African guideline is part of the SA Food-based dietary guidelines (Temple and Steyn 2013; Vorster et al. 2013) and reflects the WHO recommendations with the wording: "Use foods and drinks that contain sugar sparingly and not between meals". It is recommended that added sugar should not exceed 10% of total energy (Temple and Steyn 2013) or 6% of total energy in people that are pre-diabetic, obese, or do not regularly consume fluoride, such as in drinking water or from fluorinated toothpaste. Furthermore, it is recommended that no drinks containing sugar be given to babies, toddlers and children.

The average moderately active adult woman needs about 8 000 kJ a day and a moderately active man, 10 000 kJ. An added sugar intake of ten percent (10%) thus comes to 800 and 1 000 kJ respectively. With a regular teaspoon (tsp) containing 5 grams of table sugar (sucrose), equal to about 85 kJ (Goran and Astrup 2002), the 10% maximum recommended added sugar intake is therefore approximately 9.4 tsp/day for women and 11.8 tsp/day for men. Five percent is therefore 4.7 tsp/day for women and 5.9 tsp/day for men.

This recommendation includes all added sugars including honey, syrup, dried and concentrated fruit products, dried fruits such as raisins, and others, as well as fruit concentrates, for example, in fruit juices and jams, together with other sugars in cakes, tarts, hot and cold desserts, salad dressing, chutney, pickled fruit and cold drinks. It is clear then, that the use of these products should be limited to meet the recommendation.

South Africans' sugar intake

Sugar intake by children

Temple and Steyn (2013) showed in a 1999 national study that white children (6–9 years old) consumed an average of 67 g of added sugar per day. In comparison, black children of the same age group had an intake of 47 g per day. Jointly, these children have about 5.5% of their total energy as added sugars, though in urban areas, they already exceeded the recommendation with added sugar at more than 10% of total energy intake. The most common sources of these sugars (from most to the least) were: table sugar, sugar-sweetened squash (concentrates where water is added), jam, cookies, sugar-sweetened carbonated cold drinks, and breakfast cereals.

Sugar intake by adolescents

MacKeown et al. (2007) showed that adolescents in Gauteng, studied in 2000 (at 10 years of age) and 2003 (at 13 years of age) had an intake of 68 g of added sugars, which represented 16% of their total energy intake at age 10. By age 13, this amount had increased to 102 g per day (20% of total energy intake).

Sugar intake by adults

Temple and Steyn (2013) refer to the CRIBSA study's unpublished data from 1 010 adult participants in four urban areas (Townships) in Cape Town. The men had an intake of 52 g of added sugars daily (11% of their total energy) and the younger women 51 g per day (15% of their energy intake). The older women showed a lower intake of 38 g per day (11% of their energy intake).

In the North West Province, changes in dietary intake, anthropometry and other health outcomes of rural and urban black adults were examined in 2005, 2010 and 2015 in the "Prospective, Urban and Rural Epidemiology" (PURE) study. Vorster et al. (2014) reported disturbing

increases in sugar intake over the five-year period from 2005 to 2010 (Table I). This is specifically attributed to the number of people drinking sweetened beverages and the quantity of these drinks consumed. The intake of sugars as a percentage of total energy in 2010, in most rural and urban participants, exceeded the recommended amount. However, sugars were not the only energy-providing nutrient for which intake increased, as can be seen by the increases in total energy intake.

