Exploring the Acceptability of a Tax on Sugar-Sweetened Beverages

Brief Evidence Review

April 2013

Rachel Lavin & Hannah Timpson

Applied Health and Wellbeing Partnership
Centre for Public Health
Liverpool John Moores University

Contents

1. Context

Currently, 65% of men and 58% of women in the UK are overweight or obese. Obesity levels have risen amongst both males (from 13% in 1993, to 24% in 2011) and females (from 16% in 1993, to 26% in 2011) (Eastwood, 2013). In children, 16.6% of boys and 15.9% of girls were obese in 2011. In comparison to the rest of the UK, Northern England has significantly higher obesity prevalence rates than Southern England; the North East has the highest rates of obesity in the UK (13.5%) followed by the North West (11.7%) (Eastwood, 2013).

The rising trends in obesity among children and adults in the UK and other high-income countries have been accompanied by lifestyle changes such as increased sedentary and unhealthy eating behaviours (often based on high-density processed food and drink) which has contributed to high rates of obesity among young people and adults (Butland et al., 2007; Al-Nakeeb et al, 2012). These patterns of increasing overweight and obesity in the general population are documented among many different populations of developed countries, leading many to hypothesize that the environment, rather than individual-level factors, may be driving the obesity epidemic (Giskes, van Lenthe, Avendano-Pabon & Brug, 2010). A notable global dietary trend has been the rise in consumption of sugar sweetened beverages (SSBs) (Bleich, Wang, Wang & Gortmaker, 2009; Ng, Mhurchu, Jebb & Popkin 2011).

Market research data illustrates a steady upward trend in global consumption of SSBs from 2005 to 2011 (Zenith International, 2013). Consumption of SSBs in the UK reached 14,685 million litres in 2011 (Sustain, 2013). SSBs are beverages that contain added caloric sweeteners (such as sucrose, high-fructose corn syrup or fruit juice concentrates) that include the full spectrum of soft drinks (such as carbonated soft drinks, fruit drinks, sports drinks, energy and vitamin water drinks, sweetened iced tea, cordial, squashes, and lemonade) (Malik, Popkin, Bray, Desperes & Hu, 2010).

1.1 SSB consumption and health

High intake of SSBs is associated with increased energy intake, dental caries, overweight, obesity, gout, fatty liver disease, and is also an independent risk factor for diabetes and heart disease (Johnson et al., 2007; Underwood, 2008; van Baak & Astrup, 2009; Malik et al., 2010; Popkin, 2012; Gibson & Shirreffs, 2013). SSBs have also been documented to induce independent metabolic effects by providing high gylcemic load, leading to inflammation, insulin resistance and impaired b cell function (Malik et al., 2010; Popkin, 2012).

The association of SSB consumption and weight gain has been found to be stronger than for any other food or beverage (Woodward-Lopez, Koa & Ritchie, 2010), with research suggesting strong evidence for the independent role of the intake of SSBs in the promotion of weight gain and obesity, particularly in children and adolescents (Malik, Schulze & Hu, 2006; Gibson, 2008). A meta-analysis of 88 studies indicated that the effect of this increased energy intake appeared to be stronger in adult women (Vartanian, Schwartz & Brownwell, 2007). A more recent systematic review, involving a meta-analysis of randomised controlled trials and prospective cohort studies, concluded that intake of sugars was a determinant of body weight, with a clear positive association between higher intake of sugars and body fatness in adults (Morenga, Mallard & Mann, 2013). A systematic review of evidence for early-life (from conception to 5 years of age) determinants of obesity also found that consumption of sugar-sweetened beverages was a factor associated with later overweight and obesity (Monasta et al., 2010).

Although many epidemiologic studies have found positive associations between SSBs, obesity and related cardio-metabolic diseases; some research has reported results inconsistent with these findings (e.g. little or no association). Associations tend to be strongest in prospective cohort studies with large numbers of participants with methods that capture long-term dietary patterns (Pérez-Morales, Bacardí-Gascón & Jiménez-Cruz, 2013).

Study design appears to significantly influence results; larger effects sizes are yielded where stronger methods such as longitudinal and experimental studies are utilised (rather than cross-sectional studies examining consumption isolated at one specific point in time), with studies funded by the food industry additionally reporting significantly smaller effects than non-industry funded studies (Vartanian et al., 2007).

Adding to this literature base illustrating the effects of SSBs and weight gain, experimental studies of SSBs have shown regular consumption of SSBs in children result in larger weight gain compared to children who consume SSBs less often or rarely (Mrdjenovic & Levitsky, 2003; Welsh et al., 2005). Similarly, masking (i.e. hiding) replacement of SSBs with non-caloric beverages has been found to reduce weight gain and fat accumulation in children (de Ruyter, Olthof, Seidell & Katan, 2012). A UK study of primary school children (aged 7-11) found that educational activities aiming to reduce SSB consumption led to a decrease in the percentage of overweight and obese children of 0.2%, compared to an increase of 7.5% in the control group over a follow-up period of 12-months (James, Thomas & Cavan, 2004).

1.2 Mechanisms

The mechanisms linking SSB intake to weight gain include low satiety associated with liquid calories and incomplete compensatory reduction in energy intake at subsequent meals that lead to an increase in total energy (Malik & Hu, 2011). SBBs have been suggested to alter long-term taste preferences toward increased sugary food, and it is also proposed SSBs increase hunger and/or decrease satiety (Vartanian et al., 2007; Cassady, Consideine & Mattes, 2012; Popkin, 2012).

SSBs are suggested to be processed differently compared to food when consumed, with fluid calories not being accounted for in the same way as calories from solid foods. The shift from water to SSBs for hydration adds extra calories and sugars into the diet, which are supplemental to food intake (Popkin, 2012) and there appears to be no dietary compensation (e.g. reducing food intake) for the extra 'empty' calories that are consumed from SSBs. The direct satiety effects of beverages are not yet fully understood however, and more research is needed in order to fully understand such mechanisms (Butland et al., 2007; Popkin, 2012; Gibson & Shirreffs, 2013).

The most palatable foods usually contain sugar (and/or fat and salt) which are rewarding as they stimulate dopamine release from neurons in the brain's opiod centre, which in turn can reinforce people to consume such foods. These neurons are stimulated by taste and drive people to consume more sugar through their rewarding effects (Kessler, 2009). It has been proposed that people lose control over their ability to regulate their consumption of sugary foods and drink, due to high concentrations of sugar potentially being addictive, with research highlighting similarities between high consumers and substance use disorders (Swencionis & Rendell, 2012). Particularly in children, unhealthy sugary foods are often used as rewards (by their parents), with sugary foods/drinks providing children with the most instant form of food gratification (Academy of Medical Royal Colleges, 2013).

