# THE BIGGER PICTURE: THE HIDDEN CONSEQUENCES OF THE SUGAR REDUCTION STRATEGY FOR TACKLING CHILDHOOD OBESITY IN THE UK

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**Abbreviations list:**

| | |
|---|---|
| *Total sugar* | All mono- and disaccharides present in food, derived from any source. |
| *Free sugar* | Free sugars include monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates (SACN, 2015). |
| *NMES* | Non-milk extrinsic sugars are the sugars that are not contained within the cellular structure of a food except lactose in milk and milk products. This includes sugars that are added to foods, e.g. sucrose, glucose and fructose, and sugars naturally present in fruit juices, e.g. glucose and fructose (SACN, 2015). |
| *SSB* | Sugar- Sweetened Beverages. |
| *CBC* | Choice-based Conjoint. |
| *HAC* | Hierarchical Agglomerative Clustering. |
| *WPR* | What's the Problem Represented to be. |

**Abstract**

The focus on reducing rates of childhood obesity has become one of the main public health priorities in the United Kingdom. The government is addressing this through various strategies including Public Health England's sugar reduction programme, which aims to decrease free sugar intake to 5% of individuals' total energy intake (PHE, 2015a).

There is precedent in the UK of using a single-nutrient approach in the management of non-communicable diseases (NCDs), with salt being used to address hypertension, and dietary fat for cardiovascular diseases and obesity. Using a four mixed- method studies, this PhD aims to investigate possible unintended consequences associated with the one-nutrient focus on sugar, including demonising the single nutrient targeted, promoting unhealthy dieting, detracting from a balanced healthy diet, creating stigma around obesity and exacerbating other health-related inequalities.

**Study one: Sugar looks brighter on Traffic Light Nutrition Labelling: Choice-Based Conjoint Analysis and Cross-sectional Survey**

With the current emphasis of public health on sugar reduction, this two-part study aimed to investigate the influence of Traffic Light Labelling (TLL) information about total sugar compared to other macronutrients when making decisions about the healthiness of products. The first part was a Choice-Based Conjoint analysis (CBC) assessing the relative importance of four macro-nutrient attributes commonly used in TLL (sugar, fat, saturated fat, salt) and the colour of each based on three food products (biscuits, cereal, and sandwich). The second part was a cross-sectional survey assessing public knowledge of the recommendations underpinning the TLL.

The results suggest that, when participants decided upon the healthiness of biscuits, cereal or sandwich, sugar was the most important factor compared to fat, saturated fat, salt and price. While this may be considered a success in terms of sugar-reduction efforts, the lower level of attention paid to other macro-nutrients illustrates the potential negative impact of a single-nutrient focus to wider health campaigns. This is especially significant since participants had poor and overestimated nutritional knowledge.

This research was published in the Journal of Human Nutrition and Dietetics: https://onlinelibrary.wiley.com/doi/abs/10.1111/jhn.12741 (Anabtawi et al., 2020)

**Study two: Are SSBs the devil? An exploratory analysis of children who consume sugar sweetened beverages in the UK**

The Soft Drinks Industry Levy (SDIL) came into effect on the 6th of April 2018 and was designed to reduce the intake of Sugar-Sweetened Beverages (SSBs), identified to be the largest contributor of sugar in children's diets in the UK. This study used data collected as part of the National Diet and Nutrition Survey (NDNS) to explore the underlying characteristics of children who drink SSBs, through the application of a bias-free technique called hierarchical agglomerative clustering (HAC).

The results demonstrated that there is no clear association between drinking SSBs and BMI among children aged 4-10. The logistic regression analysis illustrated that there is no specific trend across clusters in terms of significant association between children with different drinking habits and other variables.

This analysis confirms the complexity of relationships across demographic and other health-related variables and emphasises the problematic nature of simplistic interventions that aim to tackle a particular behaviour or address a particular bodyweight category.

**Study three: The effect of three "Ps" on public perception of childhood obesity policy in the UK; Parenthood, Perceived weight and Political orientation**

A survey was conducted to investigate the perception of a representative sample of adults living in the UK (n=990) on the solutions to the childhood obesity issue and the effectiveness and appropriateness of interventions proposed by the UK Government in "Childhood Obesity: a Plan for Action", parts 1 and 2. In the analysis there was a specific focus on how participants' parenthood status, perception of their own bodyweight status and political orientation affects their views.

The results showed a high level support from the public for most interventions proposed by the Government related to childhood obesity. Individuals' political orientation played a role in shaping their attitudes and beliefs, with more conservative participants reporting higher support for individualistic solutions including biological, psychological and behavioural interventions. Being a parent had an influence on individuals' attitudes toward the likelihood of childhood obesity solutions being effective and suitable. However, the effect of participants' perceived weight status on their perceptions was less influential.

These results demonstrate the importance of considering individuals' different characteristics when developing policies and interventions to ensure that they are effective.

**Study four: Problems hiding in plain sight: A thematic analysis of the UK Government Policy "Childhood Obesity: a Plan for Action" parts 1 and 2**

This study aimed to conduct a thematic analysis of the content of the documents representing the current Government position on childhood obesity and its policies relating to public health interventions: "Childhood Obesity: a Plan for Action" parts 1 and 2. This was undertaken through the application of Bacchi's "What's-the-Problem-Represented-to-be?" (WPR) approach. (Bacchi, 1999). The objectives were to (1) conduct a critical thematic analysis of "Childhood Obesity: a Plan for Action" parts 1 and 2 and (2) consider the potential negative consequences of promoting a specific obesity narrative.

Three main themes identified using the interpretative inductive thematic analysis (Fade and Swift, 2011), were Where does responsibility for action lie?, Weight-centrism and Think inside the box.

Using the WPR approach, three themes and two main issues were identified to be problematised in these documents: responsibility and weight. The analysis explored how and why these 'problems' were presented in a specific manner in the documents, through the process of examining the language and supporting evidence that were used to reflect the values and assumptions underlying the proposed interventions. The possible unintended consequences of these representations were considered. In particular, this research highlighted some negative effects that are correlated with the simplistic approach in tackling childhood obesity through focusing on individual behaviour and individuals' control over their lifestyle for weight loss. These consequences include weight-bias, stigma, discrimination and cultural imperialism. For these reasons, health policies should be analysed comprehensively to increase their potential effectiveness and decrease associated concerns and negative unintended consequences.

**Discussion and Conclusion**

Each study individually, and the analysis of the studies and literature review combined, demonstrated that current strategies to reduce the rates of childhood obesity in the UK focus on reducing sugar intake. This linear and simplistic approach has not taken into account the complexity of the determinants and the interactions between them. The other significant issue is the pervasive theme of weight problematisation and sugar demonisation, both of which carry negative framing. This framing, as well as the complexities and interactions mentioned, may have potential negative consequences.

# CHAPTER 1: LITERATURE REVIEW

This chapter aims to describe the current prevalence of obesity worldwide and in the UK. It also outlines the causes and health-related consequences of weight gain and obesity. This chapter includes the various policies and interventions that were put forward in the UK over the past three decades to address the issue of obesity. The development of these policies over the years has been underpinned by increasing knowledge of the contributors to obesity and the associated determinants. Whilst the positive energy balance has long been identified as the main contributor to weight gain, the recognition of the multifactorial nature of obesity took a long time to become a mainstream idea. This chapter links past policies regarding obesity with the available scientific evidence at the time.

## 1.1 THE INCREASING PREVALENCE OF OBESITY

According to the most recent worldwide statistics (WHO, 2020), there are more than 1.9 billion overweight adults, 650 million of whom are considered obese. These numbers account for 39% and 13% of the global adult population respectively. This indicates that the rate of obesity globally has nearly tripled since 1975. There are some differences in these percentages between different age and gender groups. In 2016, 39% and 11% of men were overweight and obese respectively, whereas 40% and 15% of women were overweight and obese, respectively. Similar prevalence levels were found among children and adolescents. It is estimated that 40 million children aged 5 years or younger were overweight or obese and more than 340 million children and adolescents between the ages of 5 and 19 were overweight or obese. Expressed in percentages, in 2016, 18% of boys and girls globally were overweight, and 7% were obese. This is a dramatic increase compared to the statistics of 1975, when the percentages of overweight and obesity among children and adolescents were 4% and 1%, respectively (WHO, 2020).

This is extremely alarming, as the increase in BMI, which is currently used as the main indicator of overweight and obesity, increases the risk of non-communicable diseases (NCDs) (The Lancet Public Health, 2018). NCDs include cardiovascular diseases, such as

heart disease and strokes, which were the leading causes of death globally in 2012, type 2 diabetes, osteoarthritis and other musculoskeletal disorders, and a range of cancers, including breast, ovarian, prostate, liver, kidney and colon (WHO, 2020). Obesity in children and adolescents is no less worrying, where it is associated with difficulty in breathing, increased risks of fractures, hypertension, insulin resistance and negative psychological effects (WHO, 2020). These risks of childhood illness are in addition to future risks of premature death and disability in adulthood (Hruby and Hu, 2015).

Economic challenges related to overweight and obesity are also concerning, as they increase the burden on health systems and services (Garnett et al., 2015). It was estimated that the global cost of obesity was £1.6 trillion in 2014, which accounts for 2.8% of the global gross domestic product (GDP) (Woetzel et al., 2014). This not only considers the financial burden on health services; it also includes the Cost of Illness (COI). This is defined as the costs of a specific disease or its related complications in different sectors of society. For obesity this would include mortality or permanent disability that result in additional burden on individuals, families and nations (Tremmel et al., 2017).

Statistics from the United Kingdom (UK) show a similar pattern to the global one, where 62% of the adult population are overweight or obese, which is estimated at 35 million adults. The percentage of males (41%) with overweight was higher than that of females (32%). However, similar percentages of obesity were found among women and men, 25% and 27% respectively. Childhood obesity is also an issue facing the UK, as 15% and 14% of children between the ages of 0 and 15 are with overweight and obesity, respectively (Health Survey of England, 2019, Northern Ireland Department of Health, 2020, Scottish Government, 2020, Welsh Government, 2020). Obesity in the UK is associated with an estimated healthcare cost of £5.1 billion a year to the National Health Service, representing 5% of the total NHS budget. The healthcare costs of obesity are believed to be growing with the ongoing increase in obesity rates (Scarborough et al., 2011). This is in addition to wider societal costs of obesity of £27 billion (OHA, PHE, 2017a). Importantly, similar to the inequalities observed in health outcomes, the rates of obesity follow similar patterns along

socioeconomic status. Some of the most deprived Local Authorities in England had more than double the rates of obesity compared to wealthier areas (ONS, 2017a). For example, in Barnsley, the 39th most deprived area in England, out of 326 Local Authorities, 33.8% of individuals were classified as obese, compared to 13.9% of individuals in Richmond upon Thames, which is ranked 296th (ONS, 2017a, Steward and Ahlawa, 2016, Barnsley's Research and Business Intelligence Team, 2016).

While childhood obesity is a major public health issue in England in general, this is especially true for London, where the London Health Commission revealed that the rates of childhood obesity in 2016 were highest in London in comparison to other countries' capital cities. The rates in Paris were 5%; Hong Kong 7%; Sydney 10%; Toronto 12% and New York 21%. The rate in London was 22% (London Health Commission, 2018). The increased rates of obesity among children is considered critical, as overweight and obesity in childhood are believed to have a considerable impact on morbidity and mortality rates, as they are likely to track into adulthood and increase the risk of non-communicable diseases (NCDs) (Lloyd et al., 2010, Sahoo et al., 2015).

## 1.2 OBESITY-RELATED UK POLICIES (1980s-2010s)

Given the increasing prevalence levels, there is intensive ongoing work to address the issue of obesity in the UK. However, this effort is not a recent focus as the first report to address aspects of food and health was published in 1983. The National Advisory Committee on Nutrition Education prepared this report, informally known as the 'NACNE report', to present proposals for nutritional guidelines for health education. This paper put forward recommendations to quantify dietary goals for the public (James, 1983) (Table 1.1). Around the year 1991, the WHO launched an initiative to improve people's health, the 'Health for all by the year 2000' strategy. This led the UK Government at the time to recognise the rising importance of obesity and the potential risk it posed to the country's health system. Accordingly, the Government presented the 'Health of the Nation - A Strategy for England'

report as a Government 'White Paper'. White Papers in the UK are Command Papers that set out the Government's initiatives, such as in this case, and/or draft legislation. Although this White Paper did not aim to tackle obesity specifically, it outlined a framework to apply policies forming part of a population-wide health improvement programme that was intended for implementation between the years 1992 and 1997 (Government White Paper, 1992). A subsequent report, 'Saving Lives: Our Healthier Nation', was published in 1999 to tackle poor health by setting a target of reducing the rates of obesity among adults by 7% by 2005, compared to the prevalence of obesity recorded in 1980. Although this policy paper acknowledged the role of social, environmental and economic determinants on health, the main focus was on the role of individuals in taking more responsibility with healthier eating and increasing physical activity levels (Government White Paper, 1999).

In 2000, the WHO stated that the high prevalence of overweight and obesity in Europe is very likely to be associated with sedentary lifestyles (WHO, 2000). Therefore, the main focus in addressing obesity in different countries, including the UK, was on promoting physical activity. At around the same time, it was proposed that targeting childhood obesity may yield better results on the overall statistics of obesity among the population (Jebb et al., 2013). This was clarified in subsequent reports published in the UK in 2004 and 2005. It started with the announcement of the Public Service Agreement (PSA) of 'to halt, by 2010, the year-on-year increase in obesity among children under 11 years in the context of a broader strategy to tackle obesity in the population as a whole' (Select Committee on Public Accounts, 2007). This was followed by the 'At least Five a Week' report, which presented the health problems associated with inactivity and the scientific evidence for encouraging adults to engage in 30 minutes of moderate intensity physical activity on five or more days a week, and children and young people to engage in at least 60 minutes of at least moderate intensity exercise every day (DoH, 2004a). 'Choosing Health: Making Healthier Choices Easier' was then published to illustrate the Government's commitment to developing public communication campaigns to encourage positive individual behaviour change with a focus on sexual health, mental health, active lifestyles, obesity, smoking and alcohol consumption.

This report was the first to introduce the idea of corporations and food industries developing better food labelling (DoH, 2004b). The emphasis on the importance of physical activity increased in 2005, with a specific focus on children where new policy interventions began to emerge. In England, two reports were published; 'Choosing a Better Diet: A Food and Health Action Plan' and 'Choosing Activity: A Physical Activity Action Plan' (DoH, 2005b, 2005a). The Scottish and Welsh Governments also published reports with specific action plans for physical activity, including 'Climbing Higher: Creating an Active Wales: A 5 Year Strategic Action Plan' in Wales and the 'Let's Get Scotland More Active' as a five year strategy in Scotland (Scotland Government, 2003, Welsh Assembly Government, 2006).

This focus on physical activity originated from the energy balance equation, which dictates that calories in (energy consumption) need to equal calories out (energy expenditure) to prevent excess energy being stored as adipose tissue. Increasing physical activity levels and reducing sedentary behaviours provides the opportunity to increase energy expenditure, in order to counter-balance overconsumption of food (National Research Council, 1989). The alternative would be to reduce the calories consumed in order to maintain an appropriate energy balance to maintain a healthy weight. Energy dense, nutrient poor foods were suggested as promoting a positive energy balance and thus contributing to obesity levels (WHO, 2003a).

Despite all of these policies and initiatives, the rates of obesity in the UK continued to rise. In 2006, the National Audit Office released a report under the name of 'Tackling Child Obesity – First Step'. This report examined the Department of Health's previous approach to tackling childhood obesity. The report concluded that there was not enough evidence to determine if the proposed range of interventions and initiatives to improve children's dietary intake and physical activity levels are sufficient to achieve the targets set. Therefore, it proposed greater clarity of the role of the Government, where it leads and directs other agencies and organisations to achieve its obesity targets, with clearer definitions of regional responsibilities and strengthening of local partnerships (National Audit Office, 2006).

Following this, the HM Stationary Office published 'Tackling Obesities: Future Choices - Project Report'. This report was intended as a foresight project to present a strategic 40-year vision for programmes and policies that can respond sustainably to reduce obesity levels (HM Stationary Office, 2007). Foresight provided several maps to illustrate the multi-factorial nature of obesity. These system maps were developed to consider around 100 factors that are derived from the social, environmental, biological, psychological, economic and other determinants that interact with the prevalence of obesity. Figure 1.1 is a simplified version of the potential contributing factors that were recognised within the maps. This paper was considered a great partnership between scientists and policymakers. In 2008, the Department of Health launched 'Healthy Weight, Healthy Lives: a Cross-Government Strategy for England', a scheme which mainly focused on the energy balance equation concept, where it encouraged individuals to eat more healthy food and to be more active to maintain a healthier weight (DoH, 2008). A large budget of £372 million was guaranteed over three years for this scheme, with a focus on children with overweight and obesity. A target was set to increase the proportion of healthy weight children across the population by 2020, "to reduce the proportion of overweight and obese children to 2000 levels". It is important to note that this marked a change in policies, by including children with overweight to the scope of interventions beyond just those with obesity. This was followed in 2009 by the social marketing campaign Change4Life, which aimed to support families, including parents, carers and individuals in making healthier choices about food and activity (Jebb et al., 2013).

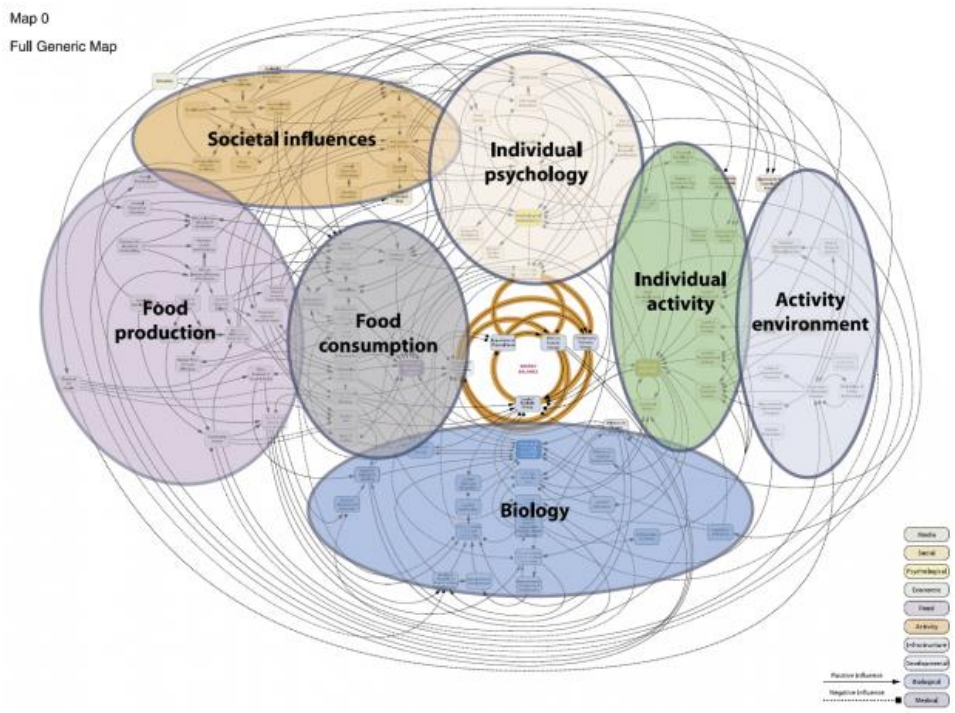



*Figure 1.1: The full obesity system map with thematic clusters. Adapted from Tackling Obesities: Future Choices report (HM Stationary Office, 2007)*

Although there was a focus on children with the aforementioned strategies and policies, adults were not neglected. Another report was published in 2009 to deliver a framework to work with Local Authorities and Primary Care Trusts (PCTs), to identify and respond to the needs of each of their local populations to encourage physical activity. The 'Be Active, Be Healthy: A Plan for Getting the Nation Moving' strategy aimed to lead up to the 2012 London Olympic and Paralympic Games (DoH, 2009).

However, with the 2010 economic crises and the change of the government, a new White Paper, 'Healthy Lives, Healthy People: Our Strategy for Public Health in England', was published to reaffirm what was established in previous reports (DoH, 2010). This White Paper discussed the "Public Health Responsibility Deal", a voluntary partnership between Government, industry and other businesses, non-governmental organisation (NGOs) and other public heath bodies. This Responsibility Deal was established to encourage organisations to take action in four specific areas; food, alcohol, physical activity and health at work, in order to improve the overall environment, to support individuals to make healthier and informed food and activity decisions. Eventually, the Responsibility Deal was

formally launched in 2011 as part of the 'Healthy Lives, Healthy People: a Call to Action on Obesity' report. This document emphasised the role of individual-level behaviour change, while still recognising environmental factors and organisational responsibilities, to allow Government and Local Authorities to support individuals to change their behaviour (DoH, 2011a). There were positive pledges made by several corporations as part of this deal. From the food sector, thirty four businesses took action to support individuals to reduce their total energy intake. For instance, some work was done to reduce portion sizes of chocolate bars and savoury snacks whilst other manufacturers worked on reformulation to make their products healthier. Also in 2010, "Fair Society, Healthy Lives" was published. This report, also known as the Marmot Review, described health inequalities across different segments of society and proposed several actions to reduce these inequalities (Local Government Association, 2010).

Table 1.1: Government policy documents published in the UK to tackle obesity, 1983-2011

| | Publishing year | Policy document | Main recommendations |
|---|---|---|---|
| 1 | 1983 | NACNE report | • Reduce the population's average consumption of total dietary fat intake to 30% with saturated fatty acids being no greater than 10%<br>• Reduce both sugar and salt consumption<br>• Increase the consumption of fibre to 30 gram/day<br>• Increase the intake of fruits and vegetable<br>• National campaigns on nutritional education |
| 2 | 1992 | The Health of the Nation- A strategy for England | • Health promotion and disease prevention rather than solely through improvements in healthcare services<br>• Obesity results from a dietary energy intake chronically in excess of energy expenditure and is made more likely by a diet rich in fat combined with a lack of physical activity.<br>• Progress towards reducing obesity rates through education campaigns on fat consumption and physical activity |
| 3 | 1999 | Saving Lives: Our Healthier Nation | • People to be treated as active partners in reducing ill-health<br>• Keep physically active (30 minutes of moderate exercise 5 times each week)<br>• Consumption of plenty of fruit and vegetables, cereals, and not too much fatty and salty food<br>• Avoiding sugary foods and drinks helps to prevent tooth decay |
| 4 | 2003 | Let's Get Scotland More Active | • Adults should build up at least 30 minutes of moderate activity (the equivalent of brisk walking) on most days of the week<br>• Children should build up at least one hour of moderate activity on most days of the week' |
| 5 | 2004 | At Least Five a Week | • Scientific evidence of physical activity and the health problems associated with inactivity<br>• Individuals should participate in at least 30 minutes of at least moderate intensity activity on five or more days a week |

| | | | |
|---|---|---|---|
| 6 | 2004 | Choosing Health: Making Healthier Choices Easier | • The Government to provide people with information about health to make informed choices<br>• The Government to work with schools to help children be healthier<br>• Encourage individuals to lose weight and be more physically active |
| 7 | 2005 | Choosing a Better Diet: a Food and Health Action Plan | • Increase the average consumption of a variety of fruit and vegetables to at least five portions per day<br>• Increase the average intake of dietary fibre to 18 grams per day<br>• Reduce the average intake of salt to 6 grams per day by 2010<br>• Reduce the average intake of saturated fat to 11% of food energy<br>• Maintain the current trend in the average total intake of fat at 35% of food energy<br>• Reduce the average intake of free sugar to 11% of food energy<br>• Education campaigns (5 A DAY campaign, Salt Awareness Campaign) |
| 8 | 2005 | Choosing Activity: a Physical Activity Action Plan | • Children and young people should achieve a total of at least 60 minutes of at least moderate-intensity physical activity each day<br>• Adults should achieve a total of at least 30 minutes a day of at least moderate-intensity physical activity on five or more days of the week.<br>• Encouraging activity in early years, schools, further and higher education.<br>• Extending further the use of education facilities as a community resource for sport and physical activity, including out-of-hours use |
| 9 | 2006 | Climbing Higher: Creating an Active Wales Strategic Action Plan: A 5 Year Strategic Action Plan | • Ensuring that the natural and built environment encourages people to be physically active<br>• Creating opportunities for families to undertake physical activity together<br>• Increase the percentage of adults and children who meet the physical activity recommendations by 5 percentage points over 5 years |
| 10 | 2006 | Tackling Child Obesity – First Steps | • Greater clarity and direction from central Government<br>• Better definition of regional roles and responsibilities<br>• More support for front line staff: better information and training on roles and responsibilities and improved dissemination of advice and guidance<br>• Strengthening local partnerships |

| | | | |
|---|---|---|---|
| 11 | 2007 | Tackling Obesities: Future Choices – Project report | • The obesity epidemic cannot be prevented by individual action alone and demands a societal approach<br>• Tackling obesity requires far greater change than anything tried so far, and at multiple levels: personal, family, community and national<br>• It also requires partnership between government, science, business and civil society |
| 12 | 2008 | Healthy Weight, Healthy Lives: a Cross-Government Strategy for England | • Promotion of breastfeeding<br>• Working more closely with parents to help them make changes to the diet and activity levels of their children<br>• Provide food that is healthier through the reduction of fat, sugar and salt, with increased consumption of fruit and vegetables<br>• A vision of a more physically active society<br>• Personalised advice and support for weight loss or maintenance |
| 13 | 2009 | Be Active, Be Healthy: A Plan for Getting the Nation Moving | • Established a new framework for the delivery of physical activity aligned with sport for the period leading up to the London 2012 Olympic Games and Paralympic Games and beyond<br>• Set out new ideas for local authorities and primary care trusts to help determine and respond to the needs of their local populations |
| 14 | 2010 | Healthy Lives, Healthy People: Our Strategy for Public Health in England | • Sets out the government's long-term vision for the future of public health in England.<br>• The shift of power from central government to local communities and communities<br>• The role of Industry through the discussion on Public Health Responsibility Deal |
| 15 | 2011 | Healthy Lives, Healthy People: a Call to Action on Obesity in England | • Updates the previous report (#14)<br>• Launching of the Public Health Responsibility Deal |

**The full timeline for obesity-related policies in the UK can be found at the end of this chapter*

As highlighted, the main focus was that the problem underlying NCDs and overweight/obesity was the consumption of an energy-dense diet, high in saturated fat and low in fruits and vegetables, in conjunction with sedentary lifestyle (WHO, 2003a). This belief was linked to the fact that fat is the most energy dense macronutrient, as each gram of fat provides nine calories, in comparison to the four calories per each gram provided by carbohydrates or protein (NRC, 1989). In addition to their energy content, saturated fats were specifically linked to several health risks compared to other kinds of fats. In 2006, the National Institute for Health and Clinical Excellence (NICE) and the National Collaborating Centre for Primary Care (NCC-PC) published a document aiming to tackle the prevention, treatment and management of overweight and obesity among children and adults (NICE, 2006). This document focused on the consumption of five portions of fruits and vegetables daily in place of foods that are higher in fat and calories. They also recommended a low-fat diet to avoid an increase in total fat and calorie intake, to support people in achieving and maintaining a healthy weight.

In 2008, the WHO indicated that, internationally, the intake of fat is higher than the recommendation, which leads to an increased risk of many diseases and higher rates of NCDs globally. Accordingly, they conducted an international consultation with the Food & Agriculture Organisation (FAO) to review scientific data around diet, in order to provide an updated internationally valid recommendation for the intake of fats and fatty acids (WHO & FAO, 2008). This led to the publication of a new report on the recommendation of total fat, saturated fat and trans fat consumptions (WHO & FAO, 2010). For these reasons, the public health work on obesity in the UK gradually shifted to focus on the consumption of total fat and saturated fat as the main part of an individual's diet that needed to be addressed and improved. The policy paper that summarises the work that was done between the years 2010 to 2015 indicates that people were asked to pay more attention to their intakes of fat and salt to be healthier (DoH, 2015). In addition, major reformulation efforts that were undertaken as part of the Responsibility Deal mainly led to a reduction in fat and salt content. For example, the production of low-fat milk, reduced-fat yogurt and reduced-fat

cheese increased during this period to support people to eat healthier (DoH, 2015) (Table 1.2).

Parallel to these efforts, across these years, there was extensive work being conducted acknowledging the complexity of obesity in both means of occurrence and treatment. Obesity is associated with multiple factors, including environmental, social, biological, economic and behavioural ones (WHO, 2017). For instance, several environmental factors were believed to facilitate increased food intake and sedentary lifestyle, such as increased availability of unhealthy food, convenience, taste and marketing (Chandon and Wansink, 2012). There is a strong evidence base to demonstrate the critical role of the international nutritional transition in the increased prevalence of obesity, particularly among children (Kac and Pérez-Escamilla, 2013). The nutrition transition refers to the increased income, increased availability of high-calorie food and less active lifestyles associated with modernisation, urbanisation and economic development (Misra and Khurana, 2008). This includes the shift to higher consumption of fat and sugar (Popkin et al., 2012), which may be promoting a positive energy balance (WHO, 2015a).

## 1.3 SHIFTING THE FOCUS TO SUGAR

Given that international efforts to decrease obesity rates have not been effective, the WHO reassessed the population's consumption of the main macronutrients, fat, carbohydrates and protein, in addition to a specific assessment of sugar intake. As a result, in 2015, they published three reports illustrating that there has been a significant increase in global sugar consumption to levels above the WHO guidelines, and that this may have contributed to rising rates of overweight and obesity. The reports also explained the measures that can be taken to address sugar intake in the context of obesity. They included guidelines for policy makers for measures to reduce populations' sugar intake to lead to an overall reduction in the prevalence of obesity, dental caries and NCDs (WHO, 2015d, 2015a), based on the new recommendation of sugar intake for adults and children (WHO, 2015b). In the same year,

in the UK, the Scientific Advisory Committee on Nutrition (SACN) reported that the mean intake of Non Milk Extrinsic Sugars (NMES) at that time was three times higher than the recommended level. Consequently, SACN updated their recommendations and advised that free sugar intake should not exceed 5% of the total daily energy intake of an individual's diet for everyone aged 2 years and above (SACN, 2015). This was to replace the old recommendation of 11% of the total daily intake, which had been set in 1991 (COMA). Analysis of the National Dietary and Nutritional Survey (NDNS) data showed that the consumption of free sugar was highest among children aged 4 to 10 years, accounting for 13.5% of their total daily energy intake (PHE, 2018c). Major contributors to the intake of sugar in children were cereal and cereal products (32%), followed by non-alcoholic beverages (sugar-sweetened beverages (SSBs) and fruit juice) (21.5%), and preserves and confectionery (21.5%). Several studies report that the consumption of SSBs and fruit juices is linked to weight gain and obesity (Malik et al., 2010, Malik et al., 2006).

SACN's change of sugar recommendation was a turning point for tackling obesity in the UK. From that point on, much more work was focused on the population's free sugar intake, aiming to achieve the SACN recommendation and decrease the rates of obesity. Although Public Health England (PHE) had already published 'Sugar Reduction: Responding to the Challenge' in 2014 (PHE, 2014b), the Department of Health requested an updated report from PHE based on the new SACN free sugar recommendations. PHE therefore published 'Sugar Reduction: The Evidence for Action'. This reviewed a large body of evidence across a broad range of areas to suggest a set of possible effective interventions and actions that would identify sources of free sugar intake and its associated health issues (PHE, 2015a). It proposed that achieving the recommended intake of free sugar across different age groups would succeed in decreasing the cases of type 2 diabetes and obesity. One study had shown that a sugar reduction programme for 10 weeks to 8 months would significantly decrease body weight (Hu, 2013). Achieving the reduction to 5% total energy from free sugars target in five years was projected to save the NHS up to £576 million. The House of Commons Health Committee then published a report, 'Childhood obesity — Brave and Bold Action', to

urge the Prime Minister at the time to act fast and make a positive and lasting difference to children's health through their set of recommendations to reduce sugar intake in people's diets (House of Commons Health Committee, 2015).

In 2016, PHE launched the 'sugar smart app' as part of the Change4Life campaign. This mobile phone application was created to enable parents to identify the sugar content of a wide range of food items through scanning the barcode, either at home or during shopping. This was established to help parents choose healthier alternatives that contain less sugar (Campaign, 2016). After a short time, a small-scale quasi-experimental evaluation was conducted on 267 intervention families and 135 controls to assess the effectiveness of this application. This study found that the application was successful, with 32% of the intervention group purchasing a lower-sugar drink compared with 19% of the comparison group (P-value= 0.01) (Wrieden and Levy, 2016).

Subsequent published reports related to childhood obesity mainly focused on children's sugar intake and physical activity. The first report, 'Childhood Obesity: a Plan for Action', was published in 2016. A follow-up report was published in 2018; 'Childhood Obesity: a Plan for Action Chapter 2'. (HM Government, 2016, 2018). These two documents included a wide range of interventions and policies that will be discussed separately and comprehensively in the next section.