TABLE I: Consumption of added sugars through the PURE cohort from 2005 to 2010*

Variables	n	Baseline (2005)	Follow-up (2010)
Energy intake (MJ)			
Men rural	203	7.3 (6.9, 7.8)	10.3 (9.5, 10.9)
Men urban	205	10.2 (9.6, 10.8)	13.9 (13.2, 14.7)
Women rural	459	6.2 (5.9, 6.4)	9.7 (9.3, 10.2)
Women urban	366	9.2 (8.8, 9.6)	12.0 (11.5, 12.5)
Added sugar (g)			
Men rural	203	27.5 (23.2, 31.9)	63.2 (54.6, 71.9)
Men urban	205	44.7 (39.8, 49.5)	74.3 (66.9, 81.1)
Women rural	459	26.7 (24.6, 28.8)	65.7 (58.6, 72.7)
Women urban	366	47.1 (43.8, 50.4)	78.5 (71.8, 85.1)
% Energie v suiker			
Men rural	203	6.9 (5.9, 7.9)	10.5 (9.4, 11.7)
Men urban	205	7.4 (6.7, 8.1)	9.5 (8.6, 10.4)
Women rural	459	7.6 (7.1, 8.2)	11.3 (10.5, 12.2)
Women urban	366	8.8 (8.3, 9.2)	11.2 (10.5, 11 9)
% wat SVKe drink	Uit:		
Men rural	203	25	56
Men urban	205	60	58
Women rural	459	33	63
Women urban	366	65	52
Hoeveelheid koeldrank (g/dag)			
Men rural		69.9 (50.8, 89.1)	98.6 (73.2, 124.0)
Men urban		58.0 (49.0, 70.2)	114.6 (89.2, 134.0)
Women rural		59.7 (43.7, 57.6)	74.3 (55.5, 93.1)
Women urban		61.3 (48.4, 74.2)	147.7 (142.2, 171.3)

Data is reported as means (95% Confidence Interval)
**Adapted from Vorster et al. (2014)*

A review of all diet-related studies conducted on SA adults for the period 2000 to 2015 by Mchiza et al. (2015) included thirteen studies. Most focused on the black SA population with only one study in the Indian population. Worrying results indicate that all participants exceeded the WHO's recommendations of 25 g added sugar or 10% of total energy (Mchiza et al. 2015).

Overweight and obesity

This is often expressed as body mass index (BMI), calculated as the weight in kilogram divided by the height in meters squared. A BMI of 25–29.9 kg/m^2 is categorised as overweight, while people with a BMI equal to or greater than 30 kg/m^2 is classed as obese. There is no doubt that overweight and obesity are a public health problem in both adults and children in SA (Joubert et al. 2007). Overweight and obesity are risk factors for various NCDs and estimated to account for 7% of the 521 000 deaths in SA in 2000 – the fifth biggest cause of death (Norman et al. 2007).

The WHO guidelines for intake of added sugars (WHO 2015) are based on findings from the international literature which indicate that reducing added sugar intake is associated with reduced body weight for adults. This finding is based on systematic reviews including 30 of 7 895 randomised controlled intervention studies and 38 of 9 445 cohort studies. Only cohort studies were available for children, with five studies that met the inclusion criteria. A meta-analysis of these five studies, that followed children for 12 months or longer, has shown that children with the highest intake of SSBs had a significantly greater chance of being overweight or obese, compared to children with the lowest intake of SSBs (WHO 2015).

In SA the PURE study showed that, between 2005 and 2010, added sugar intake increased especially from SSBs. Individuals with added sugar intake above 10% of their total energy had significantly higher body weight indices in comparison with those with an intake of added sugars less than 10% of their energy (Vorster et al. 2014). The complexity of the global obesity problem has been described by Swinburn et al. (2011) as a consequence of the changes in the global food system, thereby creating an "obesogenic" environment in which highly processed food products are increasingly available and affordable. The result is passive excessive consumption of energy and thus obesity. Variation in obesity prevalence between different populations has been explained by differences in local and national socio-cultural, economic and transport environments.

Figure 1 illustrates, in a customised framework (Swinburn et al. 2011), the factors contributing to overweight and obesity and the possible solutions to the problem. The framework shows the interaction between environmental, behavioural and physiological factors that need to be addressed jointly in health promotion programmes.

The systemic and environmental factors on the left of the framework can promote, amplify, or minimise the effect of interventions. Most interventions are aimed at moderators in the environment or are based on policies. Health promotion programmes can affect the environment as well as behaviour, while medication and operations take place on the physiological level. Interventions have a greater effect on the population if directed toward systemic factors, while the political implementation of health promotion programmes and services is more complicated. It is clear that added sugars and thus taxes on these sugars are but one of the factors in this complex problem that need to be addressed at the population level.

