

**Exploring the potential impact of sugar taxation on secondary school-age children and young people's dietary intake:  
an evidence review**

Kate Langley, Jill Muirie, Fiona Crawford, David Walsh

October 2017



## Acknowledgements

Grateful thanks are due to Lorraine Tulloch, Obesity Action Scotland, and Stephanie Chambers, MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, for their help and advice in developing this literature review.

## Contact

Jill Muirie  
Public Health Programme Manager  
Glasgow Centre for Population Health  
Email: [jill.muirie@glasgow.ac.uk](mailto:jill.muirie@glasgow.ac.uk)  
Tel: 0141 330 2683  
Web: [www.gcph.co.uk](http://www.gcph.co.uk)  
Twitter: [@theGCPH](https://twitter.com/theGCPH)

## Contents

Acknowledgements .....	2
Executive summary .....	4
Introduction .....	7
Aims and methods .....	9
Findings .....	11
Literature review .....	11
What is already known about the potential impact of the UK government's specific proposed tax? .....	14
Assessing the potential benefits of SSB taxation on the health of secondary school-age CYP in Scotland .....	17
Discussion .....	21
Conclusions and recommendations .....	24
References .....	26

## Executive summary

### Background and aims

Too much sugar is bad for our health – added sugars should not make up more than 5% of our daily energy intake from food and drinks. Secondary school-age children and young people (CYP) in Scotland experience a range of adverse health impacts, including high levels of obesity and dental decay, associated with ‘added sugar’ intake in their diets which is well in excess of national recommendations. Among 11-18 year-olds – the age group with the highest sugar intake – the single largest contributor is sugar-sweetened beverages (SSBs). There is, therefore, a public imperative to reduce SSB consumption in this age group.

A tax on SSBs is due to be implemented by the UK government in 2018. In light of this, the overall aim of this research was, by means of an evidence review, to better understand the likely impacts of the tax, in particular on the dietary intake of secondary school-age CYP in Scotland. A key motivation was to understand whether, given the health issues affecting young people in Scotland, the UK tax was likely to be a sufficient measure, or whether instead there would be a need for additional action by the Scottish Government.

The specific research questions included:

- What do we know about the potential benefits of sugar taxation in high-income countries on specific population groups?
- What do we know about the potential impact of the UK government's proposed tax?
- What can available survey and other data tell us about Scottish secondary school-age children and young people's dietary habits (principally in relation to sugared drinks)?
- Can any meaningful conclusions be drawn from the evidence review regarding the likely impact of the sugar tax on school-age dietary consumption and health in Scotland?

### Methods

The work comprised a structured literature review of the evidence, and examination of relevant survey and other available data.

## Results

The existing literature shows a promising relationship between increasing prices of SSBs and reductions in consumption. There is less certainty regarding the effects on weight and obesity, given that: the nature and impact of 'substitution effects' (the increase in demand for other products in response to the increase in the price of SSBs) are difficult to predict; estimates generally do not take account of energy expenditure; and it is too early to know the health effects of the 'real life' (i.e. rather than statistically modelled) examples of implementation. Taxes on SSBs can generate substantial revenue for governments, and their potential health benefits mean they have been deemed likely to be cost-effective by many researchers and governments.

The population characteristics and consumption levels of SSBs in the UK provide a suitable context for the introduction of a tax on SSBs. Previous research on SSB taxation suggests that an increase in the price of SSBs is likely to reduce their consumption and ultimately be beneficial to health. However, there are several potential unintended effects of the UK tax that make it difficult to draw definitive conclusions about the likely effects. These include possible substitution with alternative soft drinks (such as full fat milk or fruit juice), calorific snacks or a shift in which SSBs are bought (i.e. those from untaxed small manufacturers) may mean that overall sugar intake is not significantly reduced, and thus may limit the potential benefits of the tax in the UK. However, the intended effect of encouraging manufacturers to reduce the sugar content of SSBs through reformulation could, through reducing sugar intake from SSBs rather than reducing the quantity of SSBs consumed, contribute to a reduction in overall sugar consumption (although this relies on an assumption that consumption of the reformulated SSBs does not increase as the sugar content per unit falls).

The diet of the Scottish population as a whole falls short of several nutritional recommendations and secondary school-age CYP have a particularly poor diet compared with other age groups. In general, the 11-18 year old group consume too much sugar and saturated fat and too few portions of fruit, vegetables and important vitamins and minerals. These patterns are amplified among children and young people from more deprived backgrounds. Given the high prevalence of overweight/obesity and dental problems in this population group, the consumption of added sugar stands out as a major concern. Intake of added sugar is far in excess of the recommended daily maximum level, and the largest single source of added sugar in secondary school children and young people's diets is SSBs. Data on purchases during the school day confirm that a large proportion of secondary school pupils regularly purchase SSBs, often at very low prices or as part of an offer. Leaving the school grounds to purchase low priced and low nutritional quality foods is a very popular lunchtime activity and is influenced by complex interacting social and financial 'push and pull' factors that vary depending on the school environment, level of deprivation and age and sex of pupils. The available survey data for Scottish

secondary school-age pupils have underlined the public health imperative to reduce the consumption of sugary drinks, but has also drawn attention to other unhealthy dietary habits of children and young people (such as consumption of cheap food of poor nutritional quality purchased beyond the school gates). These all warrant attention as part of a broader, more comprehensive strategy (i.e. alongside actions such as marketing regulations, sponsorship restrictions and school meal incentives) to improve the diet of Scottish children and young people and address diet-related health problems in this population.

## **Conclusions**

The prevalence of sugar-related health problems, and the major contribution that consumption of SSBs make to sugar in the diets of Scottish CYP, builds a strong case for prioritising measures to reduce SSB consumption. Given SSBs offer very little nutritional value, there are seemingly no disadvantages to reducing their consumption among this population group, and the population of Scotland as a whole would stand to benefit considerably from sugar-reduction measures. One such measure is SSB taxation, and the available evidence suggests that this could benefit the health of secondary school-age CYP in Scotland, particularly those of lower socioeconomic status. Although there are caveats regarding possible substitution effects, the potential of reduced sugar intake for improvements in weight and dental health at a population level is significant and a tax on SSBs should be considered as a part of a wider strategy to address sugar-related health problems in CYP. That said, however, clearly one additional tax will be insufficient in addressing the dietary health issues associated with Scotland's young population. There is a need, therefore, for the Scottish Government to take a lead in building upon the UK government taxation measure and embarking on a bold, broader strategy – focusing on 'upstream determinants' in terms of regulation, price and availability – to improve the diet of Scottish CYP.

## Introduction

Too much sugar is bad for our health – added sugars should not make up more than 5% of our daily energy intake from food and drinks<sup>1</sup>. Secondary school-age children and young people (CYP) in Scotland experience adverse health impacts that are associated with high sugar intake: around a third are overweight or obese<sup>2</sup> and a third have signs of tooth decay by age five<sup>2</sup>. Nearly three-quarters of secondary school children have had treatment for dental decay<sup>3</sup>. Across the Scottish population, all age groups have ‘added sugar’ intakes in excess of national recommendations; however, the 11-18 year old group have the highest intakes of any group. The largest single contributor to the sugar intake of this age group is sugar-sweetened beverages (SSBs)<sup>4</sup>. Furthermore, teenage boys in Scotland have the highest intakes of SSBs in the UK<sup>2</sup>. There is a clear public health imperative to prioritise the reduction of SSB consumption in this age group. Sugar taxation has been central to recent discourse on obesity prevention and various jurisdictions have now introduced a tax on SSBs including Hungary, France, Finland, Mexico and several US states<sup>5</sup>. The types, rates and scope of these taxes vary between examples but most have shown promising results in terms of reductions in demand for the taxed products and increased revenue generation. The UK government has announced that a tax on SSBs will be introduced in 2018<sup>6</sup>. The potential health benefits are dependent on a host of population and tax regime characteristics, but a reduction in sugar consumption has the potential to confer particular benefits to secondary school-age CYP in Scotland.