Table 1.2: Government and parliamentary policy documents published in the UK to tackle obesity between, 2014-2019

| | Publishing year | Policy document | Main recommendations |
|---|---|---|---|
| 1 | 2014 | Sugar Reduction: Responding to the Challenge | • Outlining the steps PHE will take to help families and individuals to reduce their sugar intake<br>• launching a digital marketing package to help families and individuals reduce their sugar intakes<br>• A refresh of the fruits and vegetables "5 a day" campaign<br>• Focus on the work with the food and drink industry to reformulate |
| 2 | 2015 | 2010 to 2015 Government Policy: Obesity and Healthy Eating | • Set out plans for involving the whole of society in reducing obesity<br>• Helping people to eat fewer calories<br>• Reformulation to reduce ingredients (for example salt and fat)<br>• Encouraging people to eat more fruit and vegetable<br>• Encouraging businesses on the high street to include calorie information on their menus<br>• Improving labelling on food and drink<br>• Helping people to make healthier food choices and be more active |
| 3 | 2015 | Sugar Reduction: The Evidence for Action | • Details a review of the evidence on interventions to help the nation reduce their sugar consumption, including:<br>• Reduce and rebalance the number and type of price promotions in all retail outlets<br>• Significant reduce opportunities to market and advertise high sugar food and drink products to children and adults across all media including digital platforms and through sponsorship<br>• Introduction of a price increase of a minimum of 10-20% on high sugar products<br>• Adopt, implement and monitor the government buying standards for food and catering services (GBSF)<br>• Raising awareness of concerns around sugar levels in the diet to the public as well as health professionals, employers, the food industry |
| 4 | 2015 | Childhood Obesity- Brave and Bold Action | • Strong controls on price promotions of unhealthy food and drink<br>• Tougher controls on marketing and advertising of unhealthy food and drink<br>• A centrally led reformulation programme to reduce sugar in food and drink<br>• A 20% sugary drinks tax on full sugar soft drinks |

| | | | |
|---|---|---|---|
| | | | • Labelling of single portions of products with free sugar<br>• Improved education and information about diet |
| 5 | 2016 | Childhood Obesity: a Plan for Action | • Introducing a soft drinks industry levy<br>• Taking out 20% of sugar in products<br>• Supporting innovation to help businesses to make their products healthier<br>• Making healthy options available in the public sector<br>• Helping all children to enjoy an hour of physical activity every day<br>• Making school food healthier<br>• Clearer food labelling<br>• Use of technology to support families (ex. Mobile applications) |
| 6 | 2018 | Childhood Obesity: a Plan for Action Chapter 2 | • Challenged industry to take 20% of sugar out of the food most commonly eaten by children by 2020<br>• Discussing the need for consistent calorie labelling for the out of home sector<br>• Develop resources that support local authorities who want to use their powers to build a healthy food environment<br>• Update of the School Food Standards to reduce sugar consumption |
| 7 | 2018 | Calorie Reduction: The Scope and Ambition for Action | • Challenges the food industry to achieve a 20% reduction in calories by 2024 in product categories that contribute significantly to children's calorie intakes |
| 8 | 2019 | School Sport and Activity Action Plan | • Set out a joint commitment between different Government departments at national level to ensure that sport and physical activity are an integral part of both the school day and after-school activities<br>• All children have the opportunity to take part in at least 60 minutes of physical activity every day |
| 9 | 2019 | Advancing Our Health: Prevention in the 2020s | • Different approach through: targeted support, tailored lifestyle advice, personalised care, greater protection against future threats<br>• Incentivise businesses to improve their retail offer<br>• Create healthier food environments through the planning system<br>• Improve job opportunities and growth in health, food and physical activity sectors<br>• Support for individuals to achieve and maintain a healthier weight |

**The full timeline for obesity-related policies in the UK can be found at the end of this chapter*

## 1.4 CURRENT CHILDHOOD OBESITY INTERVENTIONS

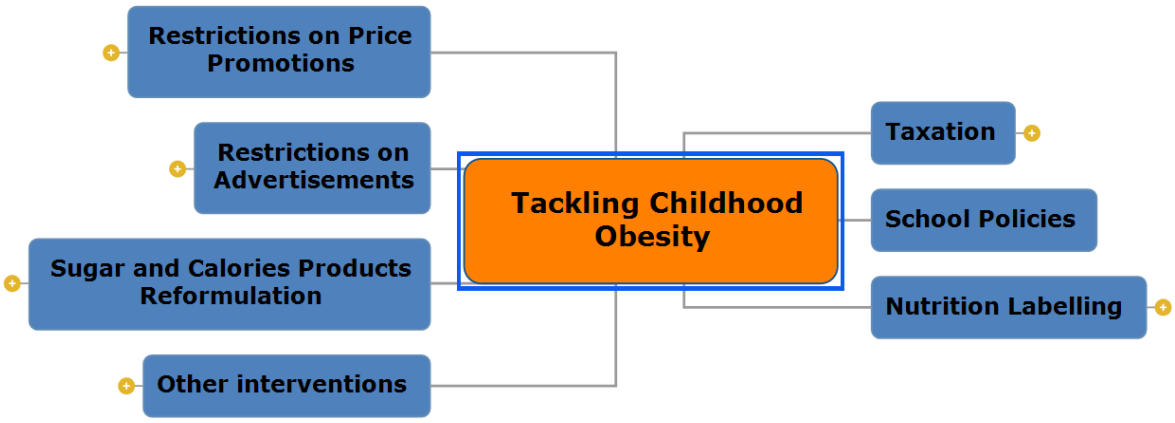



*Figure 1.2: The interventions proposed in "Childhood Obesity: a Plan for Action" documents*

### 1.4.1 The Soft Drinks Industry Levy

The only mandated policy in the Plan for Action documents is the Soft Drinks Industry Levy (SDIL). It was originally proposed as an effective approach to tackling childhood obesity as part of the Evidence for Action paper in 2015, as SSBs were found to be among the main contributors to free sugar intake among children and adolescents (PHE, 2015a). This levy was to be applied to the producers and importers of SSBs. It has different rates based on the total sugar content in grams for each 100 millilitres of the drink, with 18p per litre taxation on drinks that contain 5g to 8g per 100 ml, and 24p per litre on drinks containing over 8g per 100 ml (Customs, 2016). An online petition to the Government, which was open for six months, acquired more than 155,000 signatures from people supportive of a levy (UK Government & Parliament, 2016). Investigating public opinion about the levy, OnePoll conducted a survey of 2,000 people aged between 18 and 50. It found that almost 50% of people responded positively (OnePoll, 2015). Similar results were found by BMG when they polled more than 1,500 adults in the UK to understand their reaction to the levy (BMG Research, 2016).

There has been a strong evidence base in support the levy on SSBs. A study conducted in the UK claimed that SSBs were the major source of free sugar intake in both children and adults (Ma et al., 2016), and might be the most common snack choice among adolescents aged 13 to 16 years in Britain and North Ireland (Kerr et al., 2009). Another study estimated that the daily average proportion of calories that came from SSBs consumption was approximately 4.9% (Collins et al., 2015). In addition, a meta-analysis of eight cohort studies illustrated that the daily intake of one to two servings of SSB was associated with a 26% greater risk of developing type 2 diabetes in comparison to individuals who had less than one drink per month (Hu, 2013).

A large and growing body of literature has investigated the expected outcomes of the levy. A comparative risk assessment model predicted that the price change would result in 8.55% reduction in the number of obese children and adolescents in the age group of 4-18 years, and 24,290 fewer cases of DMFT (decay, missing or filled teeth) (Briggs et al., 2016). Another study found that people do not compensate the calories missed from cutting SSBs by getting more calories from other meals (Berkey et al., 2004). One systematic review included sixteen studies that modelled the effect of a different range of levies on SSBs. It illustrated that levies reduced the sales and the caloric intake from SSBs by 5-48% depending on the levy applied (Thow et al., 2014). A second systematic review showed negative price-elasticity that would reduce demand for SSBs (Escobar et al., 2013).

With regards to the expected outcomes from the UK Government, it is anticipated that the implementation of the levy may add around a quarter of a percentage point (0.25%) to the Consumer Price Index growth in 2018/19 and have a positive effect on consumer behaviour (Customs, 2016). Furthermore, the Government has stated that the levy revenue will be invested in a wide range of programmes that will help reduce obesity rates and encourage physical activity and balanced diets for school-age children. This includes doubling the Primary Physical Activity and Sport Premium and putting a further £10 million a year into school healthy breakfast clubs to give more children a healthier start to their day (HM Government, 2016).

The levy came into effect on 6 April 2018 (HM Government, 2018). Plan for Action Chapter 2 highlighted the success of the levy by influencing industry to reformulate and reduce the sugar content of their drinks to avoid the levy. Almost half of the drinks that would fall within the scope of the levy had been reformulated before the levy even came into force. Overall, it is estimated that soft drinks produced by manufacturers have reduced their sales weighted average (SWA) of sugar by 11% (HM Government, 2018). The Government proposed the inclusion of sugary milk-based drinks in the SDIL if insufficient progress on sugar reduction has been made.

### 1.4.2 Restrictions on Marketing

Restrictions on advertisements of High Fat Sugar Salt (HFSS) food items is another strategy that was proposed in the Plan for Action documents to address childhood obesity. It is established that children in the UK are exposed to a high volume of advertisements through different forms, including TV, radio, cinemas, billboards and other newer media platforms, such as advergames and social media. This is in addition to the marketing strategies used by food and drink companies to sponsor TV programmes or public events (PHE, 2015a). It is also believed that children's exposure to HFSS advertisements is associated with increased calorie intake. One meta-analysis concluded that an average exposure of 4.4 minutes of unhealthy food advertisement is correlated with a short term additional consumption of 60 calories, which may in turn contribute to the total positive energy balance of a child (Russell et al., 2019). An experimental study conducted in Liverpool compared the effect of toy advertisements to food advertisements on a child, where children were asked to watch some TV with one kind of advertisement in the middle. The results of this study showed that children who watched the food advertisements ate significantly more snacks after the experiment. This was also true when the children watched specific advertisements for a branded food (Boyland et al., 2011).

The first means of regulation was introduced in 2007 by the Office of Communication (Ofcom) to place some restrictions on the advertisements of HFSS foods. This was specifically during children's TV programmes. This selection of restricted advertisements

was based on the nutrient profile model that was created to identify unhealthy food items (Ofcom, 2006). This initiative was only partially effective, as it stopped the products with the highest levels of sugar, fat and salt being advertised. However it still allowed products that were relatively high in only one or two of these nutrients to be advertised.

There has been a recent shift in the means of advertising. TV advertisements fell by 43% between 2010 and 2017 (PHE, 2015a). The Advertising Standards Authority (ASA) and the Committee of Advertising Practise (CAP) illustrated that the exposure of children to TV advertisements of HFSS food fell in 2017 to 3.6 billion compared to the 12 billion previously recorded in 2005 (ASA & CAP, 2018). CAP conducted a further review that confirmed that children's exposure to online advertisements has significantly increased. In 2013/14 Internet advertising expenditure reached £6.3 billion, which represents a 15.6-fold increase compared to the 2012 statistics. The report expected these rates of increase to grow further (Clarke and Svanaes, 2014). In addition, Ofcom stated that 5-15 year-old children spend around 15 hours a week online, while the Government has argued that the application of advertisements' restrictions on online platforms is complicated and hard to assess and address (Health and Social Care Committee, 2018). As of July 2017, CAP currently applies online advertising rules only on a self-regulatory and complaint-led basis (HM Government, 2018). Due to the Government's belief that TV advertisements are still dominant, it launched a consultation on introducing a 9pm watershed on TV advertising of HFSS products in 2018 (Health and Social Care Committee, 2018).

Under the same category of marketing, the Government is addressing price promotion to tackle childhood obesity. Higher sugar food products are promoted heavily in British supermarkets at significantly higher levels compared to products with lower sugar content (PHE, 2015a). Price promotions include a variety of different special offers available in shops which include temporary price reduction, multi-buy and extra free amount within items' size. PHE therefore commissioned Kantar Worldpanel to investigate price promotions offered in retail and to quantify any effects they may have on purchasing behaviour, through their continuous reporting panel of 30,000 British shoppers. Their analysis found that 40% of

purchases were made on price promotions and that this was associated with a 20% increase in the total purchases. They also found that around 6% of total sugar purchased could potentially be prevented if promotions on higher sugar products did not occur (Kantar Worldpanel UK and PHE, 2015). For this reason, the second Plan for Action document proposed that some policies should take place to reduce and rebalance the number and type of price promotions in all retail outlets including supermarkets and convenience stores, and the out of home sector (HM Government, 2018).

The nutrient profiling model has been proposed as a tool to identify food items that should fall under the HFSS advertisement restrictions. The nutrient profile model is based on assigning each food or drink item a score based on its content of sugar, fat, salt, fruits, vegetables, nuts, fibres and protein (ASA & CAP, 2017). The first Plan for Action document discussed the need to update the current nutrient profile model. Currently, the profile used is 14 years old, and has not been updated since the recent SACN recommendations of free sugar intake. Hence, PHE set a plan to work with scientists, NGOs and other stakeholders to review the nutrient profile to reflect the latest dietary guidelines (HM Government, 2016).

### 1.4.3 Nutrition Labelling

It has long been established that nutrition education plays a critical role in supporting individuals to choose healthier food options (WHO, 2003b). One of the most frequently used tools to provide people with clear and easy nutritional information is Front of Pack labelling (FoP), which includes Traffic Light Labelling (TLL). The TLL includes information on the item's content of calories, fat, saturated fat, total sugar and salt (DoH, 2016). In 2007, and based on the guidance of the Food Standard Agency (FSA), the UK has adopted a voluntary TLL scheme for manufacturers (Baynton, 2010), which now covers two-thirds of the products sold in the UK (HM Government, 2016). Diabetes UK reported that in a survey of 2,121 participants aged 18+ years old, almost nine in ten agreed that the TLL system helps them to make informed food purchasing decisions (Diabetes UK, 2018). In the first Plan for Action document, the UK Government discussed the possibility of updating the TLL and other FoP labelling systems to provide people with clearer visual labelling, such as teaspoons of sugar

on the package, to illustrate the sugar content in each food item. It has also stated that leaving the European Union would give greater flexibility for future changes in food labelling (HM Government, 2016). For instance, it suggested the need to exchange the current total sugar content that is part of TLL with the free sugar content instead.

A systematic review conducted in 2018 showed evidence for the effectiveness of calorie labelling in helping individuals to make lower-calorie purchases in grocery stores. However, this impact was shown to be small compared to its effect on the outside of home sector overall, which includes restaurant and takeaways (Crockett et al., 2018). This may be due to the fact that it is easier for individuals to make an immediate food decision of a particular item in an out-of-home eating setting compared to a whole basket of food purchases in a store (Health and Social Care Committee, 2019). Public perception surveys indicated that 79% of people agree that menus should include the content of calories in food and drinks (PHE, 2018a), and around 60% of participants thought that they are more likely to eat from a restaurant, café or takeaway if it presented calorie labelling on its menu (Diabetes UK, 2018). Yet it is estimated that only one quarter of the food we purchase to eat outside the home has calorie labelling at the point of choice. As a result, and as part of the 'Calorie Reduction: The Scope and Ambition for Action' document that was published in 2018 (PHE, 2018a), the Government set out a consultation to introduce legislation to mandate consistent calorie labelling for the out of home sector. This consultation ran from September to December 2018 but the results are yet to be released (Department of Health and Social Care, 2018).

### 1.4.4 Reformulation

The main goal of all the interventions discussed above is to encourage industries to reformulate their products to lower their sugar and calorie contents. The Government has suggested that focusing on mandating calorie labelling for the out-of-home sector, placing restrictions on HFSS advertisements and promotions, and the SSBs levy would drive manufacturers and owners to reformulate to make their products more 'acceptable' (Health and Social Care Committee, 2018). As part of the first Plan for Action document, companies

were challenged to reduce the sugar content of their food and drinks by 20% by 2020, with a goal of 5% reduction in the first year of the sugar reduction programme (HM Government, 2016). This initiative was set to address the largest contributors to children's free sugar consumption. These ten items were SSBs, breakfast cereals, yoghurts, biscuits, cakes, confectionery, morning goods (e.g. pastries), puddings, ice cream and sweet spreads (HM Government, 2016). This was based on prior analysis indicating that a structured programme of reformulation in all contributory food and drinks would significantly lower children's daily sugar intakes.

The first year progress report for the sugar reduction programme showed that the majority of the soft drink industry succeeded in reducing the sugar content of their drinks before the Levy came into force. Overall, the industry delivered a 2% reduction in sugar content across the ten food items. However, specific food items have met or exceeded the 5% sugar reduction target, including yogurts, breakfast cereals, sweet spreads and sauces (PHE, 2018e). In addition, this report acknowledged that reformulation may be harder for some industries who may face technical issues with reducing the sugar content, with biscuits and cakes as notable examples. For such items, industry has been urged to reduce portion sizes to lower the sugar content in an item instead.

### 1.4.5 Calorie Reduction Programme

Officials stated that, on average, children who are considered overweight or obese consume between 140 and 500 excess calories per day (PHE, 2018a). The 2018 calorie reduction plan, launched by the Government to challenge the food and drink industry to use reformulation to reduce calories by 20% by 2024, included a range of everyday items that are most commonly consumed by children in the UK (PHE, 2018a). Accordingly, the interventions that are applied in both the sugar and the calorie reduction programmes address the food and drinks items which account for around 50% of children's overall calorie intake (HM Government, 2018).

### 1.4.6 School-Related Interventions

Children spend most of their time in schools. For this reason, part of the Plan for Action documents was directed at strategies that can be implemented within schools. The highest priority was given to increasing children's physical activity. It has been established that every primary school child should engage in at least 60 minutes of moderate to vigorous physical activity every day. The Government has suggested that half of the required physical activity should be delivered in schools, through active break times, Physical Education, extra-curricular clubs, active lessons, or other sport and physical activity events (HM Government, 2016). This is based on strong evidence on the benefits of physical activity on children's health, wellbeing and academic performance (PHE, 2014a). The Government has also offered new interactive online tool to help schools identify gaps in the existing opportunities for children to be active. This tool aims to recommend a set of solutions that can be used, including after school clubs, and a number of other initiatives such as the daily mile, creating an active playground or having an active lesson (HM Government, 2016). In addition, as a response to the Government policy document 'Sporting Future: A New Strategy for an Active Nation', England Sport published a report to set out their role in achieving the physical activity goals of the nation. This document included a major new investment of £40 million into projects which offer new opportunities for families and children to get active and play sport together during pre- and post-school activities (England Sport, 2016). Furthermore, in 2019, the Government published the 'School Sport and Activity Action Plan', a cross-Government action plan to provide pupils with greater opportunity to access 60 minutes of sport and physical activity every day (DfE & DCMS & DHSC, 2019).

Food supply in schools was another area that was addressed within the schools' plan. Within school canteens, schools have been expected to use the Government buying standards for food and catering (GBSF) services since 2015, to help reduce the levels of sugar in children's diets. This is alongside the School Food Plan and the School Food Standards that were to be updated by the Department of Education and PHE to meet the new dietary guidelines (HM

Government, 2016). In addition, the Government announced that, from the revenue of the SDIL, £10 million per year will be invested to expand the project of breakfast clubs.

### 1.4.7 Availability of Healthy Food

Providing healthy food was not limited to the GBSF services in schools, as these services are also mandated to national and local Government departments and the NHS, to ensure the provision and sale of healthier food and drinks in hospitals and leisure centres. The Government also delivers Healthy Food Schemes which include Healthy Start, School Fruit and Vegetable, and the Nursery Milk schemes. The aim of these programmes is to encourage good eating habits from an early age. It is suggested that more investments will be applied to benefit more children, using the Healthy Start Vouchers which can be exchanged for fruit, vegetables and milk, and are accepted by a wide range of retailers (HM Government, 2016).

The Government plans also recognise the role of local government in providing the best support for their plan to address childhood obesity. It was recognised that local authorities can use their powers to create healthier environments, by prioritising active travel in transport plans, delivering walking and cycling infrastructure, limiting the opening of additional fast food outlets close to schools, and ensuring access to quality green space to promote physical activity (HM Government, 2018).

Finally, the Department of Health and Social Care published a new consultation document, 'Advancing Our Health: Prevention in the 2020s', which is a green paper aiming to offer a new approach for the health and care system. This approach is focused on putting prevention at the centre of all decision-making (DHSC, 2019). In relation to childhood obesity specifically, it is suggested that the 3rd chapter of Plan for Action will be published to present new bold actions on infant food labelling, clear food/nutrient labelling, food reformulation and strategies to support individuals to maintain a healthier weight.

## 1.5 SINGLE-NUTRIENT APPROACH

The energy balance equation has been at the centre of diet-related interventions in the UK. The common factor across all the interventions that have been applied to tackle obesity in the UK is the focus on physical activity and healthy eating. Efforts have been made to identify, at each particular time-point, the nutrient with the highest consumption which leads to a positive energy balance, and consequently contributed to increased rates of obesity at a population level.

Historically if we consider obesity-related public health interventions in the UK, we can see that there has been a focus on the single-nutrient approach. Taking each strategy in turn, the focus was first on acquiring a healthy diet by reducing total energy intake. This was followed by focusing on reducing total and saturated fat intake. Finally, with the increase of the population's free sugar intake, the Government has invested heavily to reduce free sugar consumption.

The single-nutrient approach has not been exclusive to approaches to address obesity. To reduce the consumption of trans-fats, to lower the risk of NCDs and in particular the risk of cancers, there was a challenge to industry to remove trans-fats from their food products, which was considered to be the most straightforward public health approach (WHO, 2014b). Salt reduction is another example, where it was used as a priority policy action to lower hypertension at a population level. It was identified to be the most cost-effective intervention to reduce the risks of NCDs. This was also delivered through product reformulation, clear labelling and other educational campaigns (WHO, 2014a).

The efforts taken to determine the appropriate interventions that are needed to tackle childhood obesity in the UK are not to be underestimated. These interventions were implemented based on a strong scientific evidence base. Therefore it is likely that these policies will lead to a reduction in sugar intake and increase awareness about the importance of sugar reduction within the population. The interventions were supported by modelling studies to quantify possible outcomes to support the appropriateness of these strategies to

tackle specific health issues (Brownson et al., 2018b, PHE, 2015a). These studies were also conducted to evaluate the potential effectiveness of such interventions, defined as achieving the intended end results of decreasing the incidence of defined negative health outcomes. However, the way policy aims are set and policies are targeted may not be equally effective for all groups of children, depending on the studies that are used when designing the policies. This is because there are inevitable limitations to the design and use of the studies used in policy creation. This PhD will assess some of these limitations in the premise and aims of policies to tackle childhood obesity, and the evidence that underpins them.

The aim of this PhD is to evaluate the use of the single nutrient approach in tackling childhood obesity and to examine the wider context in which the approach is being used. It will consider the potential benefits and focus on the potential unintended consequences of this approach, by shining a spotlight on the policies and language used in "Childhood Obesity: a Plan for Action". There are several unintended consequences to the approach used in England that are not immediately apparent when considering the interventions and language used in the sugar reduction strategy. These may lead to lack of effectiveness at reducing childhood obesity rates, and internal and external stigma, and may fail at addressing inequality in health outcomes. These consequences may be mitigated or reduced by improving the framing of the policies, by considering the bigger picture of the policy aims, and understanding the needs and characteristics of the target populations better, and by using positive messaging to encourage healthy behaviour rather than deterring negative health behaviour.

The first objective of the PhD was to assess whether there is use of the single nutrient approach in England's Childhood Obesity strategy, which this literature review established. From here, it will identify the intended outcomes of this approach as it is used for Childhood Obesity, as well as the barriers to the effectiveness of this approach, considering the strategy documents as a whole, as well as its two most significant policies. It will then investigate whether this could also be associated with unintended negative consequences, and if so, what the source of these potential consequences could be. For example,

unintended consequences could be as a result of the policy design, the implementation of policy, or the language that is used to present and frame policies.

Studies 1 and 2 will consider specific policies in "Childhood Obesity: a Plan for Action", the TLL and SDIL . These two interventions were selected as the ones the public is most exposed to, the SDIL being the only mandatory policy in the document, and the TLL being widely used to provide nutrition information. Studies 3 and 4 consider the "Childhood Obesity: a Plan for Action" documents as a whole. Study 3 considers it from the perspective of the public, while Study 4 explores the perspective of policymakers. Both take into account the framing of the policies as a whole, through the individual versus structural lens. The first study aims to explore people's understanding of TLL and people's perceived healthiness of different food items based on the information provided on the TLL. TLL as FoP nutrition labelling has been recommended to help individuals, parents and families to make informed food purchases that may support their healthy eating decisions. The purpose for using TLL and other calorie labelling approaches in Plan for Action is to enable the public to identify unhealthy products that may contain high amounts of sugar, which would lead to a reduction in people's consumption of these food and drinks items and help to reduce the rates of childhood obesity. This assertion assumes a relatively high level of nutrition education among the general public and their awareness of the different components of the TLL. It also assumes the TLL's overall effectiveness during buying decisions. Although there is extensive work being implemented to increase people's understanding of the use of TLL though educational campaigns, school curriculums and other platforms, some people still perceive TLL to be confusing and that the information it presents is hard to interpret under different settings (Grunert and Wills, 2007, Baynton, 2010). The first study will consider these various aims and assumptions.

The second study is to explore the demographic, behavioural, or anthropometric characteristics of children who consume SSBs in the UK. Currently, the only mandated policy in the Plan for Action documents is the SDIL. This levy is applied on SSBs which are considered to be the major contributor to the high intake of free sugar among children in

the UK. Several modelling studies have predicted that the levy will be effective in reducing the rates of childhood obesity, in addition to other benefits on the overall health of children (Briggs et al., 2016, Malik et al., 2010). Similar levies were introduced in different countries, such as France, Denmark, Finland, Mexico and Hungary (PHE, 2015a). However, Jou and Techakehakij (2012), who conducted a study to explore the factors that may influence the effectiveness of volume-based soft drink excise taxes in 19 European countries' contexts, stated that specific measures like the levy would have different effects on different countries, depending on the population obesity rate, consumption behaviours and other sociodemographic characteristics (2012). For this reason, it is vital to develop a deeper understanding of SSBs consumption among children in the UK, and how it relates to childhood obesity.

The third study will assess the perceptions of a representative sample of the UK public of the interventions proposed in the Childhood Obesity: a Plan for Action documents 1 and 2. It will also aim to assess associations of these perceptions with socio-demographic factors and other characteristics including parenthood status and political orientation. It has been suggested that, when considering health problems, policy-makers tend to value and place importance on medical explanations and solutions rather than social ones (Rychetnik et al., 2002). They may also be greatly influenced by the input of academics, who are believed to be generally detached from the reality of policies' impact on the ground (Kelly and Barker, 2016). This may not be reflected in the public's attitude to policies. For instance, Ogden and Flanagan have shown the difference between the perception of general practitioners and lay population in terms of causes of obesity (2008). Researchers have argued that comprehensive work is necessary to understand the social factors associated with the issue (Schwartz and Brownell, 2007). Decision makers should be able to assess the weight of each factor and its perceived magnitude to maximise the possible effectiveness and feasibility of the intervention. That is why it is important to know what the public believes about the causes and solutions of one of the main public health priorities for the UK Government.

The fourth study will be a content analysis of both documents of Childhood Obesity: a Plan for Action. This qualitative analysis aims to identify the themes related to language and narratives found within the documents. This analysis will identify the key issues that the policy aims to address, and will assess for potential unintended consequences of the policies.

Put together, these studies will take a comprehensive critical approach to assessing the focus on sugar reduction in the UK Government strategy to tackling childhood obesity. The findings will shed an important light on the expected effectiveness, as well as possible shortcomings and potential unintended consequences, of these policies.

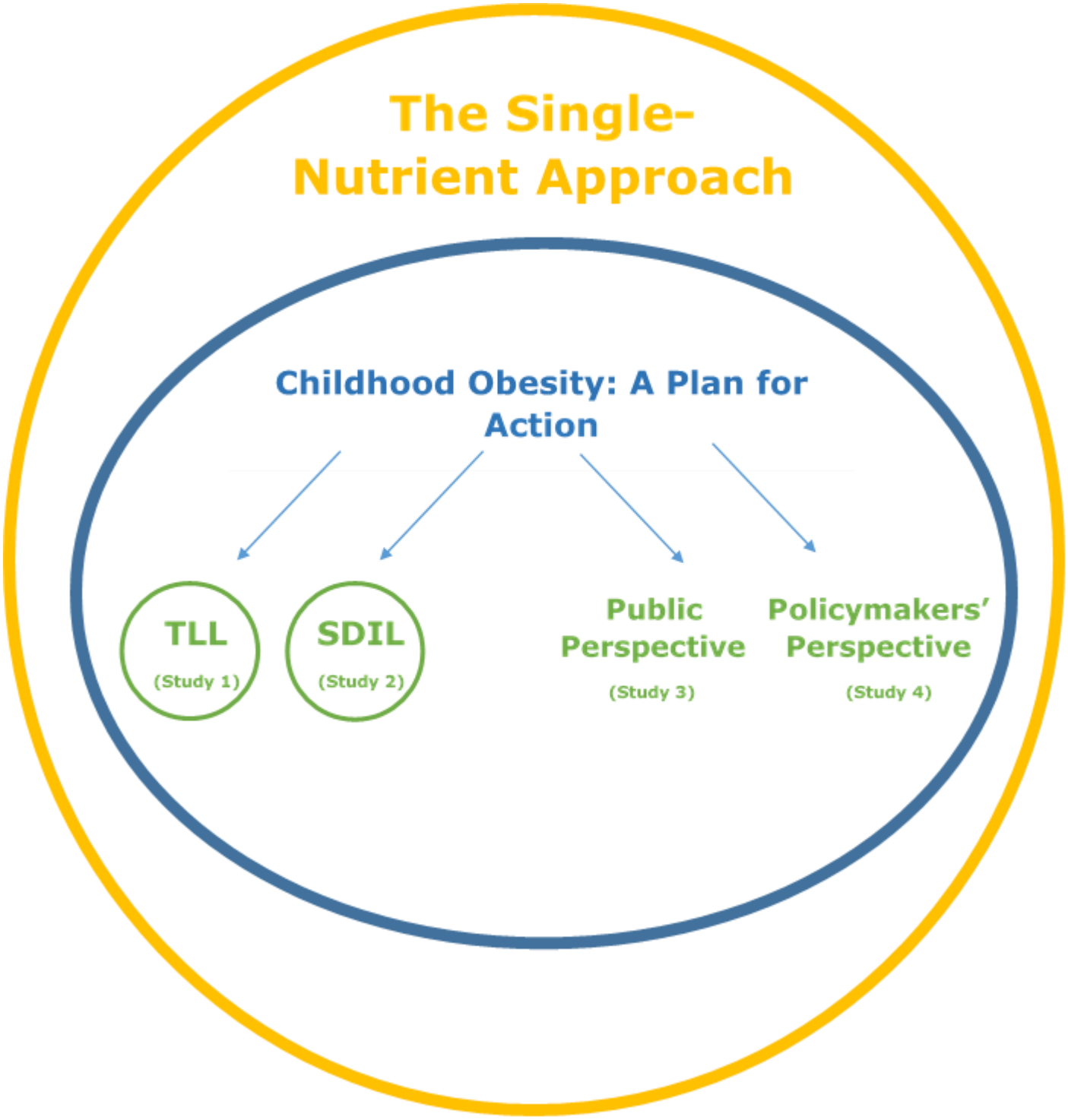
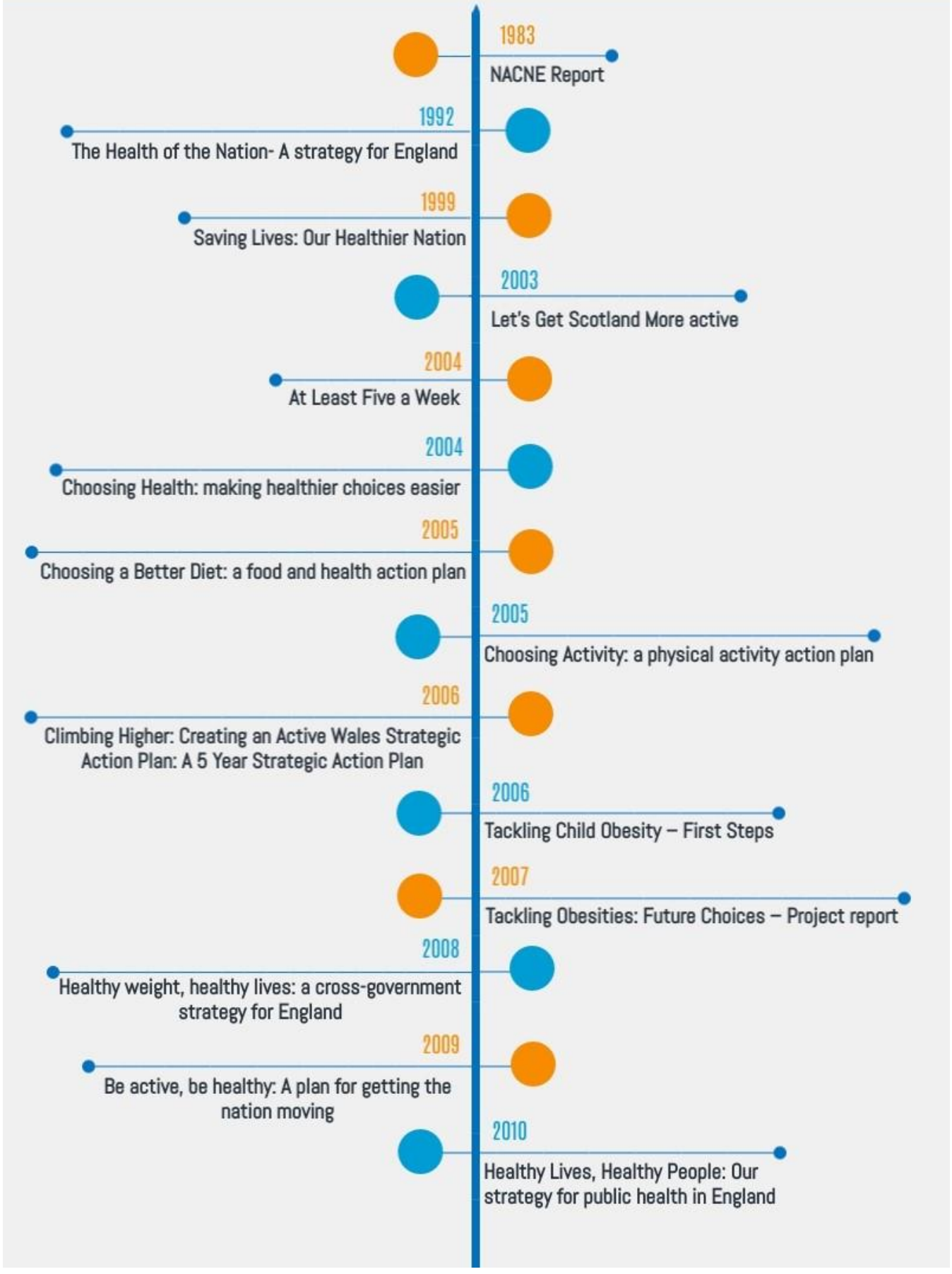



*Figure 1.3: A schematic diagram illustrating studies conducted within this PhD*

# CHILDHOOD OBESITY POLICIES-TIMELINE



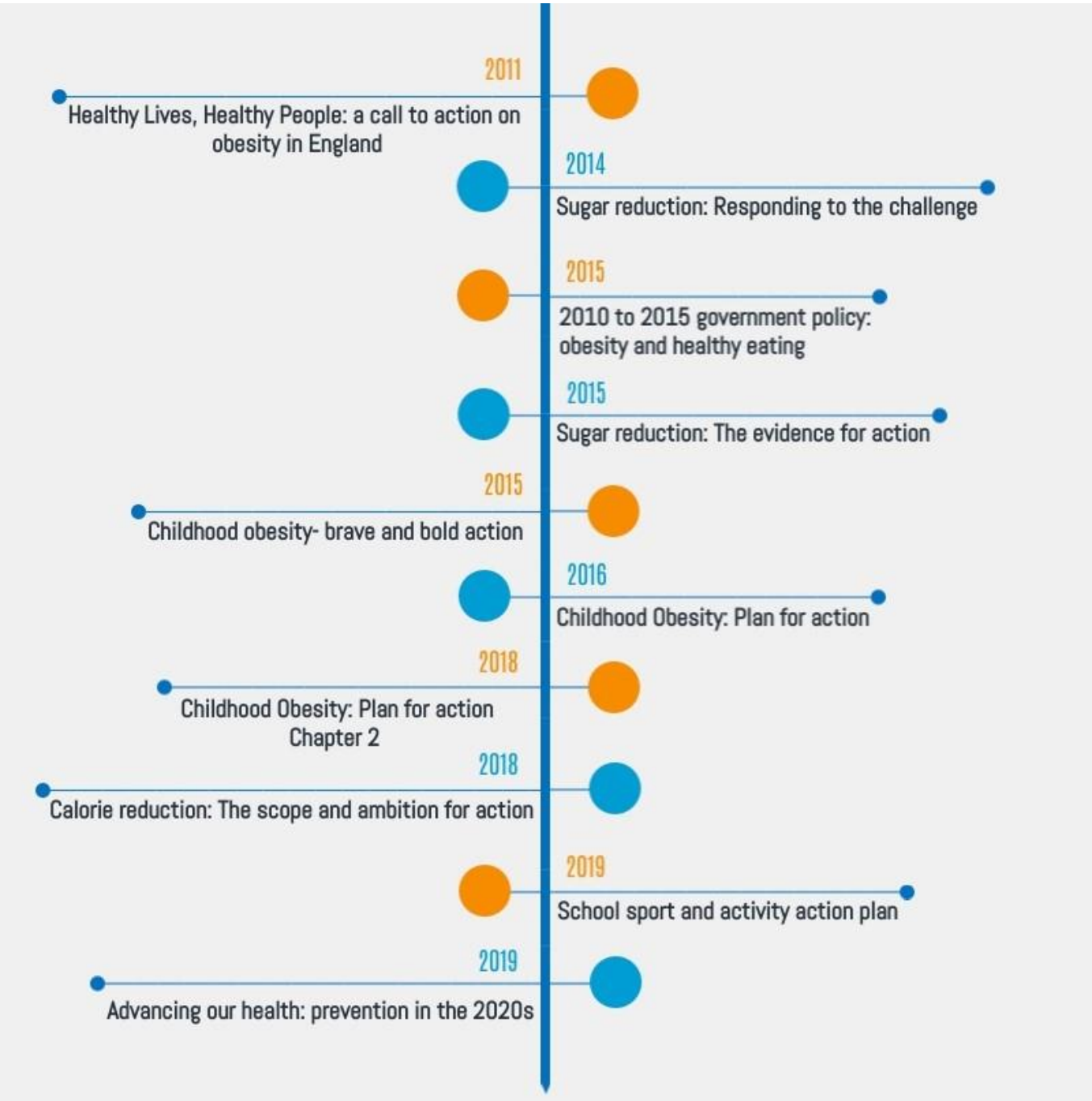



*Figure 1.4: The full timeline of obesity-related policies in the UK (1983-2019)*

# CHAPTER 2: NOVELTY

## The methods used in this thesis are not less worthy of attention than the outcomes of each study

This small chapter is included as part of the thesis to comprehensively present the choice of methods that were used in each study and to explain their value.