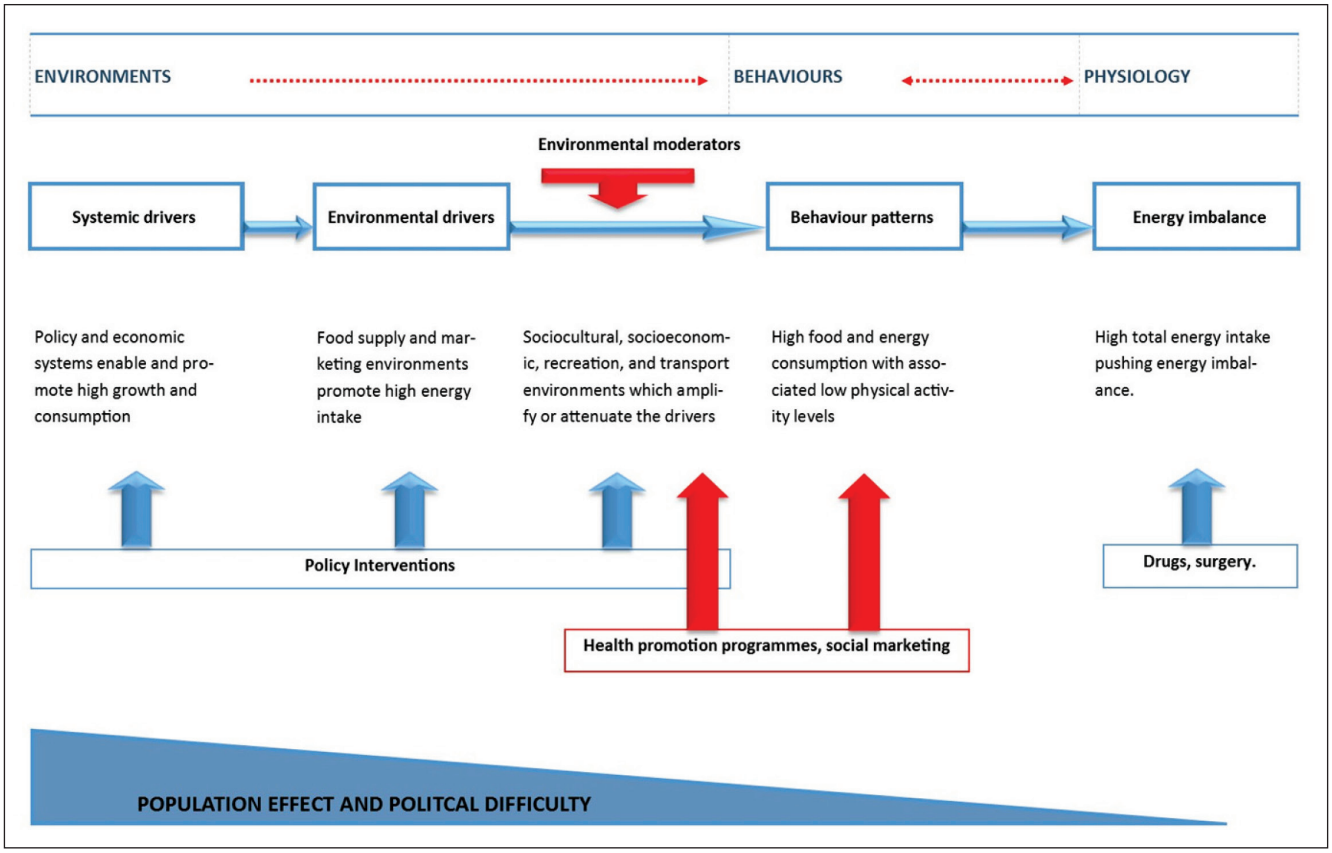

FIGURE 1: The framework developed by Swinburn et al. (2011) to categorise obesity determinants and solutions

Ethical considerations for taxation on SSBs

Tax legislation that aims to influence dietary habits and prevent NCDs is receiving continuous attention due to the immense role that costs play in food choices. The rationale for taxing products with a view to improving public health is mostly based on the view that these products are associated with negative health effects. These negative health effects result in high healthcare costs which are not borne by either the consumer or the producer of the product (World Health Organization 2015b). Therefore, a government wants to act to correct the use of those products scientifically found to have a negative impact on health. By channelling food choices in the right direction, better health outcomes and healthier eating habits can be cultivated.