Taxing SSBs has emerged in recent years as a promising policy option to reduce their consumption, with evidence suggesting that the biggest reductions are likely to be in the highest consuming groups<sup>7</sup>. ‘SSB’ refers to any non-alcoholic drink with added sugar, including sugar-sweetened carbonated beverages (such as non-diet Coca Cola and Irn Bru), sports drinks (such as Lucozade Sport, Powerade and Gatorade), sweet teas and ready-mixed coffees<sup>8</sup>.

As part of the 2016 UK government budget, it was announced that a soft drinks industry levy (SDIL) involving a new tax on packaged high-sugar drinks will be introduced in April 2018. The stated objective of this levy is to encourage SSB manufacturers to reformulate their products to reduce the added sugar<sup>6</sup>. The SDIL will be imposed on producers and importers of soft drinks with added sugar, and will apply to SSBs with total sugar content of 5g or more per 100ml of prepared drink<sup>a</sup> (18p per litre), with a higher rate for drinks with 8g or more of total sugar per 100ml of prepared drink (24p per litre). It will not apply to any drink where no sugar is added, or to alcoholic beverages with alcohol content above 1.2% ABV<sup>b</sup> (which cannot lawfully be sold in a shop to under-18s) although some drinks with less than

---

<sup>a</sup> Under the soft drinks industry levy a ‘prepared’ drink is one that is at the appropriate diluted volume, and it is this that will be assessed against the ‘sugar content condition’.

<sup>b</sup> Alcohol by volume

1.2% ABV may be exempt. Milk-based drinks with a milk content of 75% or more and milk substitute drinks will not be subject to the levy. The levy differs from a consumption tax as it is explicitly aimed at encouraging producer-led behaviour change. The levy is designed so that, if producers bring down the sugar content of their products, reduce portion sizes and help customers to choose low sugar and sugar-free brands, then they can pay less or no levy<sup>9</sup>.

The UK government conducted a consultation on the implementation of the new levy during the summer of 2016<sup>10</sup> receiving 154 responses. Twenty-six percent of responses were from medical and health groups (26%). Over half of all respondents were in favour of the levy, with many wishing to extend the scope of the levy to other products. In particular, 95% of medical and health bodies who responded to the consultation were supportive of the proposals, and 73% of retailers. A majority of manufacturers and associated trade bodies were opposed to the levy (78%)<sup>11</sup>.

Draft legislation for the levy was published by the UK government as part of the draft Finance Bill in December 2016 and April 2017, with draft secondary legislation to be published later in 2017. The likely impact on the dietary intake of the Scottish and Glasgow population (including specific impacts on different population groups) is uncertain. The Scottish Parliament has the power to introduce its own, separate, sugar tax, although it would need the approval of the UK government to do so. As secondary school-age CYP are known to be particularly frequent consumers of high-sugar soft drinks in Scotland, there is a specific interest in the potential impact of a tax on SSBs on that population.



## Aims and methods

The overall aims of this evidence review were to provide a better understanding of what is already known about the likely (positive and negative) impacts of the proposed UK sugar tax, and its implications for the dietary intake of secondary school-age CYP in Scotland. The following questions formed the basis of the review:

1. What do we know about the potential benefits of sugar taxation in high-income countries on specific population groups?
2. What do we know about the potential impact of the UK government's proposed tax?
3. What can available survey and other data tell us about secondary school-age children and young people's dietary habits (principally in relation to sugared drinks) in Scotland as a whole, in different parts of Scotland (in particular Glasgow), and across Scottish socioeconomic groups?
4. Can any meaningful conclusions be drawn both from survey data and evidence regarding the likely impact of the sugar tax on school-age dietary consumption and health in Scotland?
5. Are there any lessons for implementation or policy in Scotland?
6. What further research is required to answer these questions more robustly?

A structured literature review using defined search terms was conducted across a range of academic databases and websites to explore the current understanding of the potential benefits of sugar taxation and subsequently consider the likely impacts of the UK government's proposed sugar tax. Search terms were combined in a number of ways and were generally limited to 'review articles' and policy documents; however, several modelling studies were found to provide helpful evidence and were therefore included.

A review of survey data was undertaken to explore various aspects of children and young people's diets in Scotland to gauge areas for dietary improvement, and identify where a UK sugar tax could contribute to a strategy to address diet-related health problems. The following surveys were reviewed for relevant findings:

- Scottish Health Survey 2014<sup>12</sup>
- Scottish Health Survey 2011 (this edition had a focus on child health)<sup>13</sup>
- Survey of diet among children in Scotland 2010<sup>14</sup>
- National Diet and Nutrition Survey results from years 1-4 of rolling programme in Scotland<sup>4</sup>
- Health Behaviour in School-Aged Children 2014: World Health Organization Collaborative Cross-National Study (HBSC)<sup>15</sup>
- Survey of sugar intake among children in Scotland 2008<sup>3</sup>
- DEFRA Family Food Survey 2014<sup>16</sup>
- Low income diet and nutrition survey 2007<sup>17</sup>
- Survey of sports drinks consumption among adolescents 2016<sup>18</sup>

- Attitudes to diet and health in Scotland 2015<sup>19</sup>
- Glasgow Health and Wellbeing Questionnaire 2011<sup>20</sup>

Other relevant studies were identified through the Food Standards Scotland and NHS Health Scotland websites and through exploring relevant cited work. Three particular studies provided substantial relevant information about the diets of Scottish secondary school-age children and young people<sup>2,21,22</sup>.

Findings were synthesised and discussed between co-authors and with experts in the field to develop the discussion section of this report and to draw tentative conclusions regarding the potential impact of a sugar tax on dietary consumption and health of Scottish secondary school-age children and young people.

## Findings

### Literature review

#### Introduction

There is substantial evidence that SSB consumption is associated with weight gain, obesity, development of type 2 diabetes mellitus and several cancers<sup>23</sup>. The detrimental dental impact of SSB consumption is also a major concern, with tooth decay being the leading cause of admission to hospital in children aged 5-9<sup>24</sup>. The price of SSBs has fallen over the last decade in real terms<sup>25</sup>, accompanied by rising levels of consumption in populations of high-, middle- and low-income countries<sup>26</sup>. SSBs are the single largest source of sugar in British children's diets, and in Scotland over a third of children's sugar intakes comes from SSBs<sup>3</sup>. Over a third of Scottish CYP are obese, and 74% of secondary school-age children and young people have received treatment for dental decay<sup>27</sup>. These detrimental health impacts make sugar reduction an important public health priority for Scotland<sup>2</sup>.

