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Taxation of sugar-sweetened beverages for reducing their consumption and preventing obesity or other adverse health outcomes (Protocol)

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[Intervention Protocol]

Taxation of sugar-sweetened beverages for reducing their consumption and preventing obesity or other adverse health outcomes

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ABSTRACT

This is the protocol for a review and there is no abstract. The objectives are as follows:

To assess the effects of taxation of sugar-sweetened beverages (SSBs) on SSB consumption, energy intake, overweight, obesity, and other adverse health outcomes in the general population.

BACKGROUND

Description of the condition

Obesity

Overweight and obesity refer to adverse medical conditions of "abnormal or excessive body fat accumulations in adipose tissue" (WHO 2000; WHO 2011). The increase in prevalence of overweight and obesity among children and adults is one of the leading contemporary global public health issues, and puts overweight and obesity prevention on local, national and international policy agendas. Limiting the intake of 'free sugars' (monosaccharides and disaccharides added to foods) or other added sugars from sources such as sugar-sweetened beverage (SSB) products through price and tax-based measures could be one important means of reducing this burden, as well as achieving other public health goals (Chan 2010; NICE 2012; WHO 2013). Such interventions may increasingly be warranted in many countries, given that the combined global prevalence of overweight and obesity has substantially increased over the last decades in low-, middle-, and high-income countries (1980 to 2013: + 27.5% adults; + 47.1% children) (Ng 2014). According to data for 2014 from the latest WHO reports, 39% (40% female; 38% male) of the worldwide adult population is overweight, defined as a body mass index (BMI) $\geq$ 25 kg/m². Furthermore, 15% of females and 11% of males of the global adult population are obese, defined as a BMI $\geq$ 30 kg/m². However, there are considerable between-country inequalities in the prevalence of obesity. Countries of the Pacific Islands are among those with the highest obesity prevalence globally. For example, in some of these countries more than half of all females are obese. In the USA, over one third of the general adult population is obese, whereas other populous countries like India and China currently have a relatively low obesity prevalence of less than 10%. In 2010, overweight and obesity accounted for an estimated 93.6 million disability-adjusted life years (DALYs) and 3.4 million deaths worldwide (WHO 2014).

Health conditions associated with obesity

Human metabolism, dietary intake and physical activity - all of which are influenced by social, economic, and built environments as well as genetic traits - play a vital and interrelated role in the aetiology of overweight and obesity. Furthermore, behavioural, environmental, economic and cultural factors can affect dietary intake and the level of physical activity (Goni 2015; MacLean 2015; Qi 2012; Weinsier 1998). The major physiological cause of overweight and obesity is an imbalanced energy intake resulting from a combination of the overconsumption of energy-dense foods, such as SSBs, disproportionate to the energy expended (e.g. due to lack of exercise or other physical activity) (Hall 2011; Hill 2006). The early onset of an abnormal share of body fat accumulation in childhood can adversely impact upon an individual's health in adulthood and predispose them to lifelong obesity (Juonala 2011). In general, overweight and obesity are considered to be major risk factors for several leading non-communicable diseases such as cardiovascular diseases (CVDs), type 2 diabetes, various cancers and osteoarthritis (Guh 2009). Overweight and obesity are also associated with severe psychiatric disorders (Simon 2006). In addition, in some countries, overweight and obesity may also contribute to loss of social capital as obese people are often socially stigmatised, and thus may lead to social exclusion (Puhl 2009). However, in other countries such as some Pacific Islands countries, overweight and obesity can be signifiers of high social status, and may thus be seen as socially desirable (Mavoa 2008).

Social inequality and economic burden of obesity

There are both between-country and within-country inequalities in overweight and obesity. With regard to between-country inequalities, morbidity and mortality rates associated with overweight and obesity are generally higher in middle- and high-income countries than in low-income countries (WHO 2009). With regards to within-country inequalities, the prevalence of overweight and obesity is highly influenced by aspects relevant to health disparities and the social determinants of health. These include both individual (e.g. socio-economic status (SES), age, gender, ethnicity, education, occupation) and contextual factors (e.g. food security, built environment including housing) (Drewnowski 2004; Ng 2014; Robroek 2013; Salois 2012; Valera 2015). Evidence from a recent review of studies in low-income countries shows a positive association between SES and obesity: obesity is more prevalent in higher SES groups (Dinsa 2012). In contrast, in middle- and high-income countries the relationship between SES and obesity is mixed or negatively associated: obesity is more prevalent in lower SES groups (Dinsa 2012; McLaren 2007; Ogden 2010; Wang 2012).

In economic terms, overweight and obesity have a serious impact on public health systems via direct (e.g. treatment costs) and indirect (e.g. reduced work productivity) costs (Van Nuys 2014). A recent review - with a majority of studies from high-income countries - reports a range of 0.7% to 2.8% of national healthcare expenditures being attributable to direct costs of obesity in the reported countries (Withrow 2011). A review, limited to studies from the USA, also took direct costs for overweight into consideration. Direct costs of overweight and obesity combined account for 5% to 10% of USA healthcare costs (Tsai 2011). In general, indirect costs - highly dependent on which indirect costs are included - can considerably exceed direct costs of overweight and obesity (Dee 2014).

Measurement of obesity

There is no internationally agreed gold standard for measuring overweight and obesity, as well as a measuring technique to predict the majority of obesity-related health risks (e.g. type 2 diabetes) (Kodama 2012). The BMI is based on a person's weight and height and is one of the surrogate measures most commonly used to estimate total body fat accumulation. However, this measure may produce misleading results, particularly amongst those with high muscle mass, some ethnic groups, and children (Javed 2015; Rahman 2010; Rothman 2008). Common surrogate measures for abdominal obesity specifically include waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR) (Ashwell 2012). In recent years, more advanced measurement techniques are used to determine the level of body fat more precisely, such as bioelectrical impedance analysis (BIA), magnetic resonance imaging (MRI), isotope dilution analysis (IDA), ultrasound, and computed tomography (CT) (Kodama 2012; Roubenoff 1995; WHO 2000).

SSBs and obesity

As stated above, the excessive intake of calories and insufficient physical activity are two of the main drivers for the rise in obesity globally. Furthermore, the availability and affordability of energy-dense foods and changes in eating patterns partly explain the increase in obesity and other health conditions (Drewnowski 2004; Sturm 2014). SSBs substantially contribute to total daily energy intake, especially in high-income countries, but also in middle-income countries (e.g. Mexico) (Bhaumik 2014; Lasater 2011; Stern 2014). As with other countries, added sugar intake of individuals in the USA - based on food sources such as SSBs - is above standard nutritional recommendations (Slining 2013). The most recent WHO guideline strongly recommends that sugar should not exceed 10% of the total energy intake per day. A daily intake of less than 5% - approximately 25 grams of sugar for an adult - might lead to even greater health benefits (WHO 2015). By way of comparison, one serving (330 mL) of a regular SSB contains up to 53 g of sugar (Action on Sugar 2014). Based on data from national and sub-national dietary surveys as well as data from the Food and Agriculture Organization of the United Nations (FAO), global average daily SSB consumption is estimated to be 137 mL (95% confidence interval (CI) 88 mL to 211 mL) for adults (Singh 2015a). Regarding socio-economic and regional patterns, the trend of SSB consumption over the past two decades is twofold: in North America - with high levels of SSB consumption and income - overall SSB demand declined and beverage products with no- or low-caloric sweeteners gained market share, whereas in low- and middle-income countries SSB sales and consumption increased, especially in Asian, Latin American, and African countries (Kit 2013; Popkin 2015; Singh 2015a; Slining 2013). In general, adolescents and young adults consume SSBs more frequently than younger children and older adults. In adulthood, SSB consumption declines with ageing (Han 2013; Singh 2015a). The disproportionate overconsumption of SSBs by children, who are often considered a particularly vulnerable population group, has been seen as providing an important justification for government intervention (Popkin 2015). However, interventions to prevent overweight and obesity throughout the life course should always consider both, children and adults (Lhachimi 2013). In contrast to several other food products (e.g. water, fruits, and vegetables) as recommended in dietary guidelines, SSBs are predominantly not considered to provide unique nutritional and health benefits for the general population in the long run (Colantuoni 2002; Keast 2015; Pan 2011; Poppitt 2015).