1.3 Consumer characteristics

In the US, SSBs are identified as the leading source of added sugar and calories in the diet (Reedy & Krebs-Smith, 2010; Welsh, Sharma, Grellinger & Vos, 2011). Consumer choices of SSBs are driven by both product and consumer characteristics; with studies in the US suggesting those with lower income and younger consumers are the highest consumers (Lopez & Fantuzzi, 2012). There are few studies that have examined consumption patterns in the British population (Gibson, 2008; Gibson & Shirreffs, 2013). A study indicated that in the UK in 2008-2009, beverages accounted for 14% of daily energy intake for children aged 4–18 years, with the bulk of energy coming from SSBs such as soda, fruit drinks, juices and sweetened dairy. Similarly, for adults aged 19–64 years, beverages accounted for 18% of daily energy intake, with the bulk of energy coming from alcohol and SSBs such as soda,

fruit drinks, sweetened coffee, tea and juices. SSB intake was found to be especially high among adolescents (Ng et al., 2011). Increased intake of SSBs in children aged 11-12 years old has been documented in the UK over the past twenty years, with the intake of sugar being substantially higher than recommended (Rugg-Gunn et al., 2007). Similar to patterns of consumption in the US; Gibson (2010), showed the increasing amount of soft drinks being consumed by children and adolescents, with the conclusion that SSBs are now the biggest contributor to sugar in the diet in the UK for this age group. Intake of SSBs has been found to be lower among young children and preschoolers in the UK (Ng et al., 2011; Popkin, 2012). A recent study examining consumption pattern in 1724 British adults aged 19-64 years, found younger men and women tended to consume more soft drinks than older adults (those 19 – 35 years consuming more than those 35 years and older), with males consuming slightly more caloric soft drinks than women (Gibson & Shirreffs, 2013).

In general, SSBs tend to be consumed more by younger children and adults from lower income households, with consumption appearing to decline with age (those over 50 are less likely to consume SSBs) (Pomeranz, 2012; Lopez & Fantuzzi, 2012). Research illustrates that beverage preferences and consumption patterns begin to develop early in childhood and can persist over time (Jimenez-Cruz et al., 2010; Pérez-Morales et al., 2013). Considering that sugar intake stimulates dopamine release which is rewarding and reinforces people to consume more (Kessler, 2009); once a habit of SSBs consumption is formed, it may be difficult to eliminate.

1.4 What drives SSB consumption?

The reasons why people choose to consume SSBs are numerous, complex and multifaceted (Butland et al, 2007). Understanding drivers of consumption will enable effective targeting of interventions to reduce intake; the following will briefly summarise some key points in relation to SSB consumption.

Psychological drivers of SSB consumption

Habit behaviours are often repeated, fairly automatic and can be difficult to control. Changes in attitude and intentions can have less of an impact once a habit is formed, and often, people will have reduced motivation to acquire new information if it is inconsistent with their habitual behaviour (Butland et al., 2007). In terms of development of habits and preference, childhood and adolescence are crucial stages of development where lifestyle habits are formed and set. These behaviour patterns that are established during early years have immediate and long-term implications on health and well-being (Al-Nakeeb et al., 2012). Further factors identified as important influences on unhealthy eating/drinking behaviour include personal beliefs, the degree of control or perceived control an individual has over their environment and their perceived vulnerability to risk (Butland et al., 2007).

Level of food literacy and health knowledge has been found to be an important driving factor in obesity (Kalavana, Maes & de Guht, 2010). Literacy and numeracy skills have been found to be associated with obesity, with lower literacy skills being associated with an inability to accurately estimate healthy portion sizes (Huizinga, Beech, Cavanaugh, Elasy & Rothman, 2009) and lower numeracy skills being associated with higher BMI (Huizinga et al., 2008). Furthermore, human clinical studies indicate that high energy-dense diets can undermine normal appetite regulation (termed ‘passive overconsumption’) due to an inability to recognise the energy density of food and compensate appropriately to maintain energy balance (Viskaal-van Dongen, de Graaf, Siebelink & Kok, 2009). Obesity levels may be further impacted/compounded by the fact that increased energy intake in liquid form may not be accounted for in the same way as calories from solid foods. Research also illustrates that higher levels of stress and low self-esteem are related to unhealthy eating behaviour, with patterns of high levels of stress and unhealthy diet behaviours being more pronounced in women than men (Martyn-Nemeth, Penckofer, Gulanick, Velsor-Friedrich & Bryant, 2009; Talen & Mann, 2009).

Environmental drivers of SSB consumption

Specific environmental factors shape the availability and consumption of different foods and drink, thus affecting health behaviour choices (Butland et al., 2007). Greater access to SSBs in school and their proximity to fast food establishments result in higher consumption (Pomeranz, 2012). Fast food restaurant outlet densities have also been found to be significantly associated with fast food consumption pattern in children (Khan, Powell & Wada, 2012).

A recent review of studies examining the influence of the food environment on overweight and obesity in children up to eight years, found that one of the environmental exposures having the most impact was the availability of SSBs (Osei-Assibey et al., 2012). Furthermore, a review of 28 studies examining environmental factors influencing obesity found that weight status was consistently associated with the food environment; with greater accessibility to supermarkets or less access to takeaway outlets being associated with a lower BMI and prevalence of overweight/obesity (Giskes et al., 2010). This increased access to takeaway outlets and unhealthy food/drink retailers may increase the ease at which people make unhealthy dietary choice by minimising barriers to making these choices (Burns & Inglis, 2007; Pearce, Blakely, Witten & Bartie, 2007).

SSBs are ubiquitous in supermarkets, advertising and also across the wider environment (Academy of Medical Royal Colleges, 2013). SSBs are marketed extensively to children and adolescents, who are shown to be the largest consumers (Ng et al. 2011; Caprio, 2012). A review of the literature also found that the quantity of advertising on children's television may be related to the prevalence of excess body weight among children (Lobstein & Dibb, 2005). In terms of the environment in which SSBs are most consumed, research highlights that most consumption occurs in the home environment, followed by food service establishments and schools (for children) (Wang, Bleich & Gortmaker, 2008; Ezendam, Evans, Stigler, Brug, & Oenema, 2010; Pomeranz, 2012; Gibson & Shirreffs, 2013).

Social determinants of SSB consumption

For adults in the UK aged 19-64, most beverage consumption occurs during the evening. This is potentially attributed to our cultural reality of the evening typically being a time for eating and drinking (Gibson & Shirreffs, 2013). Time constraints due to working commitments and demand for convenience in food has seen the emergence and rise in demand of fast food and other energy consumption away from the home (Ulijaszek, 2007). Wider social determinants include socio-cultural variation of food and social norms (Butland et al., 2007; Al-Nakeeb et al., 2012).

Parental influence appears to play a part in dietary patterns in children; a study examining environmental influences of obesity related dietary behaviours in children and adolescents found consistent associations between parental influences (such as parental food intake and education) and obesity in children and adolescents aged 3-18 years (van der Horst et al., 2007). Health knowledge of parents can also impact children (Butland et al., 2007; Kalavana et al., 2010); whereby potentially damaging food habits can be engrained in young children because parents do not have the knowledge and support to understand their child's food and exercise needs (Academy of Medical Royal Colleges, 2013). Furthermore for children, conscious control of food/drink accumulation involves the level of parental control and the level of children's control over their diet (Butland et al., 2007).