Discussions and studies around sugar taxation have tended to focus on taxing SSBs, rather than sugary foods or sugar itself as a product. This is because SSBs now make up a substantial proportion of sugar intake in the diet and offer little nutritional value<sup>28</sup>. The types, rates and scope of the taxes vary between examples but most have increased the retail price of SSBs and have shown promising results in terms of reductions in demand for the taxed products and revenue generation<sup>5</sup>. The population health benefits are dependent on a host of population level factors, as well as the characteristics of the tax regime itself. The existing evidence around these is reviewed below.

#### Price elasticity and reducing consumption

Price elasticity refers to the extent to which the demand for a product changes in response to a change in price. Understanding the price elasticity of SSBs is central to determining whether their consumption is likely to be affected by a price change as a result of a tax<sup>25</sup>. Low price elasticity means that demand for a product is unlikely to change much as a result of price, while high price elasticity means that demand will be strongly influenced by price. Several systematic reviews confirm that increasing the price of SSBs is associated with a reduction in consumption<sup>25,28,29</sup>. Estimates demonstrate relatively high price elasticity: a 10% increase in the price of SSBs has been estimated to reduce consumption by 7-17%<sup>29,30</sup> and a 20% increase in the price of SSBs is estimated to reduce consumption by 20-24%<sup>25,31</sup>. While most estimates come from modelling studies, early results following the implementation of a 1 peso per litre excise tax on SSBs in Mexico, equivalent to a 10% price increase, suggest a 9%-17% reduction in purchases of taxed beverages in 2014, as compared with 2013<sup>32,33</sup>. The modelling studies and the emerging case studies from Mexico suggest that increasing the prices of SSBs is an effective measure to reduce their consumption.

Groups with the highest levels of consumption may show a greater reduction in demand in response to a price increase when compared with groups with lower levels of consumption<sup>7</sup>. It follows that these groups stand to benefit the most in health terms from the implementation of a sugar tax<sup>34</sup>. Children, adolescents and groups of lower socioeconomic status tend to consume SSBs at the highest rates and therefore would be expected to be the most responsive to an increase in price and derive the greatest health benefit from the tax<sup>28</sup>. Concerns about the regressive nature of sugar taxes (i.e. impacting disproportionately on lower income groups) are often cited by industry representatives to oppose the introduction of a sugar tax. Research suggests, however, that these regressive effects are ameliorated by the expected progressive distribution of benefits: the health of lower socioeconomic groups should improve most in response to sugar taxation<sup>8</sup>. Results from Mexico confirm that lower socioeconomic status groups have reduced their consumption most; however, a modelling study in the UK did not reach the same conclusion<sup>33,35</sup>. This highlights the potential for different results to be generated between different study designs, as well as the potential for different responses to sugar taxes to occur between countries with different incomes. This has been touched upon in the literature, but further work is needed to establish the nature of the differences<sup>27</sup>.

While price elasticity estimates are promising in showing that demand is reduced when the price goes up, these estimates consider only the price of a product and do not account for the possibility of a new tax being absorbed by retailers or spread across multiple products. If the tax is not passed on to consumers, it may have no effect on consumption.

### Cross price elasticity and substitution

A significant limitation to studies modelling price elasticity is that the estimations fail to account for changes in demand for other, untaxed, products in response to the taxing of a product. This is known as 'cross-price elasticity'<sup>25</sup>. Several studies have shown that the demand for untaxed SSBs is sensitive to the price of a taxed category of beverage<sup>26,28,8</sup>: the categories of drink for which demand increases consistently in response to increased SSB price are high-fat milk and fruit juices<sup>8,28</sup>. The implication of this is that the population continues to consume high calorie beverages, and therefore the calorie reduction required to reduce the number of people who are overweight or obese is not achieved<sup>36</sup>. In children and adolescent groups, one study suggested that the calorie-reducing benefits of a tax on SSBs would be completely offset by the increase in high-fat milk and fruit juices<sup>26</sup>. Despite their high calorie content, milk and fruit juices clearly provide greater nutritional value than SSBs and the long-term health effects of this shift and its implications for cost effectiveness require further research<sup>28</sup>.

Across all the studies reviewed, there was an assumption that taxed soft drinks are likely to be substituted by other soft drinks. One author commented that this fails to acknowledge the potential for demand for food and alcoholic beverages to be

affected by an SSB tax<sup>8</sup>. The relationship between demand for other categories of food and drink requires more exploration to determine whether there are implications for health outcomes.

### Implications for weight and obesity

The purpose of the recent sugar tax proposals has been to improve public health (rather than to generate revenue, as has been the case elsewhere) particularly through reducing the prevalence of obesity and risk of type 2 diabetes. Therefore it is important to determine whether estimated reductions in SSB consumption could have a significant impact on health outcomes<sup>37</sup>. While there are many studies modelling the change in consumption of SSBs in response to a price change, fewer studies have attempted to model the impact on these population health outcomes. There is little consensus on the benefits of a sugar tax on health outcomes, partly because researchers base their estimations on differing modelling scenarios, hypothetical tax regimes and population characteristics, and use different outcomes to gauge the impact of the tax. For example, some researchers estimated the effect on weight per person<sup>8</sup>, while others used changes in BMI<sup>37</sup> or onset of diabetes<sup>38</sup>. Existing estimates for reductions in weight range from less than 2lb<sup>8</sup> to 4.5lb<sup>39</sup> per person per year in weight loss as a result of a 20% tax on SSBs. Obesity prevalence estimates generate an average of 0.99% and 1.38% reductions in adult and youth obesity rates respectively with a 16% tax rate over ten years<sup>37</sup>. In contrast, several studies found that once calorie replacement and substitution effects have been accounted for, there would be no benefit of a tax on SSBs in terms of weight and obesity<sup>25,26</sup>. With regards to diabetes prevalence, one study from the USA estimated that a 'one penny per ounce' tax (equating to around 25p per litre in the UK) could reduce diabetes by 2.6% among 25-64 year olds, and this association was found to be independent of reductions in body mass index (BMI)<sup>38</sup>.

Despite the conflicting evidence and lack of real life data, it is worth noting that significant pieces of work in high income countries by the US Department of Agriculture<sup>39</sup>, Public Health England<sup>40</sup> and the World Health Organization<sup>41</sup> concluded that a tax on SSBs would most likely be beneficial to population health, and therefore supported the implementation of a sugar tax.

### Revenue generation

Previous taxes on SSBs have been introduced as a means of revenue generation rather than for health improvement<sup>26</sup>, and these have demonstrated the potential for a higher level of tax to mobilise significant financial resources for governments. The revenue generated would decrease with the falling purchasing of SSBs, in line with the intended effects of a tax; however, there is the potential for a tax, at the right level, to be a cost-effective and a significant revenue-generating option<sup>42</sup>. A modelling study of the cost effectiveness of a proposed cent per ounce tax on SSBs in the USA over a ten-year period found it to be a cost-saving intervention,

accounting for the substantial health cost savings and the projected administrative costs associated with implementing and collecting a new tax<sup>37</sup>. Another study estimated that the same proposed tax could generate US\$78 billion in the five-year period between 2010 and 2015, in addition to public health benefits from reduced obesity<sup>31</sup>. The ring-fencing of the revenue for obesity prevention and other health policies could augment the potential benefits of the tax and is included as part of many of the existing 'real-life' (i.e. not modelled) and proposed sugar taxes. For example, revenue has been used to fund sports in primary and secondary schools, to provide nutritious breakfasts to children<sup>43</sup>, to subsidise the purchase of healthier foods<sup>42</sup>, to ensure access to safe drinking water<sup>28</sup> and to promote healthy food choices<sup>7</sup>.