## 2.1 CHOICE-BASED CONJOINT ANALYSIS (CBC)

The manual application of the Choice-Based Conjoint analysis was introduced in 1995 by DeSarbo and his colleagues to evaluate market segmentation (DeSarbo et al., 1995). Over the last two decades, software companies have enabled the analysis to be automated and computerised, and it has become the most widely used conjoint-related technique (Sawtooth Software, 2017). It is widely adopted in different sciences, such as evaluating the components of the Patient-Centred approach in medicine, wine quality perception in food science, and in exploring the choice of battery electric vehicles in city logistics in engineering (Cunningham et al., 2010, Tempesta et al., 2010, Karniouchina et al., 2009, Lebeau et al., 2016).

There have been a large number of studies in the field of nutrition that have used the methodology of conjoint analysis to assess its use and effectiveness. For instance, in 2012, a study evaluated the nutritional factors that affect consumers' choices of different types of coffee beverages (Jervis et al., 2012). Another study that applied the conjoint analysis to investigate the feasibility and effectiveness of Front of Packaging (FoP) labels, including nutrients' content and other related health claims (Drewnowski et al., 2010). However, a group of researchers argued that the outcomes of the conjoint analysis did not consider if a certain nutrient or piece of information was relevant for all consumers or if it caught their attention or not (Vidal et al., 2013).

The Choice-Based Conjoint (CBC), also known as discrete-choice conjoint analysis, is one type of the conjoint analysis methods. The structure base of the CBC is presented by asking respondents to express their preference for one choice of a full-profile product (also called concept) from a set of concepts rather than rating or ranking them. The process of selecting one concept from a set is repeated multiple times. One main advantage about the use of

CBC is that it typically involves leveraging the data across each participant her/himself and other participants, making it feasible to quantify interactions. Results can indicate the extent to which a particular concept influences choice and the relative preferences for the alternatives that are not chosen. This capability is facilitated by the application of the random designs used by the CBC System, which permit the exploration of all interactions, when a large enough sample is collected. The CBC system generates different versions of the overall design, where each participant randomly receives one version of a big selection of efficient designs. Each of these efficient designs is carefully selected using a computer algorithm (Sawtooth Software, 2017).

It is also suggested that the activity of choosing through CBC simulates a real buying situation, which potentially leads to a close interpretation of true shopping behaviours (Sigurdsson et al., 2017). For this reason a growing number of studies are applying this technique to understand the use of FoP labelling. Through the use of CBC, one study evaluated the influence of three elements of the FoP packaging of two popular snacks for children including cartoon characters, nutrition claims and traffic-light system (Ares et al., 2016). Although Balcombe and his colleagues also used the CBC analysis to assess the effectiveness of Traffic Light Labelling (TLL) in the UK, it evaluated its combined use on a group of items in a shopping basket and did not target any particular food item (Balcombe et al., 2010). Although one of the main limitations of CBC software is that it is not appropriate for studies with a large number of attributes, it is valid for this study as the number of attributes to be included from the TLL is small. "Attributes" is a general term that describes the factors which determine participants' choices; these can vary depending on the field and the study. Based on the aforementioned advantages of the CBC, it was applied to assess the current use of TLL in the UK across specific food items.

## 2.2 HIERARCHICAL AGGLOMERATIVE CLUSTERING TECHNIQUE (HAC)

The use of regression analysis, which is considered a traditional statistical approach to test various characteristics of different combinations of individuals, is associated with multiple issues including multiple testing, statistical power, and increasing the likelihood of chance findings. Therefore, updated analysis techniques have been created to better incorporate multiple variables, which permit broader exploration of the outcomes and their correlation with different variables. This updated analysis is called Hierarchical Agglomerative Clustering (HAC) (Murtagh and Contreras, 2011).

HAC is identified as an "unsupervised learning" approach that is commonly used by data scientists to generate groups of similar individuals based on the combined values of their measured characteristics, without knowledge of the outcomes. The process of hierarchical clustering relies on computer programming to learn all the complex interactions between variables and individuals. Accordingly, results are easily reproducible and this process is fixed once clusters are assigned, so participants cannot be reclassified into a different cluster. Clustering takes into account all variables, providing a way to holistically represent the entirety of the data collected.

There is an increasing use of this approach, mainly in the domain of health care (Ahmad et al., 2016, Fontanella et al., 2018). These studies suggested that more precise identification of patient subgroups and underlying characteristics through the use of HAC could potentially result in more precision and personalisation of therapies to achieve better health outcomes. In addition, the application of this technique allows for numerous ways to visualise the whole dataset, presenting clusters and the distribution of the sample across them. This feature is usually considered in Randomised Control Trials to ensure that the experimental group is similar to the control group.

In the field of nutrition-related topics, the HAC technique was used for a sub-sample of individuals with a BMI≥30 from the Yorkshire Health Study looking at data on demographics, health and behavioural characteristics (Green et al., 2015). The choice of using the HAC

technique for the doctoral study on the relationship between the consumption of sugar-sweetened beverages and obesity in childhood was considered given that the use of this approach has been very limited in the field of public health nutrition and its effectiveness in producing nuanced outcomes may help in reducing bias in the analysis and lead to more appropriate conclusions.

## 2.3 SURVEYMONKEY™

The use of surveys and questionnaires is extensively used across different research fields. The survey developed for the third study is novel in that it is asking participants about government policy documents which address different areas related to childhood obesity.

The use of SurveyMonkey™ was chosen to overcome the limitations that were faced during the first study on Traffic Light Labelling. It was important to try to attain a representative sample for the English population to be able to generalise the outcomes of the study as much as possible. In some countries, SurveyMonkeyTM acts as the main platform for recruiting participants. However, in others where they do not have the capability to do so, the invitations are sent through trusted survey panel companies. These individuals receive an invitation email to complete a survey, in which they are informed that participation is voluntary and 50 cents will be paid to a charity for each completed response. This is set to allow selfless and thoughtful participation. The survey data is collected and held by SurveyMonkeyTM. In addition, the platform SurveyMonkey™ allowed the recruitment of a stratified sample, as survey links are closed to a specific group of responders when the required number of these individuals is collected (SurveyMonkey™, 2019).

## 2.4 "WHAT'S-THE-PROBLEM-REPRESENTED-TO-BE?" (WPR) APPROACH

Generally, qualitative content analysis in the literature has been used to identify themes, relationships between themes, and the structure of the framework. There are many methods

of qualitative analysis that are applied in different studies and research areas. This section aims to present the WPR approach, originally developed by Bacchi to investigate how women tend to be represented in different areas of social policies, addressing several issues, including pay equality, discrimination, education, childcare, abortion, domestic violence and sexual harassment (Bacchi, 1999).

The WPR framework is based on an entirely different rationale to more traditional frameworks (Goodwin, 2011). In Bacchi's first study, she argued that there is not enough consideration of the possible factors and determinants associated with the definition of a "problem" and how it is presented to a community. The more traditional focus in policy analysis is on the proposed solutions to a defined problem. This in turn affects how the "problem" is discussed and addressed between individuals within the population. For this reason, Bacchi developed this different form of policy analysis that aims to focus on improving the definition of a certain "problem" and, consequently, improving the policies that are put in place to solve it (Bacchi, 1999). Following this framework requires the researcher to actively question and explore why a particular problem is presented in a specific manner (Bacchi, 2009). In addition, she emphasised the fact that the focus should not be on finding the correct solution to the problem, but instead on identifying the process of problematisation, in which policies present problems and their related solutions (Bacchi, 1999).

The premise of this framework is to closely examine and identify the ways of presenting a 'problem' in a policy document. Bacchi stated "how we perceive or think about something will affect what we think should be done about it" in Page 1 of her book (Bacchi, 1999). Therefore, she insisted on the need to look at 'problems' as unbiased descriptions. This would allow expansive exploration of assumptions of how and why the 'problem' is perceived in a particular way, who takes responsibility for its existence and what measures should be taken to resolve it.

Bacchi supported her framework with a book she authored in 2009, called '*Analysing Policy: What's the problem represented to be?*' in which she explored the framework in much

greater depth. She provided further clarifications to the six main questions of the approach and to the wide scope of policy areas in which it can be applied, in order to demonstrate its versatility and utility (Bacchi, 2009). It is stated that applying this set of questions allows the researcher to follow a structured approach throughout the policy analysis (Kriznik, 2015).

The first question of the approach is centred on the concept of problematisation. It is vital to start the analysis by identifying the 'problem' presented in the document, and questioning why it is presented in that manner. This will indirectly consider a wide range of effects and consequences for people who this document is mainly directed to. The second question is concerned with the thoughts behind these assumptions, where it focuses on the knowledge used by the government to form policies and present the 'problem' the way it is. Within this analysis, it is recognised that there are different forms of knowledge that can form the underlying assumptions. The third question is to investigate possible explanations for the problematisation of issues, to explore why they are dominant at a particular time and to question if they are proxies for other issues. Very interestingly, the fourth question keeps the door open for opposing perspectives on the presentation of 'problems'. This question is to encourage the researcher to consider the government viewpoint on matters related to issues discussed in question 1 to 3 that may keep the presentation of the 'problem' as it is explicitly represented. The last two questions are to identify the measures and mechanisms that are used for 'problem' presentation, and how these efforts are used to shed light on the 'problem' to urge immediate change. In addition and most importantly, these questions allow the examination of the effects of these presentations. To sum up, Bacchi detailed "every postulated solution has built into it a particular representation of what the problem is, and it is these representations, and their implications, we need to discuss", page 21 (Bacchi, 1999).

It is suggested that problematisation may limit people's attention to a 'problem' and reduce their awareness of the presence of other issues related to this particular 'problem'. This is mainly associated with the way a 'problem' is presented at the centre of the document and

of political discussions and debates (Kriznik, 2015). Policies are generally set to propose changes and interventions to address a particular issue, where these changes are created by government as a 'response' or a solution to a 'problem' that exists 'out there' in the community (Bacchi, 2000). Within these changes, there are considerable expectations from individuals and groups who are considered the centre of this 'problem'. For this reason, policy analysis researchers should comprehensively understand the language used to frame and discuss the 'problem' in the policy document, to unfold both explicit and implicit details of interventions that are expected to be problematic.

This policy analysis framework has previously been used in different fields, including medical education, where it investigated the 'problematisation' of medical students with disabilities (Shrewsbury et al., 2018). It was applied in another area of critical policy analysis that investigated the two-child policy in China to address social equality and feminism (Du, 2016). Yet, until recently, it has not been applied to the analysis of public health policies in the UK. Ramos Salas and her colleagues used the WPR approach to critically analyse Canadian obesity prevention policies and strategies (Ramos Salas et al., 2018). Their study represents the first attempt to systematically identify values and assumptions underpinning major obesity public health policies that can promote inequality. Therefore, as part of the focus of this thesis on childhood obesity in the UK, and aiming to describe the context and potential effects and consequences of the current public health practises, it was decided to apply the WPR approach to the most recent policy documents aimed at addressing childhood obesity, "Childhood Obesity: a Plan for Action" 1 and 2.

# CHAPTER 3: SUGAR LOOKS BRIGHTER ON TRAFFIC LIGHT NUTRITION LABELLING: CHOICE-BASED CONJOINT ANALYSIS AND CROSS-SECTIONAL

*Aim*: To take a closer look at people's understanding of the TLL and the possible effect of the sugar reduction campaigns on their perception of food healthfulness.

*Hypothesis*: The current public health climate focusing on sugar reduction has affected people's perceived healthfulness of food items by shifting them to place a higher level of importance on sugar compared to other nutrients presented on traffic light labelling and items' price.

*The objectives of this study are as follows:*

1. to identify which nutrient on Traffic Light Labels (TLL) has the biggest influence on the perceived healthiness of different food items using Choice-Based Conjoint analysis
2. To explore if food items' price has an effect on the perceived healthiness of food items
3. To examine if aversion from the red colour presented on TLL is greater for one nutrient compared to other nutrients
4. To compare findings with the published literature and to determine whether there is any change in the most influential nutrient and if this may be associated with the current single nutrient approach
5. To assess the public's level of knowledge in reading traffic light labels using SurveyMonkey™

## 3.1 INTRODUCTION

Over the past three decades, a range of policies have been proposed to help the public make healthier food choices, and improve their diet and quality of life. This in turn may help tackle many nutrition-related diseases at a national level, including obesity and cardiovascular disease (CVD) (Hawkes, 2010). In the UK, these interventions have included several health campaigns, such as "Eatwell", "Change 4life", "6 grams of salt" and "Healthy lives, Healthy people" (Action on Salt, 2014, DoH, 2011b, PHE, 2016a, PHE, 2017b). This is similar to other public health campaigns around the world (e.g. Mexico, Canada, USA) that aim to improve individuals' health thought reducing their sugary drinks intake worldwide campaigns (OECD, 2017) and increasing their fruits and vegetable intake, like the "2+5 a day" campaign in Australia (Pollard et al., 2008). The World Health Organization has recommended improved nutrition labelling (WHO, 2004) to support individuals in achieving their health goals and making better food choices, such as those proposed in such health

campaigns. The concept of labelling has evolved to provide simple and accessible nutritional information on food items. Front of Pack (FoP) labelling has been developed in various formats (Institute of Medicine, 2010). Labels are categorised as nutrient-specific, system-indicator, and other nutrition-related label types (L'Abbe et al., 2016). The nutrient-specific type itself includes several kinds of labels that are adopted in different countries around the world. For instance, Australia implemented the Health Star Rating (HSR) scheme, which uses a nutrient profiling algorithm to assign a score between 0.5 stars (least healthy) and 5.0 stars (most healthy) to rate the healthiness of food items (AFGC, 2012). However, there are other labelling systems partially adopted by the food industry in Australia including the Daily Intake Guide (DIG) and the recommendations/warnings (WARN) programme (AFGC, 2012). These have been studied thoroughly and are considered not as helpful to consumers as the HSR scheme (Neal et al., 2017). Similar labelling systems are used in the USA, called the Guiding Stars scheme (Rahkovsky et al., 2013), and France, called the 5-Colour Nutrition Label (5-CNL) (Julia et al., 2016).

FoP labelling is believed to help individuals overcome the difficulties of understanding the Back of Pack (BoP) nutrition labelling (Kleef and Dagevos, 2015). In the UK, the government has adopted a voluntary TLL application. This colour-coding system presents the content of food products in terms of four nutrients (fat, saturated fat, total sugar and salt in grams) and energy (kcal). The threshold for each colour (red, amber, green) is set for each nutrient by the Department of Health (DoH, 2016). Health campaigns have focused on educating families and increasing their knowledge and awareness of the uses of FoP (PHE, 2017b). Research by the Foods and Standards Agency (FSA) into the types of FoP since 2004, backed by several studies, reinforced the use of the Traffic Light Labelling (TLL), with most consumers indicating preference towards it, citing the features of usefulness and simplicity (Malam, 2009).

Internationally, a comprehensive base of literature has illustrated the effectiveness of FoP labelling where its use favourably affected consumers' behaviour in food choices (Ikonen et

al., 2020), as it increased the visibility and simplicity of nutritional information (Hawley et al., 2013). A French study concluded that the French population recognised the 5-colour nutrition label to be the easiest to identify, as well as being simple and quick to understand (Ducrot et al., 2015a). Other studies have found that TLL is easier to understand than other labelling format (Lang, 2006). Similar outcomes were illustrated in South Africa and Uruguay, where TLL was identified as the most effective FoP label to convey the level of healthiness of a food item (Machin et al., 2018, Montandon and Colli, 2016). In addition, the TLL is also considered a way to nudge consumers toward healthier food options, by offering quick and simple visual cues (Scrinis and Parker, 2016).

A large and growing body of literature has investigated consumers' use of and behaviour towards nutritional information provided on food packaging, and it has generally reached positive conclusions. However, more recently, studies have emerged to offer contradictory findings about the over-simplicity of nutritional information (Holdsworth et al., 2010). Black and Rayner (Black, 1992) first suggested that some consumers may not understand how to process information when presented with several nutrients simultaneously. This links to later research which found that consumers use nutrition labels less than they claim to in surveys (Balcombe et al., 2010). In a major review, Grunert and Wills (2007), reported that consumers partially struggled to connect multiple food items to construct a meal, and they suggested that TLL may cause a level of confusion (2007).

Despite the purpose of presenting TLL on food items, and the use of "lights" that are coordinated based on nutrient content to facilitate the comparison between items or against recommendation, a prerequisite of nutrition understanding is needed to lead to appropriate use of the information (Kleef and Dagevos, 2015). This level of nutrition understanding is associated with consumers' age, gender, level of education, beliefs and most importantly dietary needs and desires (Provencher and Jacob, 2016). A deficit of the nutritional knowledge required may lead to misinterpretation of information and negatively affect people's food-related decisions. Another level of confusion may occur due to different FoP labelling schemes co-existing for some food items (Baynton, 2010).

Evidence shows that there are multiple factors associated with individuals' decisions, including their psychological status, age, gender, health status, food preferences, socioeconomic level, literacy background, and perceptions of healthy eating (Emrich et al., 2017). Food choices differ over the lifespan of an individual, where children and adolescents are more affected by advertisements and peer pressure, and older people tend to choose food with more intense flavours (Van Meer et al., 2016). The role of gender is also considerable, as women have heightened concerns about health and shape which influence their food choices by preferring healthier options (Missagia et al., 2012). Socioeconomic status influences purchasing decisions as more fruit and vegetables are purchased by high-income compared to lower income households (ONS, 2017b). In addition, perceptions of healthy eating are thought to be an important determinant (Provencher et al., 2009), where food items are often categorised as healthy or unhealthy (Carels et al., 2007).

The perception of food item healthiness itself can be greatly affected by many factors, including the type of FoP, the stereotypical beliefs related to brands, and cognitive and environmental factors (Saarloos et al., 2009, Oakes, 2006). Furthermore, individuals' health perception is influenced by their socioeconomic status (Machin et al., 2018). For instance, one study concluded that people with lower income perceived ultra-processed food items to be healthier than people with higher income (Machín et al., 2017). Haws and her colleagues presented the concept of "health halo" which connects the perception of food item healthiness to its cost, where higher food prices may be perceived as healthier compared to cheaper options (2017). They also identified that the public hold an unconscious belief that healthier food items need to be expensive and that higher prices indicate higher nutritional quality, and vice versa. Further research emphasised the effect of brand and price on the perception of food item healthiness (Chandon and Wansink, 2007). Authors investigated the purchasing behaviour across consumers for two brands, Subway and MacDonald's, and highlighted the power of brand-derived health halo effect on altering buying decisions.

Based on the presented information, perceived healthiness of food items is considered important in the process of food purchasing. It can cause significant undesirable negative

attitudes by forming judgmental bias and illusory assumptions for choosing the healthier item (Provencher and Jacob, 2016) and, in turn, increase the intake of misinterpreted healthy food items. This is especially true when considering the possible confusion in public perception of the healthiness of food items that is influenced by the focus of public health campaigns addressing nutrition-related issues in a specific period of time. As previously discussed, the focus is typically on one or two nutrients presented on the FoP labelling, specifically the TLL. Currently, sugar is the focus of a Public Health England (PHE) action plan to reduce sugar consumption to tackle the national childhood obesity issue (HM Government, 2018, HM Government, 2016, Action on Sugar, 2017). For these reasons, study one aimed to take a closer look at people's understanding of the TLL in the UK, and the possible effect of sugar reduction campaigns on people's perception of food healthiness. It is hypothesised that the current public health climate has affected people's perceived healthiness of food items by shifting them to place a higher level of importance on sugar compared to other nutrients presented on traffic light labelling. A further objective of this study is to investigate the effect of price on the perception of food items' healthiness compared to the effect of the other nutrients presented on the TLL. This study was done in two parts. The first part was done to assess the level of perceived healthiness of different food items based on the information provided on the TLL. The second part was conducted to evaluate the level of nutritional knowledge that individuals should have to be able to read the TLL labels correctly.

## 3.2 METHODS

### 3.2.1 Experimental Design of Part One

This cross-sectional study was designed to examine the influence of the TLL components on food purchasing decisions among laypeople. The importance given to each of the four attributes (fat, saturated fat, total sugar and salt) displayed on TLL and price were assessed. In addition, the three possible colours for each attribute (red, amber and green) were also tested to investigate the attribute level, which is described as the utility.

This research was based on a 12-screen survey that was created online using the Choice-Based Conjoint analysis (CBC) technique, delivered using Sawtooth™ software. Each screen presented three options of the same food item with different nutrition traffic light label combinations (Figure 3.1). The same survey was generated for three products: pre-packed sandwiches, breakfast cereals and biscuits, where the participants were approximately equally distributed across the surveys of the three food items. These products were selected as popular food items that are commonly purchased on a daily basis; cereal and packaged sandwiches at mealtimes and biscuits as a snack. The three food items were also popular manufactured products that are required to display nutritional information. In addition, most manufacturers of these products voluntarily present this information as TLL in the UK. In terms of products presentation on the survey screens, non-branded and non-descript food images were chosen to illustrate the three products.

The first step of using the CBC software is to determine the attributes (nutrients presented on the traffic light label and the price of each item) and the utilities. Realistic values for the utilities for each food item were determined by surveying 20 items for each product from a range of online supermarket websites, including Morrisons, Tesco own-brand, Tesco, Sainsbury's and Waitrose (Table 3.2). These values were classified according to the criteria by the Department of Health for each nutrient content per 100 grams (DoH, 2016) (Table 3.1). Regarding product prices, the procedure of selecting low, medium and high price for each product may be considered subjective. For each product, the lowest cost item in the

sample was used as the low price in the survey and the highest price sampled was used as the high survey price. The medium price on the survey was selected as the mode price of the 20 products. However, for biscuits the mode was £0.45, which is close to the low price (£0.25) and far from the high price (£2.29). Hence, the sample mean (£1.01) was rounded to £1. Prices displayed were per item (Table 3.2).

The inputs into the CBC software are these values (attributes and utilities) and the design of the screen as shown in figure 3.1. The combinations presented on the survey screens are automatically generated by the CBC analysis software, where the D-efficient design – a measure of efficiency – is applied to test the precision of outcome prediction based on a minimum number of combinations in the survey. The software may present unrealistic combinations (prohibited combinations), such as a higher content of saturated fat than total fat. Deleting these options decreased the precision of the results (Sawtooth Software: Choice based Conjoint (CBC)). Therefore, the decision was made to keep these combinations as including these prohibited combinations does not negatively affect the outcomes of the survey, but excluding them may reduce the precision of the results.

The survey is then automatically generated based on the inputs outlined above and a link is provided. The CBC software stores the data from the surveys and calculates the level of importance for each attribute and utility. These results are then exported in full into SPSS.

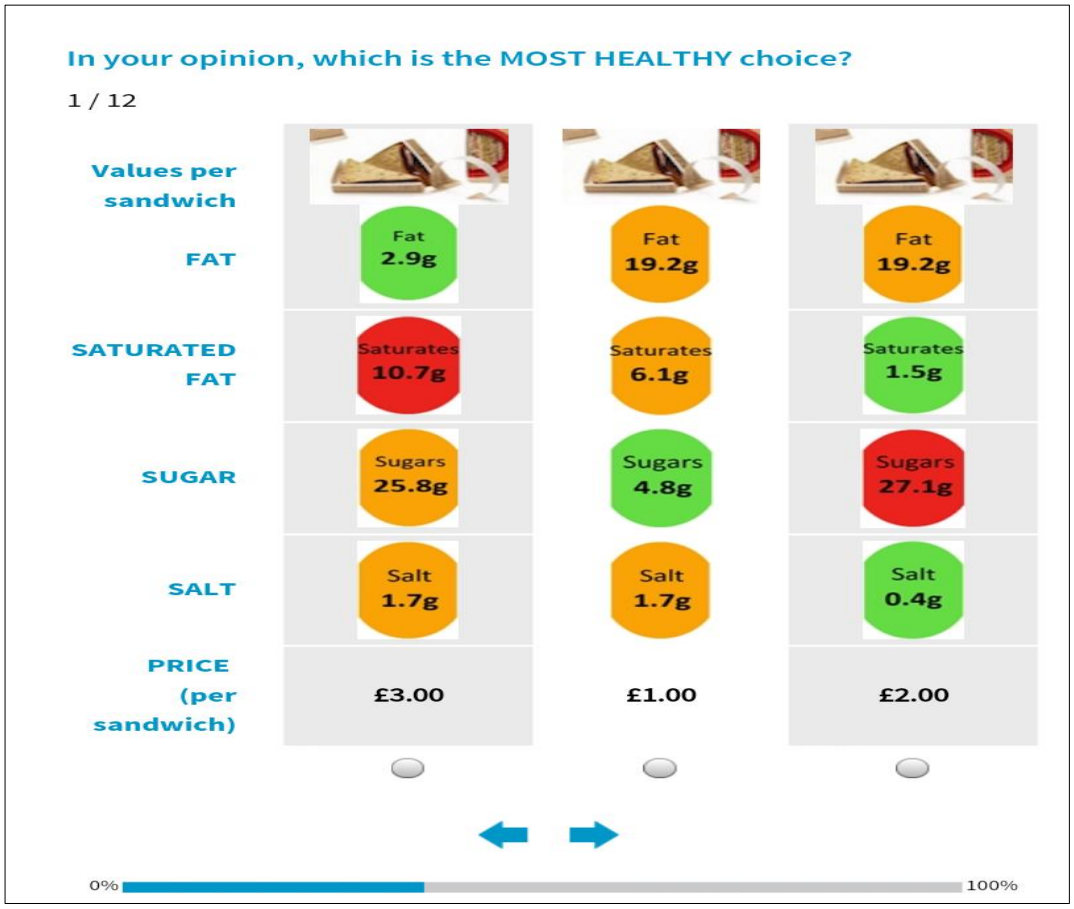



*Figure 3.1 A sample of the Sawtooth Software sandwich survey screen.*

*Table 3.1: Criteria for 100g food (Department of Health, 2016)*

| Text | LOW | MEDIUM | HIGH | |
|---|---|---|---|---|
| Colour code | Green | Amber | Red | |
| | | | >25% of RIs | >30% of RIs |
| Fat | ≤3.0g/100g | >3.0g to ≤ 17.5g/100g | >17.5g/100g | >21.0g/portion |
| Saturated fat | ≤1.5g/100g | >1.5g to ≤ 5.0 g/100g | >5.0g/100g | >6.0g/portion |
| (Total) Sugars | ≤5.0g/100g | >5.0g to ≤ 22.5g/100g | >22.5g/100g | >27g/portion |
| Salt | ≤0.3g/100g | >0.3g to ≤ 1.5g/100g | >1.5g/100g | >1.8g/portion |

*Table 3.2: Attributes and attribute levels for the three surveys.*

| | | Survey | | |
|---|---|---|---|---|
| Attribute | Attribute level | Biscuits | Cereal | Sandwich |
| Fat (g) | Low | 0.2 | 0.5 | 2.9 |
| | Medium | 1.6 | 3.1 | 19.2 |
| | High | 3.7 | 5.8 | 26.6 |
| Saturated Fat (g) | Low | 0.1 | 0.2 | 1.5 |
| | Medium | 0.5 | 1.0 | 6.1 |
| | High | 1.9 | 1.5 | 10.7 |
| Sugar (g) | Low | 0.4 | 0.8 | 4.8 |
| | Medium | 2.2 | 4.1 | 25.8 |
| | High | 5.0 | 8.3 | 27.1 |
| Salt (g) | Low | 0.0 | 0.1 | 0.4 |
| | Medium | 0.1 | 0.3 | 1.7 |
| | High | 0.3 | 0.5 | 2.4 |
| Price (£) | Low | 0.25 | 0.65 | 1.00 |
| | Medium | 1.00 | 1.00 | 2.00 |
| | High | 2.29 | 3.00 | 3.00 |

*Attributes: the nutrients presented on the TLL and Price*
*Attribute levels: based on a selection of supermarket items for the three chosen food items*

### 3.2.2 Ethical Approval

Ethical approval was obtained from the School of Biosciences Research Ethics Committee at the University of Nottingham (Reference #SBREC170103A) (Appendix two). Potential participants were presented with an on-screen summary of the research, and they were required to read and accept the information before starting the questionnaire. There was no need to fill a consent form, due to the anonymous nature of the study. Participants could withdraw any time before the completion of the survey

### 3.2.3 Data Collection

#### *3.2.3.1 Participants*

For this study, the only inclusion criterion was to be 18 years and above. No other age or demographic specifications were required to participate. The aim was to recruit 200 participants for each study, the number recommended by Sawtooth™ software for significant results (Orme, 2010).

#### *3.2.3.2 Pilot study*

An initial version of the survey was circulated to 40 individuals known personally to the researchers to test the survey's feasibility and explore the practicality of design. Accordingly, some revisions were made, in response to participants' questions, to develop standard responses and increase clarity in the wording of questions, e.g. rating of priority of household food spending. Responses from the pilot study were not included in the main study data analysis.

#### *3.2.3.3 Recruitment*

Participants were recruited, over a period of two weeks during November 2017, from multiple locations across the city of Nottingham, such as the Victoria Bus Station, the University of Nottingham and Broadway Cinema. These locations were chosen to ensure diversity in terms of age, gender and other background differences. Participants were provided with an information sheet and invited to complete the survey, displayed on a hand-held touch screen device. The survey asked participants to select the healthiest food item from the three options that were presented on each of the 12 screens. Other data were also collected; demographics, participants' priorities for spending money on food (low, medium and high) and if they altered their diet for specific health reasons (e.g. trying to lose weight, lower their blood pressure, manage diabetes, etc.). The survey was self-administrated and did not involve any help from the researchers throughout the completion of the questions. Web links to the survey were then shared with associates of the research team in order to increase the diversity and the number of the sample to reach 200 responses for each survey.

### 3.2.4 Experimental Design of Part Two

The objective of this cross-sectional study was to investigate public knowledge and perceptions of the nutrition traffic light labelling. An online cross-sectional survey was designed on SurveyMonkey™. It consisted of 15 different questions (Appendix one), including participants' demographics, their knowledge surrounding the TLL and nutritional recommendations. Participants were asked to select the correct choice of the maximum recommended daily intake for an adult in the UK of all nutrients presented on TLL (salt, fat, SF, free sugar and total sugar). Similar to part one of this study, the only inclusion criterion was to be 18 years old and over. To maximise the similarity between the samples for Part one (which was a relatively young sample) and Part two, participants were recruited through the university and social media, which are skewed towards a younger population. Therefore, a separate sample was recruited by sending the survey to university staff and student e-mails, and through other social media platforms including Facebook and Twitter.

#### *3.2.4.1 Analysis*

The IBM SPSS Statistics 24 data editor was used to analyse the collected data from both studies. Categorical variables were presented as percentages, and Chi-square tests ($\chi^2$) were used to assess demographic differences across different groups of participants who were recruited for each of the three-product surveys, considering significance as a P-value of $<0.05$. A Chi-square test was run to assess any significant differences in age and gender associated with being a non-completer. For each of the food items, a single-factor repeated measure ANOVA was used to assess the difference of mean importance of the attributes, which was presented in percentages with 95% confidence intervals. This was followed by *post-hoc* pairwise comparisons with Bonferroni correction, to further compare attributes and utilities of each. Mauchly's test rejected the hypothesis of sample sphericity, which was then corrected using Huynh-Feldt estimates of sphericity. Mauchly's test tests the hypothesis that variance is not significant within a subject (a single participant). If Mauchly's test is significant then sphericity is violated. Therefore the Huynh-Feldt corrected values were used, as the value of Epsilon in Mauchly's test was >.75.

## 3.3 RESULTS

### 3.3.1 Part One Results

#### *3.3.1.1 CBC Demographics*

Out of 858 participants who consented to take part in the survey, 74.7% (n=641) completed all the screens of the survey and were similarly distributed across the surveys of the three food items (pre-packed sandwiches, cereal and biscuits). The participation rate was higher among females, with only 35.8% of the sample being male, and among young people, with 49.2% in the 18-24 years age category (Table 3.3). However, there was no significant difference between age and gender across the three surveys, nor among completers and non-completers. 69.4% to 75.1% of the participants in the three surveys were making purposeful dietary changes. Specifically, 52.7% of them were trying to follow a healthy diet.

#### *3.3.1.2 CBC Importance of attributes*

The nature of the statistics allows the comparison of the five attributes (fat, saturated fat, total sugar, salt and price) across the three food items. The analysis showed that sugar had the highest mean value of importance in choosing the food item, with a significant difference compared to the other four attributes. The following means are the average means for each attribute across the three products:

*Table 3.3: Mean importance of each attribute*

| Attribute | Mean importance | 95% Confidence Interval |
|---|---|---|
| Sugar | 0.335 | 0.304 - 0.376 |
| Fat | 0.239 | 0.218 - 0.259 |
| Saturated Fat | 0.216 | 0.194 - 0.236 |
| Salt | 0.155 | 0.129 - 0.178 |
| Price | 0.055 | 0.038 - 0.076 |

The measures are presented in a descending order of importance. In CBC analysis, the total means of attributes' importance levels must equal 1, and the higher the mean for each attribute, the higher its importance in making a choice. This pattern was consistent across the three food items surveys. Although fat was more important than saturated fat in

choosing the food item, it wasn't statistically significant – the 95% confidence intervals overlapped (Figure 3.2).

Furthermore, in terms of dietary changes, statistical analysis across importance levels of attributes and participants' purposeful dietary changes showed some significant differences. For the biscuit survey, participants who wanted to lose weight placed a significantly higher level of importance on saturated fat compared to the group that did not want to lose weight (P-value = 0.049). Participants who did not want to lose weight placed a higher importance level on sugar compared to the group wanting to lose weight (p-value= 0.041). No differences were significant for the other two food products (Table 3.4).

*3.3.1.3 CBC Utilities of attributes*

The results of this study show that participants tended to have a significant preference towards the green colour of the traffic light nutrition labelling system when they made food choices. This was true for all the attributes and across the three food items.

For sugar, a green attribute level for cereals (83.03, 95% CI: 78.58 - 87.48) and sandwiches (83.18, 95% CI: 78.57 - 87.80) had a significantly higher impact than for biscuits (73.33, 95% CI: 69.1 - 77.55). Comparing cereals and sandwiches, there was no significant difference in the impact of a green attribute level for sugar.

The strong focus on choosing green and avoiding red was also a trend for all the attributes (Figure 3.3). However, the aversion to red labels for sugar was stronger than for other nutrients. Again, taking biscuits as an example: the sugar red attribute level was -90.748 (95% CI -95.156 - -86.339), and the sugar green attribute level was 73.33 (95% CI: 69.12 - 77.55), whereas the salt red attribute level was -42.961 (95% CI: -46.23 - -39.693), and the salt green attribute level was 37.478 (95% CI: 34.642 - 40.313).

### 3.3.2 Part Two Results

87% percent of the 1031 participants completed the survey (n=901). Age ranged from 18 to 85 years, with 35% in the 18-24 year category and 38% in the 25-34 year group. More than sixty percent of participants were female. Almost 63% of all participants wanted to lose weight or were trying to follow a healthy diet.