Economic influences of SSB consumption

Food prices have been found to be key determinants of consumption (Epstein, Dearing, Handley, Roemmich & Paluch, 2006; Epstein, Dearing, Paluch, Roemmich & Cho, 2007). Price frames the context in which consumer responses are made (Khan et al., 2012). The price of SSBs has not kept up with economic inflation, remaining at consistently low prices, whilst the price of healthier foods, such as fruits and vegetables, has risen (Brownwell &

Frieden, 2009; Finkelstein, Zhen, Nonnemaker & Todd, 2010; Powell, Chriqui, Khan, Wada & Chaloupka, 2013). Cheaper food sources tend to be more energy-dense and nutrient-poor, with added fat and sugar, providing relatively low levels of vitamins and minerals and excessive calories (Butland et al., 2007; O'Neil, Michael & Victor, 2011).

Consistent with these findings, research has found living in a socioeconomically-deprived area to be a factor consistently associated with a number of obesogenic dietary behaviours (Giskes et al., 2010; Khan et al., 2012). Due to economic struggles and pressured lives, those with lower incomes tend to consume food and drink which is cheaper, more energy-dense and more convenient (Deshmukh-Taskar, Nicklas, Yang & Berenson, 2007; Sustain, 2013). Research in the UK has found that low income neighbourhoods have higher proportions of fast food outlets and very few shops (at times none) selling healthy food options (Macdonald, Cummins & Macintyre, 2007). Research in the US suggests that the availability of reasonably priced healthy food is constrained for those who live in low-income neighbourhoods, and furthermore, that this limitation may be associated with poor diet and obesity (Butland et al., 2007). Similarly, a survey of the diet of children in Scotland indicated that as deprivation increased, the intake of SSBs increased and the intake of fruit and vegetables decreased, leading to higher rates of overweight and obesity in deprived areas (McNeill et al., 2010).

2. How food tax can influence behaviour

There are numerous psychological, environmental, social and economic factors that appear to be driving SSB consumption. Given the increasing rates of obesity and the fact that our environment is increasingly becoming obesogenic (the sum of the influences that the surroundings, opportunities or conditions of life have on promoting obesity in individuals and populations), modifying this environment could produce a more lasting effect on behavioural change and levels of obesity (Osei-Assibey et al., 2012). The National Heart Forum (NHF) recommends the application of additional taxes on unhealthy food and drink as a proportionate response to the current crisis in diet-related health (Landon & Graff, 2012). Fiscal measures are increasingly being recognised as a plausible way to tackle the obesity epidemic at a population level (EU Food Policy, 2012; Mytton, Clarke & Rayner, 2012; Popkin, 2012). As food prices have consistently been found to be a key determinant of consumption (Epstein et al., 2006; Epstein et al., 2007), they are good candidates for effective policy intervention aimed at improving dietary patterns among children, adolescents and adults (Khan et al., 2012). In the UK, there is a growing literature on fat taxes, which concludes that well designed and targeted taxes could be useful in reducing the burden of nutrition-related diseases (Sustain, 2013). However, there are limited studies looking at pricing policies on SSBs (Ng et al., 2011).

Economic theory predicts that as the price of an item rises the consumption of that item will typically fall, therefore increasing the price of unhealthy food and drinks by taxation should reduce consumption of the taxed items with an aim of changing consumer demand and behaviour at the broad population level (Powell & Chaloupka, 2009; Mytton et al., 2012; Powell et al., 2013). The taxation of SSBs could tackle over-consumption of SSBs and decrease the risk of overweight and obesity in children and adults (Landon & Graff, 2012; Osei-Assibey et al., 2012). Even small changes in diet can lead to meaningful changes in important risk factors across the whole population, which can result in substantial health benefits (Mytton et al., 2012).

3. Can food tax interventions be effective?

There are three types of evidence for the effectiveness of food duties in improving health: empirical evidence from countries where food duties have been implemented, experimental

studies (e.g. where prices were artificially increased in closed settings), and modelling studies.

3.1 Examples of tax, reported effects and industry response

Algeria: Currently has a soft drinks tax at 0.5% on the sales volume of soft drink producers (CQPP, 2012).
Effect:
Industry response: The Algerian association of beverage producers took a stance against this tax and demanded its removal.

Denmark: Current taxes on SSBs stand at 0.34 DKK (£0.04) per litre for sugary drinks. Denmark also introduced a saturated fat tax in October 2011 at 16 DKK (£1.78 GBP) per kg of saturated fat in food.
Effect: Statistics from FDB, Denmark's largest consumer goods retailer, show that Danish shoppers purchased more leaner and low fat meat between November 2011 and August 2012 as well a decrease in butter and mixed butter products sales (Le Figaro, 2012).
Industry response: Fierce industry response, that led to the saturated fat tax being abolished thirteen months after it came into effect by the Danish Government (Sustain, 2013).

USA: States in the US have taxed soft drinks as a means of raising revenue, with 38 states currently taxing SSBs at levels ranging from 1-7% (taxed range from 1.225% in Missouri to 7% in Indiana, Mississippi, New Jersey, and Rhode Island) (Powell et al., 2013). Only recently has this policy been evaluated for its potential effect on reducing obesity rates (Mytton et al., 2012; Fletcher, Frisvold &Tefft, 2013).
Effect: Research suggests current levels of tax on SSBs (an average tax of 5%) are too low to have a substantial effect on obesity.
Industry response: Within the US, companies in the SSB industry have spent an estimated £44 million ($70 million) since 2009 lobbying against soda taxes (Sustain, 2013).

France: Currently taxes all drinks with added sugar or artificial sweeteners at 0.07 EUR (£0.06) per litre and also energy drinks at 0.50 EUR (£0.40) per litre (Sustain, 2013).
Effect: Supermarket sales of soft drinks declined for the first time in many years by 3.3% in the first four months after the introduction of their tax (of approximately EUR 0.07 per litre and resulting in nearly a 5% price increase) on sugar added and artificially sweetened drinks.
Industry response: The French national association of food industries (ANIA) has launched a lobbying campaign aimed primarily at refuting government claims that the tax was motivated by public health concerns with obesity (Roux, 2012).

Ireland: SSBs taxes were implemented during the 1980s, due to a need to obtain additional revenues, with an excise tax levied on physical production (this being collected directly from the producers of SSBs) at IR£0.37 per gallon.
Effect: An 11% decrease in consumption for each 10% increase in price, however the health effects of the tax were not examined.
Industry: There was pressure to begin harmonising tax systems from the European Union, who urged elimination of special excise taxes on SSBs. These taxes were then removed in 1992 (Bahl, Bird & Walker, 2003).