#### Key points from the literature review

The existing evidence shows a promising relationship between increasing prices of SSBs and reductions in consumption. There is less consistency regarding the effects on weight and obesity, given that the nature and impact of substitution effects are difficult to predict, estimates generally do not take account of energy expenditure, and it is too early to establish the health effects of the real life examples of implementation. Taxes on SSBs can generate substantial revenue for governments and their potential health benefits mean they have been deemed likely to be cost-effective by many researchers and governments.

#### What is already known about the potential impact of the UK government's specific proposed tax?

In its 2016 budget, the UK government proposed a soft drinks industry levy (SDIL) on SSBs<sup>43</sup>. SSBs containing between 5g and 8g per 100ml will be subject to a lower band of tax and those containing more than 8g per 100ml will face a higher rate<sup>6</sup>. The English portion of the tax revenue will be spent on supporting sport and nutritious breakfasts in schools in England<sup>43</sup>. How the revenue will be spent in Scotland, Wales and Northern Ireland is a devolved issue and no announcements have yet been made.

A consultation on the implementation of the new levy was undertaken by the UK government between August and October 2016<sup>10</sup>. As the levy is on SSB manufacturers rather than consumers, and is intended to encourage lower sugar reformulations of SSB products, it is not clear to what extent the levy will be passed onto consumers. Limited modelling and real-life studies, as well as the relative infancy of the discourse around sugar taxation as a policy option in the UK, render projections of its impact difficult. Small businesses will be exempt from paying the

tax<sup>6</sup> and the implications of this are, again, unknown as this has the potential to impact on the type of drinks consumed (branded versus unbranded), and the manufacturers from which soft drinks are purchased. Jou *et al.* suggest three factors to guide considerations of how successful a tax on SSBs might be, and these offer a starting point for determining the likely effects of the UK-specific tax<sup>34</sup>. They are: obesity prevalence; existing level of SSB consumption; and baseline taxes on SSBs. These factors can inform tentative conclusions about the impact of a sugar tax in the absence of modelling studies for the proposed regime in the UK. Given the possibility of substitution effects noted earlier, a fourth factor of overall sugar consumption might also be usefully considered.

### Prevalence of overweight and obesity

Weight, BMI and obesity characteristics of any given population can help to determine how successful a tax on sugar might be, as this determines the size of the target population who would benefit from the tax<sup>34</sup>. According to recent survey data<sup>12,44</sup>, 65% of English men and 58% of English women are overweight or obese, and these figures are slightly higher for Scotland at 69% and 61% for men and women respectively. Across the UK, approximately 30% of children aged 11-15 years are overweight or obese<sup>44</sup>. These figures reflect the scale of the public health challenge of obesity and clearly represent a large target population for which a sugar tax could be a beneficial intervention. There is also significant concern around the dental health of the UK population, particularly among children and young people, who are the highest consumers of SSBs.

### SSB consumption

While the increasing prevalence of obesity and high BMI in the UK population point to a large number of potential beneficiaries of a sugar tax, the existing level of SSB consumption (and specifically carbonated SSB consumption, in the case of the UK) must also be considered<sup>34</sup>. If SSBs are not consumed to high levels across the population they are unlikely to be significant contributors to weight gain and obesity, and reducing their consumption may have a negligible impact on population health. One study calculated that the UK population consumes on average 49.2 calories per person per day from SSBs, with 16-29 year olds consuming the most with more than four times as much energy from SSBs as those over 50 years old<sup>35</sup>. These levels of consumption are significantly lower than those of American adults, who consume an average of 145Kcal per day<sup>45</sup>. However, other UK survey data show that average sugar intake is three times the new maximum recommended intake (5% of all energy intake) in school-aged CYP, and around twice the recommended level for adults<sup>46</sup>.

### Type and scope of tax

The new proposed UK tax on SSBs is to be applied at the level of producers or importers: therefore there is potential for the tax to be partially or fully absorbed by these corporations leaving the sale prices of carbonated SSBs unaffected<sup>47</sup>.

However UK-specific modelling studies have suggested that taxes of 10% or 20% are likely to be transferred to consumers and would impact on consumption levels<sup>35,48</sup>. The UK tax will be applied as a set cost per volume (known as ‘specific’ tax) rather than a percentage of price (known as ‘*ad valorem*’<sup>c</sup> tax) which means consumers will be less likely to substitute for lower cost SSBs<sup>47</sup>.

Consumption of diet drinks, milk and fruit juices are likely to rise in response to the UK’s proposed tax<sup>8,28</sup>; however, the effect on confectionery and other sugar-sweetened products is unknown. Furthermore, groups consuming high levels of SSBs show different patterns of substitution to groups that consume fewer SSBs, so unintended effects as a result of substitutions are difficult to predict<sup>48</sup>. The fact that ‘small’ soft drink producers<sup>9</sup> will not have to pay the tax may also mean that some high-sugar drinks will still be available to buy at the pre-tax cost. Further unintended effects might relate to the criteria that ‘small producers’ must meet to be exempt from the tax<sup>9</sup>, and how businesses might reorganise in line with that.

### Modelling studies

One study has considered in detail the likely effect of 20% and 10% increases in prices due to SSB taxes on the number of overweight and obese people in the UK<sup>35</sup>. The study takes into account the likelihood of cross-price elasticity/substitution and estimates the income- and age-specific effects. While it is not specific to the proposed tax, it provides useful information about the likely effect of a tax on the UK population. The 20% tax was estimated to reduce obesity among adults by 1.3% and the proportion of the adult population classed as overweight by 0.9%. The study found predicted annual revenue from the tax to be £276 million. A 10% tax was found to have roughly half the impact, producing a 0.6% reduction in obesity and raising £139 million. The group that were found to derive the greatest benefit from the taxes (in terms of reduced SSB consumption) were children and young people under the age of 30, who are the highest consumers of SSBs. The reductions in SSB consumption were also found to be greater among those with higher household incomes, which is not consistent with estimations from US-based modelling studies and raises concerns about unintended regressive effects of the tax in the UK on low-income groups. In line with most of the modelling studies this study did not consider the benefits to dental health of a sugar tax. It is also important to note that this modelling study assumed that the SSB tax would be fully reflected in an increased retail price, which may not be the case with the proposed UK tax.

---

<sup>c</sup> Latin for ‘according to value’.



## Key points about the potential impact of the UK SSB levy

The population characteristics and consumption levels of SSBs in the UK provide a suitable context for the introduction of a tax on SSBs. In line with previous research on SSB taxation, an increase in the price of SSBs is likely to reduce their consumption and ultimately be beneficial to health. However, there are several aspects of the proposed UK tax that make it difficult to draw definitive conclusions about the effects of the tax, for example, potential unintended effects including substitution with alternative soft drinks (such as milk or fruit juice), calorific snacks, or a shift in which SSBs are bought (i.e. from small manufacturers) may mean that overall sugar intake is not significantly reduced, and thus may limit the potential benefits of the tax in the UK. However, the intended effect of encouraging manufacturers to reduce the sugar content of SSBs through reformulation could, through reducing sugar intake rather than SSB consumption, contribute to a reduction in overall sugar consumption, although this relies on an assumption that consumption of the reformulated SSBs does not increase as the sugar content per unit falls.