In terms of engagement with traffic light labelling, only 4% indicated that they always use the TLL to decide whether or not to buy a product, and 45% indicated using it occasionally. The results highlighted that 47% of participants believed their knowledge about the traffic light labels was good or very good, and 66% of the sample self-rated ≥7/10 in terms of their confidence in reading the label. When the participants were asked specific questions about the recommended daily intake of nutrients on the TLL, more than 40% of them indicated that they did not know the recommended maximum daily intake of total sugar, and only 13% were able to correctly identify the 90 grams (British Nutrition Foundation, 2016). Similarly, 69% did not know the maximum recommended intake of free sugars and 43% of the sample could not identify whether the sugar displayed on the TLL is the total or the free sugar content.

*Table 3.4:* Participant gender and age across for each survey, and dietary modifications that participants reported making

| | | Surveys | | | |
|---|---|---|---|---|---|
| | | Biscuit (B) (n=201) (%) | Cereal (C) (n=219) (%) | Sandwich (S) (n=221) (%) | Mean (%) |
| Gender[1] | Female | 68.7 | 55.7 | 67.4 | 63.9 |
| | Male | 31.3 | 43.4 | 32.6 | 35.8 |
| | Non-binary | 0.0 | 0.9 | 0.0 | 0.3 |
| Age bracket[2] | 18-24 | 45.8 | 47.9 | 53.8 | 49.2 |
| | 25-34 | 14.4 | 16.4 | 9.0 | 13.3 |
| | 35-44 | 6.5 | 5.0 | 5.0 | 5.5 |
| | 45-54 | 6.5 | 7.3 | 9.5 | 7.8 |
| | 55-64 | 11.4 | 9.6 | 8.6 | 9.9 |
| | 65-74 | 9.0 | 8.7 | 10.4 | 9.4 |
| | 75-84 | 6.5 | 3.7 | 2.7 | 4.3 |
| | 85+ | 0.0 | 1.4 | 0.9 | 0.8 |
| Dietary changes[3] | Selected any of the any changes | 75.1 | 69.4 | 75.1 | 73.2 |
| | Selected 'Follow healthy diet' | 53.7 | 50.2 | 54.3 | 52.7 |

[1]Chi-squared results: B-C p=0.602; B-S p=0.730; C-S p=0.821 (no significant differences). Non-binary category could not be included in chi-squared analysis as the population was too small (<5).
[2]Chi-squared results: B-C p=0.138; B-S p=0.183; C-S p=0.623 (no significant differences).
[3]Dietary changes options included: not trying to make any changes to diet, trying to lose weight, trying to gain weight, following a healthy diet, manage my diabetes, trying to lower my blood pressure and managing a food tolerance or a food allergy.

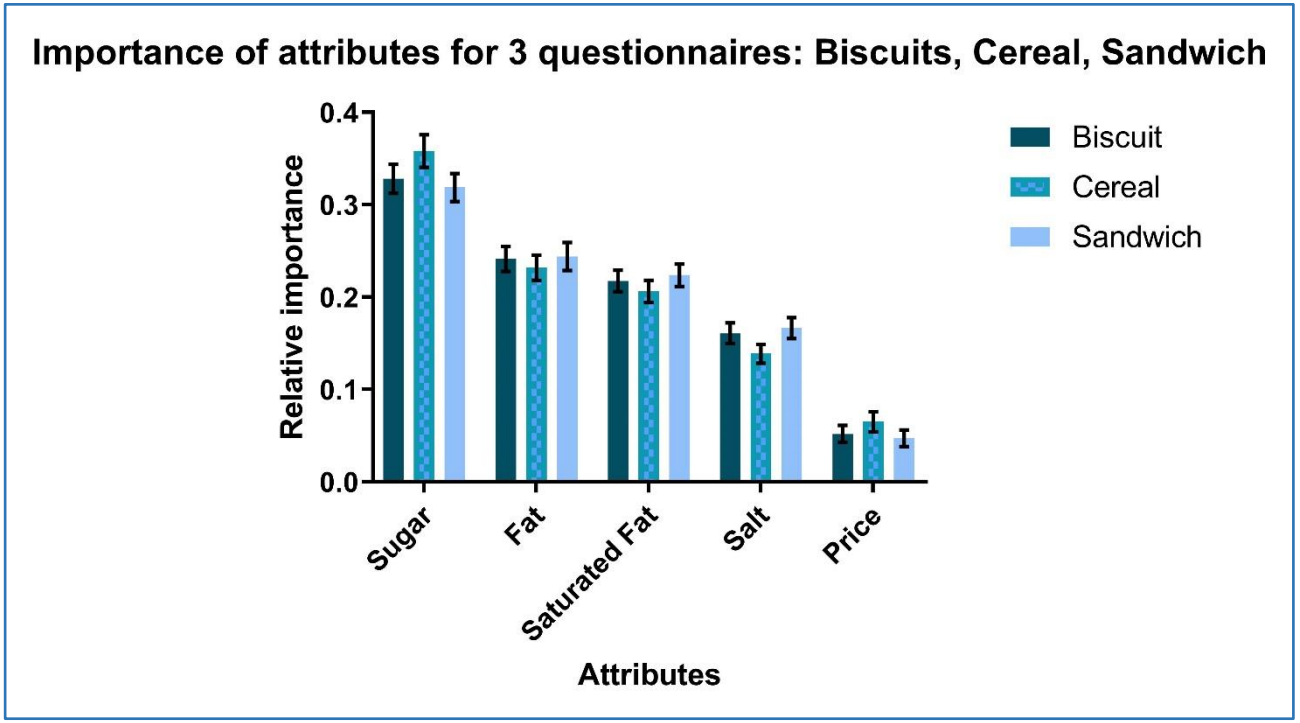



*Figure 3.2 Relative importance between attributes for the three surveys (biscuit, cereal and sandwich) as created with PRISM, version 7.03 (GraphPad Software Inc., San Diego, CA, USA).*

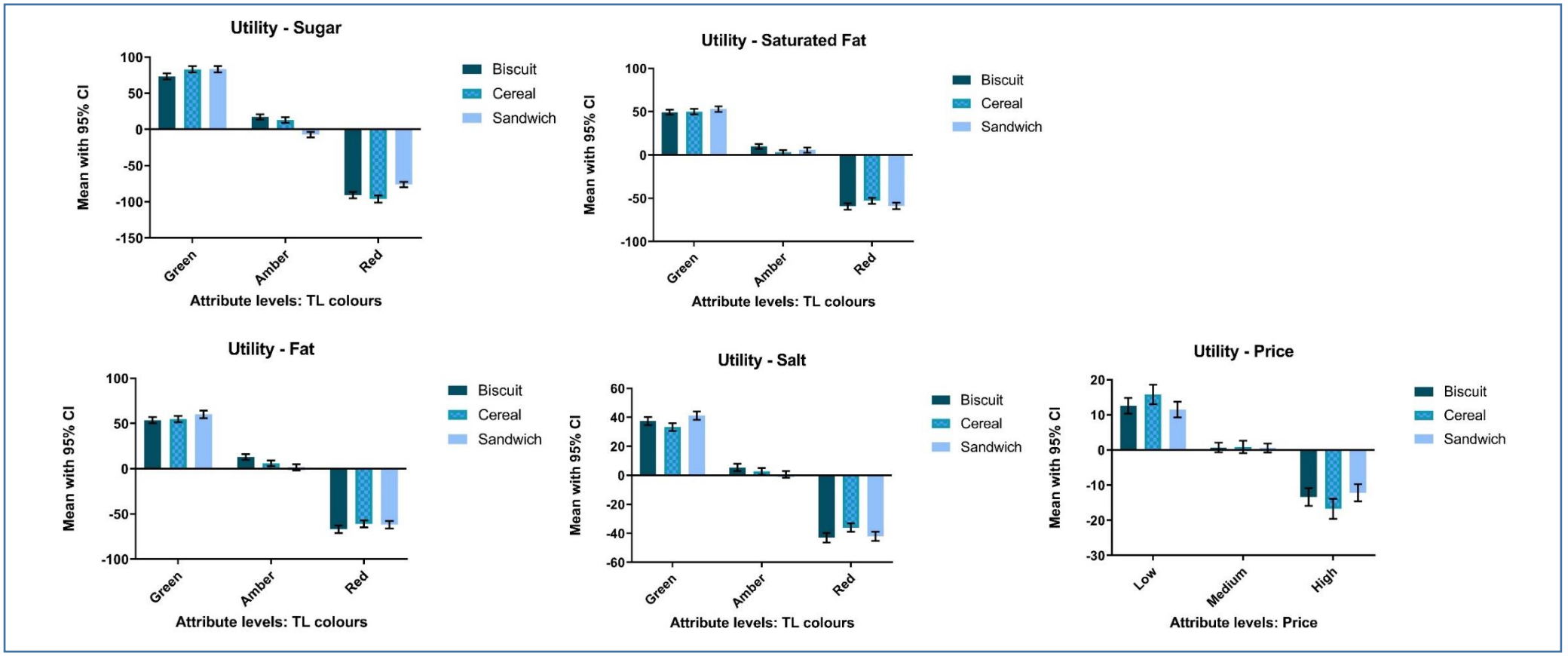



*Figure 3.3 Parts (a) to (e) show the attribute levels, which is described as utility for each of the 5 attributes (a), sugar (b), saturated fat (c), fat (d) salt (e), price. Comparing the three food items for each attribute*

*Table 3.5: Comparison of importance levels for the five attributes across the three food items for participants who wanted to lose weight and/or follow a healthy diet*

| | Importance mean | | |
|---|---|---|---|
| **Biscuit** | **Did not want to lose weight (70.6%)** | **Want to lose weight (29.4%)** | **P-value** |
| Fat | 0.244 | 0.236 | 0.703 |
| Saturated fat | 0.225 | 0.200 | 0.049 |
| Sugar | 0.320 | 0.347 | 0.041 |
| Salt | 0.160 | 0.164 | 0.865 |
| Price | 0.051 | 0.054 | 0.137 |
| **Biscuit** | **Did not want to follow a healthy diet (47.2%)** | **Want to follow a healthy diet (52.8%)** | **P-value** |
| Fat | 0.247 | 0.236 | 0.688 |
| Saturated fat | 0.212 | 0.223 | 0.296 |
| Sugar | 0.320 | 0.336 | 0.358 |
| Salt | 0.166 | 0.156 | 0.642 |
| Price | 0.055 | 0.046 | 0.097 |

| **Cereal** | **Did not want to lose weight (77.1%)** | **Want to lose weight (22.9%)** | **P-value** |
|---|---|---|---|
| Fat | 0.233 | 0.228 | 0.877 |
| Saturated fat | 0.205 | 0.210 | 0.766 |
| Sugar | 0.355 | 0.370 | 0.992 |
| Salt | 0.135 | 0.151 | 0.115 |
| Price | 0.072 | 0.041 | 0.086 |
| **Cereal** | **Did not want to follow a healthy diet (49.8%)** | **Want to follow a healthy diet (50.2%)** | **P-value** |
| Fat | 0.232 | 0.232 | 0.878 |
| Saturated fat | 0.196 | 0.216 | 0.087 |
| Sugar | 0.352 | 0.365 | 0.292 |
| Salt | 0.143 | 0.134 | 0.502 |
| Price | 0.077 | 0.053 | 0.159 |

| **Sandwich** | **Did not want to lose weight (66.8%)** | **Want to lose weight (33.2%)** | **P-value** |
|---|---|---|---|
| Fat | 0.235 | 0.262 | 0.136 |
| Saturated fat | 0.233 | 0.204 | 0.053 |
| Sugar | 0.320 | 0.316 | 0.662 |
| Salt | 0.161 | 0.178 | 0.157 |
| Price | 0.051 | 0.039 | 0.647 |
| **Sandwich** | **Did not want to follow a healthy diet (46.8%)** | **Want to follow a healthy diet (53.2%)** | **P-value** |
| Fat | 0.245 | 0.243 | 0.764 |
| Saturated fat | 0.216 | 0.230 | 0.486 |
| Sugar | 0.311 | 0.325 | 0.355 |
| Salt | 0.174 | 0.160 | 0.451 |
| Price | 0.055 | 0.041 | 0.371 |

## 3.4 DISCUSSION

The results of this study showed that, for individuals in the UK, total sugar was the dominant nutrient in terms of importance to choose a healthy food item, where it had a significantly higher mean of importance compared to other nutrients presented on the TLL (fat, saturated fat, salt). Similar results were obtained across different age groups and genders who participated in this study. This also includes participants who wanted to adopt dietary changes including weight loss or following a healthy diet. This can be considered a success for the current movement on sugar reduction in the UK (HM Government, 2018, HM Government, 2016). This is widely represented by recent public health policies to reduce children's sugar intake by at least 20% by 2020, the spreading of nutritional messages, national campaigns (PHE, 2017b, Action on Sugar, 2017), media coverage and other interventions such as the sugar levy (PHE, 2015a). This focus of all these policies and campaigns on sugar has led individuals to prioritise sugar when choosing any food items, regardless of those items' sugar intake, including sandwiches according to this study, which typically have relatively low sugar intake.

However, these results differ from previously published outcomes, as one systematic review indicated that calories and fat are more frequently referred to as "nutrients of interest" followed by sugar and other nutrients (Grunert and Wills, 2007). More recently, Scarborough and his colleagues found that saturated fat and salt were the two most influential nutrients on people's choices of healthy ready meals from the supermarkets (Scarborough et al., 2015). Interestingly, the time of data collection for their research occurred after the Food Standard Agency (FSA) had launched their campaign on replacing saturated fat with polyunsaturated fat consumption (NA, 2010). It also coincided with when the Consensus Action on Salt and Health worked successfully with the UK Government and manufacturers to reduce salt content in processing food and home cooking through increasing people's awareness regarding salt consumption (Shankar et al., 2013).

To tackle the increase of CVDs (SACN, 2003), the Committee on Medical Aspects of Food and Nutrition Policy (COMA) recommended in 1994 reducing adult average salt intake from 9g/day to 6g/day, which was followed by several national strategies by SACN and Public Health England to meet this goal. However, 20 year later, the average daily salt intake was 8.0 grams per adult in the English population in 2014 (PHE, 2016d). More recent statistics of 2018/2019 showed that average salt intake was 40% higher than the Government recommendation (8.4g/day) (PHE, 2020).

The results of the first part of the present study maybe correlated with the fact that more than half of the sample were trying to follow a healthy diet, which would make them health conscious individuals. It is believed that health consciousness is a significant predictor of behavioural intentions and food decisions (DiPietro et al., 2016). It is also associated with a positive impact on consumers' health-related knowledge, beliefs and attitudes toward food purchasing (Hoque et al., 2018). However, the results of second part of this study contradict these associations, where participants' nutritional knowledge was not consistent with the fact that almost 60% of them wanted to lose weight or a follow a healthy diet.

Regarding the outcomes relating to the effect of price on perceived healthiness of food, our results indicated that price played the smallest role in selecting healthy food items, while sugar played a 5.5- to 6.8-fold more important role than price. These results are similar to those reported by Montandon and Colli (2016), where nutrient information on TLL was the greatest influencer (41.4%), while price (32.6%) and brand (26%) of food items played less importance. Other researchers have presented different conclusions by emphasising the existence of a higher-price health halo (Haws et al., 2017). These outcomes may not be directly comparable to this study, as the latter study was conducted in real-world shopping scenarios. The former study contained a brand and a clear image of the product, which is considered a great confounding factor in affecting buying behaviour and creating a brand-derived health halo (Chandon and Wansink, 2007). It is important to bear in mind that socioeconomic status is a contributor to the effect of price on relative importance. However, this was beyond the main scope of this research.

Our analysis reproduced similar patterns to previous studies where people tend to avoid the red colour on TLLs, and give a higher importance to green (Scarborough et al., 2015). Consumers' interpretation of red and green labels has been well-investigated, with one study reporting that people have a preference to green labels (Sonnenberg et al., 2013). Another study identified the off-putting effect of red labels compared to the positive influence of green Labels (Balcombe et al., 2010). Despite this, it is essential to consider how different cultures interpret coloured labels differently, especially in terms of the amber colour (Chen et al., 2017). It is suggested that participants tend to consider the amber colour to be closer to a green colour than to a red colour (Scarborough et al., 2015). Whereas for consumers who prefer the majority of their purchases to have the green colour of certain nutrients, an amber light may be perceived as less healthy and consequently less desired (Rosentreter et al., 2013). Results of the present study showed that the effect of amber colour was minimal on the perceived healthiness of products compared to the effect of red and green colours.

Notably, in the current study, the aversion to red colour for sugar was greater than all other nutrients displayed on TLLs. This supports the findings of other research which claims that the usage of TLL is a cost-effective obesity prevention approach (Sacks et al., 2011). However, specialists claimed that the cut-off values for sugar were stricter than ones for other nutrients, which may limit the ability of individuals to make informed food decisions and meal planning (Green and Fern, 2016).

This change in public perception of healthiness of food items sheds light on the effect of public health interventions and the approaches used to tackle health issues. The current methods used to tackle obesity in the UK through focusing on sugar are very similar to ones used to decrease salt and fat consumption previously (FSA, 2010, Action on Salt, 2014). Although the intention of these campaigns is to enhance health, and decrease the national rates of diet-related diseases, like obesity, hypertension or CVDs, these campaigns may implicitly direct attention solely towards the nutrient of focus in each public health campaign's era. This may also deflect an individual's focus from an overall well-balanced

diet (PHE, 2016b). This would explain the difference between the results of this study (high impact of sugar) and the earlier studies (high impact of salt and fat). The effect of the one-nutrient focus of public health campaigns is illustrated by the change in people's perceived healthiness of food items, and the shift in their opinions toward the prominent nutrient in the latest research and public health campaigns.

It is vital to state the considerable efforts being undertaken to help the public attain a well-balanced diet. The collaboration between Public Health England and the British Dietetic Association resulting in the Eatwell guide, which displays the content of a balanced daily diet that consists of fruits and vegetables, low-glycaemic index carbohydrates, protein and dairy sources. This guide also encourages individuals to consume fat, sugar and salt in moderation (PHE, 2016b, Jackson, 2016). Nevertheless, there is very limited guidance on the concept of moderation or small amounts in the intake of fat, sugar and salt, where they are now excluded from the main "circle" of the guide (PHE, 2016a).

Checking the TLL of food packages is part of the Eatwell guide to support members of the public in making informed food-related decisions. Yet, it is suggested that people need adequate information to be able to do so. A group of authors described the process of reading a TLL to be a high cognitive task, as consumers are required to evaluate several pieces of information simultaneously and instantaneously (Ducrot et al., 2015b). Some researchers have pointed to health literacy as a key factor in understanding TLL (Persoskie et al., 2017). A study conducted in New Zealand established that participants, especially those with particular nutritional needs, wanted more up-to-date evidence-based advice on food-purchasing decisions (Lawrence et al., 2017). Another study that was done in South America with a relatively small sample size concluded that TLL did not enable individuals to distinguish between healthy and unhealthy choices (Arrua et al., 2017).

Based on the aforementioned information regarding the one-nutrient focus and the process of making food decisions, it is essential to give sufficient consideration to the potential of disqualifying other nutrients in food choices (Tetens et al., 2007). In other words, there is a possibility of neglecting other essential macronutrients and micronutrients in food items,

as individuals seem to place more significance on one nutrient over others (Hieke and Wilczynski, 2012). This is particularly concerning for those individuals with health concerns or poor nutritional knowledge. These behaviours highlight possible unintended consequences of the effect of the single-nutrient approach on perceptions of health, taking into account that the perception of food healthiness is one of the main determinants in making food choices (Provencher et al., 2009).

The single-nutrient approach may have another potential adverse effect, on the processing and composition of a food item (Scrinis, 2013). Focusing on reducing the intake of one nutrient may drive people to neglect the overall quality of food items, which gives the food industry the chance to modify other ingredients, regardless of their healthiness, while keeping the level of the nutrient of choice in the recommended quantities. The process of reformulation provides the food manufacturing industry the chance to increase the effectiveness of their marketing tools displayed on food packages, resulting in more attractive yet misleading messages (Scrinis and Parker, 2016). In the long term, this could increase the sales of food items of a lower quality, and risk repeating the cycle of aiming to decrease the intake of another nutrient at a later point.

In the current climate of focusing on sugar, and as evidenced in this study of giving sugar the highest importance, people may perceive any food item with low-sugar content to be healthy. This may be worrying, as Ross and Murphy identified that the categorisation of food as healthy may imply to consumers that a particular "healthy" food item can be eaten in greater amounts (1999). More recent research supports this argument, where beliefs about the healthiness of foods significantly affected the eating behaviour by increasing the intake of the specific item that is perceived as healthy (Provencher et al., 2009). Previous trends with low-fat diets confirm this correlation, as research revealed that having a low-fat claim on food packages allowed consumers to have reduced guilt associated with overeating these products (Wansink and Chandon, 2006).

Returning to the role of sugar campaigns to reduce sugar consumption, one study discussed the possible role of these campaigns in increasing the fear of fatness and obesity stigma,

by viewing the whole population as a target audience for the obesity "epidemic" (Catling, 2012). This may promote calorie restriction, regardless of weight status. This, in turn, could increase a pro-thinness culture and an increased acceptance of extreme food and calorie restriction, and a higher incidence of disordered eating (Puhl and Latner, 2007). The effect of these altered perceptions of health and relationships with food could be harmful both in the short and long term. This is particularly alarming in the case of children, where it may affect their long-term health and well-being. The study conducted as part of this thesis on sugar-sweetened beverages reinforced this theory by showing a high percentage of children consuming less total daily energy than their required daily energy intakes, regardless of their sugar intakes.

### 3.4.1 Ability to Read Labels

A study that was conducted on UK consumers showed that about 83.5% of participants stated they use TLL information to make food purchase decisions (Cole et al., 2018). The results of this online survey indicated that almost half of the participants claimed high levels of confidence in their understanding and knowledge of TLL reading. However, few respondents were able to correctly answer the specific nutrient intake (sugar, salt or fat) recommendations. This supports the hypothesis that the TLL system has limited efficacy in helping the public choose healthier food items. Additionally, half of the participants could not identify if the sugar displayed on the TLL is the total or free sugar. Only 4.0% of them revealed that they always, compared to occasionally or never, use TLL to make their food choices, disregarding the coverage and comprehensive efforts to make the public reduce their sugar intake through the usage of TLL (e.g. Change4life). This may be related to the findings of studies that claimed that TLL may be confusing, especially if individuals are trying to construct a whole meal (Grunert and Wills, 2007). As mentioned above, one study described the process of reading the traffic light labels as a high cognitive task, where consumers need to evaluate several pieces of information simultaneously (Ducrot et al., 2015b). Taking all the factors that would affect the process of reading nutrition labelling into consideration would increase the effectiveness of the use of TLL. This includes individual

motivation and interest in health, educational level, socioeconomic status and other critical factors (Machin et al., 2018).

## 3.5 STRENGTHS AND LIMITATIONS

The findings of this study are limited to the fact that the participation rate was higher among females and younger ages, which may negatively impact the representativeness of the sample. In addition, recruitment of university students and staff may have affected the results due to the possibility that they have high levels of health literacy (Jansen et al., 2018). The reader should also bear in mind that the findings of this study are limited by the use of a cross-sectional design. In addition, as many other researchers mention, the methodology used in this type of study does not fully represent consumer behaviour in a real-life purchasing experience. It can also be argued that there is variation in the style of TLL used between different UK supermarkets, where labels can have different shapes and be partially or fully coloured. However, the style used in the present study survey (in full colour) was selected based on what was proved previously to be the simplest and clearest style to assess healthiness perceptions (Montandon and Colli, 2016). Due to practical constraints, to provide the simplest label possible to participants, the TLL presented on the survey screen did not contain the value of total grams of each nutrient or the percentage value of the daily intake recommendation of that nutrient, which are typically found on labels in the UK. Although the minimum number of comparison questions required by the software was used in the survey, this can be another source of weakness of the study design, as having 12 questions may lead to participant fatigue and boredom, resulting in poorer quality responses toward the end of the survey. Another potential limitation of the CBC is confusion due to the presentation of screens, especially for older people.

Notwithstanding these limitations, the experimental work of this study on perceptions of Front of Pack (FOP) Traffic Light labels using a little-used technique of Choice-Based Conjoint analysis has highlighted the possible effect of public health intervention on public perception of food healthiness as there was a relatively clear pattern in participants' priorities.

Future research should explore the perception of healthiness of a wider range of foods as influenced by sugar health claims. Also, research is needed to determine the distinct impact

of public health messages on perception of health for different age groups (e.g. older adults with specific health concerns). The results of this study have shed light on the importance of investigating the use of different styles of FoP labels among members of the public. It would be important to scrutinise individuals' perceptions of the healthiness of food items through the application of more real-world purchasing settings or a more explorative qualitative analysis that would consider more factors, including calorie content and brand names.

## 3.6 CONCLUSION

This study was designed to assess if the current public health focus on sugar reduction has affected people's perception of the healthiness of food items, by leading them to place higher importance on the content of sugar compared to the content of other nutrients presented on the TLL and an item's price. The results provided insight into how people weigh-up information on multiple nutrients from TLL labels. It also emphasised the complexity of food choices and purchasing decisions that may be a naturalistic albeit more complex task than has previously been considered in the literature. Unlike a previous study (Scarborough et al., 2015), participants of this study gave the highest importance to sugar in the process of choosing healthy food items. Of particular importance is the significantly lower importance placed upon other important macronutrients such as fat and salt. In addition, the results indicated that price did not influence perceptions of product healthiness, which does not support the theory of the high-price health halo. Comparing the results of this study with previous studies illustrated a shift in the way choices are made around food and health, first based on the focus on salt and fat, then on sugar. This cycle is likely to continue as the population's dietary trends change, leading to a new focus on a different aspect of diet. This would, in turn, lead to a new influence in how the population interprets and prioritises information, affecting their perceptions and food choices.

The analysis and discussion of this research was focused around sugar as it is currently the focus of national and international health promotion to reduce sugar consumption to tackle

major nutrition-related issues, particularly childhood obesity. The outcomes of this study shed light on the oversimplification from the application of a one-nutrient approach that may have a significant impact on distracting individuals from making the right food choices regarding their health. This is especially important considering the results of Part two of this study which point to the public's overall poor nutritional knowledge, and their overestimation of this knowledge. Therefore, it is essential to raise the nutritional literacy of consumers, to enable them to correctly recognise the components of TLL and evaluate them more effectively

# CHAPTER 4: ARE SSBS THE DEVIL? AN EXPLORATORY ANALYSIS OF CHILDREN WHO CONSUME SUGAR SWEETENED BEVERAGES IN THE UK.

*Aim:* To explore the underlying characteristics of children who drink sugar-sweetened beverages (SSBs) in the UK, through the application of a bias-free technique called hierarchical agglomerative clustering.

*Hypothesis:* Children who are medically described as overweight or obese are not consuming higher amounts of sugar sweetened beverages compared to children of the same age who have normal weight.

*The objectives of this study are as follows:*

1. To use the 2008 to 2014 NDNS dataset to explore the relationship of sugary drink intake with weight, as well as with other dietary and demographic characteristics of children aged 4 to 10 years old
2. To assess the relevance of the levy as a childhood obesity policy based on the outcomes of the first objective

## 4.1 INTRODUCTION

Sugar has recently been the main target of various governmental interventions worldwide in efforts to reduce national obesity rates. These multidisciplinary approaches involve policymakers, industry, media and other institutions (Al Jawaldeh et al., 2018). The approaches use different forms of population-based policies and programmes, including fiscal measures, educational applications, school programmes and product reformulation (WHO, 2015b). Introducing a tax on High Sugar High Fat (HSHF) food items is one such example, which has been implemented in several countries (WHO, 2015d) (Table 4.1). This is in addition to national obesity campaigns and marketing networks in some countries that mainly focus on sugar reduction (WOF, 2016). In the UK, many approaches are used to tackle obesity and reduce sugar intake including school programmes, public health programmes (PHE, 2017b, Action on Sugar, 2017), and marketing regulations. These form parts of the Obesity Plan for Action report, which was set to achieve a 20% reduction in total sugar intake by the year of 2020 (HM Government, 2016).

*Table 4.1: Examples on countries implementing axes on SSBs, adapted from the Fiscal Policies for Diet and Prevention of Non-communicable Diseases*

| | Country | Year | Measure | Outcome |
|---|---|---|---|---|
| 1 | Finland | 2011 | Excise taxes have been levied on sweets, ice cream, chocolate and non-alcoholic beverages | Taxes generated revenue for governments that were used for schools and universities healthy food programmes. The tax rats were increased in 2012 and 2014.<br>The tax on all types of sweets is now abolished, it only remains in force on SSBs.** |
| 2 | France | 2011 | Levy on beverages that contain sugar or other sweeteners | The tax revenue was allocated to the National Social Health Insurance. The consumption of soda has decreased particularly among young people and low-income groups.* |
| 3 | Hungary | 2011 | Public health product tax (PHPT) was introduced. This excise tax was on packaged food with a high content of sugar, salt and methylxantine | Tax has led to a decreased consumption of products that are subjected to it. It also increased consumers' health consciousness.<br><br>PHPT encouraged industry to reformulate their products.* |
| 4 | Mauritius | 2013 | Excise duty on the sugar content of soft drinks, including carbonated beverages, syrups for dilution and fruit drinks | The revenue was 330 million Mauritian rupees (9.2 million US$). Its impact on the sale of soft drinks has not been assessed yet.* |
| 5 | Mexico | 2014 | Tax on producers of non-alcoholic beverage with added sugar<br>Tax on purchase price of non-essential energy-dense food ( snacks, confectionary, ice cream, candies) | Initial immediate results after one year of implementation showed positive results in reducing the consumption of SSBs. However, the consumption rates returned to the base line after one-year post implementation. *** |
| 6 | California - USA | 2015 | Tax on SSBs | Three years post-tax analysis showed that the consumption of SSBs has dropped, mainly among low-income residents. **** |
| 7 | Ecuador | 2016 | Tax on SSBs and HFSS food items | Was not formally implemented due to lack of standard criteria to identify what items to be included based on their nutrient content.* |
| 8 | India | 2017 | Tax on sugary carbonated drinks | N/A‡ |
| 9 | Philippines | 2018 | Tax on SSBs ***** | N/A |
| 10 | Saudi Arabia | 2019 | Excise tax on SSBs****** | N/A |

**(WHO, 2015a)* **(Ecorys and IDEA, 2014) ***(Gobierno de México (GOB), 2016) ****(Lee et al., 2019) *****(Onagan et al., 2019) ******(KPMG, 2019) ‡ Not applicable

The positive correlation between sugar-sweetened beverages (SSBs) and obesity is one of the most consistently found associations between dietary habits and levels of obesity (Bleich and Vercammen, 2018). There are numerous scientific studies validating this correlation and supporting interventions that endeavour to reduce SSB consumption. One systematic review identified fourteen out of twenty-three cohort studies that reported a positive association between increased consumption of SSBs and obesity among children (Te Morenga et al., 2013). In Australia, Huse and his colleagues stated that the restriction on SSB price promotions is likely to be highly cost-effective, taking into consideration how industry and shoppers would respond (2019). Researchers in the USA claimed that reducing access to SSBs, and their replacement with healthier beverages would have a moderate success in reducing the consumption of unhealthy beverages and decrease the rate of weight gain (Scharf and DeBoer, 2016). Therefore, the reduction of SSB consumption across populations is currently considered a priority for international and national organisations (Pan American Health Organization, 2015, PHE, 2015a, WHO, 2015b).

Returning to the UK, the NDNS data from the 2015/2016 year showed that SSBs are one of the main sources of free sugars in children's and adolescents diets (PHE, 2015a). SSBs are the largest single source of sugar for 11-18 years old children, accounting for 33% of their total free sugar intake (PHE, 2015a). Among 4-10 year old children, SSB consumption accounted for 22% of their total free sugar intake, being the second highest contributor after cereals (PHE, 2018c). In addition, SSBs may be considered the most common snack choice among adolescents aged between of 13 to 16 years in Britain and Northern Ireland (Kerr et al., 2009). In the same study, a high intake of SSBs among children was associated with a 55% increased risk of being overweight or obese.

Studies assessing the tax on "unhealthy" food products suggest that a 10% tax on SSBs would reduce their consumption by 10% on average, and a 20% tax would result in approximately 15% reduction in consumption using analysis of modelled and sales data (Thow et al., 2014). Consequently, in 2015, The Soft Drinks Industry Levy (SDIL) was proposed as an approach to tackle childhood obesity in the UK, which became effective in April 2018 (HM Government, 2018).

A comparative risk assessment model predicted that the application of the levy would result in an 8.6% reduction in the number of children and adolescents with obesity in the age group 4-18 years (Briggs et al., 2016).

Despite some early evidence on consumption patterns in children, there is currently a lack of understanding of the consumption of SSBs in relation to the characteristics of these consumers, which could be essential to maximise the effectiveness of sugar reduction interventions. Therefore, the aim of this study is to determine the underlying characteristics of children who drink sugar-sweetened beverages (SSBs) in the UK and understand the factors affecting their consumption patterns. The analysis was done in two stages, where the second stage was conducted through the application of a data-driven, machine learning technique called hierarchical clustering that allowed an enhanced use of the dataset leading to clearer outcomes and conclusions.

## 4.2 METHODS AND RESULTS

### 4.2.1 Study Population

The National Diet and Nutrition Survey (NDNS) is a continuous cross-sectional survey that aims to provide comprehensive information about the nutritional status of the UK population for public health purposes. This is done by collecting data on the dietary intake and eating habits of a representative sample of around 1000 British adults and children aged 1.5 years and over each year (PHE, 2016c).

Participants are recruited randomly from the UK Postcode Address File. They are asked to complete a computer-assisted personal interview (CAPI) to obtain their background information including age, gender, region, ethnicity (categories: white, mixed, black or black British, Asian or Asian British, and other) and household income, in addition to other nutritional and lifestyle behaviours. The information is collected by trained interviewers. Parents and caregivers are asked to complete a food diary for four consecutive days for their child or children, providing a detailed description of food and drink items that are consumed at home and outside. This includes the brand, recipes, time of consumption, and the amount, using information from packaging, household measures, and a reference guide provided with examples (Lennox et al., 2014). The interviewers repeat the visits to verify the process of recording. The food intake data from the records are analysed by a trained coder using an in-house dietary assessment system at MRC Human Nutrition Research, DINO (Data In, Nutrients Out) (Fitt et al., 2014) with a databank of more than 7000 foods, regularly updated and extended for the survey. The children's dietary behaviour analysis are described as means of total daily energy intake in kcal and means of daily consumption of other macronutrients like fat, carbohydrates and protein in grams, over the number of recorded days.

For this study, data was collected for a sub-population of 4- to 10-year-old children from the NDNS datasets collected between the years 2008 and 2014, consisting of 1298 children with roughly equal proportions from each age contributing to the total sample.

### 4.2.2 Ethical Approval

Ethical approval for the NDNS was obtained from the Oxfordshire Research Ethics Committee. An ethical approval for our study was not required since the datasets are publicly available upon formal requests (ONS & FSA).

### 4.2.3 Analysis Stage One

The interviewers measured participants' weight and height, which was used to calculate BMI (weight in kilograms divided by the square of height in metres) that was used to categorise the children into weight classification groups of underweight, normal weight, overweight and obese, using Cole et al.'s age-specific cut-offs (Cole et al., 2007).

Table 4.2 shows in detail the variables that were included in this stage of the analysis. The total intake of non-milk extrinsic sugars (NMES) were extracted from the dataset. Based on the definition of SACN, non-milk extrinsic sugars (NMES) are defined as all free sugars (naturally occurring sugars in honey, syrup and fruit juices, in addition to the added monosaccharides and disaccharides) and 50.0% of fruit sugars from stewed, dried or canned fruit (SACN, 2015). In addition, energy and NMES total daily intake were categorised as low, medium (or recommended), and high groups (Please see Table 4.2 for more details on these groups –CalCat and NMECat).

