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Sugar Reduction: The evidence for action

Annexe 2: A mixed method review of behaviour changes resulting from experimental studies that examine the effect of fiscal measures targeted at high sugar food and non-alcoholic drink

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Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. It does this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. PHE is an operationally autonomous executive agency of the Department of Health.

Public Health England
Wellington House
133-155 Waterloo Road
London SE1 8UG
Tel: 020 7654 8000
www.gov.uk/phe
Twitter: @PHE_uk
Facebook: www.facebook.com/PublicHealthEngland

Prepared by: Louisa J Ells, Katharine Roberts, Victoria J McGowan and Theodora Machaira

For queries relating to this document, please contact: sugarreduction@phe.gov.uk

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A mixed method review of behaviour changes resulting from experimental studies that examine the effect of fiscal measures targeted at high sugar food and non-alcoholic drink

Research team: Louisa J. Ells, Katharine Roberts, Victoria J. McGowan and Theodora Machaira

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1. GLOSSARY, ABBREVIATIONS AND ACRONYMS

1.1 Glossary

Excise Tax/duty: Taxes paid on specific goods, for example alcohol, tobacco and petrol

Value Added Tax: VAT – A consumption tax placed on the purchase price of most goods and services in the UK

1.2 Abbreviations and acronyms

BMI	Body mass index
COREQ	Consolidated criteria for reporting qualitative research
CVD	Cardiovascular disease
ED	Energy dense
HCFN	High calories for nutrients
HFSS	High fat, sugar, salt
JBI	Joanna Briggs Institute
LCFN	Low calories for nutrients
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
PHE	Public Health England
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
RCT	Randomised controlled trial
SACN	Scientific Advisory Committee on Nutrition
SSDs	Sugar-sweetened drinks
WHO	World Health Organization

2. EXECUTIVE SUMMARY

2.1 Background

In June 2014, alongside the publication of the Scientific Advisory Committee on Nutrition's (SACN) draft report of carbohydrates and health, Public Health England (PHE) published 'Sugar reduction: Responding to the challenge'. It described PHE's future plans relating to sugar reduction, including plans to carry out evidence reviews and further analysis to allow consideration of initiatives that have been previously identified as areas for future discussion. The existing evidence base includes natural experiments, experiments in controlled environments, and modelling studies. Although this review focuses only on data from experimental and observational studies, modelling studies are referred to for context as they provide a simulated effect of taxation suggesting a tax of 10% to 20% would be necessary to have a significant impact on purchases, consumption, and ultimately population health.

A number of countries and US states have introduced taxes on high sugar products. Sales data from Norway, Finland, Hungary, France and Mexico broadly suggests decreases in purchases of soft drinks/sugar sweetened drinks (SSDs) of up to 12%, following the implementation of taxes. However, data in the public domain did not meet the criteria for inclusion in the review of the literature, therefore it is simply described as background to the review.

This review was conducted alongside a complementary review examining the impact of marketing strategies targeted at high sugar food and non-alcoholic drinks.

2.2 Aim

The aim of this review was to examine the most recent (2010 onwards) research evidence on the health and behavioural impacts of fiscal measures that target high sugar food and non-alcoholic drink, in both adult and child populations to provide evidence to support policy development in relation to fiscal measures.

2.3 Methods

This was a mixed methods review that combined, by triangulation, the findings of the peer reviewed and grey literature (published in English language in the Organisation for Economic Co-operation and Development (OECD) countries from 2010 onwards), with findings from a series of key stakeholder interviews.

2.4 Key findings

A total of 11 publications were identified and included in the literature review and cover evidence mainly from adult populations (n=10), only one was in children. The primary studies were conducted in France (n=1), the Netherlands (n=3), and the US (n=7). The majority of studies were small scale (n<200) and study quality was generally moderate. Findings from the literature review were triangulated with emerging themes from 15 stakeholder interviews with an additional two individuals who provided written evidence.

2.4.1 Summary of published evidence, categorised by type of study

Laboratory/virtual experiments:

- seven out of eight studies (four descriptive laboratory, two randomised controlled trials (RCTs) virtual, one controlled virtual, one controlled laboratory) demonstrated that an increase in the price of SSDs or groups of unhealthy energy dense (ED)/high calorie for nutrient (HCFN) foods resulted in a decrease in purchases. The remaining study showed no effect

- two studies provided outcomes specifically related to high sugar products or sugar consumption, and both showed a reduction in consumption of high sugar products or unhealthy foods as a result of a fiscal strategy
- one study examined the different impacts of a fiscal strategy (which included subsidies on healthy foods as well as a tax on high sugar food and drink) in low and medium income groups, and while this strategy improved the energy density and nutritional quality of foods purchased overall in both income groups, it was reported that the low income group derived fewer financial (from subsidies) and nutritional benefits compared to the medium income group
- studies varied in quality; however, the majority were moderate

Supermarket/cafeteria/restaurant experiments:

- all studies were undertaken in adult US populations. One randomised controlled field study and one descriptive study were conducted in supermarkets. One controlled field study took place in a cafeteria
- all studies reported reductions in sugar purchasing as a result of the fiscal strategy
- the first study reported a short-term reduction (one month) in SSDs purchases but this reduction was not sustained at three or six months
- the second study reported that a 30% tax on unhealthy food increased the probability of purchasing ‘healthy’ food by 11% compared with the baseline
- the final study showed a 35% tax on regular soft drinks (no tax on diet drinks or water) in a hospital cafeteria resulted in a reduction in sales of regular soft drinks by 26% (increasing to 36% during a combined phase of education and tax) and an increase in sales of diet soft drinks by 20%. A ‘control’ site with no increase in price showed no change in soft drink sales during the same time period
- study quality was generally moderate

A fiscal strategy appears to impact purchasing of sugar products, however, the quality of the evidence is generally moderate and further research is required to understand compensatory behaviours and unintended consequences.

2.4.2 Summary of stakeholder interviews

Saturation of themes (the point at which no new data emerges) was almost reached as most stakeholders discussed similar points. However, the small number of interviews conducted (n=15, with an additional two individuals providing written evidence) prevented reaching full saturation. The key emerging themes focused on countries with a fiscal strategy and then more general themes around impact, evaluations, regressive and progressive nature, and response to the fiscal strategy from industry, public, and political representatives. However, the interviews revealed very little unpublished intelligence.

2.4.3 Summary of triangulated findings

When triangulated, evidence from the literature and stakeholder interviews provided convergent and complementary themes to suggest:

- increased prices on unhealthy food and drink results in a decrease in purchasing and sales
- sales data from five countries indicate that existing taxes reduce purchases, although there were no official published evaluations
- taxation may be regressive, having a higher impact on those from lower income groups, but this is believed to be progressive if this strategy reduces sugar consumption

Inter-method discrepancies were found when themes from the interviews covered areas which were either not identified in the literature review or fell outside the scope of the review. These themes, which were only identified in the stakeholder interviews, addressed the lack of evaluations from counties with a tax on high sugar products, responses from industry, political representatives, and the public, and taxation leading to a reduction in consumption.

2.5 Conclusion

Evidence from both stakeholders and current research studies suggest that increasing prices of high sugar foods and non-alcoholic drinks, potentially through taxation, is likely to reduce purchases of these products in the short term. All the empirical data assessed in the included studies reviewed demonstrated that consumers are responsive to changes in food and drink prices and those that did not report an effect had implemented a relatively low tax compared with other studies.

These findings complement the evidence from modelling studies, which indicate that taxation would lead to a reduction in purchases proportionate to the level of tax applied, suggesting a tax of 10% to 20% would be necessary to have a significant impact on purchases, consumption, and ultimately population health. Moreover, the available evidence on sales data from countries that have implemented a tax on sugar products also aligns with these findings to suggest that purchases have reduced since the tax was implemented.

The current evidence base appears to converge and suggests that a fiscal strategy is likely to reduce purchases of high sugar products at least in the short term. However, the overall lack of peer-reviewed experimental evidence has resulted in very little insight into effects that have been highlighted in the broader literature. These include the difference in short and long term effects, the extent and nature of a regressive (and progressive) effect and an understanding of compensatory behaviours and their impact

on individual and population level dietary intake and nutritional quality overall. Any new tax should be accompanied by a robust evaluation which examines the long term effects of any price increases, specifically assessing compensatory behaviours and whether price increases would exacerbate health inequalities within certain population subgroups.

KEY CONSIDERATION:

- evidence suggests that increasing prices of high sugar foods and non-alcoholic drinks, potentially through taxation, may reduce purchases of these products proportionate to the level of the price increase imposed

3. BACKGROUND

3.1 Public health and policy context

In Europe, poor diet is responsible for up to 40% of the non-communicable disease burden [1, 2]. In the UK, the contribution of diet-related risk factors to the burden of illness and disease, including high body mass index (BMI), is second only to tobacco use [3].

Currently in the UK, 25% of adults aged 16 and above are obese and around two thirds are either overweight or obese [4]. With the increasing prevalence of obesity, in developing countries as well as developed, there has been increased focus on tackling the 'obesogenic' (obesity promoting) environment through population level, coordinated action by local, regional and national policy makers. Within Europe and globally, a number of different types of public health nutrition policies have been implemented to improve the nutrition of the population [2, 5].

People in the UK consume more sugar than is recommended at the time of this review [6] and sugar consumption increases the risk of consuming too many calories which contributes to weight gain and obesity [7]. In June 2014, alongside the publication of the SACN draft report on carbohydrates and health, PHE published 'Sugar reduction – responding to the challenge' [8]. It described PHE's future plans relating to sugar reduction, including plans to carry out evidence reviews and further analysis to allow consideration of initiatives that have been previously identified as areas for future discussion. This review was conducted alongside a complementary review examining the impact of marketing strategies targeted at high sugar food and non-alcoholic drinks.

3.2 The rationale for health-related fiscal measures

As an important determinant of food choice, price is one focus for interventions aimed at changing population level dietary consumption [9]. Price-based initiatives such as taxes, subsidies and other economic initiatives are employed in some countries and US states, either to discourage the consumption of unhealthy nutrients such as salt, sugar and saturated fat or encourage the consumption of healthy foods such as fruit and vegetables.

Using fiscal measures to promote health, prevent disease and raise revenue is not a new idea. Standard economic theory hypothesises that individuals will make decisions to make themselves as well off as possible and therefore price will influence demand [10]. Tobacco and alcohol duties are a good example of where fiscal measures have been used both to change peoples' health related behaviours and to generate public revenue [11, 12]. However, it is difficult to disaggregate the effect of the tax from other concurrent policy actions.

Taxes can be implemented as a sales tax (such as Value Added Tax in the UK) or an excise tax that can be applied on a specific nutrient, a combination of nutrients or on a category of food or drink such as SSDs [13]. Most current examples of food or drinks taxes are excise taxes. The disadvantage of a sales tax compared with an excise tax is that because larger volumes of soft drink are cheaper to buy per unit, the tax does not increase proportionately to the amount purchased. An excise duty however, is a fixed rate per unit volume which removes any incentive to mitigate the effect of the duty by bulk buying or buying cheaper brands [14].

A tax on SSDs in particular has been of interest because of their association with obesity, diabetes [15] and dental caries [16]. SSDs contribute a significant proportion of sugar consumed in the UK particularly by children and young adults (up to 30% of sugar for teenagers) [17]. Intakes are above reference intake values, which have been set to reduce the risk of consuming excess calories, weight gain, and dental caries. In the final report 'Carbohydrates and health' SACN concludes that consumption of sugars increases the risk of dental caries as well as leading to increases in daily energy intake, thus contributing to a risk of overweight or obesity and that consumption of SSDs are specifically associated with increases the risk of type 2 diabetes mellitus [7]. Soft drinks consumption in the UK has risen from 13,770 million litres in 2007 to 14,520 million litres in 2013, 39% of which is made up of sugary drinks [18]. The drivers for consumption of SSDs are numerous, complex and not fully understood [19]. However, as a contributor to diet-related ill health, frequently with little nutrient value other than calories from sugar and with readily available substitutions in the form of either diet drinks or water, they are currently a target for taxation in many countries with existing taxes [20].

3.3 Theoretical basis

Interventions aimed at changing population level dietary consumption behaviours are complex and comprise multiple interacting components. Large scale RCTs are regarded as the gold standard for evaluating the effectiveness of complex interventions [21]. However, these are not always feasible due to time and financial constraints. Smaller scale experimental studies in real life, or virtual settings, offer a more viable solution to these constraints but are limited in their population level applicability. Modelling studies can explore the potential effects of fiscal strategies through simulations using a mathematical modelling framework and are useful in the incremental research process [22]. However, they should be interpreted as tentative projections and integrated with empirical evidence from evaluations of fiscal strategies in practice in order to fully understand the wider effects of such policies [22]. Therefore, this review focused on gathering empirical evidence to complement the existing plethora of modelling evidence on the effectiveness of fiscal strategies aimed at reducing sugar consumption.

3.4 Attitudes and acceptability

Robust research into the acceptability of health-related food taxes varies widely and there is a lack of research into what level of taxation may be deemed acceptable by the public [23]. In European countries where taxes have been implemented, there have been reports of varying responses from the public and industry [13, 24]. In some cases, such as Hungary and Denmark, the industry and public reaction has been reported to be negative. In Hungary a significant proportion of the population believe that the tax is primarily a revenue raising instrument rather than a public health initiative and industry argue that the tax brings about equity issues, product discrimination and possible job losses. In France, while public sentiment is neutral, industry has argued against there being sufficient evidence for the taxes to be framed as a public health initiative; and in Finland, industry have argued that the taxes have distorted competition within the food industry [24].

A UK study exploring the acceptability of a hypothetical tax on SSDs in a sample of 293 people from the North-West of England, found that 51.9% of survey participants felt that a 20% price increase would be acceptable [25]. All participants agreed that they felt that all revenues generated through SSD taxes should be used for a health-related purpose.

Additionally, a study completed by Harris Interactive on behalf of The Grocer (a food and drink magazine) found that 45% of those surveyed were in favour of a tax on sugary drinks, 65% of parents believed the sale of energy drinks to under-16s should be banned and 47% of participants believed these drinks should have a special tax [26]. However, this support was not demonstrated by a randomised study by Petrescu [27], which showed participants felt that nudge interventions were more acceptable methods for reducing population level obesity prevalence with only a minority of participants supporting taxation.

3.5 Health inequalities

As a tax is levied at the same rate regardless of income, a tax on food or drink may have a disproportionate impact on those individuals in lower income groups. Data show that lower income groups are disproportionately affected by price increases compared with the general population [28]. The potential regressive nature of a tax on food or drink is of concern and needs consideration. Estimates of this effect from modelling studies have varied but the effect is likely to be larger when the foods or drinks taxed are core items or food groups (such as dairy products) than when they are specific non-core food items (such as SSDs) [29].

Lower income groups are, however, those for whom poor diet-related health outcomes are most prevalent [30]. Therefore, they may also benefit disproportionately from the associated health gains compared with the general population and therefore a tax may

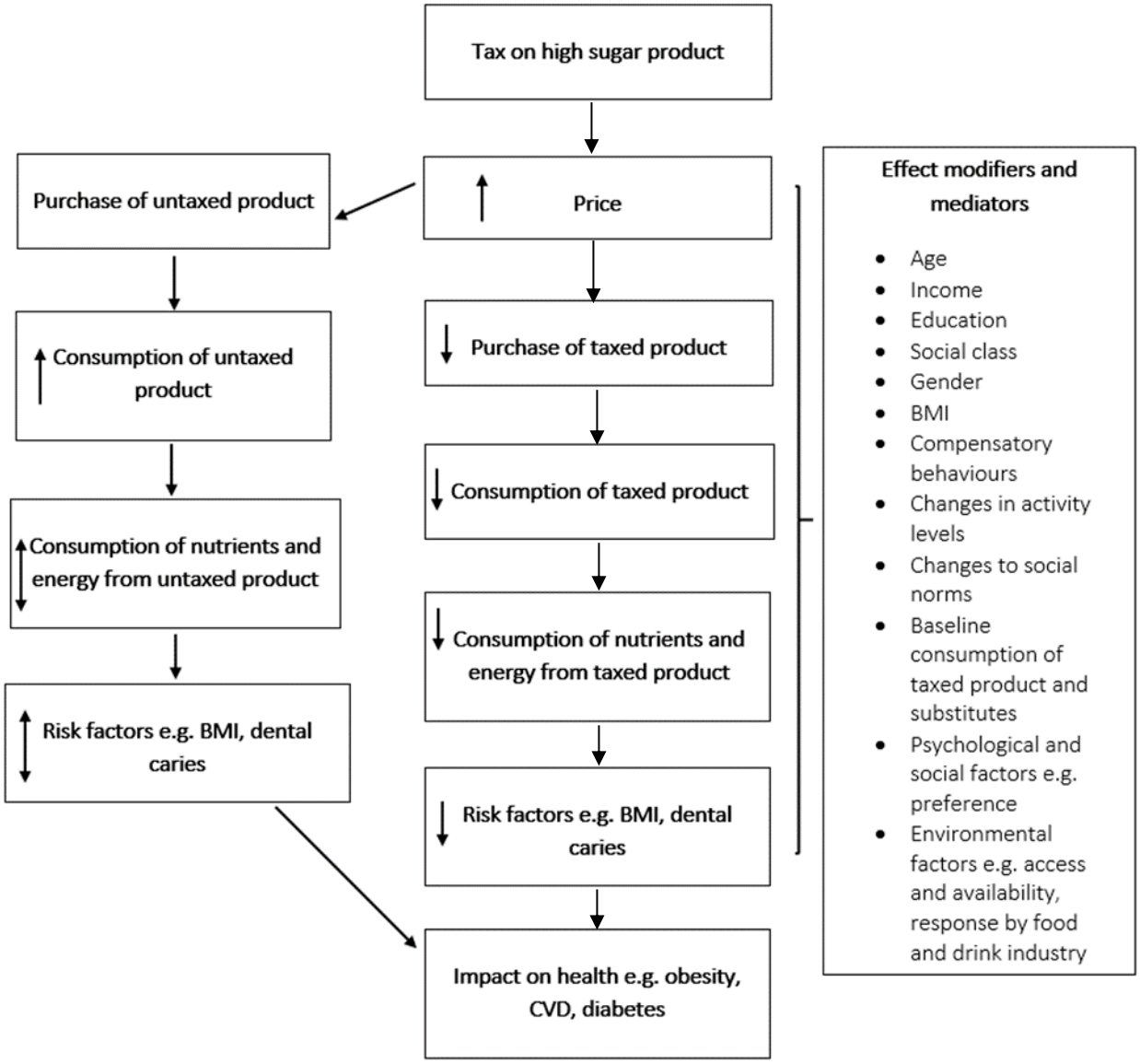
contribute to reducing health inequalities [24]. The revenue generated from such duties could also be ring-fenced to support public health programmes and other wider initiatives aimed at reducing inequalities in health [11, 24].