SSB intake as a risk factor

SSBs mainly consist of two components: (1) water and (2) added sugars (e.g. fructose, glucose, sucrose, and maltose). Moreover, companies add various other ingredients in small quantities (e.g. caffeine, citric or phosphoric acids, colour additives) to change the flavour or appearance, or for the effect of SSB products on the human metabolism (Walker 2014). Research on the association between intake of SSBs or their main ingredients and adverse health outcomes considers both physiological and psychological mechanisms. From a physiological perspective, this includes diseases and characteristics associated with metabolic syndrome (i.e. abdominal obesity, atherogenic dyslipidaemia, raised blood pressure, insulin resistance, glucose intolerance, prothrombotic state, and proinflammatory state), and dental caries (Bes-Rastrollo 2013; Hauner 2012; Malik 2010; Malik 2013; Sheiham 2014; Te Morenga 2013; Woodward-Lopez 2011). Adverse health outcomes may be supported by the unique characteristics of SSB consumption. In fact, lack of chewing, lack of satiety, endogenous opioid dependences based on sugar as well as caffeine dependences may result in positive feedback loops to consume even greater amounts of SSBs (Colantuoni 2002; Keast 2015; Pan 2011; Poppitt 2015). This also applies to exogenous effects such as ubiquitous SSB marketing by food companies in a competitive market as well as the availability of SSBs in general. Advertising to adults and children (e.g. sponsoring of sport events, television spots for children) to support a positive impression of a brand, together with product placements in stores may guide individual consumer choices. Moreover, parental attitudes to and practices regarding SSB consumption are likely to influence children's attitudes towards SSB consumption (Battram 2016; Wong 2015). Evidence from systematic reviews predominantly shows that excessive consumption of SSBs is linked with an increased risk of weight gain or obesity and associated diseases such as CVD and type 2 diabetes (Bes-Rastrollo 2013; Hauner 2012; Malik 2010; Malik 2013; Sheiham 2014; Te Morenga 2013; Woodward-Lopez 2011). Likewise, an analysis based on data from the Global Burden of Disease study 2010 estimated a total of 184,000 deaths from diabetes (72%), CVD (24%), and cancers (4%) per year and 8.5 million DALYs attributable to SSB consumption (Singh 2015b).

Description of the intervention

Interventions for preventing or reducing the prevalence of overweight or obesity

Preventive measures and treatments to tackle overweight and obesity differ in research fields and methodological characteristics (WHO 2000). Medical, educational or lifestyle-related interventions - in the long run - aim either to reduce energy intake or to increase energy expenditure to achieve weight reduction (Roqué i Figuls 2013; von Philipsborn 2016). In addition to interventions at the individual level, food policies such as restrictions (e.g. advertising of food), bans (e.g. banning unhealthy foods from cafeterias), food labelling (e.g. nutrition facts labels), and taxation (e.g. taxes on SSBs) are other options that may support the creation of healthy food environments and help prevent overweight, obesity, dental caries and other non-communicable diseases, particularly among children (Swinburn 2015). Despite limiting consumers' autonomy, policy options such as taxes on SSBs may help to reduce health inequalities in the general population by requiring less personal resources of the consumer (e.g. time, health literacy) to stimulate beneficial behaviour (Adams 2016).

Taxes on SSBs

Food-related fiscal policies may either aim to lower prices (e.g. subsidisation) or increase prices for specific goods (e.g. taxation). We will evaluate the effects of taxes imposed on SSBs. The Organisation for Economic Co-operation and Development (OECD) defines taxes as "compulsory, unrequited payments to general government" (OECD 2014). We will mainly consider two types of payments on products: (1) indirect taxes levied within national borders (e.g. excise tax, sales tax, or value added tax (VAT)), and (2) import taxes including custom duties and import sales taxes (Mytton 2012).

SSB taxes can be considered as Pigouvian taxes and will be evaluated as a fiscal policy in this review. Pigouvian taxes, as introduced by jurisdictions, are intended to correct inefficient allocations of goods in a market (market failure) and reduce costs for the society or a group of individuals that are not directly imposed to the tax (reduction of negative externalities) (Pigou 1932). In the case of SSBs, taxation on these goods aims to correct increased healthcare costs for society and lost productivity, induced by unbalanced diets provoked by the overconsumption of SSBs (Brownell 2009; Strnad 2004). Food taxes might change food consumption patterns as a consequence of changes in food prices (Chriqui 2013; Sassi 2014).

Taxation on SSBs is currently widely discussed in public and scientific research as an intervention to reduce overweight and obesity. However, these taxes can also be introduced with the main motivation to increase government revenue (Chriqui 2008; Maniadakis 2013). Various countries like France, Hungary, Mexico, Pacific Islands countries and territories and various states of the USA have already introduced taxes on SSBs (Ecorys 2014; Mytton 2012; Snowdon 2014). We summarise examples of implemented SSB taxes at national and regional level in Table 1.

The design of SSB taxes mainly varies with regard to three aspects:

1. the definition of which products are taxed as SSBs;
2. the basis for calculating taxation; and
3. the level of taxation (Mytton 2014; Powell 2009; Table 1).

Regarding the first aspect, some jurisdictions levy taxes only on soft drinks, whereas others include a wider spectrum of SSBs (e.g. sweetened fruit juice, sweetened milk) or their ingredients (e.g. instant powder or syrup for quick preparation) (Chriqui 2013). For this review, we define SSBs as non-alcoholic beverages that contain 'free sugars' (e.g. mono- and disaccharides) or other added sugars, such as sodas, fruit drinks, sport drinks, chocolate drinks, sweetened milk, and whey drinks. Moreover, we extend this definition by including ingredients for quick preparation, such as instant powder and syrup, for consumers used to make SSBs (Chriqui 2008; Chriqui 2014; Jou 2012; Mytton 2012; WHO 2015). In a second review conducted in tandem, we will focus on taxes for unprocessed sugar or sugar-added foods (Pfinder 2016).

In relation to the second aspect of the design of a SSB tax, the tax can be calculated based on volume, weight, specific item, or the origin of the product (e.g. it may be imposed only on imported SSBs) (Mytton 2012). We will consider all SSB taxes regardless of the basis for tax calculation.

The third aspect deals with different levels, i.e. rates or amounts, of SSB taxes, which can even be present within one country. In the USA, for example, soda sales taxes in food shops differ by state, ranging from 0% to 7%. Different baseline rates for pre-existing taxes on food, and political aims, can partly explain this variation that affects the relative price increase of SSBs and the capability to curb consumption (Chriqui 2013; Chriqui 2014; Jou 2012). Our review will consider all SSB taxes regardless of the tax level.

How the intervention might work

Understanding how changes in health might arise, as a consequence of food taxes, can be informed by economic theory - such as the expectation that consumer behaviour will change in response to price changes - and comparative evidence from other taxes on consumer goods with adverse health effects (e.g. taxes on tobacco or alcohol) (Chaloupka 2012; Nederkoorn 2011). For example, taxing tobacco has been proven to decrease overall consumption of tobacco at a population level (Cavazos-Rehg 2014; Chaloupka 2012). Although appropriate energy intake - based on sources like sugar - is crucial for the human metabolism, the consumption of SSBs is not necessarily required to maintain a healthy diet (WHO 2003).

Recent controlled field studies - studies that mimic SSB taxation in clearly defined environments - have shown that increased SSB prices have reduced sales of SSBs and in turn may have encouraged the purchase of food lower in energy (e.g. bottled water and non-sweetened tea). These studies are usually conducted in closed or simulated environments like cafeterias, supermarkets, or utilising vending machines within a particular compound (Block 2010; Epstein 2012; Wansink 2014; Waterlander 2014; Yang 2010).

Empirical evidence is becoming available, based on data from countries or states that have already implemented SSB taxes (Batis 2016; Beradi 2012; Colchero 2016; Kim 2006). This includes research on the association between the existence of state-level soft drink and other high-caloric food taxes, and the incidence of obesity (Kim 2006).

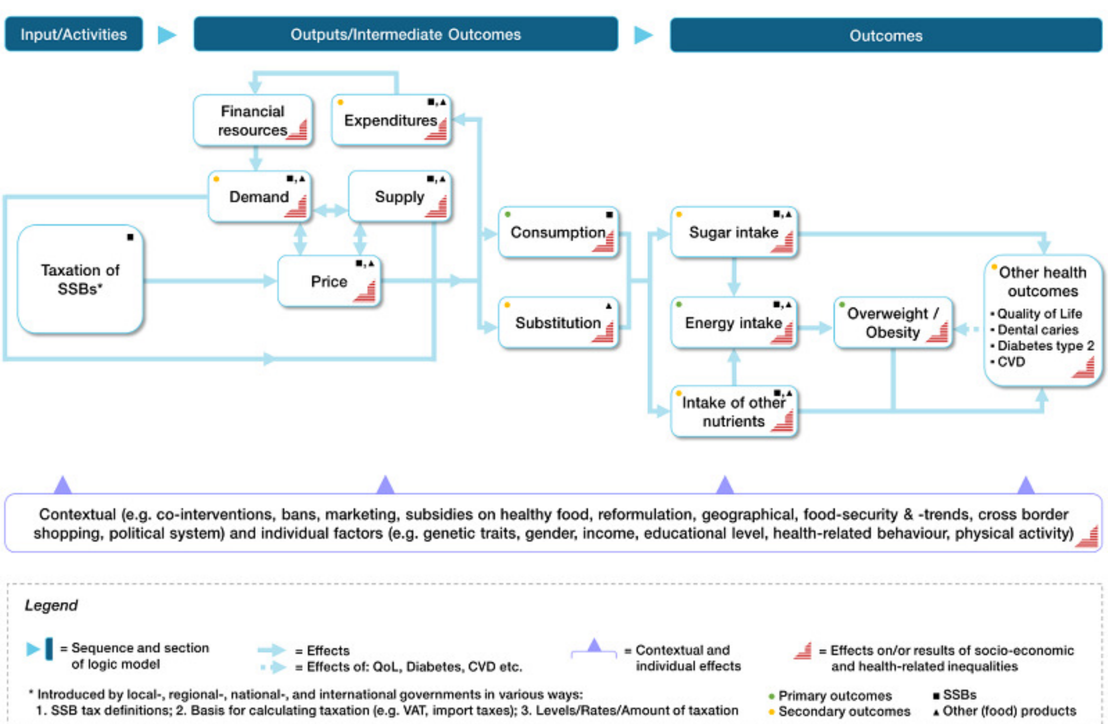
Beyond that, supply-side changes must be considered as well. SSB producers might respond to taxation in various ways (e.g. lowering prices by offering strategic price discounts). As a result, taxes might not be fully passed on to the consumer and this may limit the effectiveness of a tax in improving diets (Maniadakis 2013). In contrast, reformulation of food products as a reaction of producers to avoid taxation may lead to lower energy density of SSB products in general, especially with different tax rates that depend on the sugar content of beverages (Ecorys 2014). A change in demand for and substitution of SSBs by the consumption of more diet soda products could increase the impact on general health, and by substituting with drinking water could lead to even greater health benefits for the consumer (e.g. decrease in total energy intake, body weight reduction) (Laviada-Molina 2016; Zheng 2015). Often, subsidisation of healthy foods (e.g. raw vegetables and fruits) financed by revenue gained by taxing unhealthy food is discussed. However, simultaneous subsidisation of healthy food and taxation of unhealthy food might not substantially change consumption patterns due to no change in total expenditure on food and total energy intake (Maniadakis 2013).