## Assessing the potential benefits of SSB taxation on the health of secondary school-age CYP in Scotland using survey data

In order to assess the potential benefits of SSB taxation on the health of secondary school-age CYP in Scotland, it is essential to have an up-to-date understanding of their dietary behaviour and influencing factors. This review of survey data has looked at all aspects of CYP's diets in Scotland (not just sugar) with the aim of understanding areas for improvement where a tax on SSBs could be part of a broader strategy to address diet-related health problems.

The rest of this section presents a summary of the principal findings of analyses of survey data, alongside other relevant studies of dietary habits of secondary school-age pupils in Scotland.

### Sugar and sugary drinks

Sugar intake, particularly through SSBs, is very high among children and young people in Scotland compared with other age groups in the UK<sup>4</sup> and the National Diet and Nutrition Survey draws attention to SSB intake in secondary school-age pupils as a particularly concerning dietary trend<sup>4</sup>. No significant difference in SSB intake among children and young people has been found between Scotland and England<sup>49</sup>. All age groups in Scotland display sugar intakes in excess of the recommended 11% of total recommended daily energy consumption, with age groups 4-10 and 11-18 years being the most extreme. In secondary school-age pupils, a third of sugar intake comes from SSBs and roughly a quarter of this group drink SSBs at least once a day<sup>4</sup>. Sugar intake from SSBs also varies according to levels of socioeconomic deprivation, with CYP (of all ages) living in deprived areas deriving significantly more of their sugar intake from SSBs<sup>3</sup>. Total sugar intake is also higher among groups of children and young people living in more deprived areas, with

greater consumption of confectionary and soft drinks than those living in less deprived areas<sup>3</sup>.

Most surveys do not distinguish between different sub-categories of SSBs but it is worth considering that as well as intake of traditional soft drinks being very high, frequent consumption of non-carbonated sports drinks is becoming increasingly common. In a study of Welsh secondary school age pupils, almost 90% of participants claimed to drink sports drinks regularly<sup>3</sup>. Taste was cited most commonly as the main influential factor for choosing to drink a sports drink, rather than its claimed/ marketed potential to enhance physical ability during sport or exercise<sup>3</sup>. While this evidence is not specific to Scotland, it is worth noting as sports drink consumption has a seriously detrimental impact on dental health<sup>3</sup>, and similar habits are likely to be seen among the Scottish school-age population, a substantial proportion of whom experience tooth decay<sup>3</sup>.

A survey of secondary school pupils in Glasgow found that over half had consumed alcohol, and over a quarter did so more than once a month<sup>20</sup>. The most popular drinks were beer, cider, alcopops, spirits and fortified wine. Across Scotland as a whole, consumption figures were slightly lower, with 11% of boys and 17% of girls aged 12-16 consuming alcohol at least once a month<sup>14</sup>. Aside from the obvious alcohol-related public health concerns, many of these drinks are an additional source of sugar and are generally unaccounted for in estimates of SSB consumption.

Consumption of caffeinated energy drinks is increasing among CYP<sup>50</sup>. Much like alcoholic drinks, these are a source of additional sugar in their diets and their consumption generates further public health concerns related to high caffeine content and associated detrimental health effects<sup>50</sup>. Secondary school teachers in Scotland report substantial lesson disruption as a result of many pupils consuming high caffeine energy drinks and several schools across Scotland have banned their consumption on school premises<sup>51</sup>.

### General diet

The diet of the Scottish population falls short of nutritional recommendations and this is particularly the case among secondary school-age CYP aged 11-18<sup>4</sup>. Recent Scottish Health Survey data found that only 14% of CYP aged 2-15 were eating the recommended five portions of fruit and vegetables each day<sup>12</sup>. Approximately one tenth of all CYP do not eat fruit and vegetables at all<sup>12</sup>. Consumption decreases with increasing age and by age 13-15 the average intake is 2.5 portions with 14% eating no fruit or vegetables whatsoever<sup>12</sup>. CYP are more likely to meet recommendations if at least one of their parents do so<sup>12</sup>.

As children and young people age, they gain control over their food choices, and consume more food and drink outside of the home<sup>9,15</sup>. With increasing age, they also exhibit notably increased consumption of several food types including chips, fried and roast potatoes, non-diet soft drinks, crisps and savoury snacks and

confectionery<sup>14</sup>. Intake of saturated fatty acids in school-age pupils is above the daily recommended value (11% or less of total energy intake), as is the intake of non-milk extrinsic sugars (NMES or 'added sugars'). NMES should make up less than 10% of total energy intake but in fact make up almost 20% of both boys' and girls' diets in Scotland<sup>3</sup>. Older children and young people eat fewer meals at home with their families and are less likely to eat breakfast every day<sup>15</sup>. Skipping breakfast has been associated with an increased likelihood of snacking on sugary foods throughout the remainder of the day<sup>52</sup>. A survey of over 9,000 secondary school-age pupils in Glasgow found that 30% had skipped breakfast on the day of the survey<sup>20</sup>.

The intake of several vitamins and most minerals is low among secondary school-age CYP in Scotland<sup>17</sup>. A survey of the Scottish population found that Vitamin A and Riboflavin<sup>d</sup> intake was low in large numbers of 11-18 year olds<sup>14</sup>. Vitamin C intake was high in all age groups but the proportion derived from fruit and vegetables decreased as children aged, with a large amount coming from soft drinks and fruit juices<sup>14</sup>. Average mineral intakes (calcium, iron, magnesium, potassium, zinc) were low across all 11-18 year olds and iron intake was especially low in girls, 46% of whom consumed less than the recommended daily amount<sup>14</sup>.

Some dietary trends vary by socioeconomic status, and these trends are consistent across all age groups<sup>17</sup>. Across the whole of the UK, the most disadvantaged groups are less likely to consume wholemeal bread and vegetables and more likely to consume SSBs, processed meats, high fat milk and sugar than the least disadvantaged groups<sup>17</sup>. Among children and young people in Scotland, the more deprived groups have a higher average energy intake and eat more sugared cereals, ice cream, processed meat, chips, confectionery and soft drinks<sup>14</sup>. These groups have the highest proportions of people classed as overweight or obese, and the highest rates of dental decay, as a result of both the dietary inequalities described above, as well as other social and economic factors predisposing them to poorer health outcomes<sup>3</sup>.

### School environment

SSBs are a very popular lunchtime purchase: 28% of all young people in one Scotland-wide study purchased SSBs daily and one third of these were caffeinated energy drinks<sup>53</sup>. In a survey of pupils in Glasgow, non-diet fizzy drinks represented by far the largest category of drinks consumed: 39% had consumed one during their most recent school day<sup>12</sup>. In one of the more deprived schools in Scotland, SSBs made up over 50% of all purchases at lunchtime and some were available for as little as 30 pence<sup>53</sup>.