3.6 The complexity of dietary behaviours and unintended consequences

The complex nature of diet related behaviour and its association with health outcomes such as obesity should be carefully considered in terms of how a tax on high sugar foods and drinks is implemented. Food consumption and its association with health outcomes is non-linear and is influenced by a diverse set of determinants that operate and interact at an individual, community and population level [19, 31].

Figure 1 illustrates the logical framework for how product price may affect behaviour and, in turn, health outcomes. It also shows the numerous mediators and modifiers that may influence behaviour change and potentially lessen the impact of a tax. There is evidence from both experimental and modelling studies that adverse substitution or compensatory effects from taxation of foods and drinks can occur. For example, taxing one food or nutrient may be offset by substitution with other nutrients that also have negative or no positive consequences for dietary quality overall [24]. However, these effects may be mitigated when healthier alternatives to the taxed food or drink are available, for example sugar-free alternatives to SSDs.

Figure 1: Hypothesised logic model for the possible effect of a fiscal strategy on high sugar products



Source: Adapted from Mytton et al, 2014 [31].

3.6 Existing taxes

The nature of the current taxes that exist in OECD countries is shown in Table 1. Robust evaluations of these taxes, that demonstrate their impact on purchasing, consumption or health outcomes are not available except for Hungary [24]. [1] There are some indications of decreases in purchases of soft drinks/SSDs between 4-10% in European countries following the implementation of taxes [32]. However, data in the public domain did not meet the criteria for inclusion in the review of the literature described below, therefore it is simply described here as background to the review.

Table 1: Existing health-related taxes in OECD countries ordered by date of implementation

Country	Date of implementation	Product(s) taxed	Tax rate
US	Various	34 states and the District of Columbia have taxes on SSDs sold in food stores. 39 states and the District of Columbia have taxes on SSDs sold in vending machines. (last updated January 2014) [30]	Average tax 5.172% (max 7%) 5.261% (max 7%)
Norway	1981 (increased in the 2011 budget)	Non-alcoholic beverages containing added sugar or sweeteners Chocolate Sweets	2.81 NOK (£0.30*) per litre (drinks), 17.13 NOK (£1.87) per litre (syrups) 17.92 NOK (£1.96) per kg 6.94 NOK (£0.76) per kg (sugar)
Australia	2000	Soft drinks, confectionery, biscuits and bakery products	10%
Finland	2011 (increased in the 2012 and 2014 budget)	SSDs Sweets/ice cream Sugar-free drinks	€0.22/litre €0.95/kg €0.11/litre

[1] Please note that it has been reported by the World Health Organization (WHO) that an evaluation of the Hungary tax has been conducted and data published by the WHO are cited here, however, the original evaluation report is not available in English, therefore details of the methodology could not be described here or included in the results of the evidence review.

Sources: Adapted from Mytton et al [23], Sustain [11], the Instituto Naccional de Salud Publica [33], Powell et al [34], WHO [24], Chriqui et al [35].
*price in GBP is approximate and is taken from original published figure

Country	Date of implementation	Product(s) taxed	Tax rate
Hungary	September 2011 *(amendments post Jan 2012 in italics)*	Sugary drinks *Syrups or concentrates (>25% fruit content exempt)* *Added sugar (>8g/100ml)* Energy drinks (containing methyxanthines >1mg/100ml, taurine >100mg/100 ml) Salty snacks (>1g/100g food) and condiments (>5g/100g food – mustard and ketchup exempt) Sweets, biscuits, ice-creams and chocolate *Chocolate (added and total sugar >40g/100g and cocoa content <40g/100g)* *Other sweetened products (added and total sugar >25g/100g)* *Flavoured alcohol (Total sugar content >5g/100ml)* *Fruit jams*	5 HUF/L (£0.01) *200 HUF/L* *7 HUF/L* 250 HUF/L (£0.70) 200 HUF/kg (£0.56) 100 HUF/kg (£0.28) *130 HUF/kg* *130 HUF/Kg* *20 HUF/L* *500 HUF/kg*
Denmark	October 2011 – November 2012 (repealed)	Products with more than 2.3% of saturated fat; meat, dairy products, animal fats and oils. Further taxes due to be introduced in 2013 until tax repealed in 2012: Soft drinks Ice cream, chocolate, sweets	16 DKK/kg (£1.78) of saturated fat 0.34 DKK (£0.04)/litre for sugary drinks, 0.17 DKK (£0.02)/litre for sugar free drinks. 4.5 DKK (£0.50)/kg (chocolate, sweets), 1 DKK (£0.11)/litre (ice cream)
France	1 January 2012 1 October 2012	Drinks containing added sugar or sweeteners Energy drinks	€7.16 per hectolitre (€0.07/L) €0.50/L

Country	Date of implementation	Product(s) taxed	Tax rate
Mexico	1 January 2014	Non-alcoholic and non-dairy drinks with added sugar	10%

Norway
In Norway a tax was introduced in 1981 and increased in the 2011 budget. A study showed that average consumption of lemonade and regular soft drinks had significantly decreased (from 4.8 to 2.5 and 2.3 to 1.6 times per week respectively) between 2001 and 2008 which is contrast to rises seen in other European countries [11].

Finland
Finland introduced taxes on SSDs, sweets, ice cream, and sugar-free drinks in 2011 at varying rates. Although the impact of the tax on health, purchases or consumption has not been officially evaluated, unofficial reports have suggested that the tax led to a decrease in sales, by 4.7% of SSDs and sweets [24].

Hungary
In Hungary, the Public Health Product Tax was introduced in September 2011 as an indirect tax on pre-packed products in categories where there are healthy alternatives available: sugar sweetened beverages, soft drinks, energy drinks, confectionery, salted savoury snacks and condiments. Flavoured beers, alcopops and sugary jams were included in the tax in 2012 as well as setting additional thresholds and higher taxes for other products such as sugary drinks and confectionery [24]. Industry data suggests that there was a drop in sales of soft drinks from the last quarter of 2011 to the first quarter of 2012 [13]. By 2013, a health and financial impact assessment was conducted with the support of the WHO Regional Office for Europe. According to this report, sales of products subject to the tax have fallen by 27% with an observed reduction in consumption of 20% to 35% [24]. Moreover, demand for cola reduced by 2.7% in 2011, by 7.5% in 2012, and by 6% in 2013 [32]. In addition, manufacturers have reformulated their products to remove entirely, or substantially reduce, the targeted nutrient or ingredient. It is estimated that the tax has had an impact on population level consumption of salt and sugar, particularly among high consumers [20].

Denmark
Denmark introduced a tax on saturated fat content in 2011, that was levied on commercial producers and was principally to raise revenue although with an acknowledgement of rising rates of obesity and other diet-related diseases [13]. A sugar tax was due to be introduced in 2013, however, the saturated fat tax and all associated plans were repealed in 2013 when a new government was elected. There were also concerns over cross-border food purchasing [60].

France
In France, the tax introduced on 1 January 2012 is levied on drinks manufacturers and is also payable by food service outlets that serve their own prepared drinks with added sugar [13]. Sales data has indicated that the tax has been passed on to consumers although the nature of the price increase to consumers varied by supermarket [36]. While no robust evaluation has been carried out as yet, simulations carried out by the Toulouse School of Economics predicted that a €0.07 per litre tax would translate to a reduction in consumption of 3.4 litre per person per year. In addition, sales of SSDs fell by 3.3% between January 2012 and May 2012. An impact evaluation of the tax is planned [24].

Mexico
A recent press release relating to the Mexico tax states that data from a commercial panel of consumers, living in 53 cities with at least 50,000 residents, indicates a 6% decline in purchases of taxed beverages over 2014 compared to pre-tax trends. Moreover, it was reported that this difference accelerated over 2014 with the reduction reaching 12% by December. These preliminary results state that all socioeconomic groups reduced purchases of taxed beverages but reductions were higher in those from lower socioeconomic households, averaging a 9% decline over 2014 and increasing to a 17% reduction during December 2014. This data also shows an increase in purchases of untaxed products, mainly driven by increases in purchases of bottled water, of roughly 4% [32, 33, 70].

Slovenia
Slovenia announced a draft law adding 10% on the retail price of soft drinks in December 2014 which expected to raise 4.7 million Euro per year. However, this was recently withdrawn due to concerns that the tax would negatively affect the Slovenian economy as a result of job losses and manufacturers relocating production [59].

3.7 Background to the evidence base: the context for this review

In the peer-reviewed literature, the evidence of effectiveness of health-related taxes focused on food and drink is present in the form of natural experiments, experiments in controlled environments and modelling studies [23]. These study designs have different strengths and limitations, particularly in relation to their internal or external validity, that must be considered when judging their value. This review focuses only on experimental and observational studies. However, as much of the evidence in this area comes from modelling studies and other types of non-experimental studies, it is useful and relevant to present the broader evidence base as context and background. Several high-quality systematic reviews have examined the effectiveness of food and drinks taxes to improve diets and health outcomes and have included a wider range of study types, such as modelling studies [34, 37-39]. A range of analytical models, with varying levels of complexity, have been applied to estimate the effect of taxes on SSDs and high

sugar foods on consumption or health outcomes such as BMI. These studies are considerably heterogeneous with regards to the levels and nature of taxation and outcomes that they investigate, the data sources employed, the analytical approaches and modelling assumptions applied [40].

There are a few studies undertaken in the US in particular states where there are existing excise taxes on SSDs. These studies employ empirical data, for example sales and excise tax (price) data, and merge it with cross-sectional or longitudinal data relating to consumption or health outcomes, using temporal or geographical identifiers, to identify associations between the data [41, 42]. Several studies have then extrapolated from these effects on sales to purchases, to estimate the effect on health outcomes such as BMI and have predicted small impacts [43-45]. However, many of these studies are set in States where the levied tax levels are low (<10%). In addition, analyses of this kind are subject to a range of potential confounders and biases that, depending on the specific methodology applied, can weaken the case for causality [31]. One systematic review by Epstein, examined only experimental research on the relation between food price changes and food-purchasing patterns, including 24 studies looking at foods, rather than sugar specifically, from January 1980 until March 2011 (therefore many studies were outside the dates for inclusion criteria for this review) [44]. These studies were of varying quality.

However, it is frequently not feasible to conduct experimental economics research using study designs that follow a gold standard biomedical research model such as for RCTs. The review concluded that experimental research suggests that price changes modify purchases of targeted foods but that the impact on the nutritional quality of dietary intake more widely due to substitution effects was not known and that more complex research is needed in this area [44].

Many primary studies investigating the impact of taxes have used econometric modelling techniques to estimate price and other demand elasticities and predict or simulate the effects of various tax scenarios on consumption or sales using existing previously reported data [40, 46-49]. Reviews of the evidence from these types of studies suggest that a tax of 10% to 20% would be necessary to have a significant impact on purchases, consumption and ultimately population health [10, 24, 51, 52]. With specific reference to SSDs, reviewers have concluded that reductions in purchasing are proportionate to increases in price [10, 37, 39]. One systematic review of modelling studies estimated that the dietary effect of taxes on consumption of SSDs ranged from 5% to 30%. All included studies showed a reduction in consumption of SSDs, ranging from 5% to 48%, demonstrating an overall pattern that this reduction may be proportional to the tax applied [29].

4. RESEARCH BRIEF

PHE carried out this review in collaboration with Teesside University to bring together the most recent, robust evidence in this area to allow in-depth consideration of a possible policy initiative to reduce sugar consumption. It is intended to contribute to the package of evidence to inform the government's thinking on sugar in the diet as requested by the Department on Health [71].

As it was necessary to accommodate time and resource limitations, a rather more flexible approach was needed that still adhered to a systematic methodology, but that did not strictly follow the conventional Joanna Briggs Institute (JBI) or Cochrane approaches to systematic reviews.

Pragmatic decisions were therefore made regarding the methodology and inclusion criteria by a project steering group (for membership details see Appendix 12.1) to ensure it fulfilled these requirements. These decisions included: developing evolving inclusion criteria, which were broader than would be expected of an academic publication, to ensure that the outcomes supported policy thinking; literature searches were limited to 2010 onwards to ensure studies were most relevant to present day environment; interviews with key informants were included to support the literature review, as it was thought much evidence in relation to evaluation of existing fiscal measures implemented internationally may not yet have been published. Modelling and qualitative studies were excluded as modelling studies have been reviewed elsewhere and a decision was made to focus on only the most robust empirical quantitative studies. The findings of this review are however placed within the context of the wider literature in the general discussion. It was not within the scope of this research to consider the legal implications of implementing fiscal measures.

5. AIMS, OBJECTIVES AND RESEARCH QUESTIONS

5.1 Aim

The aim of this review is to examine the most recent (2010 onwards) evidence from experimental and observational research and key stakeholders to determine the health and behavioural impacts of fiscal measures that target high sugar food and non-alcoholic drink, in both adult and child populations.

5.2 Objectives

- to undertake a pragmatic review of the existing literature, to draw together evidence from recent (2010 onwards) primary research and grey literature on fiscal measures targeting high sugar[2] food and non-alcoholic drink and the resultant impact on attitudes, purchasing behaviours, sales, consumption and health
- to collect qualitative data from key stakeholders/informants, to gather inside knowledge on the implementation and impact of fiscal measures

5.3 Research questions

1. What fiscal measures targeted at high sugar food and non-alcoholic drink have been implemented?
2. How are these fiscal measures enforced and evaluated?
3. What has been the impact of fiscal measures on subsequent changes in attitudes, purchasing behaviours, sales, consumption and health?

6. METHODOLOGY

Given the requirement to identify and examine a range of interventions and outcomes, in both adult and child populations, a broader more flexible approach was required to construct a review that remained fit for purpose while using a systematic methodology (see research brief for further details). The resulting research protocol was developed and agreed with the project steering group. The methods are presented separately for the literature review, and the stakeholder interviews, and are reported, where possible, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA) [53].[3]

6.1 Literature review methodology

6.1.1 Inclusion criteria

Searches were conducted from 2010 onwards,[4] to identify published and unpublished experimental, quasi experimental and observational studies that met the following criteria:

[2] For the purposes of this review, 'high sugar' is defined as >5g sugar per 100g or >2.5g sugar per 100ml and refers to total sugar, however, as few papers provide a nutritional analysis of the products under investigation, the research team used their judgement to determine which were high sugar.
[3] As the literature was reviewed using a systematic approach, the PRISMA statement was followed where possible, however the following criteria were not met: item 2- structured summary was written as an executive summary for the policy audience; item 5 – the publication of the review protocol, which was not possible due to the policy and time constraints imposed upon the project; item 13 – principal measure was not identified due to the vast heterogeneity between studies; items 14, 15, 20, 21, 23 – n/a as meta-analysis was not possible due to heterogeneity.
[4] Studies from 2010 were selected to provide an overview of the most current research evidence in order to fit the resource and policy requirements outlined in the research brief.