VATs tend to be regressive in economic terms; thus, low-income groups have to spend more of their income-share than high-income groups to purchase taxed food items. This could cause an increase in economic inequality (Brownell 2009; Fletcher 2010; Sassi 2014). Despite this, people from lower-income groups are generally more likely to experience greater health benefits due to their greater health burden and their higher price sensitivity, leading to lower consumption (Eyles 2012; Maniadakis 2013). If SSB taxes were ineffective in lowering consumption of SSBs, then in relative terms SSB taxes would risk the disposable income of people with lower income more than the disposable income of people with higher income. This could lead, in turn, to adverse health effects (i.e. intervention-generated health inequalities) (Lorenc 2013).

Logic model

To conceptualise our research focus on SSB taxation, we developed a logic model with causal pathways for the relationship between SSB taxation and obesity as well as other health outcomes (Anderson 2011a). Figure 1 outlines the underlying issues and assumed causal pathways for this review. We will discuss these pathways in turn. SSB taxation - introduced by local, regional, national, or international governments - is likely to alter the prices of SSBs (Epstein 2012; Jensen 2013; Maniadakis 2013). In market economies, prices of traded goods are influenced by demand and supply (Bonnet 2013). Amongst other factors, the financial resources of individuals (e.g. income) - influenced by individual expenditure on food and other products - determine the demand for food products. These market components might affect consumer purchases and consumption choices of different food categories, including SSBs (Briggs 2013; Sharma 2014). For instance, consumers may substitute taxed food items - in this particular case, SSBs - by purchasing other (food) products (Fowler 2015; Yang 2010). As a consequence, shifts of consumption and substitution patterns result in changes of sugar intake, as well as the intake of other nutrients (Epstein 2012; Laviada-Molina 2016; Maniadakis 2013).

Figure 1. Logic/Causal-Pathway Model of SSB taxation



We will review health outcomes directly or indirectly influenced by changes in consumption as a result of SSB taxation. First, excessive sugar intake is directly associated with various diseases such as dental caries (Moynihan 2014; WHO 2015). Second, sugar intake and other sources of energy (e.g. fat, protein) jointly contribute to the general energy intake. Hence, overconsumption of either sugar or other energy-dense nutrients can support imbalanced energy intake, resulting in higher risks of becoming overweight or obese (Kim 2006; Malik 2013). Overweight and obesity in turn can be a risk factor for other unfavourable health outcomes (e.g. type 2 diabetes, CVD) (Guh 2009). Although SSB consumption seems to have no direct link to health-related quality of life (HRQoL), obesity is known to be associated with lower HRQoL (Jia 2005; Lana 2015; Ul-Haq 2013). The intake of non-caloric nutrients - in particular essential vitamins (e.g. vitamin D) and dietary minerals (e.g. sodium) - can also be affected by changes in consumption and substitution patterns. Therefore, an unbalanced diet that is deficient in non-caloric nutrients has the potential to negatively impact health outcomes as well (Marriott 2010).

Contextual and individual factors may influence the processes from the input to the outcomes, alter effect sizes and help us understand causal relationships (Qi 2012). Effects of competing and complementary interventions (e.g. product bans and marketing restrictions) - possible comparators in this review - and other SSB-related activities by governments, community, and the food industry might overlap with the effects of SSB taxation (Jou 2012; Thow 2011). Individual factors (e.g. gender, education) are of utmost importance to identify equity issues (Anderson 2011b; Figure 1).

Why it is important to do this review

The primary motivation for taxing SSBs is to decrease the intake of these beverages in the general population, with the aim of ultimately improving health outcomes. Various Cochrane reviews related to overweight and obesity already exist. These mainly focus on medical, educational, and lifestyle-related interventions with regard to individuals or at-risk groups (Roqué i Figuls 2013). There is no Cochrane review summarising the effects of food-related fiscal measures at present.

Existing systematic reviews on SSB taxation have predominantly synthesised evidence from simulation studies or simulation studies mixed with empirical studies, and predict improvements in diet; i.e. reduced consumption and energy intake from SSBs (Brambila-Macias 2011; Eyles 2012; Maniadakis 2013; Niebylski 2015; Powell 2013; Thow 2014). For example, results of included studies of one review demonstrate a proportional relationship between the applied tax level and the decrease in consumption. The review reports a range of tax levels from 10% to 20% where effects on targeted food consumption are consistent (Thow 2014). Even so, evidence from simulation studies has various methodological limitations. For example, pass-on rates to the consumers must be based upon predictions, supply-side changes cannot be fully captured, and health outcomes are mostly based on static weight change models (Lin 2011; Shemilt 2015).

However, the complex interactions of consumption patterns in response to price changes result in opaque health effects for real implementation (Faulkner 2011). A review of experimental studies on food price changes suggests that a decrease in consumption of SSBs could be substituted by equally or even more unhealthy foods or behaviours (Epstein 2012). Therefore, the discussion and evaluation of current and future implementation of SSB taxes should be based on evidence from empirical primary studies on the effects on health and not only on sales or consumption (Bhaumik 2014; Cornelsen 2013; Mytton 2012). Given that obesity remains a major global health challenge and SSBs account for a considerable share of total daily energy intake, especially for children, a Cochrane review on the effects of SSB taxation is important (Bhaumik 2014).

This research will be part of a set of reviews on different types of food taxes carried out by the same author group using a similar methodological approach. For reasons of comparability, the methodological content is similar across the three reviews. Our three reviews will focus on the effects of governmental taxation of: (1) SSBs, (2) unprocessed sugar or sugar-added foods (Pfinder 2016), and (3) the fat content of foods (Lhachimi 2016).

OBJECTIVES

To assess the effects of taxation of sugar-sweetened beverages (SSBs) on SSB consumption, energy intake, overweight, obesity, and other adverse health outcomes in the general population.

METHODS

Criteria for considering studies for this review

Types of studies

Pre-screening of studies evaluating implemented SSB taxation revealed heterogeneous study designs and inherent limitations. Besides small field studies, individual and cluster randomisation are probably impossible for evaluations of SSB interventions at the national level (Wansink 2014). Meanwhile, methodological limitations inevitably derive from the lack of blinding of participants and study personnel for the major intervention component - changes in prices of SSB products (Block 2010).

We will therefore consider evidence from various study designs and adopt a similar approach previously used in at least two other Cochrane reviews to summarise 'best available evidence' (Gruen 2004; Turley 2013). This approach clearly separates studies into two broad categories: (1) studies meeting rigorous Cochrane Effectice Practice and Organisation of Care (EPOC) criteria, and (2) supporting studies - those not meeting EPOC criteria with greater risk of bias.

First, for the synthesis of main results, in line with EPOC criteria we will include:

- randomised controlled trials (RCTs);
- cluster randomised controlled trials (cRCTs);
- non-randomised controlled trials (nRCTs);
- controlled before-after (CBA) studies; and
- interrupted time series (ITS) studies.

According to EPOC, controlled studies require more than one intervention or control site and ITS studies require a clearly defined intervention time and at least three data points before and three after the intervention (EPOC 2013).

There will be no restriction by publication date and language, but only studies focusing on human populations will be included (CPH 2011).