Hungary: Taxes have been levied on sugary drinks at 5 HUF (£0.01) per litre, energy drink at 250 HUF (£0.70) per litre, salty snacks and condiments at 200 HUF (£0.56) per kg and sweets, biscuits, ice-creams and chocolate at 100 HUF (£0.28) per kg.
Effect: There was a drop in sales of salted snacks (33% decrease in the first six months), and for soft drinks (from 117 million litres sold in the last quarter of 2011 to 69 million litres in the first quarter of 2012). It has been noted that some of the decreases in consumption

could have been partly attributed to the general economic crisis and the report that people purchased extra before the tax was introduced (Landon & Graff, 2012).

Norway: Currently taxes non-alcoholic beverages containing added sugar or sweeteners and chocolate and sugar, with rates at 2.81 NOK (£0.30) per litre (beverages), 17.13 NOK (£1.87) per litre (concentrated syrups), 17.92 NOK (£1.96) per kg (chocolate), 6.94 NOK (£0.76) per kilo (sugar) (Sustain, 2013).
Effect: Consumption of lemonade and regular soft drinks significantly decreased between 2001 and 2008 (4.8 to 2.5 times per week and 2.3 to 1.6 times per week respectively) after taxes, in contrast to rises in many other European countries.

3.2 Experimental studies
Within a hospital cafeteria, a price increase of 35% on regular soft drinks reduced consumption by 26% (Block, Chandra, McManus & Willett et al., 2010). In a further experiment, participants purchased less high calorie dense foods when there was a tax on these foods, compared to participants exposed to no additional taxes on unhealthy foods. Furthermore, this reduction in calories occurred regardless of participants' individualised budgets, leading the researchers to conclude that a food tax may be a beneficial tool, along with other measures, in promoting a diet with fewer calories (Nederkoorn, Havermans, Giesen & Jansen, 2011). A recent targeted review of experimental research suggests that price changes do modify purchases of targeted foods (Epstein et al., 2012). However, this review, in addition to other research, notes how experimental research may lack external validity as participants are often required to make limited choices and spend their entire budget, and this may not accurately predict actual life choices (Mytton et al., 2012).

3.3 Modelling studies
Most work on the dietary or health effects of health related food or beverage taxes have used modelling to effectively estimate the impact (Mytton et al., 2012). How much consumption changes in response to increased price is illustrated by price elasticity values, which describe the percentage change in consumption for a one percentage change in price (Powell et al., 2013).

In the US, an estimated 24% reduction in SSB consumption from a penny-per-ounce tax could reduce daily per capita caloric intake from 190 to 200 calories to 145 - 150 calories, if there is no substitution to other caloric beverages or food (Andreyeva, Chaloupka & Brownell, 2011). A recent review of 160 studies suggested that a hypothetical 10% increase in the price of soft drinks would be expected to reduce consumption by around 7.9% in the UK (Andreyeva, Long & Brownwell, 2010).

In relation to fast food consumption, a modelling study in the US noted that a 10% increase in the price of fast food was associated with 5.7% lower frequency of weekly fast food consumption for children and adolescents (Khan et al., 2012). Other modelling techniques predicted that a 20% tax on sugary drinks in the US would reduce the prevalence of obesity by 3.5% (Lin, Smith, Lee & Hall, 2011; Hall et al., 2011) however this rate is much higher than any of the taxes currently imposed by individual states (Mytton et al., 2012). Ng et al. (2011) note that based on UK consumption patterns, increasing the price of SSBs by only 10% is associated with a reduction in SSBs of 7.5ml per day (as based on data from 2007). A recent study suggests that a penny-per-ounce excise tax on SSBs could reduce consumption by 15% among adults aged 25 – 64, which the authors estimate that over the period 2010-2012 could have prevented 2.4million diabetes person-years, 95,000 coronary heart events, 8,000 strokes, and 26,00 premature deaths in the US (Wang, Coxson, Shen, Goldman & Bibbins-Domingo, 2012). Other recent research suggests assuming an imposition of a 20% tax on SSBs, whilst taking cross-price elasticity into account, has a potential reduction in body weight of between 1.54 and 2.55lbs per year (Dharmasena & Capps, 2012).

Some research suggests that that the evidence points to sales taxes having an insignificant effect on the prevalence of obesity (Marlow & Shiers, 2010). For example, for a 1% soft drinks tax increase, research has found only a slight decrease in BMI (Fletcher et al., 2010). A recent study examined US consumer choices in relation to SSBs, including the 33 states in the US that have taxes on soft drinks (with an average tax of 5%) that concluded that current taxes on SSBs may have little impact on obesity (Lopez & Fantuzzi, 2012). However, a review of recent literature concluded that SSB consumption is actually more price sensitive than previously reported (Powell et al., 2013), with a 10% increase in the cost of SSBs resulting in a 12% decrease in consumption. Research examining the effect of current low level SSB taxes (i.e. within the US) upon obesity prevalence and health outcomes may not be demonstrating the full potential of health related tax, as current tax levels are low (Powell et al., 2013; Mytton et al., 2012). This could potentially explain the disparity in research findings examining fiscal policy; within the US, taxes exist at a level of 1-8%, which may be too low to observe a substantial effect on population health (Mytton et al., 2012; Powell et al., 2013). This may explain why research examining the effect of current low taxes has found lesser impact upon health outcomes compared to modelling studies.

This notion is supported by a recent systematic review examining the effects of fiscal policy, which found that duties influenced consumption in the desired direction, with larger taxes being associated with more significant changes in consumption, body weight and disease incidence (Thow, Leeder & Swinburn, 2010). The empirical evidence on the effect of increased taxes on SSB consumption differentiates depending on the magnitude of the price elasticities of demand (Chouinard, Dabis, LaFrance & Perloff, 2007; Sturm, Powell, Chriqui & Chaloupka, 2010).

4. How food taxes should be delivered: Considerations and implications

4.1 Recommended tax and rates

Research unanimously agrees that the strongest evidence is for a tax on SSBs (Academy of Medical Royal Colleges, 2013; Sustain, 2013). Taxing a wide range of unhealthy foods or drinks (e.g. all sugar sweetened beverages) is recommended to result in greater health benefits than simply taxing a small narrow range of goods (Sustain, 2013). Due to recent evidence from modelling studies, experimental studies and research examining the effects of current tax levels on consumer behaviour, it is recommended that food/drink taxes need to be at least 20% to have a significant effect on obesity (Powell & Chaloupka, 2009; Mytton et al., 2012; Sustain, 2013). A systematic review of food prices in relation to population weight concluded that small price changes were not likely to produce significant changes in obesity prevalence, but that larger changes might. Additionally, effects were greater for the young, poor, and those most at risk of being overweight (Powell & Chaloupka, 2009; Mytton et al., 2012).