- Population: studies involving populations of any age, from OECD countries (to enhance the applicability of findings to the UK)
- Outcomes: consumption patterns, purchasing patterns, dietary intake, excess weight, weight gain, dental health, diabetes, cardiovascular disease (CVD) risk, attitudes, energy
- Intervention: any experimental or observational study that demonstrated a health or behavioural impact on high sugar food and/or non-alcoholic drink

Commentaries, systematic reviews, non-systematic reviews, qualitative studies or discussion pieces, research that focused on promotion or subsidies of healthy foods/drinks, modelling based (including those US studies that model the effect of state sales taxes), non-English language papers, studies published outside of stipulated publication dates, from non OECD countries, with no relevant impact data or focused on alcohol were all excluded.

6.1.2 Search strategy

A list of key search terms was developed by the project team in consultation with the steering group (shown in Appendix A12.2). Each electronic database was systematically searched using a combination of these terms, tailored to optimise sensitivity, specificity, and the syntax and functionality of each database. The final search strings were created and run (on the 30th of October 2014) by an information scientist. An example search string is shown in Appendix A12.3. The databases searched were: CINAHL, Cochrane library, Embase, Health Business Elite, HMIC, LILACS, Medline, and PsycInfo. The database search results were also supplemented by hand searches, and resources provided by the steering group, stakeholder interviewees and ongoing study author contacts.

In addition to the peer reviewed literature, a number of grey literature searches were undertaken using the broad search terms ‘sugar’ and ‘food’ and ‘drink’. These searches included key government and organisation websites as well as general searches in Google, Bing and the social media sites Facebook and Twitter. A full list of the grey literature searches is shown in Appendix A12.4.

6.1.3 Screening and data extraction

All titles and abstracts were screened by one reviewer. The resulting shortlist was reviewed by the research team to finalise the list of references that potentially met the inclusion criteria. Full text versions of these papers were extracted and assessed by one reviewer and a second reviewer was consulted where any question or ambiguity existed. Any conference proceeding or study protocol was categorised as an ongoing study, and where contact details were available, authors were contacted for further information. Details of ongoing studies are shown in Appendix A12.5. A standardised

data extraction template was developed and agreed by the steering group to record study characteristics and authors key findings. Quality appraisals were carried out for each included study, using the JBI appraisal tools for all experimental and observational studies [58] and a subjective reviewer critique of any grey reports.

All data was extracted, quality assured and checked by two reviewers. Throughout the review process a third reviewer was consulted if any queries arose during the data extraction and quality assurance process. Due to the vast heterogeneity of the included studies, meta-analyses were not possible, therefore a narrative synthesis is provided. Evidence was appraised by examining the number of studies identified within the context of the study quality and consistency of findings. Key findings were contextualised within the study design, quality assessment, objectivity of the outcome measure and funding source.

6.2 Stakeholder interview methodology

A purposive sample of key stakeholders was identified through a ‘snowballing’ approach that included discussions with the steering group members, exploring key contacts through the literature searches, interview process and PHE. Ethical clearance for the interviews was granted by Teesside University Research Governance and Ethics Committee in December 2014. All interviews were conducted over the phone using a semi structured interview method (shown in Appendix A12.6) and an audio recording was taken following the acquisition of informed consent. Interviews were conducted between 16 December 2014 and 13 February 2015.

Narrative data from these interviews was thematically analysed in NVivo (version 10) following Creswell’s methodology [68]. Emerging themes were identified by one researcher and checked for accuracy by a second researcher. The consolidated criteria for reporting qualitative research (COREQ) 32-item checklist was completed (see Appendix A12.7) for quality assurance [69]. The emerging themes are presented below and triangulated with the review data following O’Cathain et al’s methodology [54].

7. RESULTS

7.1 Literature review findings

7.1.1 Search results summary

The database searches identified 7,667 studies (after de-duplication), with 20 additional records identified through the grey literature and one paper identified through hand searches and author contacts. Preliminary screening led to the exclusion of 7,342 studies and a shortlist of 325 studies which were scrutinised by three reviewers to refine the list to 68 studies which were subjected to full text review. When combined with the hand searched and author derived papers, 11 (10 primary research studies and one grey literature primary study) met our inclusion criteria and were included in this narrative synthesis (see Figure 2).

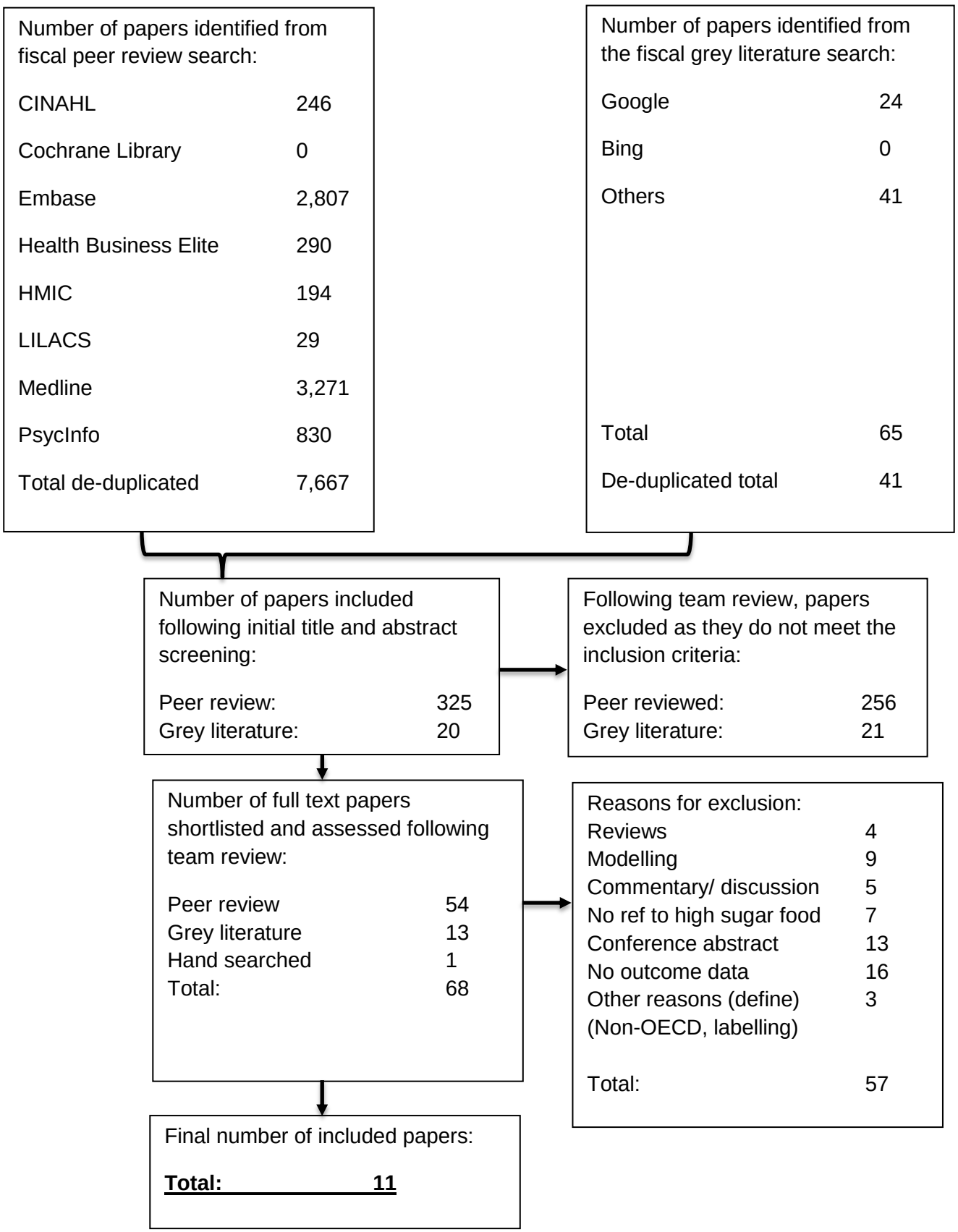
7.1.2 Characteristics of studies

Of the 11 studies included in this review, 10 were in adult populations and one was in children. Data summary tables are presented in Appendix A12.10. The 11 primary studies were conducted in France (n=1), The Netherlands (n=3) and the US (n=7) and were largely experimental in either a laboratory (n=4) virtual setting (n=4) or controlled field experiments in supermarkets (n=2) or a cafeteria (n=1). The majority of studies were small in scale with seven studies having sample sizes of n<200. Study quality was generally moderate with many of the studies lacking details about blinding, allocation concealment and withdrawals so they failed to gain higher scores on the quality assessment model applied (see Appendix 12.8 for the quality assessment summary).

Declarations of funding source for each study are presented in Appendix 12.9 and show where declared (in 6/11 studies), that funding was derived from research councils or foundation trusts. No explicit commercial funding was declared. The studies represent data from experimental and observational studies with a variety of study designs, locations, populations, outcome data, data collection methods and products (some outcomes specifying high sugar foods and drinks, others examining foods and drinks categorised as ‘high-calorie’, ‘energy dense’ or ‘unhealthy’ that include high sugar foods and drinks in those categories). The vast majority of included studies reported outcomes related to sales/purchases.

These behaviours, therefore, provide the focus of the narrative comparisons presented in this review, as it was not possible to conduct any meta-analyses given the heterogeneity between studies.

Figure 2: Fiscal literature flow diagram



7.1.3 Findings from included publications

The main characteristics and results from each included study are shown in data tables presented in Appendix 12.10, but have been summarised here by study type.

7.1.3.1 Primary research evidence

The level of tax and the effect size for each study has been summarised in Table 2. Several studies examined the effect of other factors alongside increased prices such as calorie labelling or nutrition education [55-58] and three studies assessed the effect of subsidising or lowering the price of 'healthy' or low calorie for nutrient (LCFN) foods alongside increasing the price or 'taxing' of 'unhealthy' or HCFN foods [59-61] . All studies, except for the study by Darmon [59], report on outcomes for 'tax only' conditions. The effect size for this study has therefore not been reported in Table 2 as any effect cannot be attributed to the tax condition alone. The majority of the studies targeted categories of products which were characterised as being high in sugar within a broader category of 'unhealthy', ED, high fat, sugar, salt (HFSS) or HCFN foods. Where outcome data are not available relating specifically to sugar or high sugar products, this has been stated.

Laboratory/virtual experiments

There were eight studies conducted in a laboratory (n=5, only 1 of which was controlled) [57, 59-61] or virtual, ie web-based shopping setting (n=3, 2 RCTs, 1 controlled no randomisation) [56, 62-64]. Seven of the eight were carried out in an adult only populations [56, 59, 60, 62-64] and one study was carried out in children aged 12 to 14 years [61]. Seven studies demonstrated that an increase in prices of SSDs or groups of 'unhealthy'/ED/HCFN foods (which included high sugar foods and drinks) resulted in a decrease in purchases [56, 57, 59-62, 64] with one study showing no effect [63].

Only two studies provided outcomes specifically relating to high sugar product or sugar consumption in their analysis [59, 62]. One of these studies, Waterlander [62], was an RCT conducted using a virtual supermarket in The Netherlands and focused on purchases of SSDs. Following an increase in VAT on SSDs from 6% to 19% (a mean change of 12.4%) results showed a statistically significant decrease in the consumption of SSDs of 0.9 litre per household per week in the intervention group versus control [62]. This study was relatively small (n=102) but of high quality. The other study, Darmon [59] (n=33) was poor quality, undertaken in France and employed a combined subsidy of 30% on 'healthy' foods and a 30% tax on 'unhealthy' foods. No 'tax only' outcome data were reported, and effect on sugar intake was not reported. However, there was a reduction in purchases of 'unhealthy' foods overall (which were defined as high in nutrients that should be 'limited' in the diet, ie saturated fatty acids, added sugar and sodium) [59]. This study examined the different impacts of the intervention in low

and medium income groups. While the intervention resulted in improved energy density and nutritional quality of the foods purchased overall in both income groups, the low income group derived fewer financial and nutritional benefits from the food subsidy and tax than the medium income group, suggesting that the price manipulations resulted in an increase in socioeconomic inequalities in dietary quality. This was the only study that examined impacts on these different groups.

Another high quality RCT virtual study by Waterlander [63] (n=117) examined the effects of both price increases and decreases, combined three levels of decrease in prices of healthy foods (none, 25%, 50%) with three levels of increases of unhealthy foods (5%, 10%, 25%) and conducted a factorial design study to examine the effect of different combinations of increase and decrease. Regression analysis was undertaken to assess the overall effect of the 'tax only' condition and no effect on purchases of 'unhealthy' foods was reported. The results indicate the complex nature of compensatory behaviour, as although those with the highest discount on healthy foods purchased significantly more healthy foods than the other groups, they also purchased more calories overall.

A US descriptive study by Epstein, of moderate quality (n=42), also examined the effect of increasing the price of HCFN foods and lowering the price of LCFN foods but each condition was tested separately in a group of mothers [60]. An increase of 10% on 'unhealthy' foods resulted in a 6.5% reduction in total calories purchased. Interestingly, subsidies of 'healthy' foods did not result in a decrease in total calories purchased overall as mothers spent the saving from healthy food on more unhealthy food, again providing some insight into the potentially unexpected substitution effects of price manipulations.

In the US, a moderate quality, controlled laboratory study by Giesen (n=178) [56] examined the effect on purchasing of calorie labelling alongside increased prices of high calorie foods and drinks and employed three levels of 'taxation' (none; 25% and 50%) but also added other factorial layers by either providing the participants with $10 or $20 ('high' or 'low' budget) and adding calorie information or not. A taxation of 25% or 50% on high calorie foods had a significant main effect in reducing calories purchased (estimate: -0.780, $p<0.001$, no data reported). This effect was reduced by calorie labelling when this was included in the analysis.

A moderate quality, controlled virtual study in The Netherlands (n=306) by Nederkoorn [64], found that a 'tax' on ED foods (50% on products with a caloric value of >300 kcal/100g) resulted in 16% less ED foods and 8% fewer total calories being purchased. These results were regardless of BMI. Another experimental within-subject study, by Temple in New York, with a small sample size (n=<100) employed a 25% tax on 'red' foods which were higher in calories, sugar (>25% calories/serving) and fat (>5g fat/serving). This reported that there was a main effect of taxation in relation to reducing

purchases of ‘red’ foods (no data given) and that these reductions approximate to a 10% reduction in non-obese participants and 40% in obese participants [57].

The only study with children, by Salvy (n=89) [52], was descriptive, of moderate quality and examined the effect of HCFN (and LCFN) snack food price manipulation on the purchases of a sample of children aged 12 to 14 years. Purchases of ‘unhealthy’ (high-calorie-for-nutrients) snacks decreased and purchases of healthy (low-calorie-for-nutrients) snacks increased when the price of unhealthy snacks were taxed [52].

Supermarket/cafeteria/restaurant experiments

Two studies took place in supermarkets, one was a randomised controlled field experiment [65] and one was a descriptive field study [58], and there was one controlled field study [55] which took place in a cafeteria [55, 58, 65]. All studies were in adult populations and took place in the US. Two studies targeted categories of ‘less healthy’ foods and drinks [58, 65] and one specifically targeted SSDs [55]. All studies reported outcomes relating specifically to sugar purchases. One study by Wansink [65], a high quality, controlled field experiment, randomly allocated households (n=113) to either a control (no tax) or experiment (10% tax on HCFN foods and drinks including all SSDs). The aim was to assess the impact on SSD purchasing over a six-month period. The tax resulted in a short term reduction in SSD purchase at one month, but this reduction was not seen at three or six months [65]. This study also resulted in the unintended consequence of increased purchasing of alcohol. A similar type of high-quality descriptive field study, by Elbel (purchases n=3680) [58], conducted in a store in a hospital, found that a 30% tax on unhealthy food resulted in an 11% higher chance of purchasing a ‘healthy’ food compared with baseline, in addition consumers purchased significantly less sugar (grams) [58]. The different locations and levels of taxations should be noted in comparing the results of these studies. The third study, by Block [55], a controlled field study with a small sample size (n=154) was of poor to moderate quality. A 35% tax on soft drinks (excluding diet drinks) in a hospital cafeteria resulted in a reduction of sales of regular soft drinks by 26% (95% CI = 39.0, 14.0) during the study period and increased to 36% (95% CI = 49.0, 23.0) during the combined tax and education period. Additionally there was an increase in sales of diet soft drinks by 20% (95% CI = 7.0, 33.0). A ‘control’ site with no increase in price showed no change in soft drink sales during the same time period.