We will have no restriction in terms of study duration. Closed field experiments suggest consumer behaviour adaptations expressed as SSBs sales occur within a short time frame; substantial effects become apparent even in one month (Block 2010). Implementation of SSB taxes at a national level might feature a longer time lag between intervention and outcomes, especially for health outcomes. In contrast, after one year of the SSB tax in Mexico, purchases of taxed SSBs as an important intermediate outcome already dropped on average by about 6% (Popkin 2015). In general, field experiments on SSBs recruit small numbers of participants. Nevertheless, they are a valuable source to identify important outcome pathways and effects on food patterns relevant to SSB taxation (Epstein 2012).

We will exclude simulation studies, due to their potential limitations provoked by their basic assumptions (e.g. lack of potential supply-side changes, static models to predict weight loss), and other methodological restrictions (e.g. the use of a combination of heterogeneous data sources) (Lin 2011; Shemilt 2015).

Supporting studies

We will include as supporting studies:

- studies using an RCT, cRCT, nRCT, CBA or ITS design but not fulfilling the EPOC criteria (hence, not included in the main results as outlined above);
- prospective cohort studies;
- retrospective or non-concurrent cohort studies;
- repeated cross-sectional studies; and
- uncontrolled before-after (UBA) studies.

Those studies classified as 'supporting studies' will not be included in the statistical synthesis of the primary included studies (i.e. those meeting EPOC criteria) but will be synthesised narratively in addition to the main findings. We will extract the same type of data from these supporting studies as from the included studies and will document these in a separate 'Characteristics of supporting studies' table. We will carry out 'Risk of bias' assessments on these studies, and undertake quality assessment, utilising the GRADE approach, and present the findings from these supporting studies separately, as supplemental information in the results section and in separate 'Summary of findings' tables. Observations of similarities and/or differences of findings from the included studies and the supporting studies will be made in the 'Discussion' section, to help summarise the breadth, quality and the findings of the totality of research on the effects of these interventions.

These studies may support or challenge results in the main findings and highlight uncertainty and potential research gaps. We will consider known limitations of UBA, cohort, and repeated cross-sectional studies, especially confounding and/or time trends, in assessing these studies for inclusion. If UBA, cohort, and repeated cross-sectional studies are likely to be biased and do not use appropriate analytic strategies (e.g. stratification) or other designs (e.g. regression discontinuity) to control for known confounders and/or time trends, we will consider excluding these studies from the 'supporting studies' category of the review.

Types of participants

We will include studies irrespective of participants' gender and age (children: 0 to 17 years, and adults: 18 years and over) from any country and setting.

We will exclude studies investigating the effects of taxing SSBs focusing on specific subgroups that have higher or lower health risks at baseline or post-intervention phase compared to the general population, particularly:

- people receiving a pharmaceutical intervention;
- people undergoing a surgical intervention;
- pregnant females;
- professional athletes;
- ill people who are overweight or obese as a side-effect of their treatment or condition, such as those with thyroiditis and depression; and
- people with chronic illness(es).

Types of interventions

This review will include studies that evaluate the effects of SSB taxation. We will examine studies with taxed beverages that contain added caloric sweeteners or ingredients for quick preparation that are used by consumers to make SSBs. A SSB tax can variously be described as sales tax, excise, special VAT, custom duties or import tax on the final product sold to the consumer (Chriqui 2008; Chriqui 2013; Jou 2012; Mytton 2012). We will include interventional studies on SSB taxation of any taxation level, provided for any duration, and studies that evaluate effects of artificial price increases of SSBs that mimic SSB taxation in clearly-defined environments (e.g. cafeterias, supermarkets, and vending machines) (Epstein 2012). Interventions can be at the local, regional, national, and international levels or field scenarios that imitate taxation effects. We will include studies with any control intervention, such as no intervention, as well as other food taxes, bans, minimum pricing, media campaigns, or subsidies on healthy foods (Jou 2012; Thow 2011).

Types of outcome measures

Our outcome selection and grouping was guided by preliminary evidence as discussed in the Background section, on the basis of the logic model and after feedback from the review advisory board members (email and online survey) (How the intervention might work; Table 2). All pre-selected outcomes achieved 'critical' or 'important' ratings on average, following the GRADE approach (GRADE 2013). For primary outcomes we favoured outcomes of critical importance in line with our review scope and objective (Table 3). Detailed information on advisory group involvement is provided under the subheading 'Advisory group' in the section Searching other resources.

Primary outcomes include intermediate outcomes (SSB consumption and energy intake) which are directly affected by tax-induced changes in SSB prices that are on the pathway to health harms. These outcomes may directly alter the primary health outcomes: overweight and obesity. Secondary outcomes will focus on food patterns (substitution and diet), expenditures, and other health outcomes directly or indirectly influenced by SSB taxation. We include demand as a proxy for SSB consumption (see How the intervention might work).

Primary outcomes

The review will include changes from baseline to post-intervention, in the following primary outcomes:

SSB consumption

- consumption of SSBs (e.g. frequency, amount)

Energy intake

- energy intake through SSBs
- total energy consumption

Overweight and obesity

- incidence of overweight and obesity
- prevalence of overweight and obesity

All primary outcomes can be measured by physicians and other professionals or self-reported. Overweight and obesity can be measured by different anthropometric body mass indices (e.g. body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), bioelectrical impedance analysis (BIA), magnetic resonance imaging (MRI), isotope dilution analysis (IDA), computed tomography (CT), etc.). We will report changes in body mass indices if no data are available on the incidence or prevalence of overweight and obesity.

Secondary outcomes

The review will include changes from baseline to post-intervention in the following secondary outcomes:

Substitution and diet

- composition of diet (expressed as food groups or ingredients, e.g. fat, sugar, salt)

Expenditures

- total expenditures on food
- total expenditures on SSBs

Demand

- total sales of SSBs

Other health outcomes

- health-related quality of life (e.g. Short Form 36 (SF-36), Health-Related Quality of Life (HRQOL-14))
- mortality
- any other health outcomes or health-related unintended consequences (e.g. dental caries, type 2 diabetes, cardiovascular diseases, etc.)

All secondary outcomes can be measured by physicians and other professionals or self-reported.

Search methods for identification of studies

Electronic searches

We will search the following 12 bibliographic databases:

- Cochrane Central Register of Controlled Trials (CENTRAL) via Cochrane Library (1948 to present)
- Cochrane Database of Systematic Reviews (CDSR) via Cochrane Library (1995 to present)
- Medical Literature Analysis and Retrieval System Online (MEDLINE) via OvidSP (1946 to present)
- Excerpta Medica database (Embase) via OvidSP (1947 to present)
- PsycINFO via OvidSP (1887 to present)
- Current Contents Medicine Database of German and German-Language Journals (CC MED) via LIVIVO (2000 to present)

- Latin American and Caribbean Health Science Information database (LILACS) via BIREME/VHL (1982 to present)
- EconLit via EBSCO (1969 to present)
- Campbell Library via Campbell Collaboration (2004 to present)
- Food Science and Technology Abstracts (FSTA) via OvidSP (1969 to present)
- Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCO (1937 to present)
- Web of Science (SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC) via Thomson Reuters (1900 to present)

We will apply a search strategy with additional keywords for possible comparators (e.g. "subsidy") and we will not use filters for study types, in order to maximise the sensitivity of the literature search (Higgins 2011a, chapter 6.4.4). The search strategy for the MEDLINE database is presented in Appendix 1. We will modify this strategy to fit the syntax of the other databases. We will not include African Index Medicus (AIM) - a valuable resource for literature from low- and middle-income countries (LMICs) - in our review as a sensitive preliminary search with intervention key words (e.g. tax, taxation etc.) resulted in no hits.

Searching other resources

We will search the following six electronic grey literature databases:

- ProQuest Dissertations & Theses Database (PQDT) via ProQuest
- System for Information on Grey Literature in Europe (OpenGrey) via INIST/CNRS
- The Directory of Open Access Repositories (OpenDOAR) via CRC
- EconPapers via ORU
- Social Science Research Network (SSRN eLibrary) via SSRN
- National Bureau of Economic Research (NBER) via NBER

We will search the following two databases to identify completed or ongoing studies:

- WHO's International Clinical Trials Registry Platform (WHO ICTRP) (www.who.int/ictrp)
- Trials Register of Promoting Health Interventions (TRoPHI) (eppi.ioe.ac.uk)

Internet search engines

The first 30 hits in Google Scholar will be screened. We will use a set of terms from our searches of the academic and grey literature databases.

Targeted internet searching of key organisational websites

We will search websites of major organisations and institutions, specifically:

- World Obesity Federation (www.worldobesity.org)
- The Obesity Society (TOS) (www.obesity.org)
- The Organisation for Economic Co-operation and Development (OECD) (www.oecd.org)
- World Health Organization (WHO) (www.who.int)
- European Commission (EC) (ec.europa.eu/index˙en.htm)
- Directorate-General for Health and Food Safety (DG SANTE) (ec.europa.eu/dgs/health˙food-safety/index˙en.htm)
- Centers for Disease Control and Prevention (CDC) (www.cdc.gov)
- National Institute for Health and Care Excellence (NICE) (www.nice.org.uk)
- World Trade Organization (WTO) (www.wto.org)
- World Cancer Research Fund Institute (www.wcrf.org)

Searching other resources

The reference lists of all records of all included studies will be searched by hand.