For the purpose of this research, the consumption of drinks was considered in a detailed manner. The drinks of focus were: the three sugar-sweetened beverages (concentrated soft drinks, carbonated soft drinks, ready to drink soft (RTD) drinks) and the three low-calorie (LC) alternatives (concentrated SD-LC, carbonated SD-LC and RTD SD-LC), fruit juice, different milk options, smoothies, coffee, tea and water in both flavoured and non-flavoured choices. New variables were generated to assess children's level of SSBs consumption. Four categories of consuming SSBs were created: (1) SSBs only, (2) SSBs + SSBs-LC, (3) SSBs-LC only, (4) neither. Drinkers were children who were in the first or the second group, and non-drinkers were children who were in the third or the fourth group.

According to the literature, SSBs were considered one of the main contributors to the total NMES intake among children. For this reason, total NMES intake in grams from all drinks that were consumed throughout the four days was divided by 4 to get the average NMES daily intake from drinks. Similarly, the average NMES intake from SSBs was also calculated. These variables were used to assess the percentages of NMES consumed only from SSBs in comparison to the total NMES consumed from drinks and the total NMES consumed from food and drinks.

New variables were created to understand the pattern of SSBs consumption and each child's drink intake was divided into three categories: drink, snack and meal events to indicate the time of consumption. A meal event was defined based on a 30-minute window around a meal (Figure 4.1). A drink event, unlike a snack event, indicated that the drink was consumed without any other type of food or drink. A 60-minute window around meals was also considered and then excluded, as the results did not show any significant difference in the distribution of drink consumption, compared to the 30-minute window approach. For each category, the number of drinking events, total NMES (g), calories and portion size across the four days of the food diary were determined for all children. This approach is adopted from Olea Lopez and Johnson (2016).

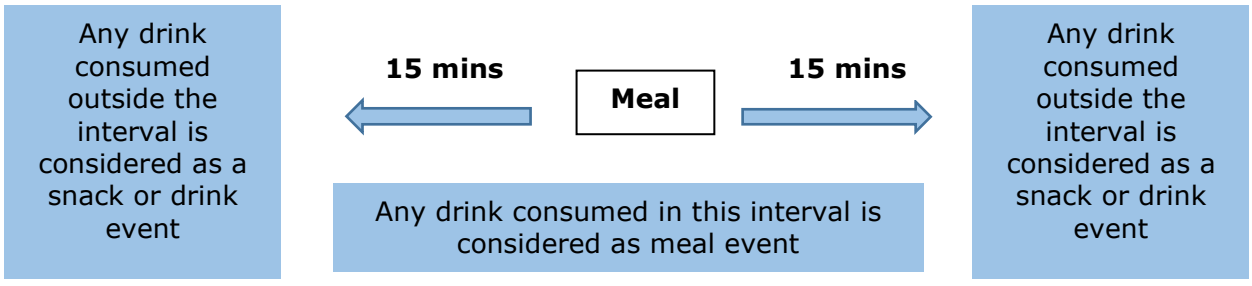



*Figure 4.1: Meal, snack and drink definition in a 30-minute window*

#### *4.2.3.1 Statistical analysis*

IBM SPSS Statistics 24 data editor was used to analyse the data. Categorical variables were presented as percentages, whereas means and standard deviations were used to describe

scale variables like energy consumption and NMES intake. The difference between children grouped as drinkers and non-drinkers in regards to their age, gender and weight classification were assessed using Chi-square test ($\chi^2$), considering significance as a P value of <0.05. Mann Whitney U and Kruskal Wallis tests were used to evaluate the difference between the two groups with respect to the continuous variables including NMES intake.

Table 4.2: Variables included in the analysis – categories highlighted in blue were calculated

| Variable | Description |
|---|---|
| Age | 4-10 years |
| Gender | Male/Female |
| Ethnicity | 1= White or any other white background.<br>2= Asian, Asian British-Indian/Pakistani/ Bangladeshi/Chinese, any other Asian/Asian British background.<br>3= Black, Black British – Caribbean/African or any other Black/Black British background.<br>4= Mixed: white and black Caribbean, white and black African, white and Asian or any other mixed background.<br>5= Any other |
| NDNS year | Year of the survey (2008-2014): 1 = 2008-2009,… 6 = 2013-2014 |
| Income | Equivalised household income in £ |
| 4-day food diaries | Parents and caregivers were asked to complete 4 consecutive days of a food diary for their child, providing a detailed description of food and drink items that were consumed at home and outside. This includes the brand, recipes, time of consumption, and the amount, using information from packaging, household measures, and a reference guide provided with examples |
| Weight | Weight in kilograms |
| Height | Height in meters |
| BMI | Weight in kilograms divided by the square of height in metres |
| BMI categories | Groups of underweight, normal weight, overweight and obese, using Cole et al. cut-offs (Cole et al., 2007) |
| Total daily energy intake | In kcal |
| Other macronutrients | Means of daily consumption of fat, saturated fat, carbohydrates and protein in grams, over the number of recorded days. Percentages of each macronutrient from the total daily energy intake were also calculated. |
| Non-milk extrinsic sugars (NMES) | Mean of the NMES intake over the number of recorded days. NMES were defined as all free sugars (naturally occurring sugars in honey, syrup and fruit juices, in addition to the added monosaccharides and disaccharides) and 50.0% of fruit sugars from stewed, dried or canned fruit (SACN, 2015). Including Food and drinks.<br>The groups of NMES included were:<br>Total NMES intake from food and drink<br>Total NMES intake from all drinks<br>Total NMES intake from sugar- sweetened drinks (including low-calorie SSBs) |

| | |
|---|---|
| Calorie categories (CalCat) | This was calculated as actual total energy consumed per day, as a percentage of the recommended daily energy requirements for each participant, estimated based on age and gender (FAO). Having a percentage of 90-100% was considered to be in the recommended calorie intake group, <90% and >110% would classify the child in the lower and higher intakes groups respectively. |
| NMES categories (NMECat) | Children who limited their NMES intake to 5% of the total daily energy consumption were grouped in the low intake category, those with 5% to 10% NMES consumption of the total calories intake into medium intake, and those with higher than 10% intake into the high intake category (WHO, 2015b). |
| Drinking behaviour | Children were grouped as "drinkers" and "non-drinkers"<br>This was based on participants' consumption of different types of SSBs with a range of sugar content; carbonated soft drinks (CSD), concentrated soft drinks (CoSD) and ready to drink soft drink (RTDSD) and their three low-calorie versions of these drinks (SSBs-LC). Four categories of consuming SSBs were created: (1) SSBs only, (2) SSBs + SSBs-LC, (3) SSBs-LC only, (4) neither. Drinkers were children who were in the first or the second group, and non-drinkers were the children who were in the third or the fourth group. |

### 4.2.4 Results of Analysis Stage One

#### *4.2.4.1 Sociodemographic and anthropometrics*

Data collected from 1298 children, aged 4-10 years old from the United Kingdom including different areas in England, Scotland, Wales and Northern Ireland, were included in the NDNS reports between the years 2008 and 2014. There was an even split across the sexes with 51.8% of the sample male, and 78.7% of the sample was white British. The mean Equivalised household income was £28,222 (SD= £19510).

Participants' daily intake was extracted from their four-day estimated food diaries, including up to two weekend days, where 98.4% of children had a 4-day food record including up to two weekend days. 70.0% of children were classified in the healthy weight group, and 17.3% and 6.8% were classified as overweight and obese, respectively. There was no significant difference in the BMI classification among different age groups, or across the years of NDNS reports. However, the number of children in the underweight group increased in the latter years. The percentage of females in the obese group was significantly higher than for males (Table 4.3).

#### *4.2.4.2 Calories and NMES intake and categories*

The average daily energy consumption among the sample was 1496.5 kcal (SD= 326.91) (Table 4.4). The categorisation of children's daily total energy intake (CalCat) showed that 80.6% of them were in the groups of recommended or low-calorie intake compared to their estimated energy requirements. The distribution of males tended to be significantly more in this group (P<.01). However, 78.4% of children were in the high NMES intake category (NMECat) (Table 4.5) without any significant difference among age groups. Males were significantly more likely to be in the high NMES intake group (P<.01). The average NMES intake from food and drinks was 57.5 grams, and the average daily intake of NMES from drinks only and SSBs in grams were 19.8 and 8.8 grams respectively.

The equivalised household income of the sample was split into tertiles. There was no significant difference in terms of the average total daily intake of NMES across the three tertiles.

Further analysis of the NMES obtained from drinks in children's daily diet demonstrated that the highest number of drinks' events – including meal, snack and drink – was 9.5, with an average of 4.23 drinks per day of the sample. Hence, the maximum total calories coming only from drinks were 629.3 kcal, making up to 44.2% of children's total calories intake per day from both food and drinks. Comparing the intake of NMES from drinks to the total NMES intake from food and drinks revealed that some children consumed 100% of their daily NMES only from drinks, while the mean for the sample was 31.9%. However, 53.5% of the sample consumed less than 10% of their total NMES intake from SSBs only, with an average of 13.5% of total NMES consumed coming from SSBs across the entire sample. Moreover, 39.4% of the sample consumed less than 10% of their NMES from SSBs compared to the NMES intake from drinks only.

#### *4.2.4.3 Drinkers and non-drinkers*

As outlined above, children were divided into two groups of drinkers and non-drinkers, based on their consumption of the four categories of SSB consumption: (1) SSBs only, (2) SSBs +

SSBs-LC, (3) SSBs-LC only, (4) neither. Of the total sample, 60.9% were categorised as drinkers, of whom 64.0% were from the second category (consumers of SSBs + SSBs-LC) (Table 4.6). Scrutinising the results highlighted that the number of drinkers significantly increased as the age of children increased ($p < 0.001$). Comparing gender, males and females had the same distribution of drinkers and non-drinkers. There was a significant drop in the number of drinkers over time. Drinking SSBs was not significantly correlated with the weight classification of children, as 60.7% of healthy weight children were drinkers, which was very similar to the drinking prevalence of overweight and obese children, where on average 61.1% of them were drinkers. While 78.1% of drinkers were grouped in the recommended and low category of energy intake (CalCat), 87.1% of the same group of drinkers were categorised in the high NMES intake (NMECat).

Although it is not the main focus of this analysis, consumption of each type of SSB was labelled as a categorical yes or no variable, to identify if each child consumed the specified type of drink or not across the four recorded diary dates. The results showed a change in the consumption of SSBs across the years of NDNS data collection (Table 4.7), where there is a clear increase in the consumption of low-calorie SSBs and a reduction in the consumption of their sugary alternatives. The percentages across each year do not equal 100%, as most children consumed more than one type of drink.

Regarding the consumption time of each of these drinks, analysis illustrated a big variation among different types of SSBs. For instance, children tended to consume ready-to-drink soft drinks and their low-calorie alternatives during snack time, which was also true for the concentrated low-calorie soft drink. Both types of carbonated soft drinks were mostly consumed during meal times (Figure 4.2). Although the time of drinking differs across various types of SSBs and their LC alternatives, children tended to take the drinks with meals or with snacks, instead of alone as a drinking event.

*Table 4.3: Children's weight classification*

| Weight Classification | | Gender | |
|---|---|---|---|
| | Percentage (%) | Female | Male |
| Underweight | 5.9 | 36 | 37 |
| Healthy weight | 70 | 389 | 481 |
| Overweight | 17.3 | 116 | 100 |
| Obese | 6.8 | 57 | 27 |

*Table 4.4: Total calories and NMES intake descriptions*

| | **Total energy (kcal)** | **NMES-total (g)** | **NMES- Drinks (g)** | **NMES-SSB (g)** |
|---|---|---|---|---|
| Average (SD) | 1496.5 (326.91) | 57.5 (26.88) | 19.8 (17.27) | 8.8 (12.97) |
| Maximum | 2971.8 | 202.0 | 109.9 | 105.2 |
| Minimum | 520.3 | 1.2 | 0.0 | 0.0 |

*Table 4.5: Categories of total energy (CalCat) and total Non-milk Extrinsic Sugar intakes (NMECat)*

| | **Energy CalCat (#)** | **%** | **NMES-NMECat (#)** | **%** |
|---|---|---|---|---|
| Low | 569 | 43.8 | 29 | 2.2 |
| Medium/ recommended | 477 | 36.8 | 252 | 19.4 |
| High | 252 | 19.4 | 1017 | 78.4 |

*Table 4.6: Comparisons of demographic, energy intake and NMES intake between drinkers and non-drinkers*

| Category | Value | P-value | Drinkers (n=791) | Non-Drinkers (n= 507) |
|---|---|---|---|---|
| | | | % | % |
| **Age groups** | 4 | 0.001 | 51.2 | 48.8 |
| | 5 | | 55.0 | 45.0 |
| | 6 | | 55.2 | 44.8 |
| | 7 | | 66.5 | 33.5 |
| | 8 | | 61.6 | 38.4 |
| | 9 | | 70.2 | 39.8 |
| | 10 | | 69.3 | 30.7 |
| **Sex** | Male | 0.210 | 60 | 40 |
| | Female | | 61.8 | 38.2 |
| **NDNS year** | 1 | 0.001 | 72.9 | 27.1 |
| | 2 | | 60.9 | 39.1 |
| | 3 | | 67.4 | 32.6 |
| | 4 | | 63.9 | 36.1 |
| | 5 | | 53.8 | 46.2 |
| | 6 | | 49.6 | 50.4 |
| **Weight Classification** | Underweight | 0.516 | 54.8 | 45.2 |
| | Healthy weight | | 61.7 | 38.3 |
| | Overweight | | 63.9 | 36.1 |
| | Obese | | 58.3 | 41.7 |
| **CalCat combined** | Recommended and low | 0.005 | 78.1 | 84.4 |
| | High | | 21.9 | 15.6 |
| **NMECat combined** | Medium and low | 0.001 | 12.9 | 35.2 |
| | High | | 87.1 | 64.8 |

*Table 4.7: The percentage of children consuming each type of sugar-sweetened beverage across each year of NDNS data collection (CoSD: Concentrated, CSD: Carbonated, RTDSD: Ready-to-drink)*

| NDNS year | CoSD | CSD | RTDSD | CoSD-low | CSD-low | RTDSD-low |
|---|---|---|---|---|---|---|
| 1 | 28.8% | 38.4% | 38.4% | 46.3% | 18.8% | 14.8% |
| 2 | 19.6% | 29.1% | 31.8% | 57.0% | 22.9% | 23.5% |
| 3 | 17.4% | 36.3% | 36.8% | 56.8% | 23.2% | 20.5% |
| 4 | 20.5% | 37.6% | 34.6% | 56.6% | 18.5% | 18.5% |
| 5 | 16.7% | 30.3% | 28.5% | 56.1% | 19.5% | 20.8% |
| 6 | 17.2% | 24.1% | 27.7% | 56.6% | 19.0% | 21.9% |

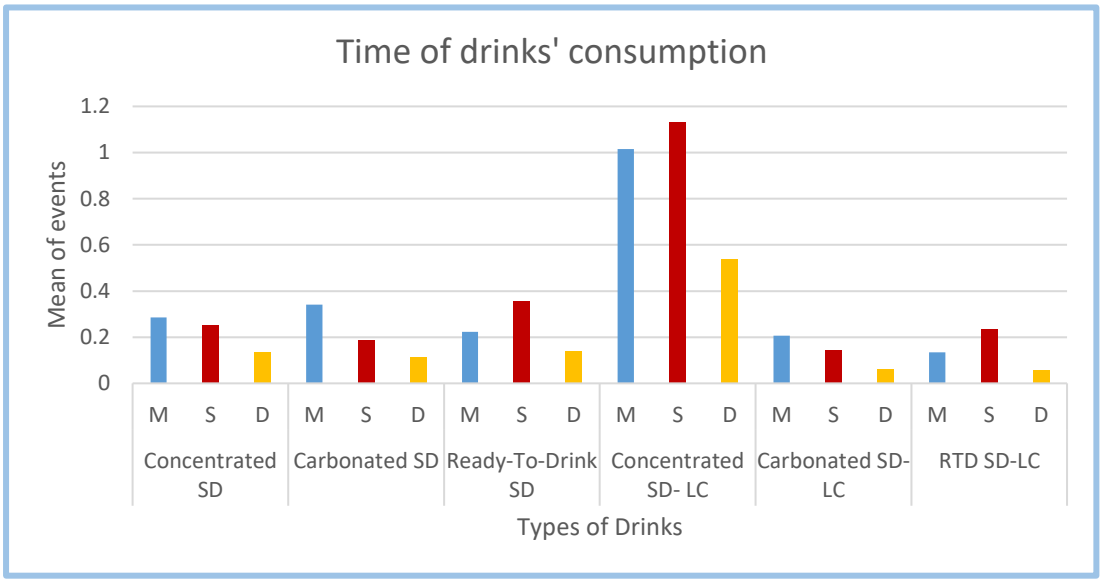



*Figure 4.2: Timing of soft drink (SD) consumption; Meal (M), Snack (S), Drink (D)*

The original aim of this study was to explore the characteristics of children who consume SSBs, to assess whether the focus on sugary drinks as part of a strategy to reduce rates of childhood obesity is justified. The first stage of the analysis identified many associations between consumption of SSBs and consumption of free sugar (which SSBs were assumed to be the main contributor to), with various demographic characteristics. It also explored when SSBs were mainly consumed. Investigating these factors is vital to understanding who consumed SSBs and when they were consumed, to feed into designing the strategy with the best chance of success. However, this would not address the objective of the study to explore important characteristics, aside from drinking SSBs, of children who are affected by the SDIL. While investigating these factors is important, it would be beyond the scope of a single study within a PhD. This design was also prone to bias due to the manual grouping of children based on their drinking behaviour. A different methodology was therefore employed to address the original aim of the study more directly, and to prevent bias in the analysis. The results from the first stage of analysis were left in. It would be important to explore them further to design more effective interventions, if the focus on sugary drinks was found to be justified based on the second stage of the analysis.

The conventional method of analysis requires a defined hypothesis that may convey bias and limit the chances of exploring correlations across different variables. It starts with prior identification of the comparison groups that are used as the independent variable during the statistical regression analysis. Each of the groups is usually selected based on a combination of individuals sharing similar characteristics that tend to be broad such as gender, age and ethnicity, or a specific behaviour, which was drinking behaviour in this study. To overcome this potential bias, in the second stage of analysis, a machine-learning approach was used; the Hierarchical Agglomerative Clustering (HAC).

### 4.2.5 Analysis Stage Two

#### *4.2.5.1 Clustering approach*

Hierarchical Agglomerative Clustering (HAC) algorithm was used to group the sample based on selected collected variables from stage one (Table 4.1), including demographics (age, gender, income, ethnicity), weight classification, energy and macronutrients intake (carbohydrates, fat and protein), NMES total daily intake, NMECat, CalCat, families' income and children's drinking behaviour.

The agglomerative method was used in the process of cluster generation that is described by placing each of the data points in its own cluster, followed by merging the two most similar clusters together based on the distance between them (similarity), which is defined as the partial or complete linkage. This step can be repeated until there is one cluster (Murtagh and Contreras, 2017).

To obtain the clusters, all the variables are exported to R-Studio. The code to obtain clusters is inputted and the clusters are produced.

The "elbow method" is used to identify the optimum number of clusters, which creates an L-shaped curve demonstrating the number of possible clusters on the x-axis against the total within-cluster sum of the squares on the y-axis (Figure 4.3) (Charrad et al., 2014). The optimal number of clusters *K* is identified when the curve transitions from an exponential into a linear curve.

The cluster variable is then exported back to Stata, which merges the 2 datasets, the original data and the cluster data. Stata matches each participant ID with the cluster assigned to it through the HAC technique.

Statistical comparisons were conducted across the identified clusters to assess their correlation with the other selected variables. These variables were BMI ($kg/m^2$), daily energy consumption (kcal), NMES total intake (g) (both groups and continuous variables), drinking behaviour, income (£) and the percentages of the four nutrients (carbohydrates, sugar, fat

and protein) from the total daily energy consumption. These variables were selected as part of multiple stages of discussions with the study supervisors, taking into consideration the aim of the study, the results of stage 1 and the available data from NDNS.

Multivariable logistic regression was applied to determine the correlation between each of these exposure variables and the cluster that is considered as the outcome variable (coded as 1 – belonging to the cluster, or coded as 0 – belonging to other clusters). All analysis models were adjusted for sex, age and ethnicity. The exposure variables' contribution to the cluster could be determined by the effect size (Adjusted Odds Ratios), with 95% confidence intervals provided. P-values <0.05 were considered statistically significant.

We further profiled each cluster generated by pre-specifying four exposure variables of interest: BMI ($kg/m^2$), daily energy consumption (kcal), NMES total intake (g) and drinking behaviour. The choice was due to general interest in these particular variables. However, this analysis model was adjusted for sex, age, ethnicity, income and the percentages of each macronutrient.

#### *4.2.5.2 Visualisation*

Multiple ways were used to visualise the entire dataset that allowed clear yet detailed assessment of variables and initial outcomes:

Principal Component Analyses (PCA): this statistical method is used as a transformation to convert a number of data points with possibly correlated variables into a set of values of uncorrelated variables, known as principal components. It is used to identify the difference between comparison groups with the emphasis of variation and highlighting strong patterns. PCA graphs were created using RStudio package pcaGoPromoter and factoextra.

Dendrogram: to visualise the hierarchical clustering process, a dendrogram (a type of tree diagram) was generated to illustrate the arrangement of the clusters produced by hierarchical clustering (Galili, 2015).

#### *4.2.5.3 Statistical analysis*

RStudio was used to create clusters using several packages *cluster, NbClust, factoextra, dendxtend and ggplot2*. Stata 15 software was then used for the next step of the analysis that is designed to describe the characteristics of each cluster generated by the hierarchical clustering. Prior to that, and using chained questions, multiple imputation was used to impute the missing values of variables which were missing-at-random and pooled across data sets using Rubin's rules (Royston and White, 2011). Number (%) and Mean (SD) were used to describe categorical and continuous variables respectively. Comparisons across clusters were conducted using the non-parametric Kruskal-Wallis test for continuous variables and Chi-squared tests for categorical variables.

### 4.2.6 Results of Analysis Stage Two

#### *4.2.6.1 Hierarchical clustering analysis*

Using HAC algorithm, up to 20 clusters of children were identified, but the elbow method identified that the optimal number of clusters was 6, as it shows in Figure 4.3 that the curve transitioned from being exponential into linear at that point. The Principal Component Analysis (PCA) showed that there is 48% variation in the NDNS dataset if children were divided as drinkers and non-drinkers. This PCA was conducted depending on the two pre-identified comparison groups that have been used in the conventional analysis approach, which allowed us to picture the distribution of individuals across these two groups of drinking behaviour (i.e. drinkers and non-drinkers) (Figure 4.4). Although the PCA of clusters illustrated similar variation, it showed different plotting of children using the 20 variables, demonstrating different sizes of clusters and the overlap between them (Figure 4.5). The distribution of children across these clusters can also be visualised as a dendrogram (Figure 4.6).

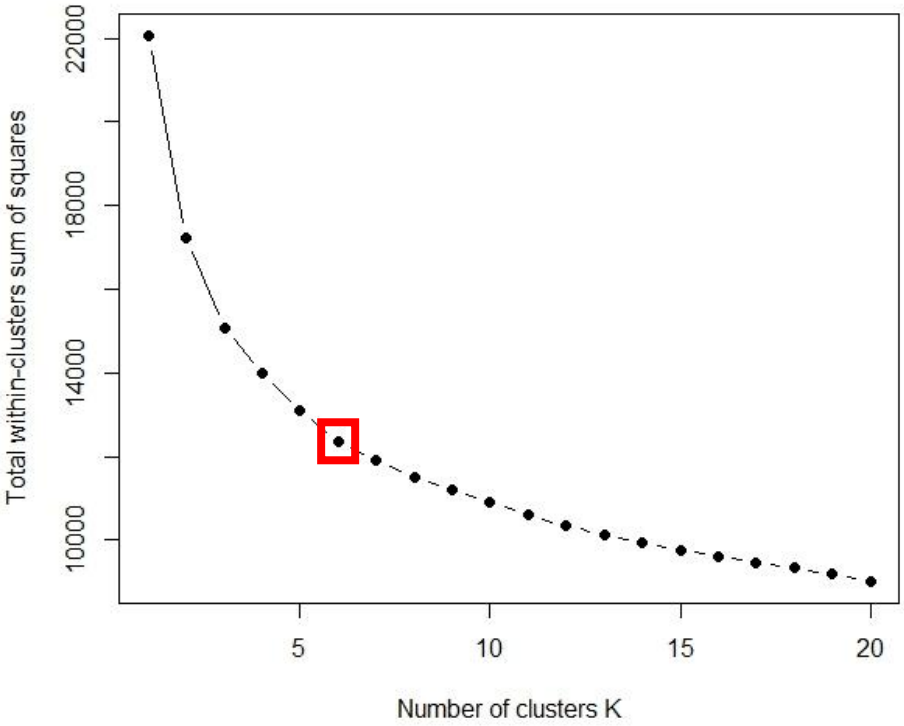



*Figure 4.3: Number of cluster K is optimal when the curve transitions from an exponential into a linear curve*

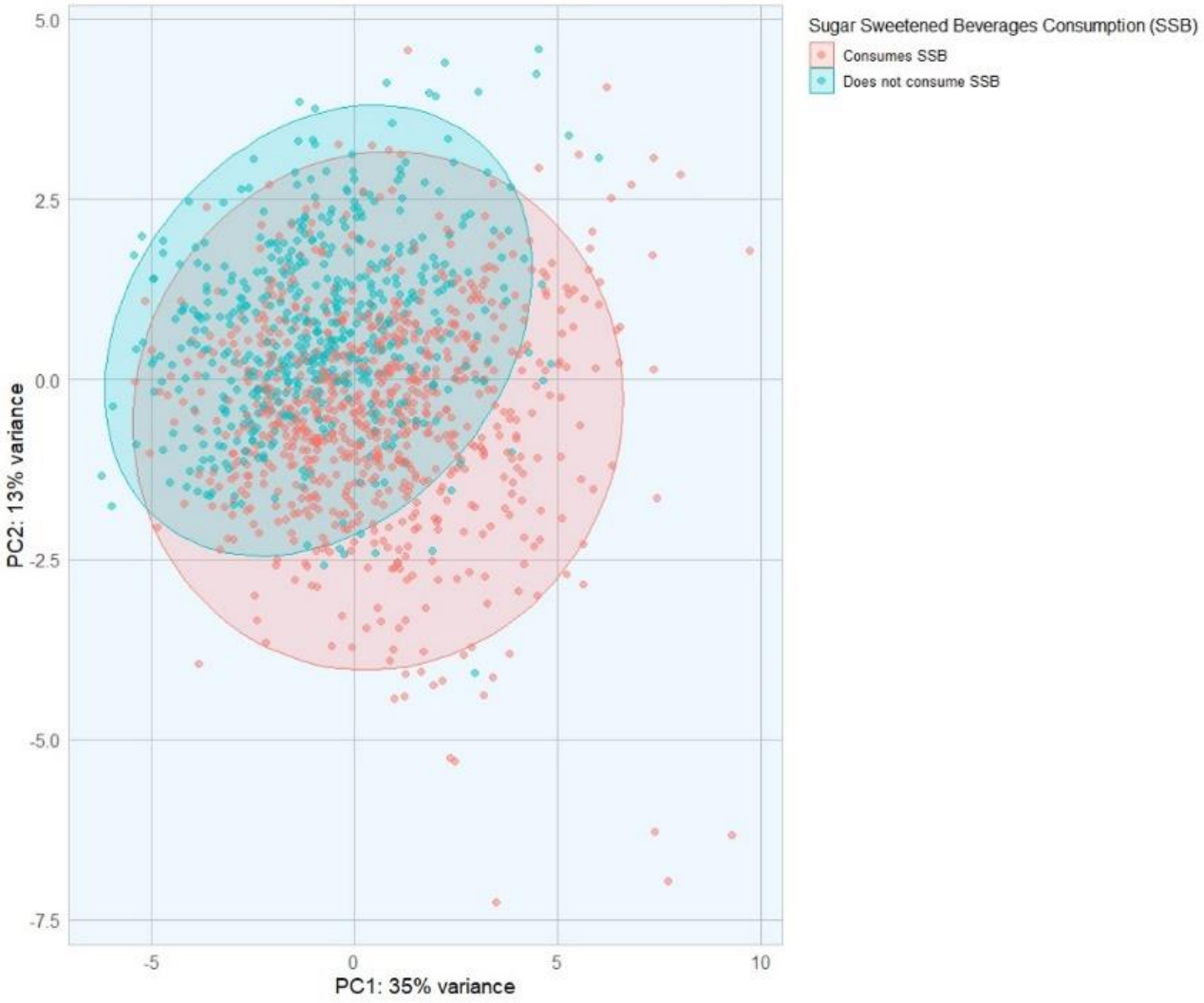



*Figure 4.4: Principal Components Analysis (PC1 35%, PC22 13%) plots visualising 1298 participants divided into drinkers and non-drinkers.*

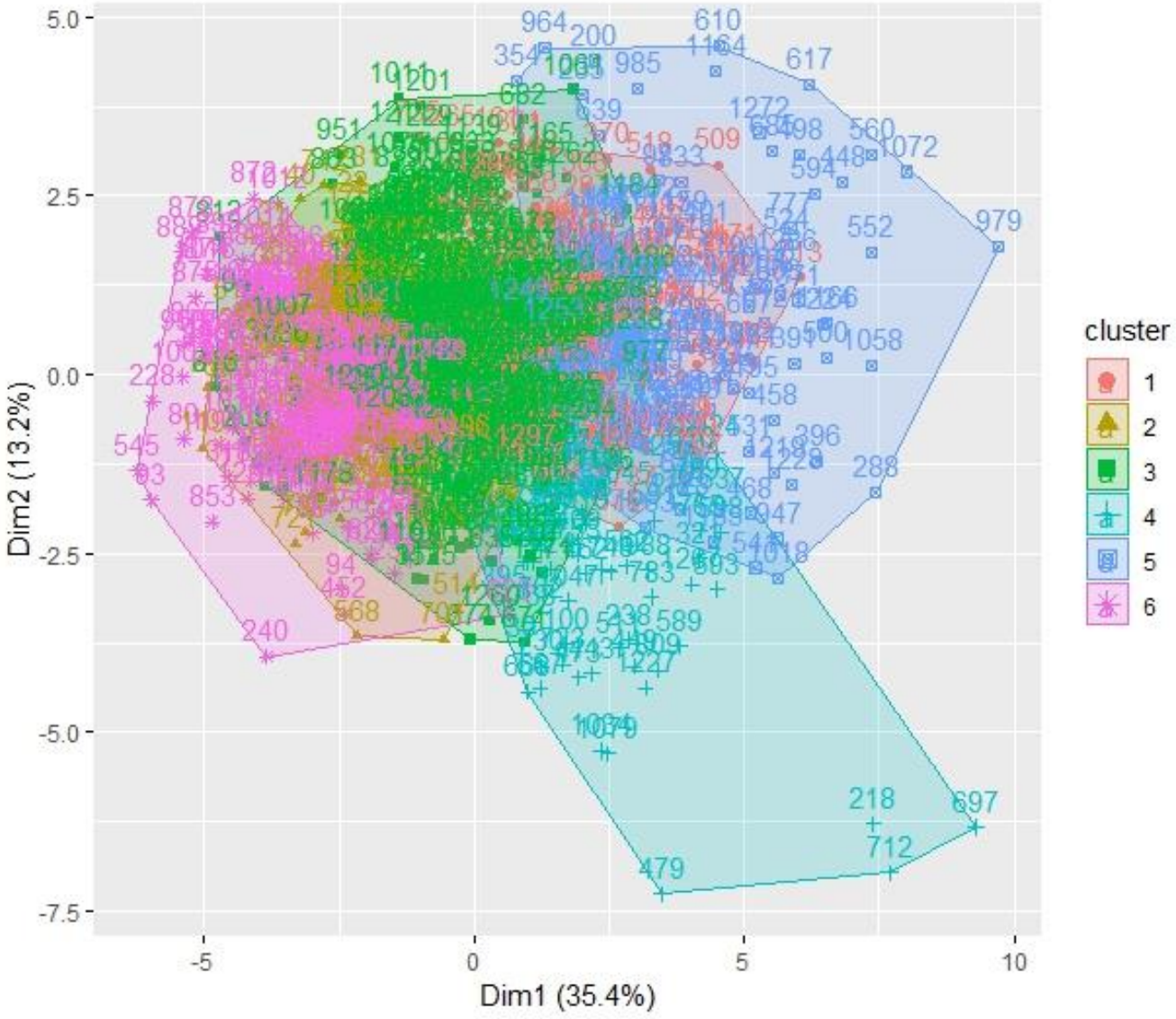



*Figure 4.5: Principal Component Analysis (Dim1 35.4%, Dim2 13.2%) cluster plots visualising 1298 participants. Each participant falls into his/her own cluster, generated from Hierarchical Agglomerative Clustering using all participant characteristics.*

** Dim1 and Dim2 are visual representation into a 2-dimensional graph of the original multi-dimensional variance in the data. The combined percentage of the two axes is the variance represented by this two-dimensional visualisation of the data.*

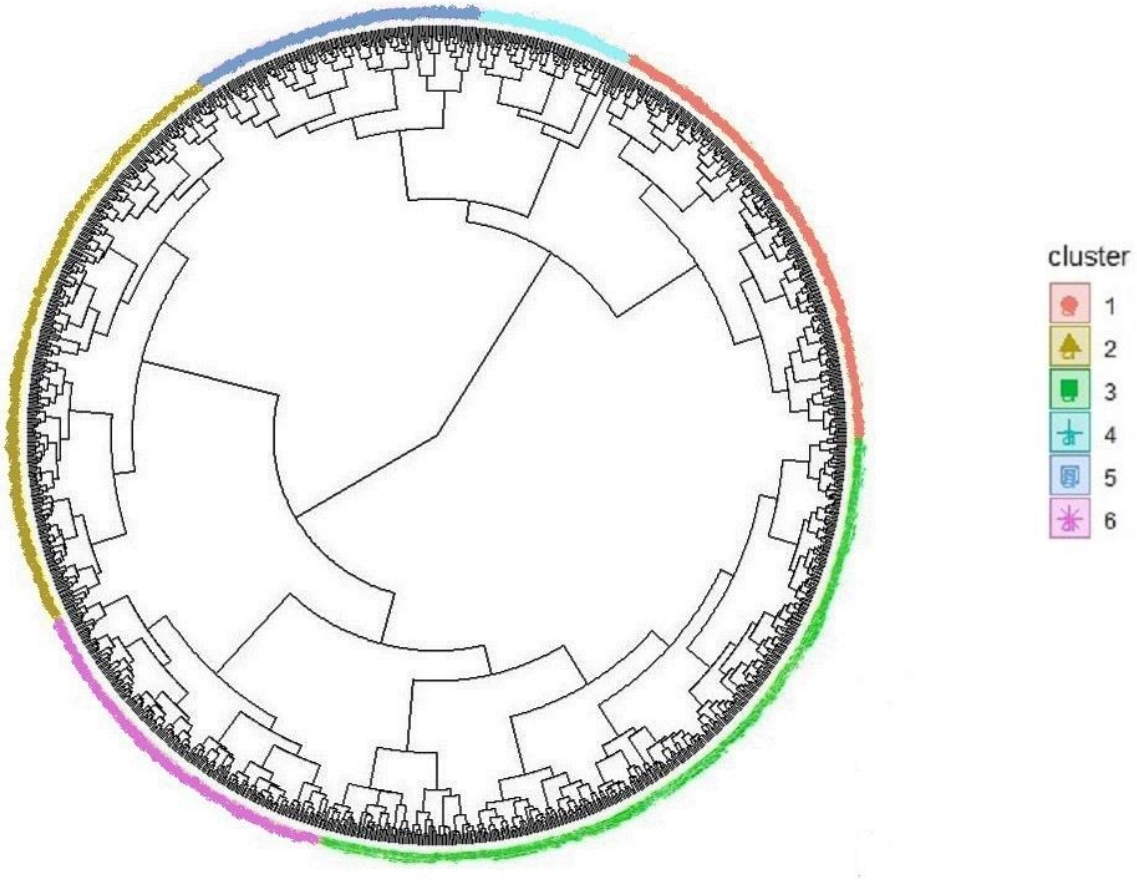



*Figure 4.6: Dendrogram generated from Hierarchical Clustering Analysis of 1,298 participants based on all collected 17 variables. Each colour represents 1 cluster, and the lines between data points demonstrate the relationships between clusters.*

#### *4.2.6.2 Characteristics of the cluster groups*

The proportion of children who were classified as drinkers varied across clusters. These proportions were not presented in any particular order, making understanding the association between drinking and other variables across clusters difficult. Therefore, clusters were relabelled to "groups", which were ranked in a descending order of proportion of drinking. Table 4.8 shows the characteristics of the children in each cluster for all the variables that were included in the analysis. The following is a brief description of each group:

Group 1 (cluster 4):

This group had the highest percentage of drinkers where only 5.3% of the group were non-drinkers. 56.6% of the sample were males with a very high percentage of white background

(93.4%). Based on children's BMI, none were classified as obese, and 83.8% were classified as normal weight. 100% were classified into the high NMES category and 63.2% of this group were categorised into the high calories category.