4.2 SSB tax and impact upon health inequalities

Individuals with lower incomes have been found to consume more SSBs; there is also evidence that people on lower incomes are more sensitive to price increases (Smed, Jensen & Denver, 2007; Powell & Chriqui, 2011; Sustain, 2013) and are more likely to change their consumption behaviour in response to price changes, and should therefore experience greater dietary improvements (Mytton et al., 2012). Some research suggests higher income consumers have significantly lower price elasticity of demand, therefore their SSB choices are less sensitive to price increases due to taxes (Lopez & Fantuzzi, 2012). Although such taxes are regressive (i.e. poorer people pay a greater proportion of their income in tax than do the rich), the health gains may be progressive (Smed et al., 2007; Brownwell & Frieden, 2009) and can narrow inequalities. As lower socioeconomic status is associated with a poorer diet and a greater burden of diet-related chronic disease, the potential health gains from even marginal changes in dietary intakes in this population group may be significant

and may help narrow health inequalities (Landon & Graff, 2012). As childhood diet behaviours are also impacted by parental influences (such as health literacy, parental food intake, parental control of child's diet, using sugary food/drink as a reward [van der Horst et al., 2007; Butland et al., 2007; Kalavana et al., 2010; Academy of Medical Royal Colleges, 2013]), lower income parents could potentially be influenced to change their consumption behaviour by SSB taxation.

4.3 SSB tax and impact upon children and adolescents

A greater impact of taxation on the young is particularly attractive in relation to SSB tax and consumption, as children and adolescents are the highest consumers and the availability of SSBs is a strong factor impacting obesity in this age group (Osei-Assibey et al., 2012). As research highlights that SSB consumption in early life is associated with later overweight and obesity (Mrdjenovic & Levitsky, 2003; Welsh et al., 2005; Muckelbauer et al., 2009; Monasta et al., 2010) and research suggesting beverage preferences develop in early childhood and persist over time (Butland et al., 2007; Jiménez-Cruz et al., 2010; Al-Nakeeb et al, 2012; Pérez-Morales et al., 2013,), interventions that impact early life are likely to be of high impact. Furthermore, obesity has been found to track from childhood into adulthood (van der Horst et al., 2007) and it is acknowledged that it is more difficult to reduce excessive weight in adolescents and adults once it becomes established (Osei-Assibey et al., 2012).

4.4 Substitution effects

When the price of one good rises, consumption of some goods will fall and consumption of other goods (substitutes) rise (Mytton et al, 2012). This is known as the 'substitution effect', which can lead to increased consumption of other unhealthy foods (Sustain, 2013). This is an important factor to account for when considering fiscal measures, as an effective tax levy would need to effectively shift people towards water and other low-calorie drinks (Fletcher et al., 2013). As mentioned earlier, taxing a wider range of unhealthy drinks (e.g. all SSBs) would result in greater benefits, however a tax combined with a subsidy for healthier alternatives would potentially be even more effective than a tax in isolation for a certain product/drink (Mytton et al., 2012; Fletcher et al., 2013; Sustain, 2013). Additionally, an SSB tax that taxes all caloric sweeteners at the manufacturer level would limit consumers' ability to easily switch to foods with caloric sweeteners or other unhealthy beverages (Miao, Beghin & Jensen, 2012). The NHF recommends a 20% price increase should be piloted for a year, as an experimental measure, looking at substitution effects, and to what extent it impacts upon consumption patterns (Landon & Graff, 2012).

4.5 Public acceptability

Views on the acceptability of health related food taxes vary widely, and there is a lack of research identifying an acceptable level of taxation (Mytton et al., 2012). Some research in the US has found greater public agreement with anti- than pro-tax arguments for SSBs. Anti-tax arguments from the public include the feeling that such food/drink taxes are a governmental incentive to increase revenue, the feeling that a tax on SSBs is arbitrary because it does not affect consumption of other unhealthy foods, and the feeling that such taxes are harmful to the poor (Barry, Niederdeppe & Gollust 2013). Support for SSB taxation in the US ranges from 37% to 72%, however, support is greater when the health benefits of the tax are clearly emphasised (Caraher & Cowburn, 2005; Mytton et al., 2012). The term used to describe a tax instrument is likely to affect its acceptability to both the public and policy makers; therefore, the term 'health-related food duty' is recommended as it conveys the health purpose of the measure (Mytton et al., 2012) and the notion of responsibility underpinning the payment of duties on goods that contribute to social harms (Landon & Graff, 2013). Sustain (2013) recommend that the funds generated from health-related food taxes such as an SSB tax should fund health incentives/research, which could in turn further increase public acceptability of such measures. This is an approach used in countries with taxes in effect to tackle obesity; Algeria uses the revenue generated from their SSB tax to fund national anti-cancer prevention, France invests the revenue generated from

SSB taxes into National Health insurance and agriculture, and Hungary intends to invest the revenue generated into obesity prevention (Sustain, 2013). Clear communication of the purpose of the tax and its potential benefits (including how revenues may be used to support health services or health programmes or to subsidise healthy foods) is recognised as crucial, as it will determine public acceptance of the tax (Landon & Graff, 2013).

4.6 Response from industry

Opposition to tax by the beverage industry is to be expected (see industry response in section 3.1) due to the high profitability of SSB consumption and significant vested interests (Brownwell & Frieden, 2009). Furthermore, the Danish saturated fat tax was abolished after thirteen months apparently after heavy criticism from Danish food manufacturers (Sustain, 2013). Food industry arguments consist of the view that taxes would be ineffective, unfair and would damage the industry, potentially leading to job losses, which are similar arguments that were used by the tobacco industry (Mytton et al., 2012). The beverage industry has created groups such as 'Americans Against Food Taxes' to fight such policy changes (Brownwell & Frieden, 2009). There has also been the concern raised that manufacturers would respond to higher taxes by lowering prices (Fletcher et al., 2013). Due to these concerns, the NHF also recommends that producer/retailer responses are examined during a year pilot of SSB taxation at 20% (Landon & Graff, 2012).

5. Summary

In summary, high SSB consumption can have detrimental effects to health, and there is strong evidence for the association between high SSB intake and weight gain. A decrease in the consumption of SSBs has the potential to reduce these detrimental health effects and reduce the prevalence of overweight and obesity. As there are many factors that drive SSB consumption, modifying the consumer environment through taxation could produce a more lasting effect on behavioural change and levels of obesity, as price has been found to be the key determinant of consumption. The evidence illustrates how food tax interventions can be effective, with modelling studies demonstrating the effect of how increased taxes on SSB consumption differentiates depending on the magnitude of the price elasticises of demand.

Key points for consideration:

- Taxation needs to be at least 20% to have a significant effect on obesity.
- Taxing a wide range of SSBs is likely to results in greater health benefits.
- Taxing all calorific sweeteners at the manufacturer level and also combining such taxes with subsidies on healthier options would limit consumer substitution effects, and thus potentially have greater health benefits.

Although the evidence for fiscal interventions is promising, additional focused research is needed to better inform food policy development with the aim of improving eating behaviour and preventing obesity (Epstein et al., 2012). Particularly within the UK, more research is needed to understand SSB consumption patterns and how fiscal measures could impact those with high levels of consumption. Therefore, from the above literature review, there are a number of key demographics that emerge as important for future research attempting to add to the evidence base upon how fiscal measures could impact behaviour.