Advisory group

We have established a review advisory group of experts in the field of food taxation and health to comment and provide advice and suggestions to inform this review at protocol and review stages. Following the GRADE approach, the advisory group members participated in an online survey and ranked pre-selected outcomes according to their relative importance on a 9-point Likert scale (categories: 1 to 3 - of limited importance; 4 to 6 - important; 7 to 9 - critical) (GRADE 2013).The review advisory group consists of policy makers, researchers, and academics.

We provided the members of the review advisory group with detailed background information on this review. At the protocol stage, the group members were asked to provide feedback specifically on the focus and the relevance of this review's question, selected endpoints, study design, search strategy, database selection, and ongoing or unpublished studies (Higgins 2011a, chapter 2.3.4.3). We received feedback via email and the online survey. All members of the advisory group and results from the online survey are listed in tables (Table 2; Table 3).

Data collection and analysis

Selection of studies

An information specialist will conduct the database searches. If a reference or a full-text paper is not written in English, German, or French, the relevant content will be translated to English by using internet-based translators or we will ask for a translated version by contacting native speakers (e.g. colleagues from cooperating research institutes) or the corresponding author of the article. Screening will be conducted in six stages. First, titles of studies, and abstracts if available, will be reviewed by at least two authors independently. If an abstract is not provided by the database it originates from, and the title appears to be potentially relevant, we will progress the record to full-text review stage. Second, both authors will compare their list of relevant studies and in case of any disagreement they will seek the opinion of a third author to achieve consensus. Third, full-text versions of potentially relevant studies will be retrieved or obtained. Fourth, the full-text versions will be screened by the two review authors independently. Fifth, each author will create a list of the studies that are considered to fulfil the inclusion criteria. Sixth, the two authors will compare their list with each other and in case of any disagreement the opinion of a third author will be decisive. Based on these six steps, studies will be selected for inclusion in the review (Higgins 2011a, chapter 7). We will present a flow chart based on PRISMA to depict the selection process (Moher 2009).

Data extraction and management

Data extraction will be performed independently by at least two authors and both authors will compare the extracted data. Disagreements will be resolved by a third author (Higgins 2011a, chapter 7.6.2). We will use a modified data extraction and assessment template from Cochrane Public Health (CPH) (CPH 2011). Prior to the main data extraction process, the authors will pilot the data extraction form to ensure standardised extraction. We will extract general information (publication type, country of study, funding source for study, potential conflict of interest), study eligibility (type of study, participants, type of intervention, duration of intervention, and type of outcome measures), study details (study aim, methods, results, intervention group, confounders, and confounder-adjusted and unadjusted outcomes), indicators of changes in food prices (price of SSBs, price of other food product categories), and other relevant information (CPH 2011). Effect estimates for study populations based on PROGRESS categories (place of residence, race/ethnicity/culture/language, occupation, gender/sex, religion, education, socio-economic status (SES), social capital) will be extracted to evaluate impacts on equity. We will also extract other contextual factors (political system, co-interventions, reason for implementation, reason for certain tax level, intended beneficiaries, implementation costs, country- and region-specific level of gross domestic product (GDP), food security (availability, access, and use) and process evaluation criteria (e.g. satisfaction of participants, adherence)) that facilitate or hinder the implementation of SSB taxation (Anderson 2011b). Data will be entered into Review Manager 5 (RevMan 2014) by one author. A second author will double-check the data entered.

Assessment of risk of bias in included studies

The risk of bias of every included study will be evaluated independently by at least two authors. In case of any disagreement, discrepancies will be discussed with a third author and resolved by consensus. Based on the template provided by CPH, the risk of bias will be assessed using the criteria for judging risk of bias in Cochrane's 'Risk of bias' assessment tool and the Cochrane Effective Practice and Organisation of Care (EPOC) Group's guidance (CPH 2011). Both tools examine the following biases: selection, performance, detection, attrition, reporting, and other (EPOC 2009; Higgins 2011b). For interrupted time series (ITS) the EPOC 'Risk of bias' tool examines three further risks of bias: "Was the intervention independent of other changes?", "Was the shape of the intervention effect pre-specified?", and "Was the intervention unlikely to affect data collection?" (EPOC 2009). For studies included in the main analysis (i.e. RCTs, cRCTs, nRCTs, CBA, and ITS) we will assess the risk of bias using the 'Risk of bias' criteria for EPOC reviews, based on the Cochrane Collaboration's tool for assessing risk of bias (Higgins 2011a, Table 8.5.a).

Risk of bias of 'supporting studies' (i.e. studies not fulfilling EPOC criteria, cohort studies, repeated cross-sectional studies, UBA) will be assessed with the Quality Assessment Tool for Quantitative Studies, developed by the Effective Public Health Practice Project (EPHPP) (EPHPP 2010).

To judge the risk of bias according to Cochrane's 'Risk of bias' assessment tool, we will use the following categories: "low", "high", and "unclear" (e.g. information is lacking or the risk of bias is unclear) (Higgins 2011a, chapter 8.6). To judge the risk of bias according to the Quality Assessment Tool for Quantitative Studies, we will use the following three categories: "strong", "moderate", and "weak" (EPHPP 2010). We will provide 'Risk of bias' tables for all included studies.

Measures of treatment effect

Data synthesis aims to combine outcome data. We will report the effects of the treatment on dichotomous outcomes as odds ratios (ORs), risk ratios (RRs) or risk differences (RDs). In accordance with the recommendations from CPH, RRs will be the preferred reported measure of treatment effect (CPH 2011). If RRs are not presented in the study, but data to calculate the RRs are provided, we will calculate them. This also applies for data suitable to calculate ORs (e.g. obesity prevalence). If data to calculate the RRs are not provided, we will contact the corresponding author of the study, by email or phone, to request the RRs or the data to calculate the RRs. If we cannot obtain RRs, we will report the treatment effect from the study report.

We will express continuous data as mean differences (MDs) where applicable or as standardised mean differences (SMDs). Shorter ordinal data will be translated into dichotomous data (expressed as ORs, RRs or RDs) and longer ordinal data will be treated as continuous data (expressed as MDs or SMDs). It is unclear whether there is a cut-off point that is common across the studies and can be used for dichotomisation (Higgins 2011a, chapter 7). The cut-off point will be part of the sensitivity analysis. We will express count data and Poisson data as rate ratios. Time-to-event data (survival data) will be translated into dichotomous data when appropriate, or into hazard ratios (HRs).

If feasible, we will report the adjusted treatment effect. If a study does not present adjusted treatment effect measures, we aim to adjust the treatment effect measures for baseline variables by conducting additional multivariate analyses as far as we have access to the data or by contacting the corresponding author of the study for the adjusted treatment effect measures by email or phone. If studies present intention-to-treat effect estimates, then we will prioritise these over average causal treatment effect estimates (Higgins 2011a, chapter 9).

When the treatment effect is described in cost estimates as derived from economic studies, we will convert the cost estimates to US dollars (USD) and the price year 2015 to compare cost estimates from different studies with each other. To convert cost estimates into USD, we will apply an international exchange rate based on Purchasing Power Parities (PPPs). To convert cost estimates to the year 2015, we will apply GDP deflators or implicit price deflators for GDP. PPP conversion rates and GDP deflator values will be derived from the International Monetary Fund in the World Economic Outlook Database (http://www.imf.org/external/data.htm) (Higgins 2011a, chapter 15).

Unit of analysis issues

We will collect data on studies irrespective of whether individuals or groups are allocated to an intervention or control group. The analysis will consider the level at which the allocation occurred, e.g. cluster randomised trials, cross-over trials, and multiple observations (repeated observations on subjects, recurring events, multiple body parts, and multiple intervention groups) for the same outcome (Higgins 2011a, chapter 9.3.1). Limited by the quality of reported data, we will consider data from cross-over trials (e.g. by incorporating the study data similar to a parallel group trial) and studies with multiple observations (e.g. by defining different periods of follow-up) (Higgins 2011a, chapter 9.3.4; chapter 16.4.5).

If control for clustering is missing or insufficient and individual-level data are not presented in the study, we will request individual-level data from the contact study author. If feasible, we will reduce the size of each trial to its 'effective sample size' in order to correct intervention effects of cluster randomised trials. The effective sample size of an intervention group is the original sample size divided by the 'design effect'. We will calculate the design effect by the formula 1 + (M - 1) ICC. M is the average cluster size and ICC is the intracluster correlation coefficient (Higgins 2011a, chapter 16.3.4).

For dichotomous data the total number of participants and the number of participants who experience the event will be divided by the same design effect. For continuous data, only the sample size will be reduced; means and standard deviations will remain unchanged (Higgins 2011a, chapter 16.3.4).

Dealing with missing data

We will request all missing information and data from principal study authors by email or phone. The following steps will be taken to deal with relevant missing data:

- contact the authors;
- screen the study and investigate important numerical data such as randomised individuals as well as intention-to-treat (ITT), as-treated and per-protocol (PP) populations;
- investigate attrition rates as part of the risk of bias assessment in terms of dropouts, losses to follow-up and withdrawals;
- critically appraise issues of missing data and imputation methods (e.g. last observation carried forward (LOCF));
- impute missing standard deviations if contacted authors do not respond (Higgins 2011a, chapter 16.1); and
- apply sensitivity analyses to estimate the impact of imputation on meta-analyses.