General principles

Public health care as a discipline has existed for more than 100 years with a focus of protecting and promoting the health of the community, and not only the individual. Given the extent of the discipline, and the issues that it addresses, there is an ever-present question of how far legislation can impact choice before personal freedom is constrained (Kass 2001).

There is general acceptance that the state must act in the interests of the general public's health. Fiscal policies, such as tax on SSBs, are a highly attractive government strategy and may be one of the most cost effective interventions to address obesity (World Health Organization 2016). Nevertheless, taxes on SSBs as part of the strategy for prevention and control of obesity in South Africa (2015–2020), have proven a source of controversy (Health-e 2016). This is clearly visible from news headlines as well as social media (Maroela editors 2016; African News Agency 2016; Van Wyk 2016).

Arguments for and against government interference

The complexity of overweight and obesity is frequently simplified as the result of an imbalance between excessive energy intake and insufficient physical activity. The question is however, whose primary responsibility is the prevention of obesity especially among children? Is it not a shared responsibility resting on parents, guardians, schools, communities and the state (Kersh et al. 2011)? Although the opinion can also be raised that every parent is best positioned to make decisions regarding the child's nutrition.

Swinburn et al. (2011) argue that intervention-driven policies against obesity should be directed towards the environment rather than the individual. Therefore, the policy aim should be to make healthy choices easier for the individual, rather than to convince individuals to make healthy choices (Swinburn et al. 2011). Eating habits cannot be managed directly by law in the same way that law has

changed other behaviours, for example, using seat belts, smoking in restaurants or public areas, the use of liquor by minors, or traffic offenses (Sacks et al. 2009). A person cannot be ordered when, how much and what to eat. As such, legislation aimed at prevention of obesity is much less intrusive in the sphere of human rights and personal freedom of choice than many other types of legislation at the health level. The goal of strategies like tax on SSBs is rather to influence behaviour by motivating individuals to make healthy choices (Swinburn et al. 2011).

A framework was designed by Kass (2001) to evaluate the ethical implications of interventions and policy proposals. This includes determining: (1) the objectives of the proposed programme; (2) the effectiveness of the programme to achieve the proposed objectives; (3) the known as well as potential liabilities/disadvantages of the programme; (4) whether the liabilities can be minimised; (5) if the programme can be implemented fairly; and lastly, (6) whether the pros and cons of the programme are evenly distributed. Kass (2001) suggests that, if the above-mentioned framework is followed, an ethically correct policy will be the result. The reality is, however, that politics play a tangible intrusive role in the formulation and execution of policies, and that an ethically correct policy may not necessarily enjoy political preference. The reality that politics triumph should not, however, prevent us from ensuring that fairness, respect, and truth lay the foundation for high standard, scientifically-founded, ethical policies. The biggest asset that the SA public health system can have is the public's confidence that decision making and policies for public welfare are carried out.

Brownell et al. (2009) states that economists agree that it is ethically justifiable for governments to take economic steps to address failures, defects and shortcomings in the market, as in the case of the marketing of SSBs. The failures of the market, according to these authors, are that many consumers: (i) are ignorant of the long-term consequences of excessive SSB consumption; (ii) are being misled by the advertisement of so-called benefits of SSB use; (iii) make decisions about a product based on instant gratification but long-term damage, especially to children and young people who are less concerned about adverse effects that may emerge over many years; (iv) do not bear the full cost of their decisions to drink SSBs themselves i.e. the medical consequences of overweight and obesity will be borne by government and taxpayers via medical services and funds.

Tugendhaft et al. (2015) argue that the playing field is already uneven with consumers who, through marketing techniques such as strategic placement of high energy products, are being deceived and that it is precisely Government's responsibility to protect the health of the population. Manyema et al. (2014) show that the SA government, and specifically the Department of Health, has already demonstrated they are willing to use legislation as an intervention to improve public health, as in the case of excise duty on tobacco products, and regulations that limit the trans-fatty acid (Department of Health, 2011) and salt content (Department of Health, 2016) of food products.

Focus on the tax

To correctly interpret the tax on SSBs, it is necessary to consider the "Strategy for prevention and control of obesity in South Africa, 2015–2020). According to the Minister of Health, Dr PA Motsoaledi, the strategy can serve as a roadmap for South Africans to be as healthy as possible. The strategy focuses on six main objectives (Figure 2). Tax on SSBs forms part of a further six sub-objectives that fall under the second objective, showing that this tax is part of a broader strategy to address obesity.