Table 2: Summary table of taxation level and effect size (where data are given for 'tax only' condition)[5,6] For more details see Appendix A12.10

Study	Study type	Country	Tax Level	Product	Effect of tax
Block, 2010 [55]	Controlled field experiment	US	35%	Regular soft drinks	26% ↓ purchases
Epstein, 2010 [60]	Experimental observation analogue purchasing	US	10%	Total calories	6.5% ↓ purchases
Giesen, 2011 [56]	Psuedo-RCT virtual web-cafeteria menu	US	25% & 50%	ED/High calorie foods	↓ high calorie purchases (Estimate = -0.780, p<0.001)
Nederkoorn, 2011 [64]	Virtual controlled web-based supermarket	Netherlands	50%	ED foods Total calories	16%↓ purchases 8%↓ purchases
Temple, 2011 [57]	Laboratory	New York, US	25%	'Red' ED foods	10% ↓purchases (obese participants) and 40% ↓purchases (non-obese participants)
Salvy, 2012 [61]	Experimental analogue purchasing task	US	25% (alone) 50% 25% (social) 50%	HCFN snacks	↓ 9 kcal ↓96 kcal ↓57 kcal ↓120 kcal Tax = significant ↓ kcal (β=-5.13, SE=1.08, p<0.001)
Wansink, 2012 [65]	Randomised controlled field experiment	US	10%	HCFN foods (primary outcome SSD sales)	Short term decrease (1 month) in SSD purchase, no effect seen after 3 or 6 months
Waterlander, 2012 [63]	RCT Virtual web-based supermarket	Netherlands	5%, 10%, 25%	'Unhealthy' foods	No effect
Elbel, 2013 [58]	Field experiment	US	30%	'Less healthy' foods and beverages	11% of consumers were more likely to buy 'healthier' item
Waterlander, 2014 [62]	RCT Virtual web-based supermarket	Netherlands	19% (from 6%)	SSDs	↓ SSDs purchases (β=-0.90 litre, 95% CI= -1.7 to -0.10L per household per week)

[5] Controlled studies highlighted in blue
[6] Darmon [59] is excluded from this table as they did not include a 'tax only' condition

KEY FINDINGS

Laboratory/virtual experiments:

- seven out of eight studies (four descriptive laboratory, two RCT virtual, one controlled virtual, one controlled laboratory) demonstrated that an increase in the price of SSDs or groups of unhealthy ED/HCFN foods resulted in a decrease in purchases. The remaining study showed no effect
- two studies provided outcomes specifically related to high sugar products or sugar consumption, and both showed a reduction in consumption of sugar products or unhealthy foods as a result of a fiscal strategy
- one study examined the different impacts of a fiscal strategy (which included subsidies on healthy foods as well as a tax on high sugar food and drink) in low and medium income groups, and while this strategy improved the energy density and nutritional quality of foods purchased overall in both income groups, it was reported that the low income group derived fewer financial (from subsidies) and nutritional benefits compared to the medium income group
- studies varied in quality; however, the majority were moderate

Supermarket/cafeteria/restaurant experiments

- two controlled field experiments and one descriptive study (two in a supermarket and one in a cafeteria) were undertaken in adult US populations
- all studies reported reductions in sugar purchasing as a result of the fiscal strategy
- the first study reported a short-term reduction (one month) in SSDs purchases but this reduction was not sustained at three or six months
- the second study reported that a 30% tax on unhealthy food increased the probability of purchasing ‘healthy’ food by 11% compared with the baseline.
- The final study showed a 35% tax on regular soft drinks (no tax on diet drinks or water) in a hospital cafeteria resulted in a reduction of sales of regular soft drinks by 26% (increasing to 36% during combined phase of education and tax) and an increase in sales of diet soft drinks by 20%. A ‘control’ site with no increase in price showed no change in soft drink sales during the same time period
- study quality was high to moderate

7.2 Stakeholder interview results

A total of 43 key stakeholders with knowledge of fiscal strategies were invited to participate. Fifteen completed interviews with an additional two providing written responses to the questions, 14 did not respond, two email addresses failed, five declined, and three were unable to arrange a date before the deadline (13 February 2015).

7.2.1 Themes identified from the interviews

The stakeholder interviews revealed a variety of themes relating to the impact, or potential impact, of fiscal strategies on behaviour and health. Academics and International stakeholders generally supported the implementation of such a strategy, however, one academic felt there was a lack of evidence to support such a measure. Individuals from non-governmental organisations (NGOs) were generally supportive of a fiscal strategy and discussed the wide variety of health benefits this measure would have and positive uses for any revenue gained. Key industry stakeholders felt there was a limited evidence base to support a fiscal strategy aimed at reducing obesity and expressed concerns that reductions in sales may not represent reductions in consumption as consumers may be switching to cheaper products. Moreover, industry stakeholders discussed the regressive nature of a fiscal strategy aimed at high sugar foods. However, this was dismissed by academic stakeholders who argued the measure would be progressive as a result of the beneficial effects of reducing sugar consumption.

Saturation (the point at which no new data emerges) of themes was almost reached as most stakeholders discussed similar points, however, the small number of interviews conducted prevented reaching full saturation. The key emerging themes have been extracted and these focused on: specific countries with fiscal strategy; more general themes around impact; evaluations; regressive/progressive nature; and response to fiscal strategy – industry, public, political.

Evidence gleaned from the interviews generally complemented and supported the literature review evidence presented above, however, no new unpublished data or intelligence was provided relating to fiscal impact (see Appendix A12.11 for a detailed discussion of the emerging themes).

7.3 Triangulation results

The key findings from the literature review and stakeholder interviews have been triangulated to assess convergence. The results are presented in Table 3 and highlight convergence on a number of themes which suggest:

1) Increased prices on unhealthy food and drink results in a decrease in purchasing and sales
2) There were very few, if any, evaluations of existing taxes aside from some information on decreases in sales
3) Taxation may be regressive having a less desirable impact on those from lower income groups but this may also be progressive if consumption of unhealthy products was reduced

Inter-method discrepancies were found when themes from the interviews covered areas, which were either not identified in the literature review or fell outside of the scope of the review. These themes included: the lack of evaluations from countries with a tax on high sugar products; responses from industry, political representatives, and the public and taxation leading to a reduction in consumption.

Table 3: Triangulation results – convergence coding matrix for themes emerging from qualitative interviews and literature review

Emerging themes from interviews and review	Findings from stakeholder interviews	Findings from literature review	Convergence assessment
Countries/states with tax - **Evaluation /Impact** - **Rationale**	France, Mexico, Hungary, Finland, Berkeley, various States in America. Nothing published, main impact discussed was decrease in sales. Differed depending on country but only two discussed – raise revenue and health.	There were no experimental studies evaluating the impact of existing taxes.	**Dissonance – due to lack of published formal evaluations in the peer reviewed literature**
Impact	Stakeholders described decrease in purchasing/sales as a result of taxation. Some stakeholders described decrease in consumption	Overall, experimental studies showed that increased pricing of unhealthier foods resulted in a decrease in purchase. There were no experimental studies assessing impact on consumption.	**Convergence** **Dissonance**
Evaluations	Very few, if any, evaluations have been conducted. Discussion of evaluations in France and Hungary but no explicit information aside from sales data in France. Mexico currently evaluating, sales and consumption have reduced but no published results.	There were no experimental studies that evaluated population level impact of existing taxes.	**Complementary**

Regressive nature	Regressive – stakeholders felt a tax would have a negative effect on poor individuals Progressive – stakeholders felt a tax would have beneficial effects on poor individuals if a fiscal strategy reduced their consumption of SSB	A small number of studies highlighted the impact on low income groups	**Complementary**
Response	Industry – Negative Public – Positive if tax is for health purposes Political – cautious	Literature review did not include studies assessing public/industry/political response	**Inter-method discrepancy**

8. DISCUSSION

The aim of this review was to examine the most recent experimental and observational evidence gathered from 2010 on the health and behavioural impacts of fiscal measures targeted at high sugar food and non-alcoholic drinks, through a pragmatic mixed methods approach. However, despite searching for studies with health and attitudinal outcomes, the majority of studies focused on impact in terms of preference, purchase, or consumption, this is likely to be accountable to 1) the short-term nature of the majority of studies in this field, which makes the examination of longer-term health related outcomes impractical; 2) the exclusion of qualitative study designs, which are more likely to have provided attitudinal data. Nevertheless, the resulting evidence indicates that fiscal strategies may have an impact on sales/purchasing providing the tax levied is large enough.

8.1 What products did the review evaluate?

Evidence from the primary studies included in this report had a broad focus including, but not exclusive to, high sugar foods and non-alcoholic drinks, as many studies also evaluated the impact of increased prices of unhealthy, ED, HCFN or HFSS foods or drinks. This is perhaps a reflection of sugar consumption within a free-living environment, where it is often consumed as a component of a food or drink product. Studies were included where they characterised their target product as being high in sugar (or it was clearly identified as a high sugar product such as regular soft drinks,

confectionery, chocolate, sweets, ice cream and jams) and reported outcomes specific to the high sugar product.

8.2 What was the evidence regarding the impact of fiscal measures?

The resulting evidence, of mainly moderate (n=5) to high (n=5) quality studies, suggests that increasing prices of high sugar foods and non-alcoholic drinks are likely to reduce purchases of these products, at least in the short term, and that this reduction may be somewhat proportionate to the level of price increase imposed. Data from almost all of the experimental studies reviewed demonstrated that consumers can be responsive to changes in food and drink prices and those that did not report an effect had implemented relatively low ‘tax’ levels compared with the other studies.

There was some consistency in the findings despite the diversity of approaches taken, which could suggest that the direction of the relationship is ‘real’ and not a result of low quality studies, unreliable statistics or small sample sizes. It would therefore seem likely that any reduction in purchases of high sugar foods and non-alcoholic drinks should result in a reduction in consumption and therefore drive a population level reduction in sugar intake. However, no studies were found examining the effects of pricing on consumption or longer-term health outcomes. The stakeholder interviews did not identify as anticipated any significant new emerging evidence or unpublished data on the impact of existing fiscal strategies adopted in several countries that would not have been accessible to the review group. This perhaps reflects the commercial and academic sensitivities of sharing emerging, unpublished, or pay-to-view intelligence. Given that overall, the stakeholder interviews provided a compilation of personal opinion and reference to the existing evidence base, it is not surprising that there were a number of convergent emerging themes when triangulated with the literature review.

8.2.1 Regressive, progressive and substitution effects

The lack of peer reviewed experimental evidence overall meant there was little robust evidence regarding effects that have been highlighted in the broader literature such as the potential difference in short versus long term effects, the extent and nature of a regressive, and subsequently progressive, effect and an understanding of compensatory behaviours and their impact on individual and population level dietary intake and nutritional quality overall. There was limited evidence from one study demonstrating a potential widening of nutritional inequalities between medium-income and low-income groups as a result of a tax on unhealthy foods and a subsidy on healthy foods [59]. Some interviewees highlighted the potential regressive nature of a tax on high sugar foods and non-alcoholic drinks while others highlighted the progressive nature of such a tax in terms of health outcomes.

Several studies discussed the compensatory behaviours that resulted from their increased pricing of high sugar products and subsidising healthy products [55, 59, 60, 63, 65]. The compensatory behaviours reported depended on the target product, outcomes measured and the nature of the intervention. For example one study reported that reduced purchasing of SSDs also resulted in an increase in alcoholic drinks purchases [65] and one study reported that reducing purchasing of unhealthy products resulted in reduced energy density overall but not significantly in relation to sugar [59]. The small number of studies, their heterogeneity and the variety of substitution effects observed suggests a need for caution in interpreting or attempting to generalise the findings. Moreover, some stakeholders interviewed for this review argued there was a need to fully understand potential compensatory behaviours before implementing a fiscal measure to ensure individuals did not swap to alternative, and equally unhealthy, products.

8.2.2 Evaluations of existing taxes

Despite there being several countries where relevant taxes are currently implemented, there were no evaluation studies from these countries that were eligible for inclusion in this review. Qualitative results and background reports in the grey literature highlighted sales and consumer panel data that have been used in several countries to suggest that there may be some short-term reduction in purchases resulting from current taxes, however, there are no data over extended time periods to show if these reductions are maintained. These data are however, supported by the results reported from experimental studies in this review. However, robust and transparent evaluations with a ‘natural experiment’ type of study design are needed before a causal effect between taxation and behaviour change for any of these countries can be determined [31].

8.2.3 Acceptability and attitudes

Robust data relating to the acceptability of taxes, either in terms of an acceptable level or method of implementation, both by the general public and by industry were either not available or were not eligible for inclusion in the literature review. Interview data however, provided some insight into how this differs between countries and the influence general public and industry attitudes can have on the overall impact, perception and sustainability of a tax. For example, interviewees described quite different initial responses by the general public in France and Hungary to the implementation of SSDs taxes and also highlighted that where taxes have recently been implemented, such as in Mexico and France, a ‘health-related’ tax has been acknowledged as an acceptable way of reducing consumption of sugar.

KEY CONSIDERATION:

- evidence suggests that increasing prices of high sugar foods and non-alcoholic drinks, potentially through taxation, may reduce purchases of these products proportionate to the level of the price increase imposed

8.3 This review in the context of the broader literature

The results from the literature review suggest that higher prices in targeted high sugar products do tend to reduce purchases of these products and that the size of the effect on purchasing levels may be proportionate to the size of the price rise implemented. This is supported by an extensive evidence base from modelled studies that show that price changes are likely to influence purchasing. It is also supported, albeit non-conclusively, by the sales and consumer panel data that have been reported by some of the European countries that have recently implemented a tax.

Data analysed from the Euromonitor Passport Database by Ecorys [66] found that demand for SSDs reduced by 4-10% as a result of fiscal strategies in Finland, France, and Hungary [32]. In addition, several studies used sales data in US states where low level (<10%) taxes on SSDs or snack foods exist, to estimate effect on purchasing, consumption or health outcomes estimated small effect sizes. These studies and other econometric modelling studies have led a number of authors to broadly estimate that a tax of between 10% and 20% is required to have an effect on behaviour and ultimately on population level health outcomes [10, 23, 24, 51]. This estimate is approximately supported by the result of this review which show that two studies with a smaller tax of <10% did not show an effect on purchasing. Higher taxes of <25% reported greater reductions in purchasing. However, it must be noted that these studies are small in number and vastly heterogeneous in nature, there were only four (out of 11) studies that tested the effect of a <25% price increase and only one of these targeted a solely high sugar product. Only one systematic review of experimental studies examining the impact of fiscal studies has been published [67], and this had a broader inclusion criteria which included foods other than sugar, over an earlier and wider date range (1980-2011). However, the findings from this review [67] align with the findings presented here, concluding that price changes can modify purchases of targeted foods, although the impact on overall dietary intake and quality, including any substitution effects, remains poorly understood and requires further research.

KEY CONSIDERATION:

- the current evidence emerging from sales data from counties with taxes, modelling and experimental studies appear to align and show a trend towards fiscal measures impacting on sales/purchasing providing the tax levied is large enough

8.4 Limitations of this review

The nature of the included evidence was too heterogeneous to attempt a meta-analysis. The vast majority of included studies measured impact in relation to purchase and consumption outcomes, rather than health or attitudes. This limitation may occur as a result of the short-term nature of the studies.

Only 11 studies were eligible for inclusion. The quality of the studies was variable when assessed against a standard critical appraisal checklist for evaluating evidence, most of the studies were small scale and short term. None of these studies were conducted in the UK; therefore any interpretation and application of the findings to the UK population should be done with caution. Few studies gave adequate information about randomisation and blinding methods. Virtual studies may not adequately reflect a real life setting and the complex and multi-dimensional nature of the subject matter being explored does not necessarily lend itself well to laboratory-style studies or RCTs in very localised settings such as hospital cafeterias.

However, a balance is clearly required between external and internal validity to ensure that findings can both be relied upon and can be applied more generally in the wider population. More robust evidence from empirical data is needed to ensure that there is not an over reliance on modelling and simulation studies [22], but careful planning and consideration is required to ensure that causality between fiscal measure based interventions, behaviour change and health outcomes can be demonstrated [20].

More pragmatic approaches should be taken to evaluating the effectiveness of taxing high sugar products while ensuring that causality, substitution effects, impact on lower income groups and sustainability can be robustly assessed. There was a paucity of studies that examined the effect of price increases on children and adolescents or the impact on different socioeconomic groups.

It is important to consider the findings presented in this review within the following methodological limitations:

1) This review specifically focused on evidence from high sugar foods and non-alcoholic drinks, however much of the research evidence is focused on broader

groups such as ‘unhealthy’ foods, ED, HCFN, HFSS products and these studies will not have been identified for inclusion unless they provided a specific reference to a high sugar component. This may have limited the size and range of the evidence base assessed

2) Given the requirement to identify and examine a range of interventions and outcomes, in both adult and child populations, a broader more flexible approach had to be applied to the review methodology (see research brief)
3) Due to time and resource restraints, only one reviewer conducted the initial reference screening. Gold standard systematic review protocols such as Cochrane and JBI recommend second reviewer screening to help reduce the likelihood of missing a relevant study and introducing selection bias
4) Time and resource constraints limited the number of stakeholder opinions that could be recorded
5) Restricting studies by date (2010), English language, and to experimental only may have limited the range of the evidence base reviewed

8.5 Research recommendations

The evidence presented in this report highlights the following future research recommendations:

- more high quality studies that are conducted in the UK to examine the impact of tax on high sugar food and non-alcoholic drinks on purchasing, consumption and associated health outcomes such as BMI
- studies that examine the impact of sugar taxation on inequalities, compensatory behaviours, and substitution effects

9. CONCLUSION

Evidence from both stakeholders and current research studies suggest that increasing prices of high sugar foods and non-alcoholic drinks, potentially through taxation, is likely to reduce purchases of these products in the short term.