Data 'not missing at random' due to systematic loss to follow-up or systematic exclusion of individuals from studies will be sought and requested from study authors (Higgins 2011a, chapter 16.1.2).

Assessment of heterogeneity

In the event of substantial heterogeneity (methodological heterogeneity, statistical heterogeneity or considerable differences in the type of study populations, interventions, comparisons, and outcomes (PICO heterogeneity)), we will not perform meta-analysis. Statistical heterogeneity will be detected through visual inspection of the forest plots and by using a standard Chi^2 test with a significance level of $P < 0.1$. The I^2 statistic will be applied to quantify inconsistency across studies and to assess the impact of heterogeneity on the meta-analysis. Potential reasons for heterogeneity will be examined by conducting theoretically-informed subgroup analyses (Higgins 2011a, chapter 9.5).

Methodological and PICO heterogeneity will be assessed through tabulation and seeking explanations for heterogeneity between study findings. We will consider potential sources of heterogeneity such as:

- study population;
- intervention area/setting;
- intervention characteristics (tax definition, basis for calculating taxation, level of taxation);
- implementation level and duration;
- comparisons;
- co-interventions; and
- outcomes.

Assessment of reporting biases

Reporting biases, including publication bias, time lag bias, multiple (duplicate) publication bias, location bias, citation bias, language bias, and outcome reporting bias, occur when the dissemination of research results depends on their magnitude and direction (Higgins 2011a, chapter 10). If we find ten or more studies reporting the same outcome, we will produce and assess funnel plots for study effects resulting from reporting biases. When testing asymmetry in funnel plots (small study effects), we will investigate whether the relationship between a measure of study size and the estimated intervention effect is asymmetrical (Higgins 2011a, chapter 10.4). Funnel plots will be drawn using Review Manager 5 (RevMan 2014).

Data synthesis

If two or more studies report the same outcome and are sufficiently homogenous conceptually, methodologically, and statistically, we will perform meta-analyses of these studies using Review Manager 5 (RevMan 2014). For dichotomous outcomes we will apply the Mantel-Haenszel method and for continuous outcomes we will apply the inverse variance method. For all analyses, the random-effects method will be applied as we expect differences in the underlying effect sizes due to contextual and implementation differences (Higgins 2011a, chapter 9.5.4). If a study reports two or more measures for the same outcome, then we will report the measure that is most frequently reported by the other included studies. If a study reports multiple follow-ups for the same outcome (e.g. six months during the intervention, one year during the intervention, and six months after the intervention), we will prioritise the longest follow-up during the intervention (e.g. one year during the intervention in the example given). Nevertheless, we will extract all follow-up data.

Study results with insufficient homogeneity will be narratively synthesised. First, we will structure narrative synthesis by outcome categories of this review. Second, within these categories we will make further separation according to intervention setting (i.e. field scenarios, evaluation of implemented SSB taxes) and study design (e.g. RCT, cRCT, nRCT, CBA, and ITS etc.) or study quality (Ryan 2016). In addition to reporting findings as text and tables, we may consider both harvest plots and effect direction plots to summarise data not suitable for meta-analyses. Harvest plots are graphical summaries of data, represented by multiple shaded or non-shaded bars with varying heights. They can be used to indicate effect directions across included studies with non-standardised effect estimates of outcomes (e.g. anthropometric measures). Similarly, effect direction plots can be used to depict information on effect directions with a stronger focus on direct comparisons across studies (Ogilvie 2008; Thomson 2013).

We will provide a 'Summary of findings' table containing the outcomes of greatest interest for decision makers. Therefore, we will include at least the following outcomes: consumption of SSBs, energy intake from SSBs, total energy intake, prevalence of overweight or obesity, and total sales of SSBs. This pre-selected list is based on feedback from our advisory group and external reviewers. This table will include information on the outcomes, comparative risks, the relative effect, the number of participants, the number of studies included, the quality of evidence based on GRADE, and additional comments. If feasible, we will use the computer software GRADEpro to prepare the 'Summary of findings' table (GRADEpro GDT; Higgins 2011a, chapter 11).

Results of data synthesis will also be mapped against our initial logic model, to refine the theory of change and to assess the credibility of the assumed causal pathways.

Subgroup analysis and investigation of heterogeneity

We will conduct meta-analyses and harvest-plots for studies assessing the following subgroups for primary outcomes, where feasible:

- high-income countries versus middle- and low-income countries;
- high-income groups versus middle- and low-income groups;
- high-educated groups versus low-educated groups;
- different levels of SSB taxes;
- single tax on SSBs versus multiple taxes on SSBs;
- tax on SSBs alone versus tax on SSBs accompanied by other fat taxes or interventions (e.g. bans, minimum pricing, media campaigns, or subsidies of healthy foods);
- different types of taxation: (1) indirect taxes levied within national borders (e.g. excise, sales tax, or VAT), and (2) import taxes including custom duties and import sales taxes;
- children versus adults; and
- BMI subgroups.

If data are available, we will perform subgroup analyses according to dimensions of disadvantage based on PROGRESS categories (e.g. place of residence, gender, education) (Anderson 2011b). If feasible, we will investigate the statistical significance of differences in the treatment effect between subgroups using t-tests and Chi^2 tests (Higgins 2011a, chapter 9.6.2).

Sensitivity analysis

Sensitivity analyses will be performed to determine the robustness of our results by conducting separate meta-analyses and harvest plots for the studies included in our review:

- with studies considered as being at 'low risk of bias' compared to those considered as being at 'high risk of bias';
- with respect to the source of funding;
- with published studies compared to unpublished studies;
- with respect to the intervention duration;
- with respect to the follow-up time;
- with objective measures compared to subjective measures;
- with respect to study design;

- with respect to cut-off points of the measures of the treatment effect; and
- with respect to imputation of data.

Studies assessed with a high or unclear risk of bias with respect to incomplete outcome data and baseline differences will not be included in these analyses. For cRCTs with adequate data provided, we will perform intra-cluster correlation value sensitivity analysis. We will report findings of sensitivity analyses as a summary table (Higgins 2011a, chapter 9.7).

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* *Indicates the major publication for the study*

ADDITIONAL TABLES

Table 1. Examples of implemented SSB taxes

Country	Year of implementation (Year of last modification/information)	Description of tax	References
American Samoa	1963 (n/a)	**General description:** Import duty and excise tax on carbonated beverages **Tax rate:** USD 0.15 per 12 fluid ounces or fraction thereof **Taxed SSB products:** Soft drinks, non-alcoholic carbonated beverages, and syrups for SSB preparation **Notable exemptions:** n/a	(American Samoa Bar Association 2015)
Australia	2000 (2012)	**General description:** Goods and services tax (GST) on various (food-)products (SSBs, bakery products, ice cream etc.) and other services **Tax rate:** 10% on goods consumed in Australia **Taxed SSB products:** Soft drinks and flavoured milk (e.g. chocolate milk) **Notable exemptions:** Fruit juices (at least containing 90% by volume of juice), bottled drinking water, tea or cof-	(Australian Taxation Office 2012)

Table 1. Examples of implemented SSB taxes *(Continued)*

		fee (non-'ready to drink'), and milk	
Barbados	2015 (2015)	**General description:** Excise tax on sweetened beverages; prior to application of VAT **Tax rate:** 10%; results in an after-VAT price increase of 11.75% for imported and locally produced drinks **Taxed SSB products:** Carbonated soft drinks, sports drinks, and sweetened juices **Notable exemptions:** Fruit juices (containing 100% natural sugars), coconut water, and milk	(Ernst & Young 2015)
Bangladesh	2014 (2014)	**General description:** Supplementary duty on soft drinks levied at manufacturing stage **Tax rate:** 25% **Taxed SSB products:** Soft drinks; energy drinks **Notable exemptions:** n/a	(National Board of Revenue Bangladesh 2014)
Chile	2015 (2015)	**General description:** Ad valorem tax on soft drinks **Tax rate:** 18% on soft drinks high-in-sugar; 10% on flavoured water, sport drinks etc. with lower sugar content **Taxed SSB products:** Highest tax rate on soft drink products with high sugar content (sugar content > 15 grams per 240 ml; 6.25 grams per 100 ml); lower tax rates on flavoured water, and sport drinks etc. with lower sugar content **Notable exemptions:** n/a	(Servicio de Impuestos Internos Chile 2014)