Any tax must comply with four principles before it can be said to be a "good policy" from an economic viewpoint (Calitz et al. 1999). The tax must firstly be economically effective, meaning that the change in price as well as its impact on sales must be limited. Secondly, it must be administratively simple, so that it can be collected at a low cost. Thirdly, it must be consistent with people's ability to pay. The tax should make up a smaller share of less wealthy people's spending and a greater share of more wealthy people's spending. Lastly, it must be flexible.

The proposed tax is what economists call a Pigouvian tax. Pigouvian tax is named after the British economist AC Pigou. It is a tax that attempts to force market participants to account for the external (or social) costs of their decisions in their calculation of costs and benefits (Black et al. 2005). It does not meet the economic efficiency principle described above, precisely because it is aimed at increasing the relative price of SSBs and reducing sales. The tax should be administratively reasonably efficient to levy as the legal burden is on private companies that are unlikely to avoid tax and will be able to partially or fully pass the price increase on to consumers.

The point of equality, or fairness, requires further discussion. On one hand, the tax is regressive and poorer people carry a greater burden. On the other hand, the argument can be made that poor populations are the most affected by the ill health associated with unhealthy eating habits (Brownell et al. 2009). These are precisely the populations that will benefit from the tax because their spending on SSBs will decrease if they replace SSBs with water, which is usually freely available or at minimum cost. Furthermore, it should benefit poorer communities when their own health is improved. In Mexico, all socio-economic groups reduced use of SSBs after a tax was introduced. The lowest socio-economic group, however, showed the biggest decrease (17%) in consumption (Backholer et al. 2016).

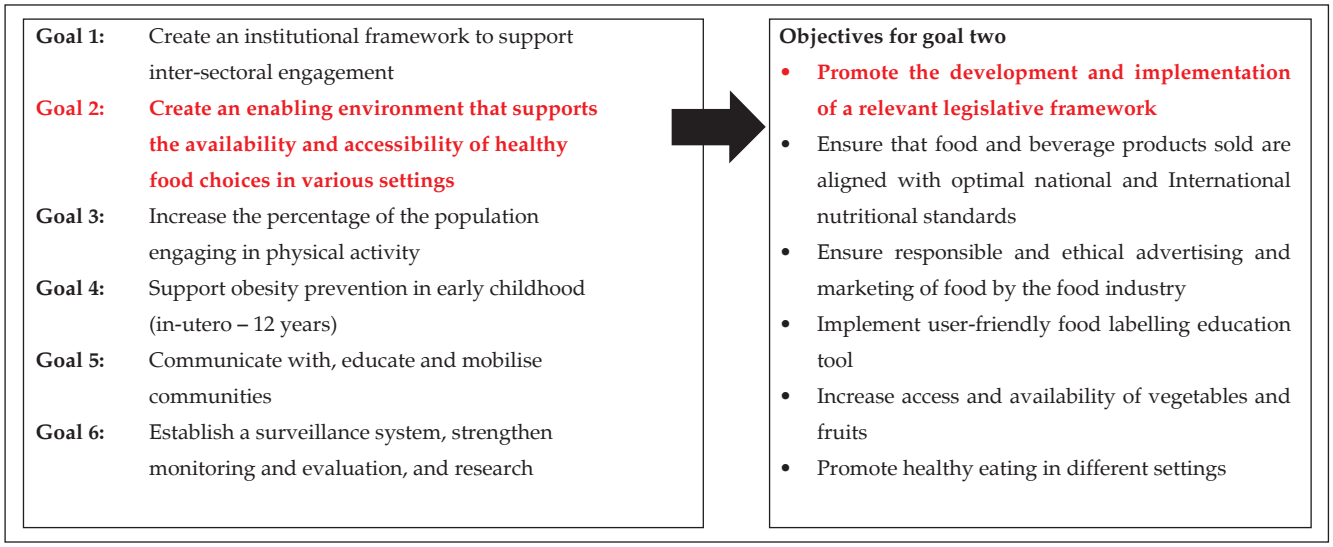

FIGURE 2: An extract from the National Strategy for Prevention and Control of Obesity of the South African Department of Health (Health-e, 2016)

International experiences with taxation on sugar-sourced products

The experience of other countries with tax on products containing sugar is summarised in Table II. Clearly similar taxes worldwide are primarily intended to be revenue generating as well as to reduce the intake of the taxed products to achieve specific health outcomes.