Key demographics to consider;

- Those with lower incomes may be a key demographic, due to increased unhealthy dietary patterns including increased SSB consumption.
- The North of the UK (North West and North East), due to higher prevalence rates of obesity and overweight compared to the rest of the UK.

- An emphasis upon children and adolescents, as research illustrates: beverage preferences begin to develop early in childhood and can persist over time, childhood is an important intervention stage for obesity prevention, and that this age group are the highest consumers.
- Young families and parents, due to research highlighting the effects of parental influence (food intake, literacy), and research indicating younger adults consume more SSBs than older adults.
- Overweight and obese adults (who potentially have at some point consumed high amounts of SSBs), with perhaps a slight focus towards females due to the slight higher rates of obesity in females in the UK and research proposing that detrimental effects of SSB consumption are stronger in women.

6. References

Academy of Medical Royal Colleges. (2013). Measuring up: The medical profession's prescription for the nation's obesity crisis. Retrieved 05/03/2013 from http://www.aomrc.org.uk/about-us/news/item/doctors-unite-to-deliver-prescription-for-uk-obesity-epidemic.html

Al-Nakeeb, Y. A., Lyons, M., Collins, P., Al-Nuaim, A., Al-Hazzaa, H., Duncan, M. J. & Nevill, A. (2012). Obesity, physical activity and sedentary behavior amongst British and Saudi youth: A cross-cultural study. *International Journal of Environmental Research and Public Health*, *9*, 1490-1506.

Andreyeva, T., Long, M. W. & Brownell, K. D. (2010). The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food, *American Journal of Public Health, 100*(2), 216–222.

Andreyeva, T., Chaloupka, F. J., & Brownell, K. D. (2011). Estimating the potential of taxes on sugar-sweetened beverages to reduce consumption and generate revenue. *Preventive Medicine*, *52*, 413–416.

Bahl, R., Bird, R. & Walker, M. B. (2003). The uneasy case against discriminatory excise taxation: soft drink taxes in Ireland. *Public Finance Review, 31*, 510-533.

Barry, C. L., Niederdeppe, J., & Gollust, S. E. (2013). Taxes on sugar-sweetened beverages results from a 2011 national public opinion survey. *American Journal of Preventive Medicine*, *44*(2), 158-163.

Bleich, S. N., Wang, Y. C., Wang, Y. & Gortmaker, S. L. (2009). Increasing consumption of sugar-sweetened beverages among US adults: 1988–1994 to 1999–2004. *American Journal of Clinical Nutrition*, *89*(1), 372-81.

Block, J. P., Chandra, A., McManus, K. D. & Willett, W. C. (2010). Point-of-purchase price and education intervention to reduce consumption of sugary soft drinks. *American Journal of Public Health, 100*(8), 1427–1433.

Brownell, K. D. & Frieden, T. R. (2009). Ounces of prevention – The public policy case for taxes on sugared beverages. *New England Journal of Medicine, 360*(18), 1805–1808.

Burns, C. M. & Inglis, A. D. (2007). Measuring food access in Melbourne: access to healthy and fast foods by car, bus and foot in an urban municipality in Melbourne. *Health Place, 13*, 877–885.

Butland, B., Jebb, S., Kopelman, P., McPherson, K., Thomas, S., Mardell, J. & Parry, V. (2007). *Tackling obesities: Future choices – Project report*, 2nd edition. Government office for science.

Caprio, S. (2012). Calories from soft drinks - Do they matter*? New England Journal of Medicine, 367*, 1462-1463*.*

Caraher, M. & Cowburn G. (2005). Taxing food: implications for public health nutrition. *Public Health Nutrition*, *8*(8), 1242-1249.

Cassady, B. A., Considine, R. V. & Mattes, R. D. (2012). Beverage consumption, appetite, and energy intake: What did you expect? *The American Journal of Clinical Nutrition*, *95*(3), 587–593.

Chouinard, H., Davis, D., LaFrance, J. & Perloff, J. (2007). Fat taxes: big money for small change. *Forum for Health Economics and Policy,* 10 (2) (Obesity), Article 2. Retrieved 05/03/2013 from http://www.bepress.com/fhep/10/2/2.

CQPP. (2012). Taxation abroad - taxation of soft and energy Drinks - Quebec coalition on weight-related problems. Accessed 05/03/2013 from http://tinyurl.com/7aakwcf

de Ruyter, J. C., Olthof, M. R., Seidell, J. C & Katan, M. B. (2012). A trial of sugar-free or sugarsweetened beverages and body weight in children. *New England Journal of Medicine*; DOI: 10.1056/NEJMoa1203034.

Deshmukh-Taskar, P., Nicklas, T. A., Yang, S. J. & Berenson, G. S. (2007). Does food group consumption vary by differences in socioeconomic, demographic, and lifestyle factors in young adults? The Bogalusa Heart Study. *Journal of the American Dietetic Association,* 107, (2), pp. 223–234.

Dharmasena, S. & Capps Jr, O. (2012). Intended and unintended consequences of a proposed national tax on sugar-sweetened beverages to combat the U.S. obesity crisis. *Health Economics*, 21 (6), pp. 669 - 694.

Eastwood, P. (2013). Statistics on obesity, physical activity and diet: England, 2013, Version 1. Health and Social Care Information Centre: Lifestyle Statics.

Epstein, L. H., Dearing, K. K., Handley, E. A., Roemmich, J. N. & Paluch, R. A. (2006). Relationship of mother and child food purchases as a function of price: a pilot study. *Appetite*, 47 (1), pp. 115–118.

Epstein, L. H., Dearing, K. K., Paluch, R. A., Roemmich, J. N. & Cho, D. (2007). Price and maternal obesity influence purchasing of low-and high-energy-dense foods. *American Journal of Clinical Nutrition*, 86 (4), pp. 914–922.

Epstein, L. H., Jankowiak, N., Nederkoorn, C., Raynor, H. A., French, S. A. & Finklestein. (2012). Experimental research on the relation between food price changes and food-purchasing patterns: a targeted review. *American Journal of Clinical Nutrition*, 95 (4), pp. 789 – 809.

EU Food Policy. (2012). Tax Unhealthy Foods - Concludes Major EU-funded Project. *EU Food Policy*, 138, pp. 4–6.

Ezendam, N. P., Evans, A. E., Stigler, M. H., Brug, J. & Oenema, A. (2010). Cognitive and home environmental predictors of change in sugar-sweetened beverage consumption among adolescents. *British Journal of Nutrition*, 103 (5), pp. 768–774.

Finkelstein, E. A., Zhen, C., Nonnemaker, J. & Todd, J. E. (2010). Impact of targeted beverage taxes on higher- and lower-income households. *Archives of Internal Medicine*, 170 (22), pp. 2028–2034.