Table 1. Examples of implemented SSB taxes *(Continued)*

Cook Islands	n/a (2014)	**General description:** Tax on sugar-added drinks **Tax rate:** NZD 9.80 per kg of sugar in soft drinks **Taxed SSB products:** Beverages containing added sugar or other sweetening matter or flavoured **Notable exemptions:** Non-sugar-added waters, including natural or artificial mineral waters	(McDonald 2015)
Denmark	1930s (2014: removed)	**General description:** Excise tax on soft drinks **Tax rate:** DKK 1.64 per litre on SSBs **Taxed SSB products:** Soft drinks **Notable exemptions:** n/a	(Scott-Thomas 2013)
Dominica	2015 (2015)	**General description:** Excise tax on soft drinks and energy drinks **Tax rate:** XCD 0.20 per litre on soft drinks; 10% on energy drinks **Taxed SSB products:** Soft drinks and energy drinks **Notable exemptions:** n/a	(Government of Dominica 2015)
Federated States of Micronesia	2004 (n/a)	**General description:** Import duty on sugar-added drinks **Tax rate:** 25% **Taxed SSB products:** Soft drinks, preparation products for soft drinks **Notable exemptions:** n/a	(McDonald 2015)
Finland	1940 (2014)	**General description:** Excise tax on sugar-added drinks, non-alcoholic drinks, sweets, and ice-cream	(Ecorys 2014)

Table 1. Examples of implemented SSB taxes *(Continued)*

		Tax rate: EUR 0.220 per litre on beverages with more than 0.5% sugar **Taxed SSB products:** Beverages containing more than 0.5% sugar **Notable exemptions:** Water, milk	
Fiji	2011 (n/a)	**General description:** Import duty on sugar-added drinks and various other food products **Tax rate:** 32% **Taxed SSB products:** Soft drinks and various other food products (e.g. bottled water) **Notable exemptions:** n/a	(McDonald 2015)
France	2012 (2016)	**General description:** Excise tax on beverages with added sugar or sweeteners levied on producers, importer or merchants **Tax rate:** EUR 7.16 per hectolitre (2012), EUR 7.53 per hectolitre (2016) of the product **Taxed SSB products:** Beverages with added sugar or sweeteners regardless the quantity of sugar **Notable exemptions:** Milk, soups, sugar-added drinks for medical treatment; drinks based on tea, coffee consumed in cups and glasses at restaurants	(Ecorys 2014; Service Public 2016)
French Polynesia	2002 (2011)	**General description:** Import duty and excise tax on sweetened drinks and various other food products **Tax rate:** XPF 40 per litre on locally produced sweetened drinks; XPF	(Thow 2011)

Table 1. Examples of implemented SSB taxes *(Continued)*

		60 per litre on imported sweetened drinks **Taxed SSB products:** Sweetened drinks **Notable exemptions:** n/a	
Hungary	2011 (2013)	**General description:** Specific product tax on soft drinks, syrups/concentrates and various other food products **Tax rate:** HUF 7 per litre on soft drink products; HUF 200 per litre on syrups/concentrates products **Taxed SSB products:** Soft drinks; syrups/concentrates for soft drink preparation high in sugar (sugar content > 8 grams per 100 ml) **Notable exemptions:** Beverages with fruit or vegetable content > 25%; beverages based on raw milk content > 50%; special syrups	(Ecorys 2014)
Kiribati	2014 (2014)	**General description:** Excise tax on beverages containing added sugars or other sweetening matters **Tax rate:** 40% **Taxed SSB products:** Beverages containing added sugars or other sweetening matters **Notable exemptions:** Unknown	(McDonald 2015)
Mauritius	2013 (2014)	**General description:** Excise tax on carbonated beverages, fruit juice and syrup **Tax rate:** MUR 0.03 per gram of sugar **Taxed SSB products:** Excise tax on carbonated beverages, fruit juices and syrups **Notable exemptions:** n/a	(Government of Mauritius 2015)

Table 1. Examples of implemented SSB taxes *(Continued)*

Mexico	2014 (2014)	**General description:** Excise tax on non-dairy and non-alcoholic beverages with added sugar; accompanied by an ad valorem tax on high energy dense food **Tax rate:** MXN 1 per litre on SSBs; applies to the largest typical volume possible utilising caloric sweeteners or concentrate as well **Taxed SSB products:** Sodas, juices, nectars, fruit concentrates, drink mix powder **Notable exemptions:** Dairy products, non-caloric beverages	(Colchero 2016)
Nauru	2007 (2010)	**General description:** Import duty on sugar and products containing added sugars **Tax rate:** 30% of value **Taxed SSB products:** Sugar and products containing added sugars **Notable exemptions:** Water	(Government of the Republic of Nauru 2010)
Norway	n/a (2016)	**General description:** Excise tax on sugar and sugar-added products **Tax rate:** NOK 7.66 per kg of sugar **Taxed SSB products:** Refined sugar or food products containing added refined sugar **Notable exemptions:** n/a	(Government of Norway 2015)
Northern Mariana Islands	1979 (1995)	**General description:** Excise tax on soft drinks **Tax rate:** USD 0.005 per fluid ounce or fractional equivalent thereof **Taxed SSB products:** Soft drinks (carbonated or non-carbonated or non-alcoholic	(Northern Marianas Commonwealth Legislature 1995)

		beverages) **Notable exemptions:** Drinkable dairy products, fruit juices, vegetable juices, bottled drinking water, tea or tea products, concentrates	
Palau	n/a (2015)	**General description:** Import duty on drinks containing added sugar or other sweetening matter **Tax rate:** USD 0.28175 per litre **Taxed SSB products:** Drinks containing added sugar or other sweetening matter **Notable exemptions:** Water, fruit juices, vegetable juices	(Palau Customs 2015)
Republic of Marshall Islands	2004 (n/a)	**General description:** Import duty on carbonated beverages **Tax rate:** USD 0.01666 per ounce on carbonated beverages **Taxed SSB products:** Carbonated beverages **Notable exemptions:** n/a	(McDonald 2015)
Samoa	1984	**General description:** Import duty and excise tax on carbonated beverages **Tax rate:** WST 0.40 per litre on carbonated beverages **Taxed SSB products:** Carbonated beverages **Notable exemptions:** n/a	(McDonald 2015; Thow 2011)
St Helena	2014 (2014)	**General description:** Excise tax on carbonated beverages **Tax rate:** SHP 0.75 per litre on carbonated beverages **Taxed SSB products:**	(Government of St Helena 2013)

Table 1. Examples of implemented SSB taxes *(Continued)*

		Carbonated beverages containing at least 15 grams sugar per litre **Notable exemptions:** n/a	
Tonga	2013 (2013)	**General description:** Excise tax on carbonated beverages **Tax rate:** TOP 1 per litre on carbonated beverages **Taxed SSB products:** Carbonated beverages **Notable exemptions:** n/a	(McDonald 2015)
Vanuatu	2014 (2014)	**General description:** Excise tax on beverages containing added sugars or other sweetening matters **Tax rate:** VUV 50 per litre on carbonated beverages **Taxed SSB products:** Carbonated beverages **Notable exemptions:** n/a	(Government of Vanuatu 2015)
United States	1920 (2015)	**General description:** Various statewide or citywide taxes on beverages containing added sugars or syrups/drinking powder/concentrates **Tax rate:** 0% to 7% on various SSB products **Taxed SSB products:** Beverages containing added sugars or syrups/drinking powder/concentrates **Notable exemptions:** Various	(Chriqui 2014; City of Berkeley 2014; City of Philadelphia 2016; New York Times 1920)
United States (Example: City of Berkeley, California)	2015 (2015)	**General description:** Excise tax on SSBs and caloric sweeteners **Tax rate:** USD 0.01 per fluid ounce on SSB products; applies to the	(City of Berkeley 2014)

Table 1. Examples of implemented SSB taxes *(Continued)*

		largest typical volume possible utilising caloric sweeteners as well **Taxed SSB products:** SSBs and added caloric sweeteners **Notable exemptions:** Natural or common sweeteners, fruit and vegetable concentrate or juice (100%), milk, beverages for medical use or weight reduction, beverage products for 'babies'	
United States (Example: City of Philadelphia, Pennsylvania)	2017 (2016)	**General description:** Excise tax on SSBs and caloric sweeteners **Tax rate:** USD 0.015 per fluid ounce on SSB products, including artificial sweeteners; syrup or other concentrates: USD 0.015 per fluid ounce on the resulting beverage, prepared to the manufacturer's specifications **Taxed SSB products:** SSBs and added caloric sweeteners **Notable exemptions:** Beverage products for 'babies', medical food, milk products (volume of milk $\geq$ 50%), fruit and vegetable products (volume $\geq$ 50%)	(City of Philadelphia 2016)

Additional taxes on cans, bottles, and containers as well as not yet fully implemented SSB taxes (e.g. Philippines, UK) are not reported. This also applies for countries with no specific tax differences between bottled water and SSBs.