Group 2 (cluster 5):

Around three quarters of this group were classified as drinkers (76.8%), and 16% and 8% were in the categories of overweight and obesity respectively. 62% were males. Although 73.2% of this group were in the low and recommended category of calorie consumption, 93.7% of them were in the high NMES intake category.

Group 3 (cluster 1):

71.7% of this group were in the group of normal weight, and more than half were in the category of low and recommended calorie intake (55.0%). However, 87.3% were categorised as high NMES consumers. Half of this group were females and 29.7% were non-drinkers of SSBs.

Group 4 (cluster 2):

This group had the highest percentage of children with overweight and obesity (28.0%), with 57.6% classified as drinkers. This group also had a relatively higher percentage of females (58.3%). Regarding this group's consumption of NMES and calories, the analysis showed that 67.5% of them were in the high NMES intake category, and only 29.8% of them were in the high calorie intake.

Group 5 (cluster 3):

The distribution of ethnicity was different in this group of children, as 26.7% were from a non-white background, which is the highest across the groups. More than half of the children were males (57.6%), and 50.8% were drinkers. 69.7% of this group were classified to be normal weight and 6.2% underweight. However, 51.8% of them were in the high calorie intake category.

Group 6 (cluster 6):

This group contained the smallest percentage of drinkers (48.3%). Almost all the children in this group were classified in the recommended calorie intake group (98.9%). However, 67.2% of them were in the high NMES category and 65.9% were classified as normal weight and another 9.2% were underweight. 13.2% of this group were Asians.

There was not a big variation across groups in terms of the percentage energy contribution of the three macronutrients (fat, protein and carbohydrates). For example, the percentage energy contribution from carbohydrates was similar for Groups 2 to 6 (avg. 54.9). However, it was 60.5% for Group 1 which had the highest percentage of drinkers. Although percentage energy contribution from protein were very comparable, the percentages were ordered in an ascending order, which is opposite to the distribution of drinkers across groups.

#### *4.2.6.3 Group associations with the exposure variables*

Using logistic regression to identify the associations between the outcome variables (each group) and the exposure variables for the two phases, the odds ratios showed no significant association across groups with different percentages of drinkers (Table 4.9). Taking the significance of drinking behaviour, the percentage of drinkers in each group was a determinant of significance; the first three groups with the higher percentages of drinkers were positively associated with drinking behaviour, as opposed to the last two groups, where the association was negative. However, this correlation was not aligned with the other variables – such as NMES and total energy intake, income, or BMI – as they were positively or negatively associated with the percentage of drinkers in each group in no identifiable order. Similarly, there was no pattern to the correlation between macronutrient percentages and the percentage of drinkers. Table 4.10, which is extracted from Table 4.9, summarises the associations of the three macronutrients across the 6 groups.

For the next step in the analysis, four variables were selected to make the comparison across clusters more distinctive. BMI, total daily energy intake, total daily NMES intake and drinking behaviour were included in the same analysis model of logistic regression for the six groups.

Different positive and negative associations were found within each group of children. These results, in the form of odds ratios and 95% confidence intervals, are presented in Table 4.11. With regards to children's BMI, the six groups with different percentages of drinkers have no significant association with both the variables, BMI and total daily energy intake. Furthermore, the first three groups were positively associated with total daily NMES intake, while the fourth and the last groups were negatively associated with this variable. For example, a child in Group 1 is more likely to drink SSBs and more likely to have a high total intake of NMES. However, a child in group 1 is not more likely to have high total energy intake or a high BMI.

*Table 4.8: The characteristics of children across the 6 groups. The groups are the clusters that were relabelled and reordered in a descending order based on percentage of children who were classified as drinkers in each cluster*

| **Characteristics** | | | **Group1** | **Group 2** | **Group 3** | **Group 4** | **Group 5** | **Group 6** |
|---|---|---|---|---|---|---|---|---|
| Total numbers | | | 76 | 142 | 229 | 295 | 382 | 174 |
| SSB drinking | # (%) | Drinkers | 72 (94.74) | 109 (76.76) | 161 (70.31) | 170 (57.63) | 194 (50.79) | 84 (48.28) |
| | | Non-drinkers | 4 (5.26) | 33 (23.24) | 68 (29.69) | 125 (42.37) | 188 (49.21) | 90 (51.72) |
| Gender | # (%) | Females | 33 (43.42) | 54 (38.03) | 113 (49.34) | 172 (58.31) | 162 (42.41) | 92 (52.87) |
| | | Males | 43 (56.58) | 88 (61.97) | 116 (50.66) | 123 (41.69) | 220 (57.59) | 82 (47.13) |
| Age | | Avg. (SD) | 7.5 (2.05) | 7.8 (1.70) | 7.1 (1.86) | 6.5 (2.00) | 6.9 (2.09) | 6 (1.82) |
| Energy Consumption (kcal/day) | | Avg. (SD) | 1629.4 (203.98) | 2005.4 (251.33) | 1721.2 (196.41) | 1282.7 (155.05) | 1494.9 (192.69) | 1093.1 (171.67) |
| Fat Consumption (g/day) | | Avg. (SD) | 55.6 (11.98) | 78.9 (16.19) | 65.9 (10.39) | 47.7 (9.28) | 55.6 (10.52) | 39.2 (9.14) |
| % of Fat to total energy | | Avg. (SD) | 30.5 (4.18) | 35.3 (4.51) | 34.5 (3.93) | 33.4 (4.64) | 33.5 (4.55) | 32.2 (5.09) |
| Protein Consumption (g/day) | | Avg. (SD) | 52.2 (10.35) | 69.2 (13.86) | 62.8 (11.03) | 47.9 (8.70) | 55.7 (10.81) | 41.8 (9.48) |
| % of Protein to total energy | | Avg. (SD) | 12.8 (2.02) | 13.8 (2.00) | 14.6 (2.01) | 15 (2.46) | 14.9 (2.35) | 15.4 (3.05) |
| Saturated Fat Consumption (g/day) | | Avg. (SD) | 21.4 (5.21) | 32.6 (7.27) | 26.7 (5.13) | 18.5 (4.56) | 21.9 (4.97) | 15.1 (4.26) |
| % of SF to total energy | | Avg. (SD) | 11.8 (2.21) | 14.6 (2.62) | 13.9 (2.46) | 13 (2.75) | 13.2 (2.58) | 12.4 (2.86) |
| Carbohydrate Consumption (g/day) | | Avg. (SD) | 245.5 (31.75) | 271.5 (35.07) | 233.8 (33.24) | 176.5 (26.50) | 205.8 (32.71) | 152.8 (28.38) |
| % Carbs to total energy | | Avg. (SD) | 60.5 (4.87) | 54.3 (5.08) | 54.3 (4.24) | 55.1 (5.12) | 55.1 (5.13) | 55.9 (5.87) |
| Total sugar Consumption (g/day) | | Avg. (SD) | 134.2 (27.42) | 133.7 (26.94) | 108.5 (23.27) | 74.9 (18.83) | 91.9 (22.64) | 66 (22.73) |
| Total free sugar Consumption (NMES) (g/day) | | Avg. (SD) | 99.5 (27.23) | 87.3 (24.80) | 66.8 (21.11) | 41.7 (14.65) | 54.2 (19.05) | 37 (18.70) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Free sugar consumption- from total drinks (g/day) | | Avg. (SD) | 55.1 (20.05) | 30.3 (17.75) | 19.9 (12.83) | 12.6 (10.37) | 17.5 (14.45) | 13 (12.65) |
| Equivalised household income | | Avg. (SD) | 26586.1 (18931.2) | 31589.5 (19345.7) | 26075.2 (16472.1) | 25856.8 (17082.9) | 30016.1 (20578.0) | 24825.1 (17810.8) |
| Ethnicity | # (%) | White | 71 (93.42) | 132 (92.96) | 203 (88.65) | 262 (88.81) | 280 (73.30) | 144 (82.75) |
| | | Asian | 2 (2.63) | 4 (2.82) | 16 (6.99) | 22 (7.46) | 26 (6.81) | 23 (13.22) |
| | | Black | 2 (2.63) | 1 (0.70) | 4 (1.75) | 9 (3.05) | 15 (3.93) | 6 (3.45) |
| | | Mixed | 1 (1.32) | 3 (2.11) | 6 (2.62) | 2 (0.68) | 40 (10.47) | 1 (0.57) |
| | | Others | 0 (0.00) | 2 (1.41) | 0 (0.00) | 0 (0.00) | 21 (5.50) | 0 (0.00) |
| BMI ($kg/m^2$) | | Avg. (SD) | 16.7 (1.85) | 17.4 (2.78) | 16.9 (2.31) | 17.2 (2.85) | 17.1 (2.61) | 16.8 (2.60) |
| BMI- categories | # (%) | Underweight | 3 (4.05) | 5 (3.62) | 12 (5.48) | 15 (5.38) | 23 (6.23) | 15 (9.15) |
| | | Normal | 62 (83.78) | 100 (72.46) | 157 (71.69) | 186 (66.67) | 257 (69.65) | 108 (65.85) |
| | | Overweight | 9 (12.16) | 22 (15.94) | 38 (17.35) | 51 (18.28) | 68 (18.43) | 28 (17.07) |
| | | Obese | 0 (0.00) | 11 (7.97) | 12 (5.48) | 27 (9.68) | 21 (5.69) | 13 (7.93) |
| NMES categories | # (%) | Low and Medium | 0 (0.00) | 9 (6.33) | 29 (12.66) | 96 (32.54) | 90 (23.56) | 57 (32.76) |
| | | High | 76 (100) | 133 (93.66) | 200 (87.34) | 199 (67.46) | 292 (76.44) | 117 (67.24) |
| Calories categories | # (%) | Low | 18 (23.68) | 8 (5.63) | 29 (12.66) | 199 (67.46) | 143 (37.43) | 172 (98.85) |
| | | Recommended | 48 (63.16) | 38 (26.76) | 103 (44.98) | 88 (29.83) | 198 (51.83) | 2 (1.15) |
| | | High | 10 (13.16) | 96 (67.61) | 97 (42.36) | 8 (2.71) | 41 (10.73) | 0 (0.00) |

*Table 4.9: The results of the logistic regression analysis, illustrating the different association between each group and exposure variables based on the odds ratios and CI (95%).*

| | Variable | Odds ratios | 95% CI | Significance (+/-) |
|---|---|---|---|---|
| Group 1 (n=76) | Drinking | 12.64 | 4.59-34.80 | Significant (+) |
| | Calcat | 1.63 | 0.83-3.22 | Not significant |
| | Energy (kcal/day) | 1.00 | 1.00-1.00 | Not significant |
| | NMEcat (high vs. low and medium) | 1 (omitted) | | - |
| | NMES-total intake | 1.05 | 1.04-1.06 | Significant (+) |
| | BMIcat | 0.42 | 0.21-0.85 | Significant (-) |
| | BMI (continuous variable) | 0.88 | 0.78-0.99 | Significant (-) |
| | Income | 0.99 | 0.99-1.00 | Not significant |
| | % Fat | 0.86 | 0.82-0.91 | Significant (-) |
| | % Protein | 0.66 | 0.59-0.74 | Significant (-) |
| | % Carbohydrates | 1.23 | 1.17-1.30 | Significant (+) |
| Group 2 (n=142) | Drinking | 2.30 | 1.53-3.46 | Significant (+) |
| | Calcat | 0.07 | 0.05-0.11 | Significant (-) |
| | Energy (kcal/day) | 1.01 | 1.00-1.01 | Not significant |
| | NMEcat (high vs. low and medium) | 0.22 | 0.11-0.44 | Significant (-) |
| | NMES-total intake | 1.06 | 1.05-1.07 | Significant (+) |
| | BMIcat | 0.99 | 0.65-1.49 | Not significant |
| | BMI (continuous variable) | 1.03 | 0.96-1.10 | Not significant |
| | Income | 1.00 | 1.00-1.00 | Not significant |
| | % Fat | 1.10 | 1.06-1.14 | Significant (+) |
| | % Protein | 0.83 | 0.76-0.90 | Significant (-) |
| | % Carbohydrates | 0.96 | 0.93-0.99 | Significant (-) |
| Group 3 (n=229) | Drinking | 1.66 | 1.22-2.25 | Significant (+) |
| | Calcat | 0.23 | 0.17-0.32 | Significant (-) |
| | Energy (kcal/day) | 1.00 | 1.00-1.00 | Not significant |
| | NMEcat (high vs. low and medium) | 0.47 | 0.31-0.71 | Significant (-) |
| | NMES-total intake | 1.02 | 1.02-1.03 | Significant (+) |
| | BMIcat | 0.92 | 0.65-1.30 | Not significant |

| | | | | |
|---|---|---|---|---|
| | BMI (continuous variable) | 0.96 | 0.89-1.02 | Not significant |
| | Income | 0.99 | 0.99-1.00 | Not significant |
| | % Fat | 1.06 | 1.03-1.09 | Significant (+) |
| | % Protein | 0.98 | 0.93-1.04 | Not significant |
| | % Carbohydrates | 0.96 | 0.93-0.98 | Significant (-) |
| Group 4 (n= 295) | Drinking | 0.87 | 0.66-1.15 | Not significant |
| | Calcat | 11.53 | 5.63-23.63 | Significant (+) |
| | Energy (kcal/day) | 0.99 | 0.99-1.00 | Not significant |
| | NMEcat (high vs. low and medium) | 2.13 | 1.59-2.85 | Significant (+) |
| | NMES-total intake | 0.95 | 0.95-0.96 | Significant (-) |
| | BMIcat | 1.30 | 0.96-1.75 | Not significant |
| | BMI (continuous variable) | 1.05 | 0.99-1.11 | Not significant |
| | Income | 0.99 | 0.99-1.00 | Not significant |
| | % Fat | 0.99 | 0.97-1.02 | Not significant |
| | % Protein | 1.06 | 1.01-1.12 | Significant (+) |
| | % Carbohydrates | 0.99 | 0.97-1.01 | Not significant |
| Group 5 (n=382) | Drinking | 0.55 | 0.43-0.71 | Significant (-) |
| | Calcat | 2.49 | 1.74-3.56 | Significant (+) |
| | Energy (kcal/day) | 0.99 | 0.99-1.00 | Not significant |
| | NMEcat (high vs. low and medium) | 1.17 | 0.8-1.56 | Not significant |
| | NMES-total intake | 0.99 | 0.98-0.99 | Significant (-) |
| | BMIcat | 0.99 | 0.75-1.33 | Not significant |
| | BMI (continuous variable) | 1.01 | 0.96-1.06 | Not significant |
| | Income | 1.00 | 1.00-1.00 | Not significant |
| | % Fat | 0.99 | 0.97-1.03 | Not significant |
| | % Protein | 1.05 | 1.00-1.11 | Not significant |
| | % Carbohydrates | 0.99 | 0.97-1.01 | Not significant |
| Group 6 (n=174) | Drinking | 0.55 | 0.40-0.76 | Significant (-) |
| | Calcat | 1(omitted) | | - |
| | Energy (kcal/day) | 0.99 | 0.98-0.99 | Significant (-) |
| | NMEcat (high vs. low and medium) | 1.96 | 1.38-2.77 | Significant (+) |

| | | | | |
|---|---|---|---|---|
| | NMES-total intake | 0.94 | 0.93-0.95 | Significant (-) |
| | BMIcat | 1.06 | 0.72-1.54 | Not significant |
| | BMI (continuous variable) | 0.96 | 0.89-1.04 | Not significant |
| | Income | 0.99 | 0.99-0.99 | Significant (-) |
| | % Fat | 0.93 | 0.90-0.96 | Significant (-) |
| | % Protein | 1.13 | 1.07-1.21 | Significant (+) |
| | % Carbohydrates | 1.03 | 0.99-1.06 | Not significant |

*Table 4.10: Significance of the three macronutrients (fat, protein, carbohydrates) across the 6 groups*

| | *Fat % (significance)* | *Protein % (significance)* | *Carbs % (significance)* |
|---|---|---|---|
| Group 1 | - | - | + |
| Group 2 | + | - | - |
| Group 3 | + | Not | - |
| Group 4 | Not | + | Not |
| Group 5 | Not | Not | Not |
| Group 6 | - | + | Not |

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**Negative** **Positive** **Not significant**

*Table 4.11: The results of the logistic regression analysis, illustrating the different association between each group and the selected four exposure variables based on the odds ratios and CI (95%).*

| Group | Variable | Odds ratios | 95% CI | P-value |
|---|---|---|---|---|
| Group 1 (n=76) | Drinking | 12.05 | 4.03-36.03 | 0.000 |
| | Energy (kcal/day) | 1.00 | 1.00-1.00 | 0.001 |
| | NMES-total intake | 1.05 | 1.04-1.06 | 0.000 |
| | BMI | 0.88 | 0.78-1.00 | 0.042 |
| Group 2 (n=142) | Drinking | 2.11 | 1.37-3.26 | 0.001 |
| | Energy (kcal/day) | 1.01 | 1.00-1.01 | 0.000 |
| | NMES-total intake | 1.06 | 1.05-1.07 | 0.000 |
| | BMI | 1.03 | 0.96-1.10 | 0.434 |
| Group 3 (n=229) | Drinking | 1.63 | 1.19-2.24 | 0.003 |
| | Energy (kcal/day) | 1.00 | 1.00-1.00 | 0.000 |
| | NMES-total intake | 1.02 | 1.02-1.03 | 0.000 |
| | BMI | 0.96 | 0.89-1.02 | 0.161 |
| Group 4 (n=295) | Drinking | 0.87 | 0.66-1.15 | 0.329 |
| | Energy (kcal/day) | 1.00 | 1.00-1.00 | 0.000 |
| | NMES-total intake | 0.95 | 0.95-0.96 | 0.000 |
| | BMI | 1.05 | 1.00-1.11 | 0.067 |
| Group 5 (n=382) | Drinking | 0.57 | 0.44-0.74 | 0.000 |
| | Energy (kcal/day) | 1.00 | 1.00- 1.00 | 0.430 |
| | NMES-total intake | 0.99 | 1.00-1.00 | 0.017 |
| | BMI | 1.01 | 0.96-1.06 | 0.739 |
| Group 6 (n=174) | Drinking | 0.63 | 0.45-0.88 | 0.008 |
| | Energy (kcal/day) | 0.99 | 1.00-1.00 | 0.000 |
| | NMES-total intake | 0.94 | 0.93-0.95 | 0.000 |
| | BMI | 0.96 | 0.89-1.04 | 0.293 |

**Negative** **Positive** **Not significant**

As stated in the methods and presented in the results section, this research has been conducted in two stages. The discussion section contains several arguments from both stages without a specific order.

## 4.3 DISCUSSION

The main objective this study was to explore the characteristics of children who consume SSBs, to investigate the level of effectiveness of the SDIL in the context of tackling childhood obesity. The outcomes of this study have generated some insights into SSBs drinking behaviour among different groupings of children. In this more recent population survey of children, it was not observed that increasing SSBs drinking was related to higher BMI or macronutrient intake in any particular group of children. Furthermore, the first phase of analysis has addressed many potential associations between the consumption of SSBs and multiple actors, including the demographic characteristics of the children consuming SSBs and when SSBs were mainly consumed.

Contrary to expectations, using the data-driven approach, using all the available data provided, the analysis demonstrated that each group (cluster) had a different mix of SSBs drinkers and non-drinkers. Additionally, the group with the highest percentage of SSB drinkers was positively associated with both SSB drinking behaviour and the total daily NMES intake, however, there was no significant association with their BMI or total daily energy intake. Although there are several limitations to the methods used in the first stage, similar outcomes were obtained, where drinking SSBs was not significantly correlated with the weight classification of children, as the ratio of drinkers to non-drinkers was similar across the three weight categories of healthy, overweight and obesity. Additionally, findings suggest important possible correlations; for example, 78.36% of the sample were in the high NMECat group (total daily NMES intake categories), when only 19.4% of the sample were in the high CalCat group (total daily energy consumption categories).

These results do not dismiss the fact that the high NMES intake is a problem as discussed by PHE when addressing the evidence for sugar reduction (2015a), yet it highlights the

importance of appreciating possible unintended consequences of policies such as the sugar tax. For example, almost half (43.8%) of this study sample was grouped in the low CalCat category, which implies that children in this group are consuming fewer calories than their estimated energy requirements. The sugar reduction strategy may be associated with a further reduction in the energy intake of these children, leading to an increase in underweight children. The results also indicate that the percentage of underweight children in recent years has increased, compared to the numbers in 2008.

There is also a relatively low level of consumption of SSBs reported among those who are overweight and obese in the sample. In Group 6, of whom 25% were grouped as overweight or obese, had the lowest proportion of SSB drinkers. This, in addition to the 43.8% of children's intake was categorised in the low-calorie intake category, raises the possibility of underreporting of food and drink consumption in the NDNS dataset.

There are multiple studies demonstrating the general tendency for people to under-report their intake in self-reported dietary surveys. A study in the US compared people's self-reported intake with purchasing data and found that people underestimate their true calorie intake to an astonishing degree, typically by 30%. The underestimation ranged from 10 to 45 percent depending on factors such as age, sex, body composition and socioeconomic status (Basiotis et al., 2002). A UK-based report which explored reported intake as well as physical activity and other related factors made similar findings for the NDNS data. Comparing the NDNS statistics which relied on self-reporting to data sources on calorie purchasing through the Kantar Worldpanel survey indicated a rise in calorie purchases over the last ten years, contrary to NDNS data. Using a different methodology, Doubly Labelled Water (DLW), the gold standard for measuring energy expenditure, the report found that the population as a whole is consuming 30 to 50 percent more calories than the levels reported in official statistics (Harper and Hallsworth, 2016).

This established effect of underestimation in self-reported surveys is even more marked among people with overweight or obesity. This is true for adults, where underreporting was higher in overweight and obese men and women compared with their lean counterparts (P

= 0.001) (Rennie et al., 2007). It is also true for children and adolescents, where those with higher weight, adiposity and BMI were consistently and significantly associated with underreporting of energy intake according to a review of 28 articles (Forrestal, 2011).

As with many self-reported behaviours, there is likely to be conscious and unconscious, as well as intentional and unintentional, elements to this underreporting (Harper and Hallsworth, 2016). The data-collection method of recalling dietary intake is prone to error due to unintentional poor memory, poor attention, literacy problems and poor estimation of portion sizes (Macdiarmid and Blundell, 1998). Intentional factors include inconvenience, the hassle involved and time consumed in completing a food record. There are more complex factors such as the impact of social desirability, peer pressure and social attitudes towards food, all of which can push individuals to underreport intake. Individuals may be diet-conscious or feel too embarrassed to record all food consumed (Macdiarmid and Blundell, 1998). Such social factors, in an environment in which obesity is prevalent and stigmatised, may play a more subconscious role on people's reporting however through social desirability bias (Subar et al., 2015).

Although there are issues with NDNS data and other self-reporting dietary surveys related to underreporting, this does not discount all the results found and discussed in this study. The findings have provided important insights. For example, the logistic regression analysis found an association between consumption of SSBs and NMES intake, but not between consumption of SSBs and total calories intake or body weight. These associations may be explained by other factors including income where it is established that low-income groups consume a higher proportion of energy-dense food (The Food Foundation, 2019). This was not found in the current study, however, as conversely, children in Group 6, the one with the lowest percentage of SSB drinkers, were more likely to have lower income. This effect was very modest, with an odds ratio of 0.99 (95% CI 0.99-0.99), and there were no significant associations found between any of the other groups and income. Ethnicity may also play a role in low or high intake of SSBs, where for example there was a higher

percentage of Asian individuals in Group 6. Specific associations between SSB consumption and ethnicity were not tested in this study.

The recent substantial focus on free sugar reduction in Government regulations engages the food industry and other media platforms to increase public awareness to reduce their free sugar consumption. This may be effective in nudging consumers to consider the negative health consequences of high free sugar intake. However, it may also carry significant undesirable effects, such as obesity stigma, food guilt and restricted eating. It is essential to consider the social stigma that children with obesity face, as it would amplify the occurrence of different kinds of emotional and physical related issues (Puhl and Latner, 2007).

Furthermore, assuming that broad messages and approaches would have similar outcomes on different groups of children may not be realistic. It is possible that these approaches will aggravate inequalities among children, particularly in a very sensitive matter such as body weight (Margetts, 2004). The wording of the guidelines and nutritional messages circulated among children and adolescents also plays a very critical role in shaping their perspective, and should not be ignored. There are already negative connotations associated with obesity (Puhl and Heuer, 2010). Accordingly, a recent report by the technical consultation of the WHO high-level commission on NCDs' supported the tax on SSBs conditioned with caution and extensive consideration, after investigating the outcomes of sugar taxes that were or are still being applied in some countries (WHO, 2018).

It is not debatable that SSBs are a major source of "empty calories" with minimal nutritional value (Collins et al., 2015), and reducing their consumption would be beneficial. However, it is vital to mention that setting the levy in the UK relied heavily on modelling studies and statistics (Briggs et al., 2016), while there is insufficient understanding of the true drinking patterns of SSBs or the social and cultural factors associated. One report claimed that the frequency of consuming food containing sugar mattered more than the quantity of sugar content on the risk of dental caries among children (EFSA, 2010). A study undertaken in Canada to describe the social context related to the consumption of different food and drinks

illustrated that 46% of 11-13 years old children tend to consume SSBs at lunch time as part of their meal with friends or family (Woodruff et al., 2010). Further research was undertaken to identify the eating context of non-core food items among adolescents in the UK. It revealed that 54.2% of its consumption was at eateries or with friends, while only 32.7% was drunk at home or with parents (Toumpakari et al., 2016). Furthermore, most SSB intake takes place on special occasions at eating outlets or home (Hawkes, 2010). This was touched on as part of the first phase of the current study, where different kinds of SSBs were consumed at different times of the day, as children consumed different drinks as part of a meal or snack, or drank them solely as a drink event. A better understanding of the determinants affecting the consumption of SSBs is critical when designing an intervention, to ensure a high level of effectiveness, in terms of application and evaluation (Mazarello Paes et al., 2015). This should take into consideration the time of consumption, the context and the other food items contained in the eating occasion. This underlines the importance of public discourse to recognise the cultural, social and environmental determinants of children's behaviour change and possible consequences, which would justify the levy with a stronger evidence base. It would also be tailored to match the public's needs and dietary related factors that would facilitate the process of individuals' behaviour change (Carels et al., 2007).

Multiple studies have challenged the use of modelling studies to assess the effectiveness of the sugar tax, where it is believed that they only measure the change in SSBs' consumption, without considering possible related dietary changes. There is insufficient research on how individuals would react to the sugar tax and what replacement drinks could be, amid concern around potential undesired substitution effects in the context of taxes on unhealthy foods (Mytton et al., 2012). This is particularly important as it is assumed that children are likely to seek another drink as a replacement (Mytton et al., 2012), with the possibility of the swapped food undermining the expected health benefits of the tax (Cornelsen et al., 2015). Potential alternative drinks include water, 10% fruit juice, coffee, tea, milk and artificially sweetened beverages (Avery et al., 2015).

Fruit juice is believed to be a very realistic alternative, especially as children perceive it as a healthy option and a good source of nutrients (Bucher and Siegrist, 2015). However, this may be associated with increased intake of free sugar (Ensaff et al., 2015). In regards to sweeteners, some international guidelines (e.g. France, Georgia, Turkey, and the US) recommend artificially sweetened beverages as an alternative to SSBs for weight control (Borges et al., 2017). For this reason, there is a tendency to shift to a greater intake of low-calorie drinks that can be identified as artificially or naturally sweetened beverages. The results of the first stage of this study support these assumptions, as they revealed that the number of children consuming low calorie versions of SSBs has increased noticeably in recent years compared to the year 2008. Potential alternatives and their associated risks are further explained in Chapter 7.

It is well recognised that there is a critical interrelation between nutrients and dietary patterns and it essential to understand it, as it plays an important role in framing the implications for the development of dietary guidelines that are set to improve health and prevent diseases (Tapsell et al., 2016). Therefore, and as part of the current public health climate, a considerable and growing number of studies have investigated the possible influence of the change in the consumption of SSBs on the daily intake of other macro and micronutrients. Although there is no clear explanation for the potential correlation, one study argued that salt intake is related to the total daily SSBs consumption, in which a reduction of salt intake (on average 3 g/day) would lead to a reduction in SSBs consumption of approximately 2.3 drinks per week per child (He et al., 2008). Thus, focusing on salt reduction may help in reducing the rates of childhood obesity. Another experiment showed the possibility of increased daily fat intake as a result of SSBs substitution (Zheng et al., 2015). The results of the second stage of the current research suggested different conclusions, where groups of children with different levels of SSB intakes had the same distribution of the three macronutrients, carbohydrates, protein and fat.

The sugar levy was introduced as part of the government's initiative to tackle the issue of childhood obesity in the UK, where it is believed that reducing children’s consumption of

SSBs would facilitate weight loss (Hu, 2013). The results of these studies were based on a short-term assessment of the tax's effect on weight loss and other metabolic disorders, yet there are other studies that support contrasting findings. For example, a group of researchers, who applied the results of their quantitative meta-analysis into a qualitative review, argued that the association between SSBs and BMI view is close to zero (Forshee et al., 2008). While Ebbeling and colleagues showed that there was a significant decrease in children's body weight after one year of the intervention to reduce SSB intake, the significant change in children's BMI lasted only for the first year (2012). This finding is mirrored by Mexico's experience with sugar tax. The Mexican government announced a big success of the application of the tax on SSB consumption in 2014. However, a year later, Mexico's National Institute of Public Health reported that the second-year statistics showed SSB consumption had not further decreased, and had gone up slightly (Gobierno de México (GOB), 2016). Similar results were reported in other countries, including Chile and the US state of Philadelphia (Cawley et al., 2019, Nakamura et al., 2018).

Mexico's experience of the sugar tax has consistently been an issue of interest for researchers, especially considering the tax's impact on people of different socioeconomic status. The context of the tax is particularly important considering the prevalence of overweight in pre-school aged children is increasing fastest in low- and lower middle-income countries (WHO, 2015a). There needs to be consideration as to how applicable such policies are in different (such as high-income country) settings. In low- and lower middle-income countries, taxes on "unhealthy" products are often aimed at having two effects: levelling the inequality between people of different socioeconomic status by altering health behaviours, and generating revenue from taxes to invest in improving health care and fund health promotion programmes at a community level. The effect of income on the quality of food consumed is well-established. One study indicated that the shift towards energy-dense over nutrient-dense foods, such as fruits and vegetables, is related to the fact that the former is cheaper (Ntouva et al., 2013). This suggests a higher intake of energy-dense food among the low-income population, which in turn may increase their intake of NMES (Bradbury,

2013). In the UK, the low-income group consumed more NMES than the general population sample (Bradbury, 2013). Surprisingly, our results showed that income was not a factor in determining the sample's intake of SSBs.

The present study makes several noteworthy contributions to the growing body of literature that argues that the dominant narrative of current public health strategies is the over-simplistic heuristic approach that is based on simple linear methods of prevention (Walls et al., 2011, Kelly and Russo, 2018). Most of the proposed solutions exclusively focus on factors that fall within individual responsibility and personal misconduct (Mansfield and Rich, 2013). This neglects the fact that obesity is a complex issue, and handling it with a mono-casual approach discounts the interrelationships between social, economic, commercial, environmental and clinical factors that heavily affect the public's choices (Gregg and O'Hara, 2007). Work in the field of sociology has clarified that the mechanism of taking up a certain behaviour is very complicated and differs between individuals (Bell et al., 2011). These studies highlight the importance of considering the multifactorial nature of obesity. This study emphasises the problematic nature of simplistic interventions, such as the sugar levy in tackling childhood obesity, that aim to tackle a particular behaviour or address a particular bodyweight category, without taking into consideration other health determinants and outcomes.

## 4.4 STRENGTHS AND LIMITATIONS

This is the first time that a Hierarchical Agglomerative Clustering technique has been used to explore the characteristics of children who drink SSBs. The findings confirm the importance of delving deeper into the relationship between behaviours, weight and other determinants or outcomes to increase the effectiveness of public health interventions and decrease the occurrence of unintended negative consequences. Furthermore, the application of this machine learning technique allowed the inclusion of multiple variables without any pre-specification of comparison variables. This data-driven approach enabled the exploration of more complex relationships, outcomes and interactions across demographics and different health-related variables with bigger scope and potential impact without missing as much of the nuance.

Almost half of the sample was females (48.2%), and 78.7% of the sample were white British, which are both representative of the United Kingdom population (Office for National Statistics, 2011). It is stated that 29% of children between the ages of 0 and 15 in the UK are with overweight and obesity respectively (Health Survey of England, 2019, Northern Ireland Department of Health, 2020, Scottish Government, 2020, Welsh Government, 2020). However, 24.4% of the present study sample were with overweight and obesity. In addition, the national statistics showed that the percentage of males were higher compared to the females in this weight group, whereas females were significantly higher in the obese group in the current study sample. This might have a slight impact on the results of NMES and calories intake and their correlation with weight classification.

The findings of this study are limited by the use of a cross-sectional design using data from the NDNS rolling programme up until 2014. Another limitation is that the estimated daily energy requirement used to categorise children's calorie or NMES intake based on their age and gender rather than their weight and height. Finally, the results are limited by the inability to take other influential variables into account, including children's physical activity level and family-related factors, such as where they live or parents' education level. Several questions

remain unanswered at present. Hence, future work should continue to focus on assessing the pattern of different food and drinks consumption and its correlation with other health related determinants. This would allow deeper understanding of the factors associated with SSBs drinking over the past six years, in order to measure the probable impacts of the sugar tax or other proposed policies, increase the effectiveness of such intervention, and decrease the possibility of wasting human and financial resources used when tackling the issue of obesity (Cornelsen et al., 2015).