All the empirical data assessed in the included studies reviewed demonstrated that consumers are responsive to changes in food and drink prices and those that did not report an effect had implemented a relatively low tax compared with other studies.

These findings complement the evidence from modelling studies, which indicate that taxation would lead to a reduction in purchases proportionate to the level of tax applied. Moreover, the available evidence on sales data from countries that have implemented a tax on sugar products also aligns with these findings to suggest that purchases have reduced since the tax was implemented. The current evidence base appears to

converge and suggests that a fiscal strategy is likely to reduce purchases of high sugar products at least in the short term.

However, the overall lack of peer-reviewed experimental evidence has resulted in very little insight into effects that have been highlighted in the broader literature. These include the difference in short and long term effects, the extent and nature of a regressive (and progressive) effect and an understanding of compensatory behaviours and their impact on individual and population level dietary intake and nutritional quality overall.

Any new tax should be accompanied by a robust evaluation that examines the long-term effects of any price increases, specifically assessing compensatory behaviours and whether price increases would exacerbate health inequalities within certain population subgroups.

KEY CONSIDERATION:

- evidence suggests that increasing prices of high sugar foods and non-alcoholic drinks, potentially through taxation, may reduce purchases of these products proportionate to the level of the price increase imposed

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Conflicts of Interest: Kath Roberts is employed by PHE; Louisa Ells is employed by Teesside University but has an academic secondment to work for PHE two days/week; Victoria McGowan and Theodora Machaira are both employed by Teesside University and have been contracted to work on this project for PHE. None of the authors have any conflicts of interest to declare.

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12. APPENDICES:

A12.1: PROJECT STEERING GROUP

Table 4: Project Steering Group

Secretariat	Jayne Owens
Chief Knowledge Officer directorate, PHE	Kath Roberts (Chair) Dr Louisa Ells – joint role with Teesside University Dr Victoria McGowan – project research associate – Teesside University Clare Perkins (Deputy Chair) Tim Chadborn/Sarah Payne PHE (Behaviour Change Unit)
Health and Wellbeing directorate, PHE	Dr Alison Tedstone Dr Rachel Allen Victoria Targett
University of Cambridge	Professor Theresa Marteau
University of Stirling	Professor Gerard Hastings
University of Nottingham	Amanda Avery
World Obesity Federation	Professor Tim Lobstein
UK Health Forum	Modi Mwatsama
Jones Knowles Ritchie (Marketing Company)	Andrew Knowles
Observers	
Department of Health	Jo Newstead Kevin Naylor Peter Dick
HM Treasury	Paul Randle/Sarah Maxwell

A12.2: KEY SEARCH TERMS: Used to inform the search string development

Table 5: Key Search Terms

Product description	Fiscal terms	High sugar food and non-alcoholic drinks terms	Consumer behaviour outcomes/ Health related outcomes**
Sugar* Sugar sweetened Added sugar Sugar containing	Fiscal Tax* jurisprudence Law Price pricing Subsid* Legislat* Policy	food drink* or beverage* Soft drink* Cake* Pastr* Biscuit* Pudding* Preserves Jam* Marmalade* Confectionery Chocolate* Sweets Energy drink* Sports drink* Yogurt/yoghurt Breakfast cereal* Juice* Squash* cordial* Snack* Candy Dessert* Soda Bake*	Purchas* Consumer behaviour* Consumption Expenditure Buy* Attitut* Acceptab* Obes* Over weight Adipos* Tooth decay Dental car* Oral health Nutrition* Energy / caloric intake Diet* Attitude* Consum*

A12.3: EXAMPLE SEARCH STRING

NB: This string was run for Medline using OVID. Numbers include duplicates which were removed prior to entry into figure 1. String included specificity checks for gold standard reference papers.

30/10/2014 Ovid: Search Form

Wolters Kluwer Health | OvidSP

Logged in as KLS PHE at Public Health England

My Account | My PayPerView | Support & Training | Help | Logoff

Search Journals Multimedia My Workspace

Search History saved as "PHE sugar gold standard fiscal obesity Medline final"

Search History (91 searches) *(close)* View Saved

# ▲	Searches	Results	Search Type	Actions
1	sugar$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	102873	Advanced	Display Delete More
2	(sugar adj sweetened).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1054	Advanced	Display Delete More
3	(added adj sugar$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	709	Advanced	Display Delete More
4	(sugar adj3 contain$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1594	Advanced	Display Delete More
5	exp "food and beverages"/	1123389	Advanced	Display More
6	drink.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	14412	Advanced	Display Delete More
7	drinks.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	10535	Advanced	Display Delete More
8	(soft adj drink$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	2508	Advanced	Display Delete More
9	fizzy.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	167	Advanced	Display Delete More
10	cake$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	3097	Advanced	Display Delete More
11	pastr$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	468	Advanced	Display Delete More
12	biscuit$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	871	Advanced	Display Delete More
13	pudding$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	358	Advanced	Display Delete More
14	dessert$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	901	Advanced	Display Delete More
15	preserve$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	111639	Advanced	Display Delete More
16	jam$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	22684	Advanced	Display Delete More

CONTRACT

http://ovidsp.uk.ovid.com/sp-3.13.1a/ovidweb.cgi 1/52

☐	17	marmalade$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	58	Advanced	Display Delete More ≫
☐	18	confectionary.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	118	Advanced	Display Delete More ≫
☐	19	chocolate$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	3506	Advanced	Display Delete More ≫
☐	20	sweet$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	21768	Advanced	Display Delete More ≫
☐	21	exp Energy Drinks/	205	Advanced	Display More ≫
☐	22	(sport$ adj drink$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	398	Advanced	Display Delete More ≫
☐	23	yog?urt$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	2784	Advanced	Display Delete More ≫
☐	24	(breakfast adj cereal$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	681	Advanced	Display Delete More ≫
☐	25	juice.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	38278	Advanced	Display Delete More ≫
☐	26	cordial$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	218	Advanced	Display Delete More ≫
☐	27	squash$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1911	Advanced	Display Delete More ≫
☐	28	snack$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	4727	Advanced	Display Delete More ≫
☐	29	candy.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1868	Advanced	Display Delete More ≫
☐	30	soda.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	2969	Advanced	Display Delete More ≫
☐	31	bake$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	8838	Advanced	Display Delete More ≫
☐	32	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31	1393059	Advanced	Display More ≫
☐	33	fiscal.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	6107	Advanced	Display Delete More ≫
☐	34	exp Taxes/	9182	Advanced	Display More ≫
☐	35	tax.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	11722	Advanced	Display Delete More ≫
☐	36	taxes.mp. [mp=title, abstract, original title, name of substance	6757	Advanced	

		word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]			Display Delete More >>
	37	taxing.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	637	Advanced	Display Delete More >>
	38	exp Jurisprudence/	182196	Advanced	Display More >>
	39	law.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	72364	Advanced	Display Delete More >>
	40	laws.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	23015	Advanced	Display Delete More >>
	41	price$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	24307	Advanced	Display Delete More >>
	42	pricing.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	3265	Advanced	Display Delete More >>
	43	subsid$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	17829	Advanced	Display Delete More >>
	44	exp Legislation, Food/	2074	Advanced	Display More >>
	45	legislat$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	83171	Advanced	Display Delete More >>
	46	exp Policy/	128445	Advanced	Display More >>
	47	Policy Making/	12960	Advanced	Display More >>
	48	33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47	481396	Advanced	Display More >>
	49	obes$.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	236878	Advanced	Display Delete More >>
	50	over?weight.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	45108	Advanced	Display Delete More >>
	51	(weight adj3 gain).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	57967	Advanced	Display Delete More >>
	52	adipos*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	112002	Advanced	Display Delete More >>
	53	(tooth adj decay*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	805	Advanced	Display Delete More >>
	54	(dental adj (caries or cary or carie)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	41544	Advanced	Display Delete More >>
	55	exp Oral Health/	10710	Advanced	Display More >>
	56	nutrition.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word,	168851	Advanced	Display

		protocol supplementary concept word, rare disease supplementary concept word, unique identifier]			Delete More ≫
	57	exp Food Preferences/	10687	Advanced	Display More ≫
	58	exp Diet/	204697	Advanced	Display More ≫
	59	exp Energy Intake/	37117	Advanced	Display More ≫
	60	caloric.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	20500	Advanced	Display Delete More ≫
	61	calorific.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	467	Advanced	Display Delete More ≫
	62	calorie.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	11945	Advanced	Display Delete More ≫
	63	impact.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	545444	Advanced	Display Delete More ≫
	64	49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63	1232158	Advanced	Display More ≫
	65	(A systematic review of the effectiveness of food taxes and subsidies).m_titl.	1	Advanced	Display More ≫
	66	"Why fat taxes won't make us thin.".m_titl.	0	Advanced	Delete More ≫
	67	The taxing of fizzy drinks.m_titl.	1	Advanced	Display More ≫
	68	Yes, the government should tax soft drinks: findings from a citizens' jury in Australia.m_titl.	1	Advanced	Display More ≫
	69	(Twenty percent tax on fizzy drinks could save lives and generate millions in revenue for health programmes in New Zealand).m_titl.	1	Advanced	Display More ≫
	70	(Taxing soft drinks could reduce obesity and diabetes in India).m_titl.	1	Advanced	Display More ≫
	71	"Lowering the price of good foods would be better than taxing bad foods in reducing obesity".m_titl.	1	Advanced	Display More ≫
	72	(Mexico attempts to tackle obesity: the process, results, push backs and future challenges).m_titl.	1	Advanced	Display More ≫
	73	(Trade policy and obesity prevention).m_titl.	1	Advanced	Display More ≫
	74	When do fat taxes increase consumer welfare?.m_titl.	3	Advanced	Display More ≫
	75	A typology of beverage taxation: multiple approaches for obesity prevention.m_titl.	1	Advanced	Display More ≫
	76	Public health doctors call for a levy on sugar sweetened drinks.m_titl.	1	Advanced	Display More ≫
	77	Building a strategy for obesity prevention one piece at a time.m_titl.	1	Advanced	Display More ≫
	78	(Fast food prices, obesity, and the minimum wage).m_titl.	1	Advanced	Display More ≫
	79	"Royal Colleges call for duty on sugary drinks in action plan against".m_titl.	1	Advanced	Display More ≫
	80	"Implications of a sugar-sweetened beverage (SSB) tax when substitutions".m_titl.	1	Advanced	Display More ≫
	81	When do fat taxes increase consumer welfare.m_titl.	3	Advanced	Display More ≫
	82	Will soda restrictions help New York win the war on	1	Advanced	Display

30/10/2014 Ovid: Search Form

		obesity.m_titl.			More ≫
☐	83	(Lack of correlation between antiobesity policy and obesity growth rates).m_titl.	1	Advanced	Display More ≫
☐	84	(The impact of initiatives to limit the advertising of food and beverage).m_titl.	1	Advanced	Display More ≫
☐	85	Priming effects of television food advertising on eating behavior.m_titl.	1	Advanced	Display More ≫
☐	86	(Availability and marketing of food and beverages to children through sports).m_titl.	1	Advanced	Display More ≫
☐	87	(Systematic literature review of the effects of food and drink advertising).m_titl.	1	Advanced	Display More ≫
☐	88	65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87	23	Advanced	Display More ≫
☐	89	32 and 48 and 64	6695	Advanced	Display More ≫
☐	90	32 and 48 and 64 and 88	18	Advanced	Display More ≫
☐	91	limit 89 to (english language and yr="2004 -Current")	4361	Advanced	Display More ≫

Remove Selected | Save Selected | Combine selections with: And Or RSS

Save Search History

A12.4: GREY LITERATURE SEARCHES

The following resources will be searched for relevant reports, papers and policy documents:

- government websites for Hungary, New York, Island of St Helena, France, Brazil, Mexico, Norway, Denmark
- Regulatory and industry body websites: Ofcom, CAP, BACP, ASA, Action on Sugar, Sugar Nutrition UK, Food and Drink Federation, Advertising Standards Authority (ASA).
- Advertising Educational Foundation, Rudd Centre for Food Research and Obesity at Yale
- All party parliamentary Group on Food and Drink manufacturing group
- Food and drink companies identified from: http://www.britishcompanies.co.uk/food.htm
- The British Retail Consortium
- Market intelligence and marketing research companies: Kantar, Nielson Europe Insights, Mintel
- Bank of America, Credite Suisse and Merill Lynch
- World advertising research centre database
- http://mednar.com/mednar/
- www.scirus.com
- www.metacrawler.com
- www.disref.com.au/
- www.hon.ch/Medhunt/Medhunt.html
- www.medworld_stanford.edu/medbot/
- http://sumsearch.uthscsa.edu/cgi-bin/SUMSearch.exe/
- www.intute.ac.uk/healthandlifesciences/omnilost.html
- www.mdchoice.com/index.asp
- www.science.gov/
- http://www.eHealthcareBot.com/
- http://medworld.stanford.edu/medbot/
- http://omnimedicalsearch.com/
- http://www.ingentaconnect.com/
- http://www.medical-zone.com/
- World Health Organization, http://www.who.int/library/
- National Institute on Alcohol Abuse and Alcoholism, http://www.niaaa.nih.gov/
- Canadian Health Network, http://www.canadian-health-network.ca/customtools/homee.html
- Health Insite, http://www.healthinsite.gov.au/
- MedlinePlus, http://www.nlm.nih.gov/medlineplus
- McKinsey and Company, www.mckinsey.com
- National Guidelines Clearinghouse, http://www.guideline.gov/index.asp

- National Electronic Library for Health (UK), http://www.nelh.nhs.uk/
- Partners in Information Access for the Public Health Workforce, http://phpartners.org/guide.html
- http://worldwidescience.org/index.html
- British Sugar – education resources http://www.britishsugar.co.uk/Education-Resources.aspx
- Sugar Nutrition UK http://www.sugarnutrition.org.uk/science-and-research.aspx
- Public Health England, 2014. Sugar reduction: Responding to the challenge https://www.gov.uk/government/publications/sugar-reduction-responding-to-the-challenge
- Action on Sugar http://www.actiononsugar.org/

A12.5: ONGOING STUDIES TABLE

This table documents conference proceedings and ongoing studies that were identified from the systematic review. Authors were contacted and asked whether there was an available published paper.

Table 6: Ongoing studies

Title and author(s)	Journal	Year	Outcome
Evaluating the impact of fat taxes and vegetables subsidies on specific food categories. HANKS, A., JUST, D. & WANSINK, B	FASEB – The Journal of the Federation of American Societies for Experimental Biology	2014	No response from authors
Special action group on obesity an intersectoral approach for Ireland. DEVLIN, J.	World Obesity – ICO Kuala Lumpur	2014	No response from authors - email address could not be located
Food taxes: What works and what does not? CLARO, R	World Obesity	2014	Presentation abstract only, no paper available
The effect of food pricing on dietary behaviors and adiposity: A systematic review and meta-analysis. AFSHIN, A., DEL GOBBO, L., SILVA, J., MICHAELSON, M. & MOZAFFARIAN, D.	Circulation	2014	Paper currently under review PLOS Medicine
Using the "4Ps" marketing approach to evaluate healthy food policies: A rapid scoping review. ORTON, L., LLOYD-WILLIAMS, F., BROMLEY, H., HAWKES, C., TAYLOR-ROBINSON, D., O'FLAHERTY, M., MOONAN, M., RAYNER, M. & CAPEWELL, S.	Journal of Epidemiology and Community Health	2013	Paper provided: Lloyd-williams et al Smorgasbord or symphony? Assessing public health nutrition policies across 30 European countries using a novel framework. Excluded as it did not fit inclusion criteria
Food taxation as a nutrition policy tool-lessons from the danish case of sugar and fat taxes. B, M. I., PEREZ-CUETO, F. J. A. & JORGENSEN, M. S.	Annals of Nutrition and Metabolism	2013	No response from authors
What is the current evidence on the cost-effectiveness of fiscal policies to prevent obesity? FLEGO, A., MOODIE, M.,	Obesity Research and Clinical Practice	2013	Paper provided: Moodie et al (2013) 2(3)211-224

SHEPPARD, L., SACKS, G. & KEATING, C			*Current Obesity Reports* – Excluded as it did not fit the inclusion criteria.
Potential of food and beverage taxes and subsidies to change behaviour and prevent disease. THOW, AM	Obesity Research and Clinical Practice	2013	Paper provided by authors already picked up in review.
Nutritional taxes as a policy instrument for public health: Rationales and expected impact – can't access full paper – abstract in English. ETILÉ, F.	Cahiers de Nutrition et de Diététique	2012	Paper only available in French – authors provided alternative modelling paper. Excluded as it did not fit the inclusion criteria.
Food taxes: Too easy a solution. GOUIN, D. M. & GERVAIS, C	Canadian Obesity Network 2nd National Obesity Summit	2011	Abstract from poster only, alternative papers sent by authors. Excluded as they did not fit the inclusion criteria.
Study: Beverage tax could raise health funds, reduce consumption. TUCKER, C	Nation's Health	2011	No response from authors - email address could not be located.
Money's too tight (to mention): taxation and subsidisation as obesity intervention measures. NICHOLLS, S. G., WILLIAMS, G., WICKINS-DRAZILOVA, D., SIANI, A., DE HENAUW, S., MARILD, S., MOLNAR, D., MORENO, L. A., TORNARITIS, M., VEIDEBAUM, T., PIGEOT, I. & AHRENS, W	International Journal of Obesity	2011	Poster abstract only, no paper available.
A Tax to Stop Sugar-Sweetened Beverages in Their Tracks! PELLERIN, S.	Obesity	2011	No response from authors - Email undeliverable
Fiscal approaches to obesity prevention. GOLD, L., SACKS, G. & BURNS, C.	Obesity Research and Clinical Practice	2011	Paper received from authors. Excluded as it did not fit the inclusion criteria.
Environmental opportunities and obstacles for physical activity and a healthy diet. HUYBRECHTS, I., DE BOURDEAUDHUI, I. & DE HENAUW, S	Obesity Reviews	2010	No response from authors.
Fast Food Restaurant Taxes, Soda Taxes, and Weight Outcomes among U.S. Adults. NICHOLSON, L., CHRIQUI, J., POWELL, L	Bridging the Gap Research ISBNPA 2010	2010	Presentation abstract only, no paper available.
Economic approaches to prevent obesity - Taxes, subsidies and regulation. STURM, R	Obesity Reviews	2010	Papers provided by authors were picked up in systematic review and excluded as they did not fit the inclusion criteria.