Table 2. Advisory group members

Name	Occupation
Cristina Cleghorn	Department of Public Health, University of Otago, Wellington, NZ
Emilia Crighton	Faculty of Public Health, London, UK
Peter Faassen de Heer	CMO and Public Health Directorate, Scottish Government, Edinburgh, UK

Table 2. Advisory group members *(Continued)*

Torben Jørgensen	Professor, Department of Public Health, University of Copenhagen, Copenhagen, Denmark
Dionne Mackison	Department for International Development, UK Government, Glasgow, UK
Barry Popkin	Professor of Global Nutrition, University of North Carolina, Chapel Hill, US

Table 3. Feedback advisory group (online survey)

	1.1. Rank outcomes according to their relative importance for the scope of the reviews and general public health decision-making in the context of food taxation; 9-point Likert scale (categories: 1 to 3 - of limited importance; 4 to 6 - important; 7 to 9 - critical)	
Outcomes:	**Average score:**	**Rank:**
prevalence of overweight	7.67	3
prevalence of obesity	7.67	3
incidence of overweight	8.00	1
incidence of obesity	8.00	1
caloric intake through SSBs or sugar/sugar-added food	7.33	8
total calorie consumption	6.67	11
consumption of SSBs or sugar/sugar-added food (e.g. frequency, amount)	7.33	8
health-related quality of life	4.00	16
total sales of SSBs or sugar/sugar-added food	5.33	15
composition of diet (e.g. fat, sugar, salt)	6.67	11
total expenditures on food	4.00	16
total expenditures on SSBs or sugar/sugar-added food (e.g. frequency, amount)	5.67	14
any health outcomes or health-related unintended consequences	7.67	3

Table 3. Feedback advisory group (online survey) *(Continued)*

e.g. mortality	7.00	10
e.g. dental caries	6.00	13
e.g. diabetes	7.67	3
e.g. CVD	7.67	3
	2.1. How well do the presented outcomes cover the basic review scope?	
Answers:	**Rating:**	**Number of responses:**
Important outcomes are presented	66.67%	2
Important outcomes are missing	33.33%	1
Comments (1):	I imagine some evidence will be presented as simply a change in BMI or other markers of obesity rather than a change in incidence or prevalence of obesity (Cristina Cleghorn)	
	3.1. Do you think the same outcomes are appropriate for both reviews (SSB; sugar or sugar-added foods)?	
Answers:	**Rating:**	**Number of responses:**
The same group of outcomes should be utilised in both reviews	66.67%	2
Different outcomes should be utilised in the two reviews	33.33%	1
Comments (1):	Foods study: Hard to go beyond kcal and weight and minimal cardio metabolic outcomes as the Morenga et al. review shows (Barry Popkin)	

Participants n = 3

APPENDICES

Appendix 1. MEDLINE search strategy

1. exp Taxes/
2. exp Government Programs/ec, lj [Economics, Legislation & Jurisprudence]
3. exp Health Policy/ec, lj [Economics, Legislation & Jurisprudence]
4. exp Food Dispensers, Automatic/ec, lj, sn [Economics, Legislation & Jurisprudence, Statistics & Numerical Data]
5. exp Health Promotion/ec, lj [Economics, Legislation & Jurisprudence]
6. exp Nutrition Policy/ec, lj [Economics, Legislation & Jurisprudence]
7. exp Public Health/ec, lj [Economics, Legislation & Jurisprudence]
8. "demand elasticity".tw.
9. "policy intervention*".tw.
10. "sales tax".tw.
11. "thin subsidies".tw.
12. "vending machine*".tw.
13. budget.tw.
14. excise.tw.
15. fiscal.tw.
16. levied.tw.
17. levy.tw.
18. price.tw.
19. priced.tw.
20. prices.tw.
21. pricing.tw.
22. subsidy.tw.
23. subsidies.tw.
24. tax.tw.
25. taxation.tw.
26. taxed.tw.
27. taxes.tw.
28. taxing.tw.
29. OR/1-28
30. exp Dietary Carbohydrates/
31. exp Dietary Sucrose/
32. exp High Fructose Corn Syrup/
33. "chewing gum".tw.
34. "dietary sucrose".tw.
35. (("energy dens*" or "highenergy" or "high energy" or "high-energy" or "low energy" or chips) and (fat* or sugar* or sweet* or food or diet* or nutrition or overweight or drink* or beverage* or protein* or carbohydrate*)).tw.
36. "HED calori*".tw.
37. "HED-calori*".tw.
38. "highcalori* food*".tw.
39. "high calori* food*".tw.
40. "high-calori* food*".tw.
41. "lowcalori* food*".tw.
42. "low calori* food*".tw.
43. "low-calori* food*".tw.
44. "ice cream*".tw.
45. "unhealthy food*".tw.
46. bakery.tw.
47. biscuit*.tw.

48. cacao.tw.
49. cake*.tw.
50. calorie*.tw.
51. candy.tw.
52. candies.tw.
53. bonbon*.tw.
54. chocolate*.tw.
55. confectionar*.tw.
56. cookie*.tw.
57. isoglucose.tw.
58. jam.tw.
59. jelly.tw.
60. jellies.tw.
61. liquorice.tw.
62. macronutrient*.tw.
63. maltose.tw.
64. marmalade.tw.
65. marzipan.tw.
66. pastr*.tw.
67. sucrose.tw.
68. sugar.tw.
69. sugars.tw.
70. sugary.tw.
71. sweet*.tw.
72. exp Butter/
73. exp Dietary Fats/
74. exp Energy Intake/
75. exp Fast Foods/
76. exp Margarine/
77. exp Plant Oils/ec [Economics]
78. “fastfood*”.tw.
79. “fast food*”.tw.
80. “fast-food*”.tw.
81. “fattening-food*”.tw.
82. “fattening food*”.tw.
83. “fried food*”.tw.
84. (coconut OR cooking OR palm OR vegetable OR soya OR soybean OR rapeseed OR linseed OR sunflower OR sesame OR peanut OR groundnut OR copra OR babassu OR olive OR thistle ADJ Oil).tw.
85. “salty-snack*”.tw.
86. “salty snack*”.tw.
87. “snack food*”.tw.
88. “snack-food*”.tw.
89. “takeaway food*”.tw.
90. “takeaway-food*”.tw.
91. “take away food*”.tw.
92. “take away-food*”.tw.
93. “take-away food*”.tw.
94. “take-away-food*”.tw.
95. “whole milk”.tw.
96. burger*.tw.
97. butter.tw.
98. cheese.tw.
99. cream.tw.

100. crisps.tw.
101. (egg AND (fat* or sugar* or sweet* or food or diet* or nutrition or overweight or drink* or beverage* or protein* or carbohydrate*)).tw.
102. (eggs AND (fat* or sugar* or sweet* or food or diet* or nutrition or overweight or drink* or beverage* or protein* or carbohydrate*)).tw.
103. (fat AND (Food* or diet* or nutrition or nutrient or eat* or meal* or oil* or carbohydrate* or protein* or obesity or obese)).tw.
104. (fatty AND (Food* or diet* or nutrition or nutrient or eat* or meal* or oil* or carbohydrate* or protein* or obesity or obese)).tw.
105. fats.tw.
106. fattening.tw.
107. fries.tw.
108. ghee.tw.
109. lard.tw.
110. margarine.tw.
111. mono-unsat*.tw.
112. monounsat*.tw.
113. omega3.tw.
114. "omega 3".tw.
115. omega-3.tw.
116. pizza.tw.
117. polyunsat*.tw.
118. poly-unsat*.tw.
119. sausage*.tw.
120. suet.tw.
121. exp Carbonated Beverages/
122. exp Food Preferences/
123. exp Food Habits/
124. "caloric-drink*".tw.
125. "caloric drink*".tw.
126. "carbonated-beverage*".tw.
127. "carbonated beverage*".tw.
128. "carbonated-drink*".tw.
129. "carbonated drink*".tw.
130. "energy-drink*".tw.
131. "energy drink*".tw.
132. "fizzy-drink*".tw.
133. "fizzy drink*".tw.
134. "high-calori* drink*".tw.
135. "high calori* drink*".tw.
136. "soda pop".tw.
137. "soft-drink*".tw.
138. "soft drink*".tw.
139. "sport-drink*".tw.
140. "sport* drink*".tw.
141. "sport*-drink*".tw.
142. cola.tw.
143. soda.tw.
144. SSB*.tw.
145. syrup*.tw.
146. OR/30-145
147. 29 AND 146
148. (animals NOT (humans AND animals)).sh.
149. 147 NOT 148

CONTRIBUTIONS OF AUTHORS

Thomas L. Heise: protocol draft, contributed to all stages of the protocol development

Srinivasa Vittal Katikireddi: reviewed and contributed to the development of the draft protocol and search strategy

Frank Pega: reviewed and contributed to the development of the draft protocol and search strategy

Gerald Gartlehner: reviewed and contributed to the development of the draft protocol

Candida Fenton: search strategy development

Ursula Griebler: reviewed the draft protocol

Isolde Sommer: reviewed the draft protocol

Manuela Pfinder: protocol draft, contributed to all stages of the protocol development

Stefan K. Lhachimi: conceived and initiated the review and contributed to all stages of the protocol development

DECLARATIONS OF INTEREST

Thomas Heise: none declared

Srinivasa Vittal Katikireddi is a member of the steering group of Obesity Action Scotland, to whom he provides unpaid advice on the evidence base for public health actions to tackle obesity

Frank Pega is a Technical Officer at the World Health Organization

Gerald Gartlehner: none declared

Candida Fenton: none declared

Ursula Griebler: none declared

Isolde Sommer: none declared

Manuela Pfinder: none declared

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