---

<sup>d</sup> Vitamin B<sub>2</sub>

### Key points from survey findings

The diet of the Scottish population as a whole falls short of several nutritional recommendations and secondary school-age CYP have a particularly poor diet compared with other age groups. In general, the 11-18 year old group consume too much sugar and saturated fat and too few portions of fruit, vegetables and important vitamins and minerals. These patterns are amplified among children and young people from more deprived backgrounds. Given the high prevalence of overweight/obesity and dental problems in this population group, the consumption of added sugar stands out as a major concern. Intake of added sugar is far in excess of the recommended daily maximum level, and the largest single source of added sugar in secondary school children and young people's diets is SSBs. Data on purchases during the school day confirm that a large proportion of secondary school pupils regularly purchase SSBs, often at very low prices or as part of an offer. The available survey data for Scottish secondary school-age pupils have underlined the public health imperative to reduce the consumption of sugary drinks, but has also drawn attention to other unhealthy dietary habits of children and young people (such as consumption of cheap, poor nutritional quality food purchased beyond the school gates). These all warrant attention as part of a comprehensive strategy to improve the diet of Scottish children and young people and address diet-related health problems in this population.

## Discussion

### The case for sugar reduction in the diets of secondary school-age children and young people in Scotland

High numbers of secondary school-age CYP in Scotland are overweight or obese; high levels of dental decay are another characteristic of this group. In recent years the Scottish Government has recognised the huge public health and economic cost of these conditions and has prioritised improvements in childhood in all three<sup>54,55</sup>. High intake of SSBs is associated with the development of these conditions, as well as other serious health problems later in life including reduced insulin sensitivity, type 2 diabetes mellitus and cardiovascular disease<sup>56</sup>. Findings from recent surveys paint a worrying picture of the average diet of secondary school-age CYP. Among other concerns, they show that added sugar intake is significantly in excess of the national recommended daily maximum: the largest single contributor to this intake is SSBs, making up 30% of the total<sup>4</sup>. The findings also highlight the popularity among secondary-school pupils of leaving school premises at lunchtime to buy poor nutritional quality foods from local retailers, and that a large proportion of such purchases include SSBs<sup>53</sup>. The prevalence of sugar-related health problems, together with the knowledge that SSBs are a major contributor to sugar in the diets of Scottish CYP, builds a strong case for prioritising SSB reduction. Given SSBs offer very little nutritional value, there are seemingly no disadvantages to reducing their consumption among this population group, and the population of Scotland as a whole would stand to benefit considerably from potential sugar-reduction measures, of which SSB taxation is one.

### Sugar-sweetened beverage consumption

A number of studies show that increasing the price of SSBs leads to reductions in their consumption<sup>7,28,29</sup>. A UK-specific study concluded that those under 30 years of age would see the greatest health benefits from a 20% tax on SSBs<sup>35</sup>. Data on the dietary habits of secondary school-age pupils throughout the school day also provide good evidence that price is an important influence on their purchases, with SSBs often being purchased as part of a lunchtime 'meal deal'<sup>53</sup>. Overall, it is likely that secondary school-age CYP will reduce their consumption of SSBs as a result of an increase in price.

### Substitution effects

The possibility of increases in demand for other products as SSB prices increase is acknowledged by much of the research on the topic. Untaxed products are likely substitutes and although these will vary depending on the final details of the tax, studies have found high fat milk, fruit juices and diet drinks to be common substitutes<sup>26</sup>. In the case of the UK tax, which will have two different levels of taxation, a likely substitute for products taxed at the higher rate are products taxed at the lower rate. Furthermore, the consumption of artificially sweetened and diet drinks

has been linked to dental erosion<sup>57</sup> and appetite-modulating effects possibly leading to weight gain<sup>58</sup> possibly due to justifying the consumption of other energy dense foods or by promoting a preference for sweet tastes<sup>59</sup>. It is particularly difficult to draw conclusions about likely substitutions in the context of lunchtime purchases by school-age pupils, as it is not known how much of the levy will be passed on to consumers, how retailers might respond and what the impact would be on offers and meal deals.

### Weight gain, obesity and dental health effects

The long-term population health effects of SSB taxes are difficult to predict: it is too soon to assess the impact of the real life cases of sugar tax implementation, and results from modelling studies vary in their conclusions. The uncertainty around substitutions also makes the impact on dental health difficult to predict as some of the drinks that are likely to replace SSBs have high sugar content (fruit juices) or acidic pH (diet drinks and sports drinks) which lead to dental decay and erosion respectively<sup>60</sup>. However, given that SSBs provide such a large proportion of the total sugar in Scottish children and young people's diets, there will be dental health benefits as a result of a sugar tax, although these benefits will only be realised if the frequency of sugar consumption falls alongside a fall in overall sugar consumption.

### Revenue generation and health cost savings

The available evidence suggests that substantial revenue could be generated from a tax on SSBs, given the current high consumption levels in Scotland. Substantial savings could also be made by the NHS if a tax is effective in reducing the sugar intake enough to influence the prevalence of associated health conditions. The acute and long term management of these, often chronic, conditions currently requires a huge amount of financial resources; for example, the costs associated with diabetes alone account for around 10% of Scottish NHS expenditure<sup>17</sup>. Modelling studies, existing SSB tax regimes and new SSB tax proposals all acknowledge the potential for revenue to be used to augment the obesity-reducing aims of the tax. Clearly, however, a successful tax will reduce the purchase and consumption of SSBs and so it should be anticipated that tax revenues would fall.

### Effect on inequalities

Several modelling studies suggest that the highest consuming groups will benefit most (in health terms) from a sugar tax, as these groups are expected to be the most sensitive to price. In Scotland it is the groups with the lowest incomes that exhibit the highest levels of SSB consumption and the highest rates of obesity, overweight and dental problems. In this context, an SSB tax would be expected to have an equitable impact on population health (i.e. population groups with the worst health problems will gain the most health benefits from the intervention). In contrast, however, a UK-based modelling study projected that the biggest reductions in consumption and obesity prevalence would actually be among the *highest* income groups<sup>35</sup>, potentially

widening inequalities further; the cost, however, was expected to be low, with a 20% tax resulting in an estimated increase of 8 pence per person per week<sup>35</sup>.

The modelling evidence is mixed but the case of tobacco taxes in the UK provides a potentially useful real-life example. Like SSB consumption, smoking is more common among groups with lower socioeconomic status<sup>14</sup>. While various policies have contributed to creating an environment that discourages smoking, increased taxation has been found to be particularly effective at reducing socioeconomic inequalities in smoking prevalence in the UK<sup>61</sup>.

## Conclusions and recommendations

### Sugar taxation

In conclusion, there is evidence that taxes on SSBs could benefit the health of secondary school-age CYP in Scotland, particularly those of lower socioeconomic status. Despite the caveats regarding possible substitution effects, the potential of reduced sugar intake for improvements in weight and dental health at a population level are significant and as such, a tax on SSBs should be considered as a part of a strategy to address sugar-related health problems in CYP.

The literature suggests that taxes on SSBs could benefit the health of secondary school-age CYP in Scotland, with some evidence suggesting that it would be particularly beneficial for those of lower socioeconomic status. Despite the caveats regarding possible substitution effects, the potential of reduced sugar intake for improvements in weight and dental health at a population level are significant and as such, a tax on SSBs should be considered as a part of a strategy to address sugar-related health problems in CYP. However, there is no consensus over which type of tax (i.e. percentage of price, fixed price per litre, fixed price per gram of sugar, industry levy) is most effective, but most research suggests a tax rate that increases the retail price of SSBs by at least 20% is required in order to have an impact on consumption levels and population health outcomes. However, the available evidence also tells us that if a tax is significant enough to lead to reduced demand for a taxed category of SSBs, it is likely to lead to increased demand for other, untaxed, SSBs.