A12.6: FISCAL INTERVIEWS: Semi-structured interview schedule

1. Are you aware of any fiscal measures that have been implemented for high sugar foods? (If you're aware government has fiscal measure begin at Q4)

2. If yes, what measure was implemented?

3. In which country?

4. What was the rationale for implementing the measures eg raise revenue, improve health?

5. Do you know whether and how it was evaluated? If so, what are your thoughts on the evaluation?

6. Do you know of any published or unpublished literature on this or any other contacts?

7. What impact do you think the measures have had?

8. What was the general public, industry, and political response?

9. If no, why do you think fiscal measures have not been introduced and how likely do you think it is that fiscal measures will be implemented in the future?

10. How do you think they might be implemented and what impact do you think they will have?

Please give details of the type of measure, how it might be evaluated and the potential barriers.

A12.7: QUALITY ASSURANCE FOR INTERVIEWS
Table 7: Consolidated criteria for reporting qualitative research (COREQ)

No	Item	Guide questions/description
Domain 1: Research team and reflexivity		
Personal Characteristics		
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group? **Victoria McGowan**
2.	Credentials	What were the researcher's credentials? *eg PhD, MD* **Victoria McGowan PhD, MA, BSc**
3.	Occupation	What was their occupation at the time of the study? **Research Associate**
4.	Gender	Was the researcher male or female? **Female**
5.	Experience and training	What experience or training did the researcher have? **PhD with qualitative interviews** **MA Research Methods – qualitative**
Relationship with participants		
6.	Relationship established	Was a relationship established prior to study commencement? **None – aside from email correspondence to arrange interview date**
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? eg *personal goals, reasons for doing the research* **Research associate conducting interviews for project commissioned by Public Health England to assess the impact of fiscal and marketing strategies aimed at reducing sugar consumption**
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? eg *Bias, assumptions, reasons and interests in the research topic* **None – no bias or conflicts of interests identified**
Domain 2: study design		
Theoretical framework		
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? *eg grounded theory, discourse analysis, ethnography, phenomenology, content analysis* **Narrative research – exploring individual's experience and knowledge of the impact of fiscal**

No	Item	Guide questions/description
		and/or marketing strategies on sugar consumption
Participant selection		
10.	Sampling	How were participants selected? *eg purposive, convenience, consecutive, snowball* **Purposive – key stakeholders identified by experience/knowledge in fiscal and marketing strategies**
11.	Method of approach	How were participants approached? eg *face-to-face, telephone, mail, email* **Email**
12.	Sample size	How many participants were in the study? **Fiscal – 15 (plus 2 provided written evidence)** **Marketing – 20 (1 provided written evidence)**
13.	Non-participation	How many people refused to participate or dropped out? Reasons? **Fiscal – 5 declined due to lack of expertise; 3 were unable to arrange a suitable date.** **Marketing – 5 declined due to lack of expertise; 4 were unable to arrange a suitable date.**
Setting		
14.	Setting of data collection	Where was the data collected? eg *home, clinic, workplace* **Home or workplace via telephone.**
15.	Presence of non-participants	Was anyone else present besides the participants and researchers? **Researchers – no, interviews took place over the phone in an empty office.** **Participants – did not divulge whether they were alone during the telephone interview.**
16.	Description of sample	What are the important characteristics of the sample? *eg demographic data, date* **The sample consisted of individuals with knowledge of fiscal or marketing strategies and included academics, industry, non-government organisations, international public health experts.**
Data collection		
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested? **Yes, a semi-structured interview was conducted with a list of questions relating to either fiscal or marketing strategies. Due to time constraints this was not pilot tested.**
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many? **Only 1 interview per participant was conducted.**

No	Item	Guide questions/description
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data? **Yes, audio recording equipment was used to collect the data.**
20.	Field notes	Were field notes made during and/or after the interview or focus group? **Yes, field notes were made during the interview where participants referred to points which were thought to be important and required follow up prior to transcription of the audio recordings ie Recommended literature or suggested other individuals with expertise in this area.**
21.	Duration	What was the duration of the interviews or focus group? **Between 15 minutes and 1 hour.**
22.	Data saturation	Was data saturation discussed? **Yes. The fiscal interviews almost reached saturation point as individuals tended to discuss similar points. Marketing was broader and therefore saturation was not reached.**
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction? **No, due to time constraints and data anonymity.**
Domain 3: analysis and findings		
Data analysis		
24.	Number of data coders	How many data coders coded the data? **One researcher coded the data which was checked and independently reviewed by a second researcher.**
25.	Description of the coding tree	Did authors provide a description of the coding tree? **No, non-hierarchical coding was adopted.**
26.	Derivation of themes	Were themes identified in advance or derived from the data? **Themes became apparent during the interviews which were then identified in the data.**
27.	Software	What software, if applicable, was used to manage the data? **NVivo v10.**
28.	Participant checking	Did participants provide feedback on the findings? **No, due to time constraints and data anonymity.**
Reporting		
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? eg

No	Item	Guide questions/description
		participant number **Yes, quotations were presented. No quotes were identified to protect anonymity.**
30.	Data and findings consistent	Was there consistency between the data presented and the findings? **Yes, presented data was reviewed and checked by a second researcher.**
31.	Clarity of major themes	Were major themes clearly presented in the findings? **Yes, major themes relating to the research questions were presented.**
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes? **No, themes which were not related to the research questions were not presented. The commissioners only requested data which were pertinent to the research brief.**

A12.8 QUALITY ASSURANCE SUMMARY TABLE

Green: yes, Red: no, Yellow: unclear; Clear (no fill) N/A

Table 8: Quality assurance summary

RCTs and pseudo-randomised trials assessments									
Study	Was the assignment to the treatment group truly random?	Were participants blinded to treatment allocation?	Was allocation to treatment groups concealed from the allocator?	Were the outcomes of people who withdrew described and inluded in the analysis?	Were those assessing outcomes blind to the treatment allocation?	Were the control and treatment groups comparable at entry?	Were groups treated identically other than for the named interventions?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?
Waterlander [62]									
Waterlander [63]									
Giesen [56]									
Nederkoorn [64]									

Comparable cohort studies:									
Study	Is sample representative of participants in the population as a whole?	Are the participants at a similar point in the course of their condition?	Has bias been minimised in relation to selection of cases and of controls?	Are confounding factors identified and strategies to deal with them stated?	Are outcomes assessed using objective criteria?	Was follow up carried out over a sufficient time period?	Were the outomes of people who withdrew described and inluded in the analysis?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?
Wansink [65]									
Block [55]									

Descriptive studies:									
Study	Was study based on a random or pseudo-ramdom sample?	Were the criteria for inclusion in the sample clearly defined?	Were confounding factors identified and strategies to deal with them stated?	Were outcomes assessed using objective criteria?	If comparisons are being made, was there sufficient descriptons of the groups?	Was follow up carried out over a sufficient time period?	Were the outcomes of people who withdrew described and included in the analysis?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?
Darmon [59]									
Temple [57]									
Epstein [60]									
Salvy [61]									
Elbel [58]									

A12.9: FUNDING DECLARATION TABLE

Table 9: Funding declarations from included studies

Author (study ref)	Funding declaration
Darmon [59]	Funded by the French National Research Agency through the Research Programme “PolNutrition” (ANR-05 PNRA-0120
Waterlander [62]	Funded by a grant from the Netherlands Organization for Health and Research Development 9ZonMw): 50-50105-96-426
Waterlander [63]	Funded by a grant from the Netherlands Organization for Health and Research Development 9ZonMw): 50-50105-96-426
Giesen [56]	No funding source for this research
Nederkoorn [64]	*Not provided*
Temple [57]	*Not provided*
Epstein [60]	*Not provided*
Salvy [61]	Funded by National Institute of Child Health and Human Development grant: 1R01HD057190-01A1
Elbel [58]	*Not provided*
Wansink [65]	Funding by National Institutes of Health, grant:1RC1HD063370-01
Block [55]	Funded by the Robert Wood Johnson Foundation Health and Society Scholars Programme, grant:053572

A12.10: FISCAL DATA SUMMARY TABLES

PRIMARY RESEARCH DATA

Key:

COLOUR CODES: blue shading: adult studies; pink shading: child studies; purple shading: adult and child studies.

IMPACT CODES: +: intervention had a positive impact on reducing sugar; - intervention had a negative impact on reducing sugar (ie sugar increased); 0 intervention had no impact on reducing sugar.

* This refers to the number of QA criteria met using the JBI criteria (each score is out of 9 but if a criteria is marked as not applicable it is deducted from the total) [58].
** population details are provided only when available.
F=female; m=male; SES=socioeconomic status

Italics: denote studies that report a high sugar food as part of the meal or products assessed but do not present separate outcomes for the high sugar foods ie the results reflect a meal or product range that may include, but is not exclusively high sugar. These studies have been included to demonstrate the impact of sugar as part of a diet, as some high sugar foods maybe consumed as part of a meal rather than in isolation. The authors acknowledge that these studies were identified from those papers that were scanned for a high sugar impact, but where it was only apparent on full review that the impact of the high sugar food is not reported in isolation, but as part of the impact analyses for all the products or meal. It is therefore possible that other studies not included in this review may include impact data on high fat, sugar, salt foods, but were not selected as the title and abstract did not suggest or refer to the high sugar component specifically.

Table 10: Fiscal data summary tables

Author (date), country, funding	Study type (size) & population**	Outcomes measured: [O: objective; S: subjective]	Intervention and target product	Key finding	QA score* [impact: +/-/0]
LABORATORY/VIRTUAL EXPERIMENTS					
Darmon (2014), France [59]	Experimental. Adults, f, low- (n = 95) and medium-incomes (n = 33) took part in the study, South-eastern France.	i) total quantities of food (beverages included) for each class (fruit and vegetables, other healthy foods, neutral products and unhealthy products) ii) quantities of beverages only iii) total expenditures (based on posted prices) iv) dietary quality indices. Energy density (kcal/100g), free sugars (% energy) and the mean adequacy ratio (MAR) were used as nutritional quality indicators. [O]	Experimental economics was used to examine two price manipulations: i) a fruit and vegetable price subsidy named “fruit and vegetables condition” ii) a 30% healthy-product subsidy coupled with a 30% unhealthy-product tax named “nutrient profile condition”. Sample selected a daily food basket, first, at current prices then at manipulated prices.	The results showed that in the subsidising healthy foods and taxing unhealthy products condition (NP condition), improved some aspects of the nutritional quality of food choices in both income groups. It especially reduced the energy density of the individual daily food baskets selected by low-income and medium-income women and in doing so tended to reduce the total energy content of the baskets as the decrease of energy density is positively correlated with a reduction in overall calorie intake. Low-income women derived fewer financial and nutritional benefits from implemented food subsidies and taxes than medium-income women. Authors conclude that this outcome suggests that food price policies may improve diet quality while increasing socioeconomic inequalities in nutrition. [Outcome data for added sugars presented in paper show that less added sugar was consumed after each manipulation in both income groups. These differences were not significant (FV/Baseline low income p=0.52, NP/Baseline low income p=0.27, FV/Baseline med income p=0.28, NP/Baseline med income p=0.78).]	4/9 [+]

Waterlander (2014), Netherlands [62]	RCT, n=102 (95 results analysed).	Purchased quantity (litres) of SSBs per household per week. [O]	The aim of this study was to examine the effects of a price increase (to reflect an increase in VAT from 6%-19%) on SSBs on beverage and snack purchases	This study showed that a higher VAT on SSB resulted in statistically significantly lower SSB purchases in an acute experimental setting. A VAT increase on SSB from 6% to 19% was effective in decreasing SSB purchases and had no significant effects on other beverage categories (including alcohol) or snack foods. This finding strengthens the foundation for the introduction of SSB pricing policies.	8/9 [+]
Waterlander (2012). Netherlands [63]	*RCT, n=117, f, low SES.*	*Primary: Purchases of healthy and unhealthy foods (items and %), fruit and vegetables (gram). Secondary: healthy products outside fruit and vegetables (number and %), proportion. [O]*	*Web based supermarket with 3 levels of price reduction for healthy foods (no; 25%; 50%) x 3 levels of price increase on unhealthy foods (5%; 10%; 25%) factorial design was used.* *(Healthy and unhealthy products defined by WHO nutritional labelling guidelines regarding sat fat, trans fat, sodium, added sugar).*	*Subjects receiving 50% discount purchased significantly more healthy foods then subjects receiving no (mean difference = 6.62 items, p<0.01) or 25% discount (mean difference = 4.87 items, p<0.05). However participants in the highest discount also purchased significantly more calories. No significant effects of the price increases on unhealthy foods were found.* *Price increases up to 25% on unhealthier products did not significantly affect food purchases.*	8/9 [0]
Giesen (2011), US. [56]	*Pseudo-RCT (within-participants*	*Baseline data: 10 point Hunger Scale, 10 item*	*Aim is to test the combined effects of providing calorie*	*Regression analysis showed a significant main effect from tax in the 'no calorie labelling' condition (estimate = -0.078, p<0.001) which*	*6/9* *[+]*

	randomly assigned to 4 different conditions). *Opportunistic sample of students, n=178 students (95 men).*	*Restraint Scale questionnaire, BMI* *Outcome data: Selections from hypothetical lunch menu (3 times – first time prices set as per university menu, second time 125%, 3rd time 150%. Students were allocated either $10 or $20 to spend and told not to exceed this).* [O]	*information and increased taxes on the total number of calories purchased for lunch. Furthermore, these public policy tools were investigated in the context of high and low restrained eaters.* *Target product: High calorie/low calorie foods (categorised into more and less expensive)*	*indicated that a price increase for high-calorie food products was associated with a decrease in calories purchases.* *Overall, there was a main effect for 'calorie information' that reduced the effect of the tax. Thus, a food tax reduced the amount of calories bought, but this was limited to those participants who had not received calorie information.* *A food tax of >= 25% makes nearly everyone buy fewer calories.* *(No outcome data specific to sugar – brownie, glazed donut, chocolate candy bar, SSDs described in menu list).*	
Nederkoorn (2011), Netherlands [64]	*Experimental, within-subject, n=306, adults.*	*Baseline: Daily budget on food, Momentary hunger Outcomes: Food purchasing behaviour (using web based supermarket task) [O]*	*Examined whether a high tax on high calorie dense foods effectively reduces the purchased calories of high energy dense foods in a web based supermarket and whether this effect is moderated by budget and weight status.*	*Results showed that relative to the no tax condition, the participants in the tax condition bought less calories. The main reduction was found in high energy dense products and in calories from carbohydrates, but not in calories from fat. A 50% tax on High Energy Density (HED) foods caused a 16% decrease of purchase in these products. BMI and budget did not influence the effectiveness of the tax. The reduction in calories occurred regardless of budget or BMI implying that a food tax may be a beneficial tool, along with other measures, in promoting a diet with few calories.*	6/9 [+]