Balance Sheet of possible benefits and disadvantages of a tax on SSBs

Possible benefits

The possible benefits of such a sugar tax are explained by several authors as both the possible contribution to public health through combating obesity and, at the same time, generating economic benefits. These benefits include the revenue collected by the tax, the lower spending on SSBs (depending on what they are replaced with), and also the benefit of saving on the cost of medical services as a result of a reduced prevalence of overweight and obesity (Brownell et al. 2009; Manyema et al. 2014). The latter benefit may increase if the additional tax revenue collected is used for public health care. In South Africa, however, this does not seem to be the case at present.

The question remains whether the proposed tax on SSBs will affect a population's intake of SSBs. Research that assesses the impact on intake of SSBs is limited. In the US, Berkeley was the first jurisdiction to tax SSBs in March 2015 (Falbe et al. 2016). Falbe et al. (2016) found that use of SSBs, four months after the implementation of the tax, decreased by 21% in Berkeley's low income and minority groups while water intake increased significantly (63%). Colchero et al. (2017) assessed the changes in consumption of non-alcoholic beverages after the tax on SSBs was introduced in January 2014. The findings match those van Falbe et al. (2016) showing that purchases of SSBs were lower while purchase of water increased. The effect was also larger in low-income households as well as urban areas (Colchero et al. 2017).

Manyema et al. (2014) used a mathematical simulation model to calculate what the potential impact of a 20% tax on SSBs would be for SA adults. They used SA data on energy intake, BMI distribution and price elasticity (defined as the extent of change in the quantity of goods demanded when the price increases). Their results show a 20% tax on SSBs will lead to an estimated reduction of 36 kJ (95% CI: 9-68 kJ) per day and an expected reduction in obesity of 3.8% (95% BI: 0.6-7.1) in men, and 2.4% (95% BI: 0.4-4.4) in women. This means that over 220 000 (95% BI: 24 197-411 795) fewer people would be obese.

An article by the same research group looked at the cost of being indifferent to the impact of SSB intake on obesity. Tugendhaft et al. (2015) used a simulation model for SA to calculate the impact of a 2.4% annual increase in SSB intake on the prevalence of obesity, based on projected SSB sales between 2012 and 2017. Such an increase in annual sales of SSBs would potentially lead to an additional 1 287 000 obese adults, of which 22% are due to increased SSB intake (Tugendhaft et al. 2015).

Similar findings have been published in Australia on the impact of an additional 20% tax on SSBs (Nomaguchi et al. 2017). According to the simulation model it seems that such a tax can reduce the prevalence of obesity by 1.96%. Together with the reduction of obesity prevalence, the positive impact on healthcare costs of such a proposed tax could also lead to increased productivity.

Unexpected outcomes

Table II shows the unexpected outcomes due to tax on products containing sugar in different countries. This includes, inter alia, product reformulation (possibly for tax evasion), lower revenue from the tax, job losses that affect low-income groups the most, increases in purchases across

borders, losses for producers, and a smaller than expected decrease in consumption.

Possible disadvantages/objections

The first objection is that there is no irrefutable evidence that the tax on SSBs will lead to reduced consumption, and consequently lower incidence of obesity, lower risk of NCDs, and therefore a smaller burden on public health. The SSB industry's objections in America (Brownell 2009) have shown they are expecting reduced sales due to such a tax. This industry believes that sales will decrease! It is also argued (South African Sugar Association – SASA 2016) that obesity is a multifactorial condition. As such, a tax on SSBs alone cannot solely be used to address overweight and obesity, and a combination of strategies and interventions should be used.