## 4.5 CONCLUSION

Returning to the initial hypothesis at the beginning of this study, the findings of both stages of this study provide insights into the factors related to the characteristics of children who drink SSBs. This study revealed that the behaviour of drinking SSBs is not particular to children with a higher body weight, therefore a more detailed understanding of the behaviour and characteristics of those affected by policies such as the SDIL is warranted. Although the first study successfully established a fair understanding of the distribution of 4-10 year old children, in terms of their calories, NMES, weight and SSB consumption, the use of the HAC approach provided a new understanding of the diversity of dietary behaviours among children. Most notably, there was no association between SSB drinking behaviour and total energy intake, or between SSB drinking behaviour and BMI for any of the clusters

# CHAPTER 5: THE EFFECT OF THREE "PS" ON PUBLIC PERCEPTION OF CHILDHOOD OBESITY POLICY IN THE UK; PARENTHOOD, PERCEIVED WEIGHT AND POLITICAL ORIENTATION.

*Aim:* To investigate the perception of a representative sample of adults living in the UK of the solutions of the childhood obesity issue, and the effectiveness of interventions proposed by the Government in the "Childhood Obesity: a Plan for Action", parts 1 and 2. To assess associations of perception with socio-demographics and political orientation

*Hypothesis:* Different factors are correlated with people's perception of the appropriateness and effectiveness of proposed interventions in the documents of Plan for Action. These factors include their sociodemographic factors, political persuasion, parenthood, and perceived weight status.

*The objectives of this study are as follows:*

1. To assess the level of public awareness of Childhood Obesity policies
2. To explore the public's perception of the overall effectiveness and appropriateness of these policies
3. To investigate where the public places responsibility for childhood obesity, and specifically how much the public holds parents responsible for children's weight status
4. To explore whether different participant characteristics lead to different perceptions with respect to the above objectives

## 5.1 INTRODUCTION

This thesis has highlighted that the issue of childhood obesity has become one of the most important public health issues in the UK. It has also highlighted that the Government and other health-related institutions are focusing their efforts on tackling childhood obesity through delivering multiple interventions, programmes and policies, reported in the "Childhood Obesity: a Plan for Action" 1 and 2 documents. It is essential that these programmes succeed in achieving their goal of improving children's health and reducing the national rates of childhood obesity. Therefore, there is substantial work on planning effective interventions that would appeal to the public as realistic, practical approaches that can be adopted rapidly by all relevant parties (Farris et al., 2007).

The evidence illustrates that the effectiveness of programmes for children and adolescents should be underpinned by national policies that decrease social inequality and improve quality of life. Programmes should be implemented at Government level and be supported by society in general (WHO, 2005). A report by the WHO reviewed several factors that influence the success of public health interventions including the socioeconomic status of the target group, the institutional burden of the health issue, the sensitivity of political factors, national planning and the approaches used to deliver the strategies, through media and other means of communications. In addition, it emphasised the significance of applying

interventions in a multifactorial setting and the engagement of all levels of society in the process (WHO, 2005). This can be achieved by appropriately using the available data on the potential impact of the intervention, and data about, and from, the target population.

Another study has recommended that the effectiveness of interventions be studied and assessed in the context of wider economic, ethical and accountability implications, where the research conducted to evaluate effectiveness is not isolated from the research relevant to the public health intervention itself (Waters et al., 2006). There is general consensus in public health research for the need to determine the effectiveness of policies, which in turn can be interpreted into recommendations and guidelines that increase the applicability of these interventions (SAC, 2010). Literature has referred to this as Evidence-Based Public Health (EBPH), which is a term used to identify the practice of developing, implementing and evaluating effective programmes and policies in public health through the systematic use of data and information systems, the application of behavioural scientific theories and planning models, in addition to the application of scientific reasoning (Brownson et al., 2018a).

There has recently been growing interest in engaging the public in the process of policy setting in public health. Some researchers argue that ensuring public support for such policies may increase their potential effectiveness (Miller et al., 2018). Public involvement is referred to as the engagement of people in strategic decision making related to their health, at either individual or collective levels (i.e. patients and organisations). In other words, the engagement of laypeople in the process of health services and policy planning at both local and national levels is expected to result in a more democratic design process and better accountability (Souliotis, 2016). Therefore, in reference to childhood obesity, it is vital to explore public support of obesity interventions that would facilitate current policy-making (Hilbert et al., 2007).

The evaluation of food- and health-related policies has been identified as high priority action that is needed to improve the UK food environment and public health policies (Watson et al., 2018). Nonetheless, public opinion regarding the current issue of childhood obesity and

the most appropriate interventions and policies to address the issue has not been comprehensively studied. Swift and her colleagues stated that public perception is often ignored (Swift et al., 2018).

There is continuous public debate about the correct government interventions to prevent and treat obesity, where it may be considered a self-inflicted condition and a personal choice to be discussed as a public issue (Beeken and Wardle, 2013). A survey commissioned by the UK Government and conducted in twenty-four countries investigated public attitudes towards behaviour change policies. The results of this survey indicated that there was limited public support for more coercive policies, and just over half (53%) believed that the government should 'not get involved in what people choose to eat' (Branson et al., 2010).

It is believed that this debate may be strongly associated with individual differences across laypeople, due to cultural, geographical, socio-economic and many other differences. In addition, one study discussed that when public health issues, such as obesity, become relevant to an increasing number of individuals, their attitudes and beliefs are partially shaped by a variety of information sources. For instance, there is public media, politicians, new personal experiences and other social network effects (Barry et al., 2009).

Political orientation is an increasingly important area in public health. In 1998, a researcher assessed the role of political persuasion in influencing individuals' preference on health insurance policies, where he stated that citizens' political party affiliation may affect his/her belief on the suitability and effectiveness of policies in public health (Koch, 1998). Regarding obesity, it is suggested that political ideology is one of the most consistent significant predictors of supporting tax-related interventions, which are also referred to as redistributive policies. However, in the same study, regression models indicated that political orientation did not significantly affect individuals' attitudes towards compensatory policies that do not include taxes, also called "helping and protecting" interventions. For these researchers, this was not surprising, as support for taxes is associated with citizens who view obesity as a personal responsibility, contrasted with more liberal individuals who place higher responsibility on social causes (Barry et al., 2009).

Individuals' personal weight perception is another factor to explore in assessing public opinion on policies. On the one hand, it is established that there is a significant number of individuals who misinterpret their own weight status, which is linked to their unwillingness to change their dietary and activity behaviours (Opie et al., 2019). On the other hand, the majority of obesity-related public health strategies and programmes are set around clinically-defined weight status (i.e. body mass index), which indirectly disregards the former statement. Therefore, multiple researchers are promoting the consideration of weight perception in the design and implementation of public health programmes (Kelleher et al., 2017, Kwon, 2017).

There are some studies that have evaluated the perception of parents of interventions related to childhood obesity. Active school travel is one such example, where researchers found that parents' perceptions were influenced by a combination of factors including environmental, safety and social determinants (Wilson et al., 2018). Other scientists have argued that it is essential to ensure that child-related public health interventions are culturally appropriate, worthwhile in terms of time and effort for parents, and offer a realistic approach to deal with their concerns (Chu et al., 2012). An Australian study concluded that there is a lack of exploration of parents' perceptions of current public health guidelines, and they considered this a vital issue to provide insight to inform effective policies (Hinkley and McCann, 2018). For these reasons, it is essential to take all the aforementioned determinants into consideration when evaluating the public's perceptions of public health policies.

In 2007, a study that included 500 adults from the general public in the UK evaluated their opinions regarding the causes of obesity. Although the policies included in this research were mostly focused on children and childhood obesity, they showed that the highest level support was for the causes associated with individual responsibility, and that genetics played an under-recognised role as a determinant in obesity (Chambers and Traill, 2011). Unlike this study, other surveys have evaluated the perceptions of specific groups of the public. For example, Ogden and Flanagan explored the beliefs of general practitioners (GPs) in the

UK about the causes and solutions of obesity, and compared the findings to the beliefs of a sample of laypeople. Lay people endorsed biological factors as the main causes of obesity, whereas GPs appeared to support behavioural, social and structural factors as greater contributors to obesity (Ogden and Flanagan, 2008). Another study showed that sedentary lifestyle and low-quality diet were identified by 90% of a diverse sample of university students in London as the causes of obesity. The same group of students supported most management strategies that were suggested in the study survey to address obesity in the UK (Okonkwo and While, 2010). However, these studies included a set of possible intervention strategies that were not extracted from a single policy document. For this reason, in 2013, a large-scale study was conducted to assess public's perceptions of the causes of overweight and obesity and their agreement on the interventions proposed in "Healthy Lives, Healthy People", the 2010 government strategy to tackle obesity in the UK (DOH, 2010). Outcomes of this study revealed that participants attributed weight gain to the food environment (61%) and lack of willpower (57 %), and people's support was highest for policies on healthy lifestyle campaigns (71%) and food labelling (66 %) (Beeken and Wardle, 2013).

With regards to the specific issue of childhood obesity, a recent study was designed to record parents' awareness of the UK soft drinks industry levy (SDIL) and to evaluate the correlation between their negative psychological reaction to the levy and their motivation and intentions to change theirs and their children's sugar sweetened beverages consumption and purchasing (Gillison et al., 2020). Although this research focused on the only mandatory policy in the recent "Childhood Obesity: a Plan for Action" 1 and 2 documents, it only covered the perception of one policy for a particular group of people, parents.

Accordingly, the objective of this study was to conduct a population-based survey to investigate the views of a diverse group of laypeople in the UK about the general solutions to tackle childhood obesity, and to assess their perception of the effectiveness and appropriateness of the interventions proposed in the "Childhood Obesity: a Plan for Action" 1 and 2 documents. In addition, this research aimed to offer some important insights into

the association between people's perceptions of childhood obesity and their perceived weight, political orientation and parental status

## 5.2 METHODS

### 5.2.1 Population Sample

The design of this research was based on a cross-sectional study, using an anonymous questionnaire that included questions regarding the interventions proposed to tackle childhood obesity in the UK. The original idea was to investigate policies that were particularly prominent in childhood obesity discussions. However, there was no significant connections between those and there was not a clear rationale to choose individual interventions. Therefore, in agreement with my supervisor, I included all interventions proposed in the Government policy documents "Childhood Obesity: a Plan for Action" as part of the survey. The survey was split into two sections, based on whether the intervention was already implemented or only suggested. Additional information was collected, such as perception of own weight, political orientation and parenthood status, to allow the hypothesis to be tested. Please see Appendix three for the full questionnaire.

A large anonymous representative sample were invited to participate in the survey through SurveyMonkey™'s trusted survey panel, as discussed in the Novelty chapter, section 2.3. The sample was stratified by age and gender, and data was collected from 1000+ participants in the UK to ensure representation.

### 5.2.2 Measures

Participants were asked to provide basic demographic information: age (minimum 18 years), gender, ethnicity, educational level, UK region of residence and political orientation. Perception of participants' own bodyweight status was also investigated by asking participants to describe their weight (too thin or underweight, recommended or healthy weight, overweight, very overweight or obese). This was then merged into two groups of individuals: one who perceive themselves as underweight or a healthy weight, and a group who perceive themselves as overweight, very overweight or obese. As the target of the policies is obesity in childhood, the survey included questions on parental status and, if

applicable, how participants perceived the weight of their children and grandchildren (Table 5.1).

*. Table 5.1: Description of variables that were included in the survey*

| Variable | Description |
|---|---|
| Age | 1 = 18-24 years, 2 = 25-29 years, 3 = 30-39 years, 4 = 40-49 years, 5 = 50-59 years, 6 = 60-69 years, 7 = 70+ |
| Gender | 1 = Male, 2 = Female |
| Ethnicity | 1 = White, 2 = Black and Black British, 3 = Mixed, 4 = Asian and Asian British, 5 = Chinese and Other Ethnic Groups, 6 = Rather not say |
| Education | 1 = No formal qualifications, 2 = GCSE or equivalent, 3 = A-level or equivalent, 4 = Undergraduate degree or equivalent, 5 = Post-graduate degree or equivalent |
| Parental status | 1 = Parent, 2 = Non-parent |
| Perceived weight | 1 = Healthy or underweight, 2 = Overweight or obese |
| Political orientation | A continuous variable where 0 indicates extremely liberal and 100 represents extremely conservative |

The survey also included questions to assess participants' views on and engagement in the issue, including:

How much are parents responsible for their children's body weight? (1-100 scale)

To what extent is childhood obesity a health priority in the UK? (1-100 scale)

Do you think the Government is doing enough about childhood obesity? (1-100 scale)

Have you heard of the UK government's "Childhood Obesity: a Plan for Action" document? (Yes/No)

#### *5.2.2.1 Interventions to tackle childhood obesity*

The survey then considered participants' knowledge around "Childhood Obesity: a Plan for Action" 1 and 2 documents, to assess their perception of the appropriateness of the current implemented policies and the effectiveness of other suggested interventions.

In addition, participants were presented with a selection of solutions related to childhood obesity (biological, psychological, behavioural, social, and structural) and asked to indicate the likelihood of each factor being suitable to tackle childhood obesity. A set of examples were provided with each category of the presented solutions. For instance, biological

solutions included drug treatments, weight loss surgery and gene therapy. Psychological solutions included counselling, mental health treatment and support groups. Behavioural solutions included that parents should change their children's lifestyle to eat less and exercise more. Social solutions included cooking lessons in schools and campaigns to educate parents about obesity. Structural solutions included strict rules on advertising of unhealthy food, cheaper fees for sports centres and taxes on high-calorie food. An overall composite variable was calculated to categorise participants' support for these solutions into two groups (Amarasinghe and D'Souza, 2012), by calculating the average rating of each of the solutions, assuming equal weighting. Grouping was as follows:

- Individual solutions included psychological, biological and behavioural solutions
- Environmental solutions included social and structural solutions

### 5.2.3 Statistical Analysis

IBM SPSS Statistics 24 data editor was used to analyse the data exported from the SurveyMonkey™ software. Descriptive statistics were reported as number and frequency for categorical data and means and standard deviations or median and IQR for Gaussian (or non-Gaussian) continuous data. Missing data were reported descriptively (Table 5.2), but were removed from the quantitative analysis. Individuals were removed from the analysis if they did not answer any questions related to solutions, if they did not respond to any appropriateness scale questions, if they did not respond to any effectiveness scale questions, or if gender was non-binary or not reported (as the small sample size insufficient for analysis). For the remaining responders, the Mann-Whitney U test was used to assess significance difference between parental status and perceived weight status with other variables.

To explore whether there was any correlation between participants' selection of the suitable solution and other variables, including sociodemographic variables, parental status, political orientation, and perceived weight status, a series of multiple linear regression analyses were conducted across the two groups of solutions; individual and environmental, where each

variable was tested separately. The dependent variables were continuous (scale), and independent variables were the ones explained in Table 5.1. Linear regression was also conducted on the same independent variables to assess their correlation with participants' perception of the appropriateness and effectiveness of interventions, where each one of the interventions was considered as a dependent variable.

### 5.2.4 Ethical Approval

Ethical approval was obtained from the School of Biosciences Research Ethics Committee at the University of Nottingham (Reference #SB1819/27) (Appendix four).

All participants were provided with detailed information about the research in the first page of the online survey, which clearly outlined how the data they provide will be stored and used, and they had the opportunity to contact a member of the research team to query any aspect of the project. Consent was implied by completion of this anonymous online survey although agreement to proceed was the first question asked in the survey. Participants were free to refuse to participate and there was no direct request from the research team.

## 5.3 RESULTS

### 5.3.1 Demographics

The total sample collected from SurveyMonkey™ was stratified for age and gender (n=1032). Excluding the missing values from all the questions reduced the number of the total sample to 990. Excluded participants were relatively similar to the included participants in terms of sociodemographic characteristics, with the exception of education as more were from the group who had A-levels and fewer from the participants who had a post-graduate degree (Table 5.2). Half of the included sample were males. Of the participants, 23.5% were 18 to 28 years old, and 48% were 40 to 70 years old. Regarding ethnicity, 86.3% of the 1032 participants were white. In addition, around half of the sample (51.9%) had a GCSE and/or an A-level or equivalent qualification, and another 12.2% had a postgraduate degree or equivalent. The recruited sample was representative of the UK population, with similar statistics to the general population with regards to age, gender, ethnicity and regional demographics. With regards to educational level, there was a minor difference between the proportions of people with postgraduate or equivalent qualifications in the recruited sample (12.2%) compared to the general population (9.5%)(ONS, 2013, 2019b, 2019a). The participants were asked to place themselves on a scale of 100 regarding their political orientation where zero indicated extremely liberal, the median response was 50 (IQR= 25).

Almost half of the sample were parents or grandparents, where 41.1% (n= 407) were parents and another 13.1% were grandparents (n= 130). We combined these two groups as "parents". Nearly twenty percent of parents identified that they have a child or grandchild who is considered overweight or obese (17.9%). 8.8% of parents stated they have children or grandchildren who are underweight, and 79.6% said they have a child or grandchild of a healthy weight. Parents had the choice to select multiple options for their children's weight, in case they have more than one child with different weight classification.

Regarding participants' weight perception, 39.9% described themselves as overweight or obese when asked to describe their weight based on the widely used medical criteria of weight categories. This group was labelled 'problematic perceived weight'. 7.5% considered themselves underweight. From the group of parents with children or grandchildren who are considered overweight or obese, only 29.8% described themselves to have healthy weight, and 66% considered themselves overweight or obese.

Out of the 990 valid responses in the total sample, on a scale of 0-100, participants placed a high level of responsibility with parents for their children's weight, with a mean rating of 76.7 (SD= 20.46). Parents had a similar response for this question, with a mean rating of 77.8 (SD= 20.47). This was significantly different from the non-parent responses (75.6, p-value = 0.029). The role of participants' perceived weight did not significantly affect their response on this question (Table 5.3).

*Table 5.2: Basic demographic characteristics of included and excluded participants.*

| **Variable** | | **Excluded (n= 83) (%)** | **Included (n= 990) (%)** |
|---|---|---|---|
| Age | 1: 18-24 years | 16.7 | 10.4 |
| | 2: 25-29 years | 7.1 | 13.1 |
| | 3: 30-39 years | 14.3 | 24.1 |
| | 4: 40-49 years | 14.3 | 19.9 |
| | 5: 50-59 years | 16.7 | 17.0 |
| | 6: 60-69 years | 9.3 | 11.1 |
| | 7: 70+ years | 0.0 | 4.4 |
| Gender | 1: Male | 50.0 | 50.0 |
| | 2: Female | 50.0 | 49.7 |
| Ethnicity | 1: White | 85.7 | 86.2 |
| | 2: Black and Black British | 2.4 | 2.4 |
| | 3: Mixed | 4.8 | 2.8 |
| | 4: Asian and Asian British | 0.0 | 5.5 |
| | 5: Chinese and Other Ethnic Groups | 2.4 | 1.0 |
| | 6: Rather not say | 4.8 | 1.9 |
| Education | 1: No formal qualifications | 11.9 | 4.3 |
| | 2: GCSE or equivalent | 28.6 | 24.8 |
| | 3: A-level or equivalent | 42.9 | 26.1 |
| | 4:Undergraduate degree or equivalent | 14.3 | 32.1 |
| | 5: Post-graduate degree or equivalent | 2.4 | 12.8 |

*Table 5.3: Statistical testing of the role of participants' parental status and perceived weight status on their answers to questions related to childhood obesity*

| **Variable** | | How much are parents are responsible for their children's weight | Childhood obesity a health priority in the UK | Do you think the Government is doing enough | Have you heard about the Childhood Obesity: a Plan for Action document? |
|---|---|---|---|---|---|
| Weight perception | Healthy weight (Mean (SD)) (n= 601) | 76.8 (20.87) | 66.6 (23.06) | 44.9 (24.78) | Yes: 30.1% |
| | Problematic weight perception (Mean (SD)) (n= 389) | 76.6 (19.87) | 69.5 (23.10) | 41.9 (25.39) | Yes: 26.2% |
| Significance (Mann-Whitney U test) | | 0.517 | 0.012 | 0.036 | - |
| Parental status | Parent (Mean (SD)) (n= 537) | 77.8 (20.47) | 69.3 (23.44) | 45.6 (26.23) | 34% said yes |
| | Non- Parent (Mean (SD))(n= 453) | 75.6 (20.35) | 66.0 (22.53) | 41.5 (23.48) | 21.9% said yes |
| Significance (Mann-Whitney U test) | | 0.029 | 0.029 | 0.011 | - |

**Cells highlighted in blue indicate significance*

### 5.3.2 Description of Causes and Solutions

On a scale of 1-100 (100 equating to the highest level of importance), participants rated the importance of childhood obesity as a health priority with a mean rating of 67.8 (SD= 23.11). The mean score for agreement with Government policy on tackling childhood obesity was 43.8 (SD= 25.10), where 100 indicates full effort has been placed to tackle the issue. Parents had a significantly higher mean rating, agreeing that childhood obesity is a health priority in the UK (P-value= 0.029) and that the Government is doing enough (P-value= 0.011). People with 'problematic perceived weight' had a significantly higher mean rating for considering childhood obesity a health priority in the UK (0.012). However, they had a lower mean for indicating that the Government is doing enough (p-value= 0.036) (Table 5.3).

To assess the public's perception of the potential suitable solutions to tackle childhood obesity, participants were asked to indicate on a scale of 0-100 the likelihood of each of five categories to be a suitable solution, including biological, psychological, behavioural, social and structural. Results shown in Table 5.4 reveal that the highest median rating among the five solutions was for behavioural interventions (77, IQR=32). There were comparable medians for the other solutions, except the biological solutions, with a median of 47 (IQR=40).

*Table 5.4: Median and IQR values for the five solutions and the composite variables: individual and environmental solutions*

| | **Solutions (Median (IQR)** |
|---|---|
| **Biological** | 47 (40) |
| **Psychological** | 62 (31) |
| **Behavioural** | 77 (32) |
| **Social** | 71 (30) |
| **Structural** | 66 (30) |
| **Individual solutions** | 59 (22) |
| **Environmental solutions** | 67 (27) |

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The linear regression that was run on the two groups of solutions, individual and environmental, established that political orientation could statistically significantly predict participants' choice of individual solutions, P-value= 0.001. However, participants' political orientation accounted for only 0.91% of the explained variability in choosing individual solutions. Parental status accounted for 1.3% of the explained variety of choosing individual solutions. Parents tended to significantly choose individual solutions compared to non-parents (P-value= 0.001). Regarding the choice of environmental solutions, gender was the only factor that significantly played a role in predicting its variation (1.2%). Females chose environmental factors more than males (P-value= 0.001) (Table 5.5).

*Table 5.5: Linear regression results of assessing the correlation between the two groups of individual and environmental solutions and other collected variables.*

| **Demographic information** | **Individual responsibility** Coefficient (P-value) | **Environmental responsibility** Coefficient (P-value) |
|---|---|---|
| **Age** | 0.051 (0.875) | 0.764 (0.048)** |
| **Gender** | 2.724 (0.010)** | 4.573 (0.001) |
| **Ethnicity** | 0.197 (0.702) | -0.242 (0.691) |
| **Education** | 0.307 (0.530) | 0.124 (0.830) |
| **Region** | -0.097 (0.528) | -0.053 (0.773) |
| **Political orientation** | 0.077 (0.002) | 0.021 (0.464) |
| **Parental status** | 3.560 (0.001) | 1.323 (0.292) |
| **Problematic weight perception** | 0.426 (0.694) | (0.454) |

**Cells highlighted in blue indicate significance*

*** Confidence intervals for this test crossed 1, which indicates insignificance.*

### 5.3.3 The "Childhood Obesity: a Plan for Action" Interventions

Less than a third of participants were aware of the "Childhood Obesity: a Plan for Action" documents (28.5%). Parents had a slightly higher level of awareness (34%) (Table 5.3).

Table 5.6 shows the median percentages and IQR values for each intervention presented in "Childhood Obesity: a Plan for Action". For interventions that are already implemented, participants were asked to indicate out of 100 how appropriate each intervention is. They were also asked to indicate the effectiveness of interventions that are proposed in the document.

A linear regression model was conducted to assess the correlation between participants' indication of the appropriateness and effectiveness of interventions and other key variables. Results show that participants who supported the introduction of a 9pm watershed on TV advertising of High Fat, Sugar and Salt (HFSS) tend to be significantly older (P-value= 0.000). A positive association was found between considering the reduction of sugar content in cereals and confectionary as an appropriate intervention and age (P-value= 0.000). Older age was also a significant factor in supporting interventions that motivate the drink industry to reformulate (P-value= 0.000). Parents supported the use of technology and data to inform eating decisions more than non-parents (P-value= 0.047) (Table 5.7).

There were no significant differences among participants for several interventions, including the development of a new framework that will consider how schools build knowledge across the whole curriculum and how they support pupils' personal development more broadly, including in relation to healthy behaviours. However, females tended to significantly support policies that challenge all food and drink companies to reduce calories by 20% in a range of everyday foods consumed by children by 2024, and the introduction of legislation to mandate consistent calorie labelling for the out of home sector, compared to males (P-value= 0.003 and 0.005 for each policy respectively). People who rated themselves as more conservative tended to significantly agree with including

sugary milk drinks in the soft drinks industry levy if insufficient progress on voluntary sugar reduction has been made (P-value= 0.040) (Table 5.8).

Although banning price promotions was the policy with the lowest rating among the proposed interventions, where the median was 57 (IQR= 39), non-parents tended to think this intervention was likely to be effective in tackling childhood obesity more than parents did (P-value= 0.003). Support for this intervention was significantly higher for participants who considered themselves to be more conservative with regards to their political orientation (P-value= 0.011). The adoption of the active mile intervention was considered one of the most effective interventions, with a median rating of 70 (IQR= 34), with females significantly supporting this approach more than males (P-value= 0.007). Similarly, females supported the introduction of legislation to end the sale of energy drinks to children under 16 years of age more than males (P-value= 0.002).

*Table 5.6: Descriptions of the questions on the appropriateness and the effectiveness of the interventions suggested in "Childhood Obesity: a Plan for Action" documents 1 and 2 as medians and IQRs*

| Question | Intervention | Median (IQR) |
|---|---|---|
| **How appropriate is: (n=1009)** | Introducing a soft drinks industry levy? ("sugar tax") | 64 (41) |
| | Introducing a 9pm watershed on TV advertising of High Fat, Sugar and Salt (HFSS) | 69 (39) |
| | Challenging manufacturers to decrease the sugar content in cereals and confectionery by at least 20% by 2020? | 76 (39) |
| | Motivating the drink industry to reformulate? | 72 (36) |
| | Investigating opportunities to bring forward a suite of applications that enable consumers to make the best use of technology and data to inform eating decisions (e.g. Change4life mobile app)? | 65 (32) |
| **How effective is: (n=1009)** | Including sugary milk drinks in the soft drinks industry levy if insufficient progress on voluntary sugar reduction has been made. | 60 (33) |
| | Challenging all food and drink companies - whether they are manufacturers, retailers, restaurants or takeaways - to reduce calories by 20% in a range of everyday foods consumed by children by 2024. | 66 (31) |
| | Introducing legislation to mandate consistent calorie labelling for the out of home sector. | 64 (32) |
| | Banning price promotions (1+1, multi-buy, unlimited refills) on unhealthy foods and drinks in the retail and out of home sector. | 57 (39) |
| | Developing a new framework that will consider how schools build knowledge across the whole curriculum and how they support pupils' personal development more broadly, including in relation to healthy behaviours. | 67 (29) |
| | Promoting a national ambition for every primary school to adopt an active mile initiative to increase children's physical activity (ex. the Daily Mile). | 70 (34) |
| | Introducing legislation to end the sale of energy drinks to children (<16 years old) by all retailers. | 68 (38) |

*Table 5.7: Linear regression results of the correlation between participants' perception of the appropriateness of interventions and other collected variables*

| **Demographic information** | **Sugar levy** Coefficient (P-value) | **9 pm Advertisement** Coefficient (P-value) | **Decrease sugar content (cereal/ confectionary)** Coefficient (P-value) | **Reformulate-drink industry** Coefficient (P-value) | **Use of technology (Change4life)** Coefficient (P-value) |
|---|---|---|---|---|---|
| **Age** | 1.297 (0.022)** | 3.474 (0.000) | 3.245 (0.000) | 2.817 (0.000) | 0.456 (0.304) |
| **Gender** | 3.427 (0.061) | 3.098 (0.062) | 2.799 (0.064) | 1.013 (0.506) | 1.843 (0.200) |
| **Ethnicity** | -0.272 (0.759) | -0.337 (0.675) | -0.921 (0.209) | -0.592 (0.423) | 0.576 (0.408) |
| **Education** | 1.837 (0.029)** | 0.640 (0.402) | 1.407 (0.044)** | 1.337 (0.057) | 0.437 (0.509) |
| **Political orientation** | 0.0248 (0.557) | 0.025 (0.520) | -0.047 (0.176) | -0.040 (0.254) | -0.009 (0.784) |
| **Parental status** | 3.465 (0.059) | 3.364 (0.043)** | 1.849 (0.224) | 2.169 (0.156) | 1.986 (0.047) |
| **Problematic weight perception** | 0.769 (0.681) | -0.726 (0.664) | -1.882 (0.223) | 1.172 (0.451) | 0.244 (0.868) |

**Cells highlighted in blue indicate significance*

*** Confidence intervals for this test crossed 1, which indicates insignificance.*

*Table 5.8: Linear regression results of the correlation between participants' perception of the effectiveness of interventions and other collected variables*

| **Demographic information** | **Milk drinks in the Levy** Coefficient (P-value) | **Reduce calories by 20% (retailers, restaurants and manufactures)** Coefficient (P-value) | **Legislation for calorie labelling for out of home sector** Coefficient (P-value) | **Ban promotions on unhealthy food and drinks** Coefficient (P-value) | **Improve school curriculums (healthy behaviours and personal development)** Coefficient (P-value) | **Every primary school - Adopt an active mile initiative** Coefficient (P-value) | **Legislation- end the sale of energy drinks <16 years)** Coefficient (P-value) |
|---|---|---|---|---|---|---|---|
| **Age** | 0.334 (0.507) | 1.112 (0.019)** | 0.062 (0.893) | 0.997 (0.062) | 0.665 (0.122) | 1.886 (0.000)** | 0.777 (0.140) |
| **Gender** | 2.017 (0.217) | 4.562 (0.003) | 4.253 (0.005) | 4.220 (0.015)** | 3.606 (0.010)** | 3.951 (0.007) | 5.203 (0.002) |
| **Ethnicity** | 0.158 (0.842) | 0.510 (0.501) | -0.258 (0.725) | 0.634 (0.450) | -0.854 (0.207) | -1.205 (0.093) | -0.413 (0.617) |
| **Education** | 1.386 (0.065) | 0.406 (0.566) | 0.718 (0.302) | 0.934 (0.241) | 0.923 (0.151) | 0.239 (0.726) | 0.652 (0.406) |
| **Political orientation** | 0.077 (0.040) | 0.046 (0.188)** | 0.057 (0.101) | 0.101 (0.011) | 0.020 (0.532) | 0.033 (0.333) | 0.008 (0.837) |
| **Parental status** | 3.250 (0.047)** | 3.633 (0.018)** | 2.320 (0.126) | 5.203 (0.003) | 2.069 (0.140) | 2.840 (0.055) | 3.940 (0.021)** |
| **Problematic weight perception** | -0.481 (0.773) | 0.480 (0.760) | -0.114 (0.941) | 0.834 (0.637) | 1.799 (0.207) | -1.133 (0.453) | -0.363 (0.835) |

**Cells highlighted in blue indicate significance*
*** Confidence intervals for this test crossed 1, which indicates insignificance.*

## 5.4 DISCUSSION

The main objective of this study was to explore individuals' perceptions of interventions aiming to tackle childhood obesity in the UK. The analysis illustrated that only 28.5 % participants were aware of the "Childhood Obesity: a Plan for Action" documents 1 and 2. On a scale of 1-100, participants rated the importance of childhood obesity as a health priority with a mean rating of 67.8. Meanwhile, the mean score for agreement with government policy on tackling childhood obesity was 43.8. This is similar to previous findings in the UK regarding obesity, where 69% of the Scottish population indicated that high levels of obesity are harmful, and that was higher than what they considered for smoking and alcohol (NHS Health Scotland, 2017). This is comparable to what has been found in other countries, where 75% of the people in the USA believed obesity to be a very serious health problem (Tompson et al., 2012). The latest UK national surveys, conducted by Ipsos MORI in 2018, showed that a higher proportion, 93% of 1,000 participants who completed the survey, recognise obesity as a big problem, and 60% of them agreed that the government could do more (Ipsos MORI, 2018). The difference in percentages of agreeing to the level of importance of obesity as a health issue in the UK may be related to the wording of questions in surveys. As only 43% of the Ipsos MORI survey participants considered obesity as a "very big problem" and another 51% of individuals stated that obesity is a "fairly big problem". The question of the present study was regarding considering addressing obesity as a health issue a priority.

In general, participants identified most interventions that are proposed and/or implemented in the "Childhood Obesity: a Plan for Action" documents to be effective and appropriate, where most median ratings ranged between 57 and 76. For instance, the median rating for the introduction of a 9pm watershed on TV advertisements for HFSS food items as an effective strategy was 69. NHS Scotland found in 2017 that 56% of the Scottish population supported this policy (NHS Health Scotland, 2017). Likewise, Americans strongly supported the use of policies that restrict fast food advertisements

during children's TV programmes (Evans et al., 2005). However, in Australia, people seem far less inclined to support the banning of food advertisements during children's watching time compared to other interventions. Participants had greater support for positive interventions including promotion of healthy eating during children's television viewing, the provision of healthy food at school and compulsory daily physical education at school. This may indicate that the majority of this group of individuals believed in positive reinforcement of health (Hardus et al., 2003). The variation in support for banning promotion strategies between the Australian survey and the former mentioned surveys, including the current one, may be due to the fact that a high level of awareness towards the effect of advertisements on children's consumption of HFSS food was not officially acknowledged before the year of 2005 (Hawkes, 2004). A more recent study would validate this argument, where 83% of the another group of Australians who were invited to participate in a study in 2012 were in favour of a ban on advertising unhealthy food at times when children watch TV (Morley et al., 2012).

Participants in the present study were in favour of the concept of reformulation, giving a median rating of 71 for challenging the drink and food industry to reformulate to achieve lower sugar and calorie content of food as an effective approach. In 2012, a high level of support was found among Australian for such a policy, as 87% of participants believed that the Government should push food companies to reduce fat and sugar content of processed food (Morley et al., 2012). A study that investigated the perception of 1047 adults in the USA in 2005 stated that there was widespread consensus for interventions related to exercise education (82%) and increasing the amount of time spent on physical activity in schools (69%), which is similar to the findings of the current study, despite the 17 years' difference between the two studies (Evans et al., 2005). It is important to note that the general support for interventions may reflect the scale to which the issue of childhood obesity and its related risks are covered and emphasised across different media platforms and other means of communication with the public.

In terms of taxes, there has been an ongoing debate around their implementation. In 2005, the previously mentioned study that included a representative sample of the American public indicated that they were opposed to any tax-based strategies such as raising the price of unhealthy food, where 39% of participants were in favour for such policies (Evans et al., 2005). In contrast to this, and more recently, 71% of 1,511 Australian adults were in favour of taxing unhealthy food only if the revenue was used to subsidise healthy food. 69% of participants were in favour of a similar tax levied on soft drink (Morley et al., 2012). Furthermore, 53% and 62% of the Scottish public supported the use of tax on sugary food and fizzy drinks respectively (NHS Health Scotland, 2017). Similar levels of support were found in the current study, where the median value for English participants considering the introduction of the Soft Drinks Industry Levy appropriate was 64." Interestingly, a study reported by Swift and colleagues in the UK showed that 50.5% of participants deemed that the soft drink levy will have no effect on children's health, and only 25.5% of them indicated that it would improve children's health (2018).