			Target product: Energy dense foods.	*(No outcome data specific to sugar– described high energy dense foods chocolate, cookies and sweets were taxed)*	
Temple, (2011), New York. [57]	*Two experimental studies, within-subject design.* *18-50 years, Experiment 1: n=35 overweight/obese, n=16 lean Experiment 2: n=20 obese, n=21 non-obese. (Opportunistic sample recruited from University students, staff and community members using flyers).*	*Baseline: Demographics, anthropometrics, basic medical info, food preferences Outcomes: Nutrition information condition of food purchased (No label, standard label, traffic light label), Energy intake. [O]*	*Two studies to test hypothesis that simplified nutrition labelling and taxation alter food selection and intake.* *Experiment 1: participants consumed lunch in the lab three times with no labels, standard nutrition labels, or traffic light diet labels at each visit. Experiment 2: participants were given $6 with which to purchase lunch in the lab twice with standard pricing on one visit and a 25% tax on 'red' foods on another visit. Participants received a brief education session on the labelling*	*Results for experiment 2 (the 'tax' experiment) showed that for 'red' food purchases there was a main effect of taxation condition on number of 'red' items purchased (F(1,39) = 6.9; p=0.012), with taxation reducing the purchasing of 'red' foods. There was also an interaction between weight status and taxation on purchasing of 'red' foods (F (1, 39) = 4.1; p=0.049), with taxation reducing red food purchases in obese participants, but not in non-obese participants.* *(No outcome data specific to sugar)*	7/8 [+]

			system being used. *Target products: Traffic light labelled foods: 'green' = foods low in calories, low added sugar <10% calories/serving; 'yellow' = moderate calories, added sugar 10-25% calories/serving; 'red' = high calories, added sugar >25% calories/serving, fat>5g/serving.*		
Epstein (2010), US [60]	*Experimental observation (within-subject design): analogue purchasing study.* *N=42, f, recruited via university database, responsible for grocery shopping and have at least one child 6-18yrs old. N=20 lower income, 45%*	*Purchasing patterns [O]*	*To examine effects of increasing the price of HCFN foods or reducing the price of LCFN foods by 12.5% and 25% on mothers' purchases of 68 common foods and drinks.* *68 common foods (high sugar products included:*	*Subsidising more healthful foods with high nutrient density increased overall energy intake (as mothers spent the saving from healthy food on more unhealthy food).* *When prices of less healthy foods were increased, there was a significant decrease in energy purchased (elasticity estimate = -0.98, p<0.0001).* *Tax that increased the price of unhealthy foods by 10% reduced total calories purchased by 6.5%, as a result of a reduction in fat and carbohydrate calories of 12.8% and 6.2%, respectively. These results favour taxes as a way*	4/7 [+]

	were obese, 23.8% with 'minority status'.		*candy, cookies, ice cream and SSB.) categorisation was based on the CNF which calculates calories required to gain 13 key nutrients.*	*to reduce caloric intake.* *(No outcome data specific to sugar)*	
Salvy (2012), US [61]	Experimental analog purchasing task. All participants aged 12-14, BMI above 5th percentile and below 95th percentile. Experiment 1: n=37, 18 male, 19 female. Experiment 2: n=52, 26 male, 26 female.	Consumption patterns, dependent on manipulation of taxes on snack food [O]	Aim is to examine the impact of price manipulation and individual characteristics on purchases of healthy and unhealthy snack food in adolescents. Experiment 1 examined behaviour when participant was alone, experiment 2 examined behaviour when participant was in the presence of a peer. Target foods: Snack foods, including fruit, cereal bars, crisps, sweets/candy, and biscuits.	Price manipulations affect adolescents' spending on snack foods. Taxing unhealthy food results in less unhealthy food purchased in both experiments. In experiment 1: fewer kilocalories of high-calorie-for-nutrition (HCFN) snacks purchased were predicted by taxing HCFN snacks (β=-5.13, SE=1.08, p<0.001). Experiment 2: fewer kilocalories of HCFN snacks purchased were predicted by taxing HCFN snacks (β=-4.32, SE=0.97, p<0.001).	4/9 [+]

SUPERMARKET EXPERIMENTS					
Author (date), country	**Study type (size) & population****	**Outcomes measured: [O: objective; S: subjective]**	**Intervention and target product**	**Key finding**	**QA score* [impact: +/-/0]**
Elbel (2013), US. [58]	Controlled field experiment. Descriptive/Case Series – no control. Study size based on number of purchases (n=3680)	Purchasing patterns. [O]	Aim is to determine whether tax or labelling of unhealthy food influenced purchasing in a controlled field experiment. The focus being to improve diet. Target product is 'healthier foods' NB the healthy foods were categorised as </=35% total weight from sugar (which is significantly more than our recommendation Purpose built experimental corner store in a large hospital in New York. Located in the outpatients area so open to	There was no significant difference between the various taxation conditions. Consumers were 11 percentage points more likely to purchase a healthier item under a 30% tax (95% CI7%, 16%, p<0.001) and 6 percentage points more likely under labelling (95% CI0%, 12%, p0.04). By product type, consumers switched away from the purchase of less-healthy food under taxation (9 percentage point decrease, po0.001) and into healthier beverages (6 percentage point increase, p0.001); there were no effects for labelling. Conditions were associated with the purchase of 11–14 fewer calories (9%–11% in relative terms) and 2 fewer grams of sugar (p<0.001). Results remained significant controlling for all items purchased in a single transaction.	7/7 [+]

			everyone but the hospital served many low income minority groups as a result of their poorer health. 3680 purchases made during the experiment.		
Wansink et al (2012), USA [65]	Randomised controlled field experiment (Comparable cohort study) 113 households randomly assigned to either a 10% tax on SSBs or control group. Final sample = 89 households (total number of purchase observations = 623)	Observation of purchases over 7 months. [O]	In the tax group all foods and drinks classified as unhealthy were taxed. All SSBs classified as unhealthy and taxed. Alcohol was not discounted or taxed.	The tax resulted in a short-term (1 month) decrease in soft drink purchase. There was no decrease over the 3 or 6 month period. There was an increase in beer purchases in the tax group. Concluded that a 10% tax on less healthy foods did not produce a significant change in SSB purchase at 3 or 6 months and there is evidence of unintended consequences in the form of increasing alcohol purchases.	7/8 [0]

CAFETERIA/RESTAURANT EXPERIMENTS					
Block (2010), US [55]	Controlled field experiment. (Comparable cohort). Within-subject design. n=154	Primary outcomes: Daily sales of soft drinks, diet soft drinks, zero calorie water. Secondary outcomes: sales of other categories of beverages. [O]	5-phase intervention in a hospital cafeteria 1) baseline 2) 35% tax on regular soft drinks 3) reversion to baseline prices (washout) 4) educational campaign 5) combination tax and education. Data collected from a comparison site, for the final 3 phases.	Sales of regular soft drinks declined by 26% during the price increase phase (95% CI = 39.0, 14.0). This reduction in sales persisted throughout the study period and was increased to 36% during the combination phase (95% CI=49, 23). Diet soft drinks sales increased during this period by 20% (95% CI=7.0, 33.0) Education had no independent effect on sales. Analysis of the comparison site showed no change in regular soft drink sales during the study period.	4/8 [+]

A11.11: FISCAL INTERVIEWS: Detailed findings

1. Countries with fiscal strategy

This section highlights the main points which stakeholders discussed with regards to countries that have implemented a fiscal strategy that may reduce sugar consumption. Table 11 below lists the various countries stakeholders discussed, whether the tax has been evaluated, and the rationale for introducing this measure. Stakeholders mainly provided information on France, Mexico, Finland, and Hungary. Discussions on Berkeley and other states in the US were not elaborated and the only information provided is listed in Table 11. For a full list of current taxes see Table 1 in the Background section above.

Table 11: Information provided by stakeholders on existing taxes in the listed countries and states

Country	Strategy	Rationale	Evaluation data
France	Tax on all soft drinks	Revenue/Health	No formal evaluation provided, discussed decrease in sales
Mexico	Tax on SSB and 'Junk Food'	Health	Evaluation ongoing discussed decrease in sales and consumption
Finland	Tax on sugar products	Revenue	No evaluation at present, discussed small reduction in consumption
Hungary	No specific strategy reported	Health and Revenue	No formal evaluation, no discussion regarding outcomes
Berkeley, California	Tax on SSB	Not reported here	Too early to evaluate
Various states in the US	Varying levels of taxation on soft drinks	Not reported here	Taxes too small to see impact

1.1 France

France introduced a tax of 11 euro cents per 1.5 litre of soda in January 2012, which covers sugar-sweetened, sugar free and low calorie drinks and according to one stakeholder there is also a tax on advertising soft drinks.

> *"French's soda tax... they have an excise duty on drinks with added sugar and also artificial sweeteners"*

> *"The French soda tax – comprising approximately 11 euro cents for a 1.5 litre of soda – has been in effect since 1 January 2012"*

1.1.1 Evaluation/Impact

Stakeholders mainly described the impact in terms of reductions in sales, however, some also provided information on the revenue that had been gained since the introduction of the tax.

> *"Sales 2012 in supermarket showed at the beginning of 2013, for the first time for very numerous years, a break in the tendency which were in a natural growth: the sales of sodas decreased in 4% (while the trend of the previous years let expect a positive growth of 2%). All the sales of "sweet drinks without alcohol" fell with 1.6%. It does not seem that this reduction is connected to a meteo effect because the sales of bottled water pursued their 1.6% growth. In the same direction, the consumption of nectars moved back 8.57% in 2012, this fall being attributed by the interprofessions UNIJUS[7] to the tax on drinks with added sugars"* [sic]

> *"280 million euros that they got"* [in revenue]

> *"and when they did that they promptly dropped the sales by 4%"*

However, it is unclear whether this reduction in sales has been sustained as some stakeholders described recent increases in purchases.

> *"Following the implementation of a soft drinks tax in France in 2012 volumes decreased by 2%. However, in 2013 volumes grew again by 0.5% and from the beginning of 2014 until the end of April volumes increased by 6%"*

> *"... in France there was an initial reduction in purchases but that reduction has, it's not nearly as great now"*

There were discussions around evaluations in France, however, it appears that these have mainly focused on whether the tax had been fully passed onto consumers rather than being absorbed by the manufacturers.

> *"France, there's been a very good evaluation showing what the passed on effects of the tax by some interior ministry in France"*

> *"there is a paper... that is called the Impact of the Soda Tax on prices and it looks primarily at whether the soda tax was fully shifted to*

[7] UNIJUS – Union Nationale Interprofessionnelle de jus de fruits http://www.jusdefruit.org/

consumers so it looked, it didn't look at the impact necessarily on the consumption of SSB it just looked at whether the tax had the desired effect of making it more expensive for consumers"

1.1.2 Rationale

There were two responses provided when asked about the rationale for introducing this tax in France, some stakeholders believed it was revenue for the general budget while others described it as being for health purposes. Moreover, this difference in responses was described by other stakeholders as being a result of industry pressure to prevent stigmatising their products.

"the main purpose is revenue and goes into the general budget"

"the product of this tax is intended for health insurance... raise revenue mainly for National Health Insurance"

"…in France while it was initially introduced on the back of the national nutritional strategy which had an objective of reducing child obesity they kind of renegotiated the explicit purpose away from health and towards revenue raising because the soft drinks industry objected very strongly to the idea that this was a health measure"

"the deal that [industry] *struck with the French government was that you can introduce this tax but you can't say that it's about health, yes and although some people did spin it as a health tax I think sort of within the French government they played that down a bit"*

Furthermore, stakeholders argued that the French population were more supportive of a tax if the revenue gained was used for health.

"it was health purposes... and suddenly the agreement from the population rose above 60%... it became clear that if all of it went to the health department and health promotion then I think it was nearly... it was something like 70% of the population thought that this was a totally acceptable thing to do, so the evidence is overwhelming"

1.2 Mexico

Mexico introduced a tax of 1 peso per litre of sugar-sweetened drinks in addition to a 'junk food' tax which covers high energy dense foods in January 2014.

> *"it was passed as a law so all sugar-sweetened beverages in Mexico have a tax that is 1 peso per litre which is about 9-10% of the price and also in addition to that there is also a tax on what is called non-basic high energy dense food that people in Mexico call junk food"*

1.2.1 Evaluation/impact

Stakeholders discussed how Mexico is currently evaluating the effects of their tax on sugar-sweetened drinks and some described how preliminary results have shown a reduction in purchasing. Moreover, some described evidence from commercial reports which indicate a reduction in consumption.

> *"it's being evaluated using data very similar to the Kantar data that are used in the UK, household consumption data we have... data that they obtain biweekly from Mexican households and they get the receipt... yes, we haven't published yet though but we've done internal work and we have a press conference but we, our publications are under review and essentially the 10%, there are two taxes, the 10% tax has reduced, the reduction started off slow in the first month and by the third month it was down to about 10-11% reduction in purchasing of sugar-sweetened beverages"*

> *I think in Mexico I have seen commercial reports that soft drink consumption has dropped significantly, purchases in Mexico since the imposition... but those are commercial reports in the trade press, I haven't seen any peer reviewed papers"*

> *"we haven't published yet but we've done internal work… and essentially the 10%, there are 2 taxes, the 10% tax has reduced, the reduction started off slow in the first month and by the third month it was down to about 10-11% reduction in purchasing of sugar-sweetened beverages"*

> *"sales volumes for Mexico, 10% decline in purchases of taxed beverages and that's 2014 in Mexico and 7% increase in purchases of untaxed beverages"*

> *"There's some preliminary results from Mexico's sugary drinks tax that over the 1st quarter it was implemented in January 2014… it has had an impact on sales of sugary drinks"*

Stakeholders described how the preliminary results were presented at a press conference which highlighted the reduction in purchasing, however, there had been

some discussion over downward trends in 2013 and there was a need to adjust the analysis model.

> *"we presented the model but there were some comments about the fact that there are first of all there seems to be a downward trend in intake sugar sweetened beverages when you look at 2013 and the downward trend is different if you use different quarter, there is a lot of variability in the purchases by month or quarter so it's not easy if you had just one quarter, it's really not easy to adjust for the previous trend but there was a reduction in the intake of sugar sweetened beverages but the percent of reduction changes for one model to the other and there was always a reduction in sugar sweetened beverages, in soda, soda was the one that had the highest reduction and on soda we had, we went from… 5%, 10% depending on the type of model we used and we also found an increase in the intake of water, in the purchase of water… the only thing we have published is a summary… we emphasised it's really preliminary results… so the feeling is there is a reduction but the amount of reduction it is, it's not very clear"*

> *"It was on the National sort of Public Health website* [the press release] *and it's been removed because the model changed in the evaluation advisory group but the results are positive… the results don't change so much but the method was so different"*

In addition to the financial implications to consumers there was a discussion around the educational effects such a strategy may have. This stakeholder described how consumers may change their behaviours if products are taxed because they have been deemed harmful.

> *"there may be also some psychological effect on the population if you tax something because it's harmful, maybe people start to realise more than before that they should reduce consumption and I think that there seems to be a small downward trend in consumption of sugar sweetened beverages and also that may be the result of the public awareness… so there may be also an effect on the knowledge of the population and attitudes towards sugar sweetened beverages as a result of the tax but also other measures, it's really complex to evaluate"*

1.2.2 Rationale

Mexico introduced the tax in order to improve public health and it was created alongside other health initiatives to reduce obesity and associated illnesses.

> *"it was introduced as a health bill and alongside it were other health initiatives targeting obesity, a bit of a national problem"*

> *"If you read the law it really points out that this tax is paid in health tax so it's really, the final objective is really to improve the health of Mexicans and so that was the rationale for implementing the tax… not, I mean, it raised revenue of course, but it's really to improve health"*

> *"Certainly in Mexico it was part of the anti-obesity drive"*

One stakeholder described Mexico's approach as holistic by combining taxation with a variety of other methods in order to create an environment which fully supports behavioural change and reinforcing the idea that this tax was primarily to improve public health.

> *"I think that taxation could have an impact if used as a last resort, as a holistic approach… which is something Mexico are doing… their approach is to follow all steps in terms of public health prevention, starting with public health education, creating a supporting environment in which behaviour change can happen, the political support for vulnerable people such as pregnant and breastfeeding women, children, the elderly etc"*

1.3 Finland

Only one stakeholder provided detailed information about the fiscal strategy in Finland, which places a tax on soft drinks and confectionery.

> *"taxes on candy, ice cream, soft drinks, and chocolate…"*

Evaluation/impact

The stakeholder described how there has not yet been an evaluation in Finland yet it is hoped that this will happen at some point in the future. However, despite this lack of formal evaluations the stakeholder reported there has been some small impact as a result of the tax.