In SA, a sugar-producing country, the strongest objections are around the possible loss of employment opportunities specifically in the agricultural sector due to reduced demand. This may have a knock-on effect from production throughout the value chain of transport, storage, product manufacturing, packaging, distribution, marketing and consumption (SASA 2016). Indeed, SASA (2016) comment that around a million job opportunities are created for the SA market through the 620 000 tonnes of sugar produced each year. SASA argue that the effect of the tax on the total value chain will hurt poor, emerging farmers and small businesses the most. The SSB industry further mention all the jobs they will lose as a result of reduced sales (SASA 2016).

Furthermore, a study requested by the European Union has shown that taxes on sugar, salt and fat-containing foods in

TABEL II: International experiences with taxation on sugar containing products

Country and year of implementation	Type of tax	Purpose	Using the tax income generated	Outcomes	Unforseen outcomes	Income
Finland In 2000, sugar tax on sweets was scrapped, but not on non-alcoholic beverages. In 2010 Parliament reinstated the sugar tax and it was implemented in 2011.	Taxation on products such as snacks, chocolates and ice cream. Exclude biscuits, baked foods, yogurts, deserts, jelly, mousse and sugar granules. Sugar-sweetened beverages.	Income generation for the government.	The tax generates income for government.	The impact of the tax has not yet been evaluated but unofficial reports indicate that sales of non-alcoholic drinks as well as sweets decreased.	Claims from the industry based on discrimination against individual food companies.	€204 million in 2013 €250 million in 2014
Hungary 2011	Taxation of food products with unhealthy levels of sugar, salt and fat. Taxation of sugar-sweetened beverages.	Reduce intake, improve healthy eating habits through advocating for healthier food choices and the development of an additional mechanism for finance of public health care.	The tax income generated is used to supplement the health budget, making a contribution to the salaries paid to healthcare staff.	Reduced intake of targeted products. The price of cola-drinks increased (3.4%, 1.2% and 3.1% respectively) and intake decreased (2.7%, 7.5% and 6% respectively) for 2011, 2012 and 2013.	Product reformulation; Possible tax evasion; Smaller income than were expected; Loss of jobs in low income groups.	€61.5 million between Jan 2013 and Dec 2013.
Denmark 2011 (Abolished in 2013)	Taxation of products with more than 2.3% saturated fat content	To generate additional income in order to reduce income tax. To reduce the intake of saturated fat.	Supports public health spending. Finances tax reductions and social spending.	Economic analysis suggests that short-term intake of some taxed products decreased with 10–15%.	Increase border trade, job losses and losses for producers.	€134 million between Nov 2011 and Aug 2012.
France 2012	Taxation of cold drinks (sugar-sweetened beverages as well as artificially sweetened beverages)	Income generation but is also aligned to address overweight and obesity in children/adolescents.	Tax is used to generate general income for government.	An immediate decrease in sales of taxed products directly after the tax was implemented.	No significant unforeseen outcomes.	Generated about €300 million per year since 2012.
Mexico 2014	Taxation of sugar-sweetened beverages as well as energy-dense foods.	Address the high obesity prevalence. 7% of the national health budget is spent on obesity-related diseases.	Part of the tax income is used to provide safe drinking water at public schools, specifically in low-income areas.	Decrease in the use of taxed products.	1 700 job losses. Unequal effect on low-income households. Smaller effect on obese individuals.	Unknown
US, Berkeley 2014	Taxation of the distributer for having the right of distribution.	Decrease intake of sugar-sweetened beverages in order to decrease the humanitarian and economic cost related to the excessive use of sugar.	The tax is seen as a general tax. There is a committee that advises the city council of Berkley.	No data available.	Concerns about purchases made outside of the borders of the country. Lower than expected decrease in usage with less than expected health improvements.	Unknown

(World Health Organization, 2015b, World Health Organization, 2016, World Health Organization, Cornelsen and Carreido, 2015, Jensen and Smed, 2013, Colchero et al., 2016, National Treasury, 2016a, Soares, 2016, Pineda, 2016, The Guardian, 2015)

Europe, do reduce consumption but are not an optimal method to promote healthy nutrition as consumers usually replace such products with cheaper products, often of lower quality (Ecorys and IDEA 2014).

Discussion, conclusions and recommendations

The SA dietary guidelines are in line with the WHO's recommendations on added sugars in the diet. It appears that large sections of the SA population currently exceed the guidelines. The restrictions on sugar intake are aimed at preventing overweight and obesity, NCDs and tooth decay. It is clear that a restriction of added sugar intake alone will probably not significantly reduce obesity, as there are so many complex and interactive factors involved in its development. There is currently also no clear evidence that a tax on SSBs does reduce sugar intake.