The UK tax will take a different approach to that of other countries, imposing a two-tier levy on manufacturers of SSBs as a means of encouraging lower sugar reformulations of their products. No evidence exists that is relevant to this proposal and it is unclear how manufacturers will respond and, specifically, whether any levy will be passed on to the consumers of SSBs in the retail price. If the levy is passed on, there may be a resulting substitution effect which increases consumption of exempted high-sugar or high-fat products, and which may undermine the sugar-reduction aims of the tax. However, if manufacturers respond by reformulating their products, a reduction in sugar consumption may follow if consumers do not substitute other high sugar products for the reformulated SSBs.

However, it is clear that Scottish secondary school-age CYP are subject to many influences when making their food and drink choices (not just price) and that a sugar tax alone is not enough to make the required improvements in health. In terms of reducing sugar intake, therefore, any soft drinks tax has the potential to be helpful but must be part of a comprehensive strategy to reduce overall sugar intake among young people in order to be optimally effective. Marketing regulations, retail policies, sponsorship restrictions, nutrition and cooking education and incentives to take up



school meals could all play a role alongside taxes in creating an environment that discourages the consumption of soft drinks. In this way, the potential benefits of a sugar tax go beyond simply influencing price-based purchasing behaviour; it can be part of a strategy that encourages manufacturers to change their products and consumers to reduce their consumption of SSBs, not just because of their price, but also through normalisation of the consumption of sugar-free beverages including water. **There is a clear need, therefore, for the Scottish Government to take a lead in building upon the UK government taxation measure and embarking on a bold, broader strategy to improve the diet of Scottish CYP.**

A further recommendation is to ring-fence the revenue generated by the tax for public health purposes. This could augment the beneficial effects of a sugar tax and is likely to garner public support. Further policy areas for attention are considered below and the substantial revenue generated by a sugar tax could contribute to improvement in these areas.

### Further policy considerations

As has been stated previously, it is important that SSB taxes are part of a multi-faceted strategy to reduce sugar intake. In the case of tobacco control, excise taxes and consequent price rises were preceded and followed by a number of other measures which made smoking less popular<sup>61</sup>. Smoking bans, packaging warnings, graphic television campaigns and restricted advertising and sales have all contributed to building an environment which discourages smoking and has reduced smoking rates over time<sup>61</sup>. Much like tobacco control, policies beyond fiscal measures (taxes) must be part of the approach to reducing sugar intake among Scottish CYP.

### Innovative approaches to sugar reduction

There are many examples of innovative approaches to improving the diets of children and young people across the UK including: school garden schemes, where pupils can grow and eat their own fruit and vegetables<sup>62</sup>; teaching on nutrition and cookery; incentive schemes to encourage children to eat in school<sup>63</sup>, and sugary drinks bans implemented by individual schools<sup>64</sup>. These approaches are not explicitly sugar reduction measures, but their focus on engaging young people in discussions around food production and nutrition may improve diets as a whole. Further evaluation of these approaches is required, but they offer potentially effective avenues for tackling dietary problems in Scotland beyond traditional governmental measures such as advertising restrictions and excise taxes.

## References

1. Scottish Government. Revised dietary goals for Scotland. Edinburgh: Scottish Government; 2016.
2. Food Standards Scotland. The Scottish diet: It needs to change . Edinburgh: Food Standards Scotland; 2015.
3. Sheey C, McNeill G, Masson L, Craig L, Macdiarmid J, Holmes B, Nelson M. Survey of sugar intake among children in Scotland 2008. Edinburgh: Food Standards Agency Scotland; 2008.
4. Food Standards Agency. National Diet and Nutrition Survey Rolling programme Results from Years 1-4 (combined) for Scotland (2008/09-2011/12). London: Food Standards Agency; 2014.
5. Cornelsen L, Carreido A. Health related taxes on food and beverages 2015. London: Food Research Collaboration; 2015.
6. HM Treasury, HM Revenue & Customs and Department of Health. Soft Drinks Industry Levy: 12 things you should know. London: HMRC/DoH; August 2016.
7. Buhler S, Raine KD, Arango M, Pellerin S, Neary NE. Building a strategy for obesity prevention on piece at a time: the case of sugar sweetened beverage taxation. Canadian Journal of Diabetes 2013;37:97-102.
8. Dharmasena S, Capps O. Intended and unintended consequences of a proposed national tax on sugar-sweetened beverages to combat the US obesity problem. Health Economics 2012;21:669-694.
9. HM Revenue & Customs. Finance Bill 2017: legislation and explanatory notes. London: HMRC; 2017.
10. HM Revenue & Customs, HM Treasury. Soft drinks industry levy consultation. London: HMRC/HM Treasury; 2016.
11. HM Treasury & HM Revenue and Customs. Consultation outcome: soft drinks levy. <https://www.gov.uk/government/consultations/soft-drinks-industry-levy>
12. Scottish Government. Scottish Health Survey 2014 Edition. Edinburgh: Scottish Government; 2015.
13. Scottish Government. Scottish Health Survey Volume 2. Edinburgh: Scottish Government; 2011.

14. Food Standards Scotland. Survey of diet among children in Scotland 2010 Volume 1: Diet, Obesity and Physical Activity. Aberdeen: Food Standards Scotland; 2012.
15. Currie C, van der Sluijs W, Whitehead R, Currie D, Rhodes G, Neville F, Inchley J. Findings from the 2014 survey in Scotland: Health behaviour in school-age children: World Health Organization Collaborative Cross-National Study. St Andrews: Child and Adolescent Research Unit (CAHARU), University of St Andrews; 2015.
16. Department for Environment, Farming and Rural Affairs. Family Food 2014. London: DEFRA; 2015.
17. Food Standards Agency. Low income diet and nutrition survey 2007. London: Food Standards Agency; 2007.
18. Broughton D, Fairchild RM, Morgan MZ. A survey of sports drinks consumption among adolescents. *British Dental Journal* 2016;220:639-643.
19. Food Standards Scotland. Attitudes to diet and health in Scotland. Aberdeen: Food Standards Scotland; 2015.
20. NHS Greater Glasgow and Clyde. Glasgow health and wellbeing survey 2011. Glasgow: NHSGGC; 2011.
21. Wrieden WR, Barton KL. Monitoring progress towards the Scottish Dietary Goals 2001 to 2012 - Report 1. Aberdeen: Food Standards Scotland; 2015.
22. Crawford F, Ellaway A, Mackison D, Mooney J. A feasibility study to explore the nutritional quality of 'out of school' foods popular with school pupils. Glasgow: GCPH; 2012. Available at: [http://www.gcph.co.uk/publications/371\\_is\\_eating\\_out\\_of\\_school\\_a\\_healthy\\_option\\_for\\_secondary\\_pupils](http://www.gcph.co.uk/publications/371_is_eating_out_of_school_a_healthy_option_for_secondary_pupils)
23. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *American Journal of Clinical Nutrition* 2006;84(2):274-288.
24. British Dental Association. Sugar and children's oral health: what do I need to know? London: British Dental Association; 2015.
25. Powel IL, Chriqui JF, Khan T, Wada R, Chaloupka FJ. 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* 2013;14(2):110-128.
26. Fletcher JM, Fisvold DE, Tefft N. The effects of soft drink taxes on child and adolescent consumption and weight outcomes. *Journal of Public Economics* 2010; 94(11-12):967-974.