> *"Well not, we'll evaluated when we get the money and somehow a little bit also what happens with consumption… we have had the tax on soft drinks and all that only for limited number of years and for the health benefits it takes time so it's not even possible to evaluate it yet"*

> *"there is some impact but it is quite small, and it is quite difficult to distinguish from the other things… but from the health benefits we don't have any data yet we hope to show something in the future for example with regards to dental care and obesity but the data is not there yet but we are seeing because obesity, we are seeing now a plateau… it's a little bit decreased but of course something that, outcome of multiple issues and it's very difficult to distinguish with other key things"*

The stakeholder went on to describe how the tax aims to limit consumption, however, it was not possible from a political perspective to introduce a relatively high tax. However, they described how it was a conscious decision to start off with a smaller tax in order to pass this through parliament with the view that this may be increased at a later stage as opposed to starting with a very high tax that would be rejected.

> *"our kind of assumption was that it limit consumption or it might limit consumption especially among children and adolescents which are the group we ae more concerned of because the price sensitivity is highest of course, they have the least money and we have some data showing that it has helped some, it is not very big one but that's something we already knew when we decided to have the tax that the level it's not, in order to have really big effects of consumption you really need to have high taxes and for political reasons that wasn't an option with the legislation... we wanted to have legislation and start with a low level of tax because that was feasible... increasing the level once you have the system operated if, it's much easier then, if you start it at a very high level you are not probably going to get it through the parliament. So that was a very conscious choice, to have it at a level that is somehow acceptable"*

1.3.1 Rationale

The stakeholder described that Finland's rationale for the tax was to raise revenue due to difficulties measuring the impact of fiscal strategies on health outcomes. If they used health as the rationale for the tax and could not show an impact, the tax could be seen as ineffective and removed.

> *"the main rationale is to raise revenue... the choice of the product was all of the health issues were kind of taken into account but really the purpose is for the revenue and it's very clear kind of reasons why we want to have it that way and that's because if you have a purpose of improving health for example you have to be able to show that really*

this happens and it's extremely difficult to evaluate the influence of something like tax on long term health benefits so it's a practical solution because whatever we have as kind of reason that needs to be somehow shown"

1.4 Hungary

Stakeholders mentioned Hungary had implemented a tax on sugar-sweetened drinks, however, only a small amount of information was provided. This suggests Hungary may not have evaluated or published details on the effect of their tax or the stakeholders interviewed here had only partial knowledge of evidence from this country.

"Hungary has kind of taxed energy drinks and sugary drinks"

1.4.1 Evaluation/impact

"I have heard reports from the food standards agency of Hungary have been looking at trends in sales and consumption data I haven't seen anything published in the literature"

1.4.2 Rationale

"some colleagues have mentioned that it seems that some of the money raise from the tax have gone in public health... some of the money raised as a result of the sugar tax went to public health and when I asked more specifically... they said 'obviously not the biggest chunk goes to other government needs but we get some of it'... so if the government wants to raise revenue that's fair enough but we can't say that we're trying to improve public health when that's not the rationale"

"I think also in Hungary it was primarily a revenue raising initiative"

2. General themes

This section provides more general themes that emerged from the interviews with stakeholders. They provided intelligence on the impact of current taxes, potential impact, evaluations, the regressive nature of this strategy, and the industry, public, and political responses to actual and potential taxes.

2.1 Impact

Stakeholders described how there was limited empirical evidence showing the impact of fiscal strategies. However, where impact was discussed it was mainly in terms of reduction in sales of sugar-sweetened drinks.

> *"just financial projections, there are some household surveys and some sales data which show some reduction in sales but nothing that has to do with public health indicators... I don't think that there is national data to show the impact of sugar tax on consumption or public health indicators"*

One stakeholder described how the impact of current sugar taxes is in line with, or even surpassing expectations, based on evidence from modelling studies.

> *"in general the taxes have had an impact in line with the modelling in my view, so firstly a lot of the modelling has had to make an assumption about the extent to which it is passed on to the consumer I think the evaluations have generally demonstrated the effect on consumption is larger than we might expect from the modelling"*

Another stakeholder described how there had been a decline in consumption of sugar-sweetened drinks, by upper educated individuals, in countries without a fiscal strategy and that this may be a result from the wider public health messages in addition to debates around taxing high sugar products.

> *"the education probably have made some impact and in our country* [Mexico] *we've had a decline in sugary beverage intake and in your country* [UK] *also and I think that has a lot to do with both the public health pressure and the debate around it... so the US has seen a profound decline, more in upper educated, Whites and Blacks, not in Hispanics or lower educated population"*

There were also discussions around whether an implemented tax is passed onto the consumer as opposed to being absorbed by retailers or manufacturers. This stakeholder described that larger taxes such as those in Mexico and Hungary are being passed onto the consumer and seem to be associated with reductions in consumption.

> *"the picture that is emerging is that the small tax rises, when I say small tax rises not talking about all that in the states, I'm talking about Mexico, Hungary price rises to the order of 5-10% do get passed on*

> *they do result in price rises and that does seem to be associated with a reduction or moderation in consumption how sustained those reductions or moderations in consumption are remains in question"*

In areas with fiscal strategies there have been reports in trade journals indicating these are having an impact on sales, however, this stakeholder goes on to say how it will be some time before any impact on health is identified.

> *"it's already being reported in the trade journals in the trade press that where they have been introduced these are having an impact on sales and having an impact on the businesses concerned, so that's a very quick indicator... as far as the longer term health impacts go we wouldn't expect to see anything quickly it will take a lot of time before we see any outcomes in terms of health improvement"*

One stakeholder described how the current evidence base does not support sugar taxation as a means to ameliorate obesity prevalence. However, as the stakeholder above describes, there would be no expectation of immediate impact on health outcomes.

> *"personally I've not seen anything that persuades me that sugar taxation is going to be the way forward in terms of tackling obesity and I've listened to some of the people who are very experienced in the policy area... there's a woman... she was in a meeting that I was at and she said 'as nice as it might seem that this would be a good way forward there really isn't the evidence base to support it at the moment'"*

This was supported by another stakeholder who described the evidence base as primarily modelling which shows modest reductions in calorie consumption.

> *"Evidence for food taxes is primarily based on theoretical modelling and even then show only a small reduction in calories of around 4kcal a day. Taxing soft drinks won't curb obesity, not least because its causes are far more complex than this simplistic approach implies."*

Only one stakeholder described evidence from an experimental study assessing the impact of imposing a 10% tax on drinks.

> *"basically, it was six months in a city where half of people had a 10% tax on drinks where half didn't, so real life but not actual introduced fiscal measure so it's not really an evaluation of a thing so that one they saw a short term decrease but it bounced back in the three*

> *months and six months, I think they had a similar purchasing level in both"*

Moreover, another stakeholder described the need for a 20% tax in order to see significant reductions in, however, it is unclear what impact this would have on total calorie intake or public health.

> *"of course in order to reduce consumption significantly we need to tax sugar with something like 20% which I'm not sure how financially viable it will be in terms of the industry... so 20% would have a big impact on consumption, however, we don't know what impact it would have on the total calorie intake and what impact it would have on public health"*

Stakeholders also gave their views on the potential impact a fiscal strategy may have and one common theme appeared to be whether consumers would switch to cheaper non-branded items or other unhealthy products.

> *"it's very hard to predict how consumers are going to react and you don't know how they're going to react and whether that's to switch to cheaper brands or buying something different"*

> *"swapping to cheaper alternatives would concern us and I guess the kind of potential restriction on industry growth"*

Another stakeholder questioned whether consumer behaviour would be influenced by a fiscal strategy and whether the assumption that people would make healthier choices had been fully examined.

> *"if it's a bigger amount and it does cause people to stop buying coke or lemonade or whatever, what do they do instead? So do they buy water or milk or drink tap water, or do they just spend that money on sweets or something else and we don't know... I think assumptions that people will be influenced by the tax and as a result have a healthier diet and I think that's an assumption that hasn't been tested"*

Moreover, another stakeholder provided an example from Australia, which demonstrated that a higher price on soft drinks had unintentional consequences whereby individuals reduced their fruit and vegetable purchases.

> *"there have been some attempts to manipulate prices of soft drinks, I think they were in remote Aboriginal areas of Australia, Queensland and unfortunately they found exactly what some people have warned is that the drinks continued to be purchased but because they cost more*

people therefore purchased fewer fruits and vegetables, that's exactly the effect you don't want from a public health point of view"

2.2 Evaluations

Considering the paucity of impact evidence it is unsurprising that stakeholders discussed a distinct lack of evaluations. Without an evaluation it is difficult to show impact of a current fiscal strategy. However, stakeholders discussed ongoing evaluations of current fiscal strategies and methodological difficulties in assessing effects on health outcomes.

"No country has evaluated yet, in France there is a group of economists that are going to but they haven't done it yet, this is the first evaluation that I've done with any country [Mexico] *on this tax, the sugary beverages tax, the only other health related tax that's been evaluated is one by colleagues in Denmark on the saturated fat tax and that's all"*

"We're now evaluating the Berkeley tax but that's just starting so it's a very tiny community with a small average consumption to start with so that won't be meaningful... the Mexico and France evaluations are much more meaningful"

Despite a lack of evaluations this stakeholder argued there was an extensive evidence base from modelling studies which supported the implementation of fiscal strategies.

"well obviously there isn't a great deal out there because not many of these strategies are being implemented and there's a huge amount of evidence to suggest they might be effective, are you looking at things like the modelling?"

Additionally stakeholders discussed potential problems with evaluations and whether they are able to control for confounding variables.

"well because these aren't trials or experiments rather, it's difficult to, and they're merely before and after studies and quite often it's only, some of the evaluations have been a point before and a point after so it's very difficult to associate any change you see in consumption or anything else with the tax itself but it would be"

This point was supported by another stakeholder who argued there was a need for further research to fully understand the impact of a fiscal strategy to reduce sugar consumption.

> *"well more research is needed to look into calorie intake and indicators like that, we need an epidemiological study with a robust methodology to get a clear idea of what the impact could be and I don't think that a study like that exists"*

> *"if countries are thinking about doing something, they really have got to invest in the evaluation to be able to demonstrate that it does work "*

2.3 Regressive nature

Some stakeholders expressed concern over the regressive nature of implementing a fiscal strategy to reduce sugar consumption. It was believed families from the lower socioeconomic strata may spend a greater proportion of their income on high sugar foods and this measure would place a greater financial burden on these individuals.

> *"there's also the regressive nature, poorer families being hit hardest because they spend more of their income on the foods"*

> *"and the point that* [name removed] *makes is that it's actually a sort of taxation that will have the biggest impact on the poor"*

However, this point was critiqued by another stakeholder who felt that any regressive element would be outweighed by the benefits of this strategy.

> *"what often gets lost in the discourse there is that as I say the push back from those who oppose food taxes is always that taxes are regressive and poor people bear the brunt more heavily what they don't point out is because of the clustering of the ill health outcomes around those same lower income groups, the benefits that accrue from those sorts of measures, assuming there is a response, is progressive"*

This idea was supported by another stakeholder who argued they had modelled the impact of the taxes and shown that they benefit individuals with lower incomes.

> *"there was discussing that all the, this type of taxes are, what's the English word for it, they hit most hard those who have less money but luckily we have simulating models that show that the benefits mostly come for those as well so you could say that of course, you know,*

know what happens but still they are the people that benefit the most from the taxes"

2.4 Response to fiscal strategy

Stakeholders generally reported that the industry opposed any form of taxation on their products, the public response as positive especially if revenue goes towards health, and the political response is dependent on the country.

2.4.1 Industry:

Stakeholders who discussed the industry response to actual or potential taxes on high sugar foods reported this had generally been negative. Some argued industry had attempted to prevent taxation by lobbying politicians.

"in the US I think that the industry has been very good at lobbying elected officials, at trying, you know, influencing through campaigns, contributions and donations and things like that... there's been a lot of progress but I think there is still a whole lot of work to be done"

"in the past the producers were very effective in lobbying the congress and also openly in the newspapers... they were successful and of course twisting arms to politicians because they are very powerful"

In Finland industry bodies have appealed to the European Union court as they believe the tax is unfair.

"the negative reaction came from the industry, they were very, very unhappy with the taxes and we are still struggling with them because actually they have appealed to the EU court saying these taxes are unfair"

Stakeholders also described how industry believes the taxes are regressive and will negatively affect those on lower incomes.

"the industry is, you know, they're responding in similar ways in New York as they are in California and Mexico, you know, they're using a lot of arguments around the regressive nature of a tax, they're using a lot of personal freedom arguments"

"Industry I'm aware that they have protested against these measure in every single environment where they have been introduced with a

range of arguments about their workability, their regressive impact on people on low incomes"

There is also concern that taxation will stigmatise particular products and that industry bodies feel it would not be an effective measure to tackle obesity.

"I think the industry is very afraid of these taxes and it suggests to me I think part of that fear is they think these taxes will generate a lot of negative publicity and stigmatise their product and one way to mitigate that would be to say well ok you can have the tax but you can't say it's about health"

"generally industry I would say is against those taxes... we don't think it's a successful measure to tackling obesity... it's very hard to predict how consumers are going to react and whether that's a switch to cheaper brands or buying something different and it's the message around one nutrient which is causing an issue rather than it being messaging around how... what an overarching balanced lifestyle would look like"

2.4.2 Public

Stakeholders described the public response as generally positive, not only in terms of accepting the tax if the revenue is used for health but also responding to the debate/implementation through reducing consumption.

"we've seen in New York a huge drop in consumption through our community health which is an annual telephone survey... so we saw a huge drop in consumption just in the last couple of years and we, while we can't point directly to one thing, we do think that the attention, the media attention and the kind of side effects of introducing a controversial policy did have an impact on consumption... we attempted to put a cap of the portion sizes of sugary drinks at our city restaurants and what we saw kind of as a side effect really is the attention and the news media around consumption of sugar sweetened beverages, the health impact... there has been a shift in social norms and in this kind of public perceptions of these products... I think the national attention... even an attempt at a tax have really kind of raised awareness around the issue and the need for consumers to consume less so I would imagine that's part of an impact beyond the direct impact of the tax"

> *"there is general public support for initiatives to reduce sugar consumption and particularly to protect kids, there is, in the UK there have been surveys suggesting there is a 40-50% public support for a tax on sugar... when the question is rephrased if the money are ploughed back into kiddies' health then the support goes up substantially"*

> *"the reaction was that... 'it's better to have taxes on something that is not necessary, bad for your health'... so we actually had quite a lot of media and interviews with people, how they feel about the taxes and it was like 'well I don't like taxes but because I know we have to collect them, this is a good choice compared to having overall higher level of taxes for everything'... so general public opinion was positive'* [Finland]

> *"people agreed that we should consume less sugar sweetened beverages but we don't like tax, but you know linked the tax to the use of the revenue for obesity prevention particularly for having water fountains in schools of the poorest in Mexico and that was very, very strong, at the end a lot of people would say 'okay, yes I am willing to pay the tax"*

> *"I think my understanding was that in France when it was introduced, I was hearing this from a representative of the French government, public response was pretty relaxed, people understood that soft drinks were bad for health and they didn't object to the tax... In Hungary I understand that the public response was to initially stockpile, frantically, before the tax took hold which sort of showed in a spike immediately before the tax was introduced"*

There was only one stakeholder who argued that public support for taxation was low, however, they describe a higher level of support in the UK.

> *"In terms of public opinion there's a couple of things I'm aware of, there's two studies I'm aware of one is slightly older... they did polls within different member states... showed really low support so they basically showed a 2.8% support for taxes across kind of as an average value across different EU member states. . but the UK they actually found a higher support, they found medium level support generally which I think comes in at 40-50%, they were looking at fiscal measures in both directions so not just a tax"*

2.4.3 Political

In terms of the political response stakeholders described mixed views. One argued that government was cautious due to industry involvement.

> *"the political response is always sort of cautious and reactive and sadly too often it's coloured by best interest, either overt or covert so until recently in the UK it was covert but with this coalition government it's been very much in your face industry sitting at the same table as government ministers for the so called responsibility deal but this is also relevant that approach has been thoroughly discredited so partnership working with industry, disaster with tobacco, disaster with alcohol, disaster with food"*

Another argued that despite having a particularly conservative government they were unable to ignore the public opinion over the impact of sugar-sweetened drinks on health and implemented a tax.

> *"there is a very complex political that led to this tax and by the end about 70% of the Mexican public was convinced from public opinion polls that sugary beverages were linked with higher risk of diabetes, very high in the country, and that was part of the reason why a very, very conservative government cast a tax despite their desire not to"*

Others described strong political will despite opposition from industry.

> *"*[Industry] *threatened the French government saying if you put a tax on we're going to with draw from the country, the French government took exception to that and said we're the French government and we set the rules and we're putting a tax in place"*

And a more general comment described the problems of government being unable to present impact within their time in office.

> *"the political response depends on the government that has implemented the tax, what I mean is, I don't think any politician or government prioritises implementing a tax in order to improve public health and that's because the impact of the tax can't be seen in 4 years which is how long government lasts"*