There is no doubt that overweight, obesity and consequent NCDs are public health problems in SA. Convincing evidence from the international literature shows that "excessive" consumption of SSBs contributes to overweight and obesity. In SA, there is sufficient evidence that the intake of these beverages has increased, and that the increase is related to body weight, body shape and some important risk factors for NCDs (Vorster et al. 2014).

Overweight and obesity are complex, multifactorial problems that need to be addressed through various government sectors and healthcare staff through multidisciplinary interventions (of which tax is only one). Temple and Steyn (2013) warn that there is uncertainty about the most optimal methods of reducing sugar intake at the population level. As with all dietary recommendations, "social marketing" and education of consumers are probably the best starting points.

The question is, are there better methods to reduce sugar intake in the total population? Replacing SSBs with water means that clean, safe drinking water has to be available and affordable in all areas, including poorly serviced rural areas, or at least that cold bottled water should be cheaper than SSBs everywhere.

Are artificial and non-energy containing natural sweeteners the solution? In Brazil it was found that the average daily energy intake of individuals who use only sugar was 16% more than those that use only artificial sweeteners (Silva Monteiro et al. 2018). The term "non-energy containing sweeteners" includes both artificial sweeteners and natural non-energy containing sweeteners like stevia and its products. These sweeteners are a few hundred to thousands of times sweeter than sucrose (sugar). Most of them, except aspartame, contain no energy. Unfortunately, there is a lack of high quality clinical research in which subjects are followed for long periods of time to make definitive statements about the disadvantages or benefits for health (Bruyère et al. 2015). The results of most systematic analyses (reviews) show contradictory and inconsistent long-term effects (Wiebe et al. 2011; Bruyère et al. 2015; Pereira 2013). Research on the possible long-term metabolic effects of artificial sweetener intake on pregnant women, toddlers and children, is also limited and inconsistent (Brown et al. 2010; Reid et al. 2016). The overall conclusion seems to be that, at this stage, it is not possible to give a definite guideline about the benefits or disadvantages of using these intense sweeteners for adults or children.

During a study conducted in Soweto, Johannesburg, we asked overweight and obese black women why they are not replacing SSBs with drinks containing artificial sweeteners. The answers given were mostly that cold drinks with artificial sweeteners "are for sick people, and we are not sick; do not taste well; taste like medicine; and reminds me of medicine". The combination of sweeteners in use does not appear to meet everyone's taste but there is also some degree of ignorance among consumers about the content of SSBs.

One should look critically at the implementation of dietary guidelines on sugar intake, at the international experience of sugar tax, and whether it has led to a reduction in sugar intake or addresses the problem of obesity in developing countries. This review also showed that the proposed tax may be ethically justified, but there remains little evidence that its intended goals will be achieved in South Africa. The chance that the tax will have its desired impact will increase significantly if the revenue raised by the tax is ploughed back into the health sector. As in the case of any intervention directed at public health, the exact consequences for SA cannot be determined until the tax act is passed and its effects monitored. It is therefore recommended that all implementation programmes around the tax should include evaluation and monitoring plans and studies, so that the tax can be recalled if it does not reduce sugar intake in vulnerable populations. It is critical that monitoring evaluates the: i) cost of products taxed and their substitutes; ii) purchasing patterns of the taxed products and substitutes; iii) food composition of taxed products and substitutes; iv) dietary intake and habits; and v) change in population prevalence of overweight, obesity and diet-related NCDs (World Health Organization 2015b).

Furthermore, it is suggested that the government urgently pay attention to possible job losses the tax may bring and find innovative ways to prevent and correct them. One possible option may be sugar cultivation not only for food but also for energy in the bio-fuel field.

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Prof Este (HH) Vorster is currently serving as scientist in the Council of South African Sugar Association (South Africa Sugar Association-SASA).

Author Contributions

Both HHV (North West University) as well as CT (North West University) contributed to the conceptualisation, writing and finalisation of the article. Both authors contributed to the interpretation of the data, and to the discussion and finalisation of the article.

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