Fletcher, J. M., Frisvold, D. & Tefft, N. (2013). Substitution patterns can limit the effects of sugar- sweetened beverage taxes on obesity. *Preventing Chronic Disease*, 10, DOI: http://dx.doi.org/10.5888/pcd10.120195

Fletcher, J. M., Frisvold, D. & Tefft, N. (2010). The effects of soft drink taxation on soft drink consumption and weight for children and adolescents. *Journal of Public Economics*, 94, 967–74.

Gibson, S. (2008). Sugar-sweetened soft drinks and obesity: a systematic review of the evidence from observational studies and interventions. *Nutrition Research Reviews,* 21, pp. 134-147.

Gibson. S. (2010). Trends in energy and sugar intakes and body mass index between 1983 and 1997 among children in Great Britain. *Journal of Human Nutrition and Dietetics*, 23, pp. 371–381.

Gibson, S. & Shirreffs, S. M. (2013). Beverage consumption habits "24/7" among British adults: association with total water intake and energy intake. *Nutrition Journal,* 12 (9), pp. 1 – 9.

Giskes, K., van Lenthe, F., Avendano-Pabon, M. & Brug, J. (2010). A systematic review of environmental factors and obesogenic dietary intakes among adults: are we getting closer to understanding obesogenic environments? *International Association for the Study of Obesity*, 12, pp. 95–106.

Hall, K. D., Sacks, G., Chandramohan, D., Chow, C. C., Wang, Y. C., Gormaker, L. G., et al. (2011). Quantification of the effect of energy imbalance on bodyweight. *Lancet,* 378, pp. 826-37.

Huizinga, M. M., Beech, B. M., Cavanaugh, K. L., Elasy, T. A. & Rothman, R. L. (2008). Low numeracy skills are associated with higher BMI. *American Journal of Preventive Medicine*, 36 (4), pp. 324-8.

Huizinga, M. M, Carlisle, A. J., Cavanaugh, K. L., Davis, D. L., Gregory, R. P., Schlundt, D. G. & Rothman, R. L. (2009). Literacy, numeracy, and portion-size estimation skills. *Obesity,* 16 (8), pp. 1966-68.

James, J., Thomas, P. & Cavan, D. (2004). Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomised controlled trial. *British Medical Journal*, 328, pp.1237–41.

Jimenez-Cruz, A., Bacardi-Gascon, M., Pichardo-Osuna, A., Mandujano-Trujillo, Z. & Catillo-Ruiz, O. (2010). Infant and toddlers' feeding practices and obesity amongst low-income families in Mexico. *Asia Pacific Journal of Clinical Nutrition,* 19 (3), pp. 316-323.

Johnson, R. J., Segal, M. S., Sautin, Y., Nakagawa, T., Feig, D. I., Kang, D. H., et al. (2007). Potential role of sugar (fructose) in the epidemic of hypertension, obesity and the metabolic syndrome, diabetes, kidney disease, and cardiovascular disease. *American Journal of Clinical Nutrition,* 86, pp. 899-906.

Kalavana, T., Maes, S. & de Guht, V. (2010). Interpersonal and self-regulation determinants of healthy and unhealthy eating behavior in adolescents. *Journal of health psychology*, 15 (44), pp. 44-54.

Kessler, D. A. (2009). The end of overeating: taking control of the insatiable American appetite. New York: Rodale.

Khan, T., Powell, L. M. & Wada, R. (2012). Fast Food Consumption and Food Prices: Evidence from Panel Data on 5th and 8th Grade Children. *Journal of Obesity.* DOI:10.1155/2012/857697.

Landon, J. & Graff, H. (2012). What is the role of health-related food duties? National Heart Forum: London.

Le Figaro. (2012). Le Marché Des Soft-drinks a La Gueule De Bois. Accessed 03/03/2013 from http://tinyurl.com/ccdqtvm

Lin, B. H., Smith, T. A., Lee, J. Y. & Hall, K. D. (2011). Measuring weight outcomes for obesity intervention strategies: the case of a sugar-sweetened beverage tax. *Economics & Human Biology,* 9, pp. 329-41.

Lobstein, T. & Dibb, S. (2005). Evidence of a possible link between obesogenic food advertising and child overweight. *Obesity Reviews*, 6 (3), pp. 203-8.

Lopez, R. A. & Fantuzzi, K. L. (2012). Demand for carbonated soft drinks: implications for obesity policy, *Applied Economics*, 44 (22), pp. 2859-2865.

Macdonald, L., Cummins, S. & Macintyre, S. (2007). Neighbourhood fast food environment and area deprivation substitution or concentration? *Appetite,* 49 (1), pp. 251–254.

Malik, V. S., Schulze, M. B. & Hu, F. B. (2006). Intake of sugar-sweetened beverages and weight gain: a systematic review. *American Journal of Clinical Nutrition,* 84, pp. 274-288.

Malik, V.S., Popkin, B. M., Bray, G. A., Despres, J. P. & Hu, F. B. (2010). Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care,* 33, pp. 2477–2483.

Malik, V. S. & Hu, F. B. (2011). Sugar-sweetened beverages and health: where does the evidence stand? *American Journal of Clinical Nutrition*, 94 (5), pp. 1-3.

Marlow, M. L. & Shiers, A. (2010). Would soda taxes really yield health benefits? *Regulation,* 33 (3), pp. 34-38.

Martyn-Nemeth, P., Penckofer, S., Gulanick, M., Velsor-Friedrich & Bryant, F. B. (2009). The relationships among self-esteem, stress, coping, eating behavior, and depressive mood in adolescents*. Research in Nursing and Health*, 32 (1), pp.96-109.

McNeill, G., Masson, L. F., Craig, L. C., Macdiarmid, J. I., Holmes, B. A., Nelson, M. & Sheey, C. (2010). Sugar and fat intake among children in Scotland: what is needed to reach the dietary targets? *Public Health Nutrition,* 13 (8), pp. 1286-1294.

Miao, Z., Beghin, J. C. & Jensen, H. H. (2012). Taxing sweets: sweetener input tax or final consumption tax? *Contemporary Economics*, 30 (3), pp. 344–61.

Monasta, L., Batty, G. D., Cattaneo, A., Lutje, V., Ronfan, L., Van Lenthe, F. J. & Brug. (2010). Early-life determinants of overweight and obesity: a review of systematic reviews. *Obesity reviews*, 11 (10), pp. 695-708.

Morenga, L. T., Mallard, S. & Mann, J. (2013). Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *British Medical Journal*, 346, pp. 7492.

Mrdjenovic, G & Levitsky, D. (2003). Nutritional and energetic consequences of sweetened drink consumption in 6 to 13 year-old children. *Pediatrics,* 142, pp. 604–10.

Muckelbauer, R., Libuda, L., Clausen, K., et al. (2009). Promotion and provision of drinking water in schools for overweight prevention: randomized, controlled cluster trial. *Pediatrics,* 23; e661–7.

Mytton, O., Clarke, D. & Rayner, M. (2012). Taxing unhealthy food and drinks to improve health. *British Medical Journal*, 344, e2931.