In line with previous studies, some demographic differences were found among participants in terms of their perceptions on policies and interventions. Age seemed to affect participants' views on the appropriateness of advertisement restrictions and sugar reduction in cereal and confectionary strategies, where the support was higher among people from older age groups. Gender also had some influence, with females showing more support for the effectiveness of certain policies, like the banning of energy drink sales to children <16 years. These differences are similar to what was found by other researchers (Beeken and Wardle, 2013, Hilbert et al., 2007). However, there was no consistent pattern for age and gender association with individuals' support for policies across different studies (Beeken and Wardle, 2013, Covic et al., 2007, Evans et al., 2005). In addition, the dissimilarities were small, which is suggested to be due to broader cultural attitude variation (Beeken and Wardle, 2013).

### 5.4.1 Perceived Weight

Based on the suggestion that a person's own weight perception influences their attitude and attributions regarding obesity (Okonkwo and While, 2010), this study had hypothesised that there is an effect of weight perception status on individuals' beliefs regarding the effectiveness and appropriateness of interventions used in tackling childhood obesity. Conversely, the results of this study correspond to earlier studies in the UK, where no association was found (Beeken and Wardle, 2013, Chambers and Traill, 2011). However, the percentage of individuals who placed themselves in the group of overweight or obese in this study (39.9%) were much lower than the national statistics of the UK for overweight or obese, with a rate of 63% in the population (Baker, 2018). This weight underreporting may be associated with different factors including lack of awareness of their own weight, denial or internal stigmatisation (Flint et al., 2019, King et al., 2018, Shiely et al., 2013).

### 5.4.2 Parental Status

Parental status has been considered in several studies when evaluating parents' perceptions about childhood obesity and its related risks and many researchers have assessed parents' attitudes towards potential solutions of childhood obesity and their effectiveness (Covic et al., 2007, Fleming-Milici et al., 2018, Morley et al., 2012). Morley and other scholars acknowledged differences between parents and non-parents in terms of their support for certain policies, including restrictions on the sales of unhealthy food, taxes on soft drinks and the use of traffic light labelling on packaged food (2012). Their results illustrated that parents were significantly more likely to support these polices compared to non-parents. This was contrary to the results of the current study, as parents were less likely to consider the banning of price promotions an effective policy. However, it is essential to mention that results reported by Morley et al, may be confounded by the fact that the Australian participants conditioned their support to taxation or price promotion restrictions with the use of these funds to subsidise healthy food.

In 2003, one study identified that parents had higher scores than non-parents in their support for "governmental action", presented as taxes, advertisements control, the provision of safe recreational facilities and community-wide prevention initiatives (Hardus et al., 2003). These results are aligned with the outcomes of the present study, where parents gave significantly higher ratings in agreement with that the Government is doing enough to address childhood obesity. Nonetheless, they were also more likely to consider themselves responsible for their children's weight.

Parents' feeling of responsibility may be influenced by feeling judged for decreasing the impact of others' efforts, including schools, communities and governments. This was highlighted by a study that investigated the perceptions of primary school head-teachers on the barriers and facilitators of childhood obesity prevention (Howard-Drake and Halliday, 2015). The results of this qualitative analysis indicated that teachers considered parents to be both the problem and the solution to the issue of childhood obesity, in terms of the effect of their knowledge, skills and behaviour on determining their children's dietary and activity choices. Similarly, Covic and her colleagues stated that participants ranked 'poor parental supervision of diet' as the seventh most recognised attribute to increasing rates of childhood obesity compared to other determinants including environmental and psychological options. Participants in the Covic study strongly supported the role of parents in finding a solution for childhood obesity, as 98%, 97% and 96% of them indicated that parents should encourage their children to do physical activity, should provide healthy food choices, and should educate their children about healthy eating respectively (Covic et al., 2007). This heuristic approach of blaming parents ignores the complexity of childhood obesity and does not take other important determinants into consideration, such as environmental elements. For example, parents who participated in a large Australian survey stated that safety fears have stopped them from allowing their children to go walking or cycling to schools (Booth et al., 2006).

On a final note on the responsibility of parents for their children's weight, it is suggested that some parents do not perceive their children to be in the categories of overweight or

obese. In 2017, results of the Health Survey of England indicated that 69% of parents of children with overweight and obesity thought that their child had the right weight (Conolly and Davies, 2018). This in turn may lead parents not to intervene to attempt to change their children's weight.

Parental responsibility may fall under the bigger umbrella of individual responsibility. This concept indicates that lack of responsibility among individuals is considered the cause of weight gain and obesity, incorporating being weak, lazy and unengaged in healthy dietary and activity behaviours. This is linked to the polices that aim to educate individuals and implore them to alter their behaviour (Brownell, 2010). In Germany, people considered interventions that focus on individual behaviour change to be strongly effective. These included providing individuals with information around focusing on healthy eating and raising their awareness of the importance of physical activity. They also supported some microenvironment strategies, such as increased marketing of healthy food in school cafeterias, which may also be imbedded under individual strategies (Hilbert et al., 2007). Similarly in the UK, the surveys of the Ipsos MORI Reputation Centre highlighted that the laypeople considered individuals as holding primary responsibility for their own diet, where 81% of the public tended to strongly agree that individuals and families are not doing enough themselves to eat more healthily. However, they also stated that industry could do more to encourage healthy eating (Bailey et al., 2017).

There was general support from participants for most interventions proposed in the current survey, where most interventions may be categorised as environmental approaches or non-individual interventions. Yet, the median rating was 77 for participants who reported that behavioural change is likely to be a suitable solution to tackling childhood obesity in the UK. This unconscious referral to individual blame has also been identified in other studies. Beeken and Wardle illustrated that although 61% of their sample agreed that the abundance of unhealthy food items is a factor in increasing rates of overweight, there was also strong agreement with the two statements: 'Being overweight is mainly the person's own fault' and 'People are overweight because they lack willpower' (2013). In line with

these findings, the Scottish national survey that assessed population attitudes to overweight and obesity showed that 82% of people agreed that the responsibility to reduce obesity rates is collective between individuals, industry and the government, but only 13% agreed it was individual. Nevertheless, 86% of the same sample supported the policy to provide more free weight management courses (NHS Health Scotland, 2017).

Although the role of parents or individuals in influencing their own or their children's weight should not be underestimated or neglected, there are potential unintended consequences related to such focus on individual responsibility that need to be addressed. Stigmatisation, both internal and external, is one of these concerns that needs to be tackled. It is suggested that the content of weight stigma in health-related media is high, a pattern that is seen in different countries. In the USA, researchers illustrated that the portrayal of individuals with overweight or obesity is presented in a stigmatising manner in different sources of information from TV programmes to books, newspapers and internet content (Ata and Thompson, 2010). Similarly in Germany, online news photographs tend to stigmatise individuals with obesity (Heuer et al., 2011). This consequently affected individuals' beliefs and led to a quarter of the population to show stigmatising attitudes towards individuals with obesity, including their labelling as lazy, unmotivated and unintelligent (Sikorski et al., 2011). Similar conclusions were drawn from an analysis of national newspapers in the UK, where weight stigmatisation was evident (Flint et al., 2016).

The occurrence of these attitudes and behaviours towards individuals with extra weight may reinforce prejudice and discrimination, especially in the context of children (Puhl and Latner, 2007). This is directly associated with negative consequences on the well-being and health of individuals (Pont et al., 2017). Although problematic weight perception did not affect individuals' support to obesity-related interventions in the present study, it is argued that these negative stereotypes may be translated into people's support for obesity-related policies (Sikorski et al., 2011), in which the public will not recognise the need for national-level measures (Beeken and Wardle, 2013).

### 5.4.3 Political Orientation

Participants' political affiliation is another factor that is often considered in discussions around individual vs. environmental responsibility. It is established that one's political ideology interacts with her/his values and beliefs including people's health-related behaviours and principles (Kannan and Veazie, 2018). This also includes their attitude towards public health interventions, as Young and her colleagues found that liberal respondents who viewed images of individuals with overweight had a higher level of agreement with the assertion that social factors were responsible for causing obesity in comparison to conservative participants (Young et al., 2016). These results align with the outcomes of the present study, as the support for banning price promotions strategy was significantly higher for participants who rated themselves as more conservative with regards to their political orientation. They also had significantly higher ratings for individual solutions as suitable in tackling childhood obesity compared to environmental ones.

## 5.5 STRENGTHS AND LIMITATIONS

This research expands our knowledge on how individuals perceive public health policies in the UK, particularly the interventions related to childhood obesity that are presented in the "Childhood Obesity: a Plan for Action" 1 and 2 documents. The findings provide additional evidence on how laypeople view these approaches in terms of effectiveness and appropriateness. Moreover, it is the first study in the UK that has gone some way towards enhancing our understanding of the associations between people's characteristics and their perceptions on childhood obesity interventions. Specifically, the results of this research make several noteworthy contributions to the interaction between parental status, political orientation and perceived weight status on the one hand, and participants' attitudes and beliefs on the other.

A number of important limitations need to be considered. First, asking participants to rate effectiveness or appropriateness of an intervention on a 0-100 scale did not allow the researchers to draw comprehensive conclusions about the correlation between individuals' characteristics and their response to these questions. It is suggested that the use of a 5 point Likert scale ranging from 1 (not at all) and 5 (totally) would have allowed the researchers to interpret the results less cautiously.

Second, creating the composite variables of individual and environmental solutions may have affected the end results. For instance the individual solution composite variable was created by calculating an average value of behavioural, biological and psychological solutions. This means that it was assumed that these three variables have equal weighting. This may not be the case, as it may be possible that participants valued one of these solutions more than another. However, creating a weighted average of the composite variable was not possible, due to the fact that there is no similar research that quantifies how people value behavioural solutions over biological or psychological solutions, or any other scenario. This would have meant that behavioural solutions had a higher impact on the total average of the composite variable and, automatically, the final outcomes.

Third, the scope of understanding the role of perceived weight status was limited by the use of a "how do you describe yourself?" question, asking participants to place themselves in one of four weight categories; underweight, healthy weight, overweight, and very overweight and obese. However, the use of silhouette figures and its comparison to individuals' self-reported weight and height would have been more informative.

Fourth, the questionnaire asked individuals whether they were parents (Question 8) and whether they were grandparents (Question 9). In hindsight, considering the significant number of participants who reported being grandparents but not parents, the survey should have included a clarification that parents do not only include parents of children, to avoid mistakes being made in the survey being completed. Alternatively, a skip logic could have been inserted to prevent those answering that they are not parents having the choice to indicate that they are grandparents. As parents and grandparents were combined when analysing the results, however, this oversight may not have significantly affected the results.

Fifth, one potential source of weakness in this study which could have affected the measurements of effectiveness of policies was the exact extraction of the wording of the interventions from the documents (HM Government, 2016, 2018). Although this is the correct scientific approach to build a survey, some interventions may have been harder for individuals to interpret and assess than others.

On a final note, although this study provides insights about the interventions that may be effective and appropriate in tackling childhood obesity based on people's opinions, analysing policies using this approach does not provide evidence to ensure the effectiveness of any intervention in practice. Future work may use a qualitative based research method that would allow further understanding of individuals' perceptions of such matters. Furthermore, the results of this study have brought up many questions in terms of the effect of laypeople's characteristics, as discussed in this study, on their willingness to change their, or their children's, behaviour.

## 5.6 CONCLUSION

The aim of this study was to assess laypeople's attitudes and beliefs around the interventions proposed in the documents of "Childhood Obesity: a Plan for Action" to tackle childhood obesity in the UK. The intention was to evaluate whether people place more responsibility on parents and individuals compared to environmental factors when considering weight gain. In addition, another one of the aims of this analysis was to identify if individuals' parental status, political orientation and perceived weight status would have an effect on their perception of these policies.

This analysis indicated that there was widespread consensus on considering the interventions proposed in the documents appropriate and effective across most participants and groups. However, political conservatism had an effect of placing a higher level of importance on individuals' personal responsibility for behaviour change. Furthermore, while laypeople perceived that weight status did not have a significant effect on their perception of policies, their parental status did.

These outcomes support the idea that different characteristics of individuals across the population interact with and affect their attitudes and perceptions towards public health interventions and their identification of obesity as a matter for individual or environmental responsibility. These results highlight the importance of taking public perception into consideration in the process of policy decision making. This may play a role in increasing the potential effectiveness of such strategies, which in turn may reduce inequality in outcomes across society and reduce the potential impact of stigmatising individuals who have extra weight and reduce discrimination against them. Scrutinising the results also sheds light on the importance of increasing the public's awareness with regards to the complexity and interdisciplinary nature of public health interventions used to address obesity.

# CHAPTER 6: PROBLEMS HIDING IN PLAIN SIGHT: A THEMATIC ANALYSIS OF THE UK GOVERNMENT POLICY "CHILDHOOD OBESITY: A PLAN FOR ACTION" PARTS 1 AND 2

*Aim*: To critically analyse the language and narratives contained in the UK Government policy documents "Childhood Obesity: a Plan for Action" parts 1 and 2 to identify themes related to language and narratives associated with inequalities.

*The objectives of this study are as follows:*

1. To undertake a thematic analysis using inductive thematic analysis to identify the main themes presented in the "Childhood Obesity: a Plan for Action" documents
2. To assess how obesity is framed in these documents, and understand the assumptions behind this presentation
3. To identify potential consequences of this framing

## 6.1 INTRODUCTION

This introduction is set to explore the different approaches that are used to evaluate obesity-related public health policies.

### 6.1.1 Solution-Based Evaluation

Using Solution-based evaluation, research focuses on the evaluation of interventions themselves as they are set as solutions to obesity (Walls et al., 2011). Some studies argue that the dominant narrative of these public health interventions is the over-simplistic heuristic approach that is based on simple linear methods of prevention and treatment (Kelly and Russo, 2018). In addition, it is suggested that most of the proposed solutions exclusively focus on factors that are considered to be within individual responsibility and personal misconduct (Mansfield and Rich, 2013). This neglects the fact that obesity is a complex issue, and handling it with a mono-casual approach dismisses the interrelationships between social, economic, commercial, environmental and clinical factors that heavily affect the public's biology and behaviours (Butland et al., 2007).

In 2015, the WHO stated that "the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems [shape] the conditions of daily life". This statement acknowledged that social determinants play a major role in influencing people's daily life behaviours (WHO, 2015c). Despite this, for the last 30 years, public health policies in the UK have persistently focused on urging individuals to change their

behaviours and improve their lifestyle (DoH, 1992, DoH, 1999, DoH, 2004d, DoH, 2004c, HM Government, 2011, HM Government, 2016, HM Government, 2018). However, it is suggested that the policy document "*The Health of the Nation: A Strategy for Health in England"* (DoH*,* 1992) and subsequent papers were a turning point for addressing the forces and systems that affect people's behaviours. Although these documents maintained an emphasis on individuals' dietary and activity habits, and personal responsibility over health, they also included the need to tackle the possible role of economic and social factors, in order to yield greater improvements in population health (Kriznik, 2015).

Nonetheless, there is ongoing debate around considering social determinants in formulating public health policy. It is claimed that Government should not be "nannying" society by dictating how people should live (DoH, 2001). It should instead create and improve the conditions for people to make better and healthier choices, which can be by improving access to information and healthy options, which will in turn help individuals overcome the constraints to a healthy lifestyle (DoH, 1999). This could implicitly point to a deficit in personal characteristics and lack of responsibility that need to be rectified through Government policy (Whitehead, 2007). Debates around responsibility in obesity and weight gain are unresolved, however this may be one of the main determinants of the effectiveness of obesity polices.

In addition, to make the most of the existing research and knowledge, policy makers should reflect on and assess the status of previously-applied solutions. However, research has indicated that there was insufficient evaluation of public health interventions in this way, leading policy makers to eventually fall back onto the same simple narratives (Kahneman, 2011). These examples illustrate the extensive work required to assess the application of different solutions and interventions to tackle obesity.

### 6.1.2 Problem-Based Evaluation

By contrast, problem-based evaluation focuses on the issue that is considered to be the problem itself, rather than the policy solutions proposed to address it. Currently, there is

very limited work on how obesity itself is presented as an issue, or more often problematised in relevant Government policies. In addition, there is little research on the assessment of the policy process. Existing work suggests that public health policies lack a critical engagement with the issue, which may affect how its associated interventions are set into a policy document that is to be viewed as the ultimate solution for this issue. In other words, polices are considered the end of a 'problem' (Kriznik, 2015). It is argued that this approach towards addressing 'problems' may lead to policies being seen to be natural, unbiased, evidence-based solutions, that sit outside the community to 'fix' an issue for a group of people. This links back to Kelly and Russo's argument of the over-simplistic interventions (Kelly and Russo, 2018), where solutions are assumed to be unbiased, linear, and that they are translated as policies directly from evidence. Accordingly, more research should focus on understanding the nature of the public health issue; in this case, obesity.

There are several types of qualitative methodologies that have been used to assess the content of public health policies. Through the exploration of different studies, multiple aspects were highlighted as crucial to consider in the process of policy examination. First, policy documents are made of language (Berger and Luckmann, 1991). This obvious fact was used to direct researchers' attention to the importance of examining both implicit and explicit messages that are presented in a policy document. This is essential to understand the underlying assumptions about the addressed 'problem', which determine the discussion of solutions and their presentation to the public. Second, the inclusion of politics in policy analysis is vital to identify the role of politics and its associated beliefs in the setting of policies and solutions, yet it seems to be almost absent in the literature, especially in health-related policy analysis. There is considerable importance to understanding the political context of any policy, as it allows the identification of the correlation between the political affiliations of the government issuing the policy and its way of conceptualising a 'problem'. Therefore, health-related policy analysis should

explore the political nature of the 'problem' and the way it is articulated in policy documents (Foucault, 1991).

The approach of examining the underlying meaning of policies is referred to as the Foucaultian post-structuralist approach, which also involves the presentation of a 'problem' in a policy. This includes problematisations of an issue, their change over time and how they are applied as part of government policy setting. This methodology was then adapted by Bacchi, who presented the "What's the problem represented to be? (WPR)" approach (Bacchi, 2015, 1999). Problematisation does not aim to expose hidden meaning or myths or to develop a more efficient solution to a 'problem' (Deacon, 2000). In fact, it is to investigate the superficial and explicit aspects of an issue and identify the context which lie behind it (Bacchi, 2012).

There is a call to shift policy analysis from focusing purely on a problem-solving to a problem-questioning technique (Bacchi, 1999). Usually health-related policy analysis assesses the effect of policy to maximise the benefit of interventions and minimise possible undesirable outcomes. On the other hand, the problem-questioning approach offers a new way of researching health issues by considering policies and health 'problems' under a different lens. The aim is to encourage researchers to draw their attention to the root of the 'problem' and the process of policy making (Bacchi, 2015, Turnbull, 2006).

This updated approach to analysis allows broader examination of policies by identifying different stages of policy decision-making, including evidence-based details of interventions, the method for formulating policies, and the means of official publication of policy documents. This will facilitate a deeper understanding of discussions around the 'problem' and eventually its presentation in the policy document to the public (Foucault, 1991).

This form of policy analysis can take place using different methods. It can be solely studied through the lenses of linguistics and/or grammar, where it is interpreted literally. Alternatively, across different disciplines, analysis can be done on different documents

including policy reports, newspaper articles, film, advertisements or interview transcriptions (Powers, 2007). Bacchi's approach, the WPR, focuses mainly on policy reports and documents.

As mentioned throughout this thesis, childhood obesity is one of the main public health issues in the UK. Therefore, the current study aims to conduct a thematic analysis. This will be through the application of WPR approach on the documents that represent the current Government position on childhood obesity and its policies relating to public health interventions: "Childhood Obesity: a Plan for Action" parts 1 and 2. The objectives of this research are to (1) critically conduct a thematic analysis of the two documents in order to identify themes that are related to the representation of obesity and (2) consider the potential negative consequences associated with this representation.

## 6.2 METHODS

### 6.2.1 First Step

The first step of this analysis was to conduct an interpretative inductive thematic analysis on the policy documents (Fade and Swift, 2011), where the two documents were coded in themes. This involved exploring the data to identify any common ideas and themes that emerge from the document text, without any pre-determination of possible themes. I initially read the documents in full without any other processes. On second reading, I coded the documents with regards to the general issues raised in the documents. I then discussed the generation of themes based on the coding with my supervisor. The themes discussed were then merged, initially independently by me, and then again in discussion with my supervisor.

Word clouds were generated by inputting all of the codes chosen for each theme, excluding common words like "and", "the" and "to" into word cloud-generating software, Wordle.

### 6.2.2 Second Step

The second step was based on using the identified themes from the first step to apply the previously mentioned WPR approach. The thematic analysis in the first step organised the documents and analysed the main issues raised by them. This allowed the exploration of the problematised issues, as per question 1 of the WPR approach.

The six questions that form Bacchi's WPR approach are as follows: from (Bacchi, 2009), Page 2.

1. What is the 'problem' represented to be in a specific policy?
2. What presuppositions or assumptions underlie this representation of the 'problem'?
3. How has this representation of the 'problem' come about?
4. What is left as unproblematic in this problem representation?
5. What effects are produced by this representation of the problem?
6. How/where is this representation of the 'problem' produced, disseminated and defended?

The outcomes of the two steps of this qualitative analysis are presented in two sections; results and discussion as follows:

- Results section: This lists the primary themes that emerged from the thematic analysis of the "Childhood Obesity: A Plan for Action" documents. This includes a set of examples on themes and sub-themes from the policy documents' text, in addition to a summary table attached at the end of the results section including one example from each sub-theme (Table 6.1)
- Discussion section: Answers to Bacchi's six questions based on the themes

## 6.3 RESULTS

The thematic analysis identified 3 main themes in "Childhood Obesity: a Plan for Action" which together summarise the main messages through which childhood obesity is addressed. These were "Where Does Responsibility of Action Lie?", "Weight Centrism" and "Think Inside the Box". This section will elaborate on each of these themes by describing its narrative and examples.

### 6.3.1 Theme 1: Where Does Responsibility of Action Lie?

There are two opposing perspectives of what contributes towards obesity. The first is the individualising frame that considers individuals to be responsible. The other is the systematic frame, also known as structural, which places responsibility on social and other environmental factors. These perspectives play an essential role in setting policies and gaining public support.

This theme illustrates how responsibility was considered within the "Childhood Obesity: A Plan for Action" documents. A word cloud has been generated from the key words of this theme (Figure 6.1).




*Figure 6.1: A word cloud from the key words of Theme 1*

Scrutinising the two documents identified the Government's acknowledgment of the need for collective action to tackle childhood obesity. This include the role of scientists, industry, NGOs, leisure centres, hospitals, health-care professionals, local leaders, schools and parents.

> "Therefore, PHE is working with academics, industry, health Non-Governmental Organisations (NGOs) and other stakeholders, to review the nutrient profile model to ensure it reflects the latest government dietary guidelines." *Plan for Action 1, Pg. 6*

> "Every public sector setting, from leisure centres to hospitals, should have a food environment designed so the easy choices are also the healthy ones… This will include encouraging local authorities to adopt the GBSF standards, particularly in leisure centre vending machines." *Plan for Action 1, Pg. 6*

> "Many schools already offer an average of two hours of PE or other physical activities per week. However, we need to do more to encourage children to be active every day." *Plan for Action 1, Pg. 7*

> "We are asking health care professionals to build on the good work they already do by always talking to parents about their family's diet, working towards making it the default to weigh everyone referring people to local weight management services, clubs and websites if they ask for more advice." *Plan for Action 1, Pg. 11*

> "We all have responsibility to work together to support young people in meeting this challenge. Whether we are parents, teachers, businesses, local leaders or health professionals, we must all play a role in helping to improve the health of our children and give future generations the best possible start in life." *Plan for Action 2, Pg. 4*

> "…ensure access to quality green space to promote physical activity. They [local authorities] can also offer professional training, parenting support, social marketing campaigns and weight management services." *Plan for Action 2, Pg. 24*

The documents highlighted the role of industry more than the role of other institutions and stakeholders. They were encouraged to reduce their products' sugar and calorie content through formulation, mainly focusing on sugary drinks. In addition, they were urged to re-assess their advertisements to help parents choose healthier options.

> "This is a [sugar] levy on producers and importers, and not on consumers, and is designed to encourage producers to reduce the amount of sugar in their products and to move consumers towards healthier alternatives" *Plan for Action 1, Pg. 4*

> "I want to see the food and advertising industries using their world-leading talents to help all parents find the healthier choice the easier choice." *Plan for Action 2, Pg. 5*

"As part of the next phase of the sugar reduction programme we will review the scope for reformulation of product ranges aimed exclusively at babies and young children." *Plan for Action 2, Pg. 14*

"How food and drink is promoted to us when we are buying food … can lead us to purchase more than we need." *Plan for Action 2, Pg. 22*

The Government was shown to play a leading role in the effort to reduce national childhood obesity rates. Part of this is through the application of taxes and advertisement restriction. Moreover, with the collaboration with PHE, the Government will work to update dietary guidelines.

"This programme will be led and run by Public Health England (PHE) and will apply to all sectors of industry" *Plan for Action 1, Pg. 4*

"PHE will advise Government on setting sugar targets per 100g of product and calorie caps for specific single serving products" *Plan for Action 1, Pg. 5*

"The restrictions on food and drink advertising that are already in place to protect children are based on a tool called a 'nutrient profile'." *Plan for Action 1, Pg. 6*

"Therefore, the Secretary of State for Education will lead a campaign encouraging all schools to commit to the standards." *Plan for Action 1, Pg. 9*

"I [the prime minister] am determined that this Government will lead this national effort." *Plan for Action 2, Pg. 4*

"The need for Government to act to reduce the amount of sugar our children consume is clear and formed the basis of our 2016 plan" *Plan for Action 2, Pg. 13*

There is also a considerable focus on parents' and carers' responsibility to provide their children with the heathiest food options, by offering healthy meals and controlling their purchases at supermarkets. This is in addition to their role to encourage them to increase their physical activity. Some interventions are directed to equip parents with vital nutrition knowledge and information and to connect them with local weight management services in particular cases.

"Whilst children spend a significant amount of time in school, keeping children active is a shared responsibility and parents and carers need to play their part" *Plan for Action 1, Pg. 8*

"The actions we are proposing will ensure that, by working together across society, we can improve …. Strengthen the information available to parents about those products and change the way that unhealthy food and sugary drinks are promoted." *Plan for Action 2, Pg. 4*

"We also want to put control back into parents' hands by making it clearer for them when and where HFSS adverts can and cannot be shown, so that they can make the best choices for their children." *Plan for Action 2, Pg. 21*

"Parents may not realise the extent to which their purchases are driven by prompts from children, but evidence suggests that twice as many purchases are triggered by children than parents are aware of…. We must act to support parents" *Plan for Action 2, Pg. 22*

"The NCMP also gives local authorities the opportunity to connect parents with health and care professionals and local weight management services to help them support their children to achieve and maintain a healthy weight" *Plan for Action 2, Pg. 26*

### 6.3.2 Theme 2: Weight-Centrism

The medicalisation of obesity and the focus on the energy balance equation are applied at the centre of policies to provide a "rational solution", on both individual and population levels, to "combat" obesity. This directs people with extra weight to track their calorie consumption and expenditure to achieve the ideal weight. For this reason, weight loss is extensively promoted through public health interventions and policies.

Examples of Theme 2 are separated into three sub-themes: (1) determinism and reductionism, (2) one size fits all, (3) evidence base. A word cloud has been generated from the key words of the theme (Figure 6.2).




Figure 6.2: *A word cloud from the key words of Theme 2*

#### *6.3.2.1 Determinism and reductionism*

Although the complexity of obesity was highlighted in the documents, the proposed solutions were reduced to interventions focusing on energy balance, aiming to reduce children's food intake and increase their physical activity. In addition, the importance of a balanced diet was addressed, yet the focus of interventions was mainly on sugar reduction and calorie intake.

It was determined that the interventions proposed in the documents will help parents make healthier choices. These interventions include restrictions on TV advertisements of HFSS (high fat, sugar and salt), banning the promotions of HFSS in supermarkets, and calorie labelling. Furthermore, the frequent use of the word "will" indicates the anticipated effectiveness of these interventions on weight loss and eventual overall improvement to children's health and chances in life.

> "Obesity is a complex problem with many drivers…. However, at its root obesity is caused by an energy imbalance: taking in more energy through food than we use through activity. Physical activity is associated with numerous health benefits for children, such as muscle and bone strength, health and fitness, improved quality of sleep and maintenance of a healthy weight" *Plan for Action 1, Pg. 3*

> "Evidence shows that slowly changing the balance of ingredients in everyday products, or making changes to product size, is a successful way of improving diets.[17, 18] …. We will therefore launch a broad, structured sugar reduction programme to … This can be achieved through reduction of sugar levels in products, reducing portion size or shifting purchasing towards lower sugar alternatives." *Plan for Action 1, Pg. 4*

> "In order to make healthier choices, families need to be presented with clear information about the food they are buying." *Plan for Action 1, Pg. 9*

> "It [Childhood obesity: Plan for Action] will improve our children's health, enhance their chances in life and, in doing so, also fundamentally reduce the pressures on the health service in the years ahead." *Plan for Action 2, Pg. 4*

> "We are confident that the additional actions outlined in this plan will help parents make the best decisions for their families by changing the default in our food environments, so that healthier choices become the easiest choices." *Plan for Action 2, Pg. 11*

> "Over time we know that small daily increases in children's calorie intakes will lead to weight gain, obesity and future ill health." *Plan for Action 2, Pg. 20*

*6.3.2.2 One size fits all*

Both policy documents discussed the need for all children to be engaged in physical activity, regardless of their age, ability and circumstances. The interventions suggested consider all children through the same lens. Under this universal approach, sugar and calorie reduction is expected to affect around 50% of children's intake. A similar assumption is made for the calorie labelling intervention, where it is assumed that introducing labelling legislation to all out of home sectors will help the public make healthier choices regardless of their social and educational backgrounds.

> "This investment will focus on helping children acquire a basic level of competence in sport and physical activity as well as supporting them to have fun, regardless of their level of ability." *Plan for Action 1, Pg. 8*

> "Initiatives like this [Daily Mile] can improve the physical, social, and mental wellbeing of our children – regardless of age, ability or circumstance" *Plan for Action 2, Pg. 5*

> "Our sugar and calorie reduction programmes will, together, apply to foods which account for around 50% of children's overall calorie intake." *Plan for Action 2, Pg. 16*

> "To provide the public with the nutritional information they need to make healthier choices wherever they choose to eat we will introduce legislation to mandate consistent calorie labelling in England for the out of home sector" *Plan for Action 2, Pg. 18*

*6.3.2.3 Evidence base*

This sub-theme aims to shed the light on the fact that several statements and proposed strategies are not supported by an appropriate evidence base. For instance, the documents state that childhood obesity is one of the biggest health problems in the UK. Moreover, the Healthy Star Scheme and weight management support services are both suggested as solutions in tackling childhood obesity.

Regarding the soft drinks industry levy (SDIL), one of the goals identified was to provide a strong incentive for industry action. This was followed by a definitive statement on the

useful use of money raised from the levy into schools programmes. Neither of these claims was supported by any link to evidence. This is in addition to the argument presented in the policy documents that there is an association between the sugar and caffeine content of energy drinks and obesity. However, energy drinks are not included in the SDIL.

"But the levy [SDIL] will create stronger incentives for action." *Plan for Action 1, Pg. 4*

"The programme will initially focus on the nine categories that make the largest contributions to children's sugar intakes: breakfast cereals, yoghurts, 5 biscuits, cakes, confectionery, morning goods (e.g. pastries), puddings, ice cream and sweet spreads." *Plan for Action 1, Pg. 4-5*

"We are re-committing to the Healthy Start scheme, which provided an estimated £60 million worth of vouchers to families on low income across England in 2015/16…" *Plan for Action 1, Pg. 7*

"We will also ask PHE to build on work which is underway around digital based weight management support for adults and explore similar approaches for children and families." *Plan for Action 1, Pg. 10*

"Childhood obesity is one of the biggest health problems this country faces" *Plan for Action 2, Pg. 6*

"Importantly, we have also seen an increasing consumer demand for healthier food and drink as a result of these programmes" *Plan for Action 2, Pg. 7*

"We have already seen the money raised by the Soft Drinks Industry Levy flowing into schools, funding breakfast clubs for the most disadvantaged children and being invested in PE and school sport" *Plan for Action 2, Pg. 10*

"Energy drinks are often high in sugar as well as caffeine, and may contain more sugar than full-sugar soft drinks[19], and are therefore a contributor to both obesity in children and dental problems." *Plan for Action 2, Pg. 15*

### 6.3.3 Theme 3: Think Inside the Box

There is a high significance placed on the use of appropriate language to communicate health messages to the public. This is mainly due to the fact that policy documents can invoke feelings, which may be associated with how individuals perceive and interact with these policies.

Examples of Theme 3 are separated into two sub-themes: (1) Is it management, prevention or cure of childhood obesity? (2) Language. A word cloud has been generated from the key words of this theme (Figure 6.3).




*Figure 6.3: A word cloud from the key words of Theme*

*6.3.3.1 Is it management, prevention or cure of childhood obesity?*

The two policy documents used a set of words to express different meanings in terms of addressing childhood obesity. This suggests that there is no clear definition for the overall aim of the plan. For instance, the main goal is to halve the rates of childhood obesity, however, the terms "protect", "treat" and "prevent" were used interchangeably.

"We aim to significantly reduce England's rate of childhood obesity within the next ten years" *Plan for Action 1, Pg. 3*

"The restrictions on food and drink advertising that are already in place to protect children are based on a tool called a 'nutrient profile'." *Plan for Action 1, Pg. 6*

"From September 2017, we will introduce a new voluntary healthy rating scheme for primary schools to recognise and encourage their contribution to preventing obesity by helping children to eat better and move more." *Plan for Action 1, Pg. 8*

"We are also keen to celebrate schools that can demonstrate healthy approaches towards tackling obesity amongst their pupils…" *Plan for Action 1, Pg. 9*

"I have set a new national ambition to halve childhood obesity rates by 2030 and significantly reduce the health inequalities that persist." *Plan for Action 2, Pg. 5*

"To protect children from this exposure the UK currently places strong restrictions on the advertising of high fat, salt or sugar (HFSS) products." *Plan for Action 2, Pg. 20*

"The NCMP also gives local authorities the opportunity to connect parents with health and care professionals and local weight management services to help them

support their children to achieve and maintain a healthy weight" *Plan for Action 2, Pg. 26*

*6.3.3.2 Language*

The language in the documents lacks the use of people-first language to address obesity or children with obesity.

"Obese adults are seven times more likely to become a type 2 diabetic than adults of a healthy weight[4] which may cause blindness or limb amputation…" *Plan for Action 1, Pg. 3*

"…presents the opportunity to engage parents of overweight and obese children…" *Plan for Action 2, Pg. 26*

There is an acknowledgement of the role of social and environmental factors in the increased rates of obesity, which is associated with reduced blame of individuals. It was mentioned implicitly and explicitly in several incidences that individuals (parents) should have more control of what is consumed and how active they and their children are. It is possible that some interventions were framed in the documents as being set to overcome the lack of willpower among individuals to control their behaviour.

"This is because the changes are universal and do not rely on individual behaviour change. We will therefore launch a broad, structured sugar reduction programme to remove sugar from the products children eat most" *Plan for Action 1, Pg. 4*

"Whilst children spend a significant amount of time in school, keeping children active is a shared responsibility and parents and carers need to play their part" *Plan for Action 1, Pg. 8*

"We know that on average overweight and obese children are consuming up to 500 extra calories per day." *Plan for Action 2, Pg. 7*

"From September 2017, we will introduce a new voluntary healthy rating scheme for primary schools to recognise and encourage their contribution to preventing obesity by helping children to eat better and move more." *Plan for Action 1, Pg. 8*

"As a parent I know that making the healthiest choices isn't always easy, In fact sometimes it feels very difficult." *Plan for Action 2, Pg. 5*

"How food and drink is promoted to us when we are buying food … can lead us to purchase more than we need." *Plan for Action 2, Pg. 22*

Several words were used in the documents to demonstrate the urgency of childhood obesity, including combatting, beating, threat