27. Lavin R, Timpson H. Exploring the acceptability of a tax on sugar sweetened beverages: brief evidence review . Liverpool: Centre for Public Health Liverpool John Moores University; 2013.
28. Cabrera Escobar MA, Veerman JL, Tollman SM, Bertram MY, Hofman KJ. Evidence that a tax on sugar sweetened beverages reduces the obesity rate: a meta-analysis. *BMC Public Health* 2013;13:1072.
29. Andreyeva T, Long M, Brownell, K. 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* 2010;100(2):216-222.
30. Brownell K, Frieden T. Ounces of prevention – the public policy case for taxes on sugared beverages. *New England Journal of Medicine* 2009;360(18):1805-1808.
31. Andreyeva, T, Cahloupka, FJ and Brownell, KD. Estimating the potential of taxes on sugar sweetend beverages to reduce consumption and generate revenue. *Preventive Medicine* 2011;52(6):413-416.
32. Pan American Health Organization. PAHO taxes on sugar sweetened beverages as a public health strategy: the experience of Mexico. Washington, DC: PAHO; 2015.
33. Colchero MA, Popkin BM, Rivera JA, Ng SW. Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. *BMJ* 2016;352:h6704.
34. Jou J, Techakehakij W. International application of sugar-sweetened beverage (SSB) taxation in obesity reduction: factors that may influence policy effectiveness in country-specific contexts. *Health Policy* 2012;107:83-90.
35. Briggs ADM, Mytton OT, Kehlbacher A, Tiffin R, Rayner M, Scarborough P. Overall and income specific effect on prevalence of overweight and obesity of 20% sugar sweetened drink tax in UK: econometric and comparative risk assessment modelling study. *BMJ* 2013;347:f6189
36. Fletcher MJ, Frisvold DE, Tefft N. Can soft drink taxes reduce population weight? *Contemporary Economic Policy* 2010;28(1):23-35.
37. Long MW, Gortmaker SL, Ward ZJ, Resch SC, Moodie ML, Sacks G, Swinburn BA, Carter RC, Wang YC. Cost effectiveness of a sugar-sweetened beverage excise tax in the US. *American Journal of Preventive Medicine* 2015;49(1):112-123.
38. Wang YC, Coxson P, Shen YM, Goldman L, Bibbins-Domingo K. A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. *Health Affairs* 2012;31(1):199-207.

39. Smith TA, Lin BC, JY L. Taxing carolic sweetened beverages: potential effects on beverage consumption, calorie intake and obesity. Washington, DC: US Department of Agriculture; 2010.
40. Public Health England. Sugar reduction: the evidence for action. London: Public Health England; 2015.
41. World Health Organization. Fiscal policies for diet and the prevention of noncommunicable diseases. Geneva: WHO; 2016.
42. Brownell KD, Farly G, Wilett WC, Popkin BM, Chaloupka FJ, Thompson JW, Ludwig DS. The public health and economic benefits of taxing sugar-sweetened beverages. *New England Journal of Medicine* 2009;361:1599-1605.
43. HM Treasury. Budget 2016. London: HM Treasury; 2016.
44. Health and Social Care Information Centre. The Health Survey for England 2014: Summary of key findings. London: HSCIC; 2015.
45. Rosinger A, Herrick K, Gahche J, Park S. Sugar-sweetened beverage consumption among U.S. adults, 2011–2014. *NCHS Data Brief* 2017;(270):1-8.
46. Food Standards Agency and Public Health England. NDNS results from years 1 to 4 combined of the rolling programme for 2008 and 2009 to 2011 and 2012: executive summary . London: Public Health England; 2012.
47. Chriqui JF, Chaloupka FJ, Powell LM, Eidson SS. A typology of beverage taxation: multiple approaches for obesity prevention and obesity prevention-related revenue generation. *Journal of Public Health Policy* 2013;34(3):403-432.
48. Tiffin R, Kehlbacher A, Solois M. The effects of a soft drink tax in the UK. *Health Economics* 2015;24:583-600.
49. Wriedon W, Chambers S, Barton K, Albani V, Anderson A. Diet and excess mortality in Glasgow and Scotland: exploring differences in diet and nutrition. Edinburgh: NHS Health Scotland; 2015.
50. Breda JJ, Whiting SH, Encarnacao R, Norberg S, Jones R, Reinap M, Jewell J. Energy drink consumption in Europe: a review of the risks, adverse effects, and policy options to respond. *Frontiers in Public Health* 2014;2:134.
51. The Courier. Councils moving to back the Courier's 'Can It' campaign. July 1 2016. <https://www.pressreader.com/uk/the-courier-advertiser-perth-and-perthshire-edition/20160701/281492160630176>
52. Berkey CS, Rockett HRH, Gillman MW, Field AD, Colditz GA. Longitudinal sutdy of skipping breakfast and weight change in adolsecents. *International Journal of Obesity and Related Medical Disorders* 2003;27(10):1258-1266.

53. Wills WJ, Kapetnaki A, Rennie K, Danesi G, Martin A, Hamilton L, Bygrave A. The influence of deprivation and the food environment on food and drink purchased by secondary school pupils beyond the school gate. Aberdeen: Food Standards Scotland; 2015.
54. Scottish Government. Improve Children's Dental Health. Edinburgh: Scottish Government; 2016.
55. Scottish Government. Preventing Overweight and Obesity in Scotland: a route map towards healthy weight. Edinburgh: Scottish Government; 2010.
56. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. *American Journal of Public Health* 2007;97(4):667-675.
57. Tahmassebi JF, Duggai MS, Malik-Kotru G, Curzon MEJ. Soft drinks and dental health: a review of the current literature. *Journal of Dentistry* 2006;34(1):2-11.
58. Fowler SP, Williams K, Resendex RG, Hunt KJ, Hazuda HP, Stern MP. Fueling the obesity epidemic? Artificially sweetened beverage use and long-term weight gain. *Obesity* 2008;16(8):1894-1900.
59. Mattes RD, Popkin BM. Nonnutritive sweetener consumption in humans: effects on appetite and food intake and their putative mechanisms. *American Journal of Clinical Nutrition* 2009;89(1):1-14.
60. Cheng R, Yang H, Shao M, Hu T, Zhou X. Dental erosion and severe tooth decay related to soft drinks: a case report and literature review. *Journal of Zhejiang University Science* 2009;10(5):395-399.
61. Hill S, Amos A, Clifford D, Platt S. Impact of tobacco control interventions on socioeconomic inequalities in smoking: review of the evidence. *Tobacco Control* 2014;23(e2):e89-e97.
62. School Food Matters. Our story. <http://www.schoolfoodmatters.org/about-us/our-story> (accessed 10/08/2017)
63. Fuel Zone. About. <http://fuelzone.co.uk/pages/about.asp> . (accessed 10/08/2017)
64. Smith C. Kirkcaldy High encourages other schools to follow their lead after sweet success of sugary drinks ban. *The Courier*. March 21 2016. Available at: <http://www.thecourier.co.uk/news/local/fife/kirkcaldy-high-encourages-other-schools-to-follow-their-lead-after-sweet-success-of-sugary-drinks-ban-1.929950> (accessed September 2017)