Nederkoorn, C., Haverman, R. C., Giesen, J. & Jansen, A. (2012). High tax on high energy dense foods and its effects on the purchase of calories in a supermarket: An experiment. *Appetite*, 56, pp. 760–765.

Ng, S. W., Mhurchu, C. N., Jebb, S. A. & Popkin, B. M. (2011). Patterns and trends of beverage consumption among children and adults in Great Britain, 1986-2009. *British Journal of Nutrition,* 20, pp. 1-16.

O'Neil, C.E., Michael, Z., & Victor, F. (2011). Diet Quality Is Positively Associated with 100% Fruit Juice Consumption in Children and Adults in the United States: NHANES 2003-2006. *Nutrition Journal,* 10 (17), DOI: 10.1186/1475-2891-10-17.

Osei-Assibey, G., Dick, S., Macdiarmid, J., Semple, S., Reilly, J. J., Ellaway, A., Cowie, H. & McNeill. G. (2012). The influence of the food environment on overweight and obesity in young children: a systematic review. *BMJ Open*:e001538. DOI:10.1136/bmjopen-2012-001538.

Pearce, J., Blakely, T., Witten, K. & Bartie, P. (2007). Neighborhood deprivation and access to fast-food retailing: a national study. *American Journal of Preventive Medicine*, 32, pp. 375–382.

Pérez-Morales, R., Bacardí-Gascón, M. & Jiménez-Cruz, A. (2013). Sugar-sweetened beverage intake before 6 years of age and weight or BMI status among older children; systematic review of prospective studies. *Nutricion Hospitalaria*, 28 (1), pp. 47-51.

Pomeranz, J. L. (2012). Advanced policy options to regulate sugar-sweetened beverages to support public health. *Journal of Public Health Policy*, 33 (1), pp. 75–88.

Popkin, B. M. (2012). Sugary beverages represent a threat to global health. *Trends in Endocrineology & Metabolism,* 23 (12), pp. 591-593.

Powell, L. M. & Chaloupka, F. J. (2009). Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q,* 87, pp. 229–257.

Powell, L. M. & Chriqui, J. (2011). Food Taxes and Subsidies: Evidence and Policies for Obesity Prevention (The handbook of the Social Science of Obesity). New York: Oxford University Press.

Powell, L. M., Chriqui, J. F., Khan, T., Wada, R. & Chaloupka, J. (2013). Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: a systematic review of prices, demand and body weight outcomes. *Obesity Reviews*, 14, pp. 110–128.

Reedy, J. & Krebs-Smith, S. M. (2010). Dietary sources of energy, solid fats, and added sugars among children and adolescents in the United States. *Journal of the American Diet Association,* 110, pp. 1477–1484.

Roux, P. (2012). *Food Taxes – State of Play* (Brussels: European Commission, 2012). Accessed 03/03/2013 from http://tinyurl.com/7jaq4j7

Rugg-Gunn, A. J., Fletcher, E. S., Matthews, J. N. S., Hackett, A. F., Moynihan, P. J., Kelly, S., Adams, J. Mathers, J. C. & Adamson, A. J. (2007). Changes in consumption of sugars by English adolescents over 20 years. *Public Health Nutrition*, 10 (4), pp. 354–363.

Smed, S., Jensen, J. D. & Denver, S. (2007). Socio-economic Characteristics and the Effect of Taxation as a Health Policy Instrument. *Food Policy,* 32 (5–6), pp.624–639.

Sturm, R., Powell, L. M., Chriqui, J. F. & Chaloupka, F. J. (2010). Soda taxes, soft drink consumption, and children's body mass index. *Health Affairs,* 29 (5), pp. 1052–1058.

Sustain (2013). A Children's Future Fund: How food duties could provide the money to protect children's health and the world they grow up in. Accessed 06/03/013 from http://www.sustainweb.org/publications/?id=263

Swencionis, C. & Rendell, S. L. (2012). The psychology of obesity. *Abdominal Imaging,* 37 (5), pp.733-737.

Talen, M. R. & Mann, M. M. (2009). Obesity and mental health. *Obesity management*, 36 (2), pp. 287 – 305.

Thow, A. M., Jan, S., Leeder, S. & Swinburn, B. (2010). The Effect of Fiscal Policy on Diet, Obesity and Chronic Disease: a Systematic Review. *Bulletin of the World Health Organization,* 88 (8), pp. 609–614.

Ulijaszek, S. (2007). Obesity: a disorder of convenience. *Obesity reviews*, 8 (1), pp. 183–187.

Underwood, M. (2008). Sugary drinks, fruit, and increased risk of gout. *British Medical Journal, 336*, pp. 285.

van Baak, M. A. & Astrup, A. (2009). Consumption of sugars and body weight. *Obesity Reviews,* 10 (1), pp. 9-23.

van der Horst, K., Oenema, A., Ferreira, I. Wendel-Vos, W. Giskes, K., van Lenthe, F. & Brug, J. (2007). A systematic review of environmental correlates of obesity-related dietary behaviours in youth. *Health Education Research*, 22, pp. 203–26.

Vartanian, L. R. Schwartz, M. B. & Brownell, K. D. (2007). Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. *American Journal of Public Health,* 97 (4), pp. 667-675.

Viskaal-van Dongen, M., de Graaf, C., Siebelink, E. & Kok, F. J. (2009). Hidden fat facilitates passive overconsumption. *Journal of Nutrition*, 139, pp. 1-6.

Wang, C. Y., Coxson, P., Shen, Y., Goldman, L. & Bibbins-Domingo, K. (2012). A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. *Health Affairs*, 31 (1), pp. 199 - 207.

Wang, Y. C., Bleich, S. N. & Gortmaker, S. L. (2008). Increasing caloric contribution from sugar-sweetened beverages and 100% fruit juices among US children and adolescents, 1988–2004. *Pediatrics,* 121: e1604–e1614.

Welsh, J. A., Cogswell, M. E., Rogers, S., Rockett, H., Mei, Z. & Grummer-Strawn, L. M. (2005). Overweight among low-income preschool children associated with the consumption of sweet drinks: Missouri, 1999–2002. *Pediatrics,* 115, e223–9.

Welsh, J. A., Sharma, A. J., Grellinger, L. & Vos, M. B. (2011). Consumption of added sugars is decreasing in the United States. *American Journal of Clinical Nutrition,* 94, pp. 726–734.

Woodward-Lopez, G., Koa, J. & Ritchie, L. (2010). To what extent have sweetened beverages contributed to the obesity epidemic? *Public Health Nutrition*, 1, pp. 1 – 11.

Zenith International (2013). Accessed 05/03/2013 from http://www.zenithinternational.com/reports_data/market_reports/soft_drinks

Authors: Rachel Lavin, Dr Hannah Timpson (nee Smith)

Centre for Public Health
Research Directorate
Faculty of Education, Health & Community
Liverpool John Moores University
2nd Floor Henry Cotton Campus
15-21 Webster Street
Liverpool
L3 2ET

Tel: +44 (0)151 231 4382

Web: www.cph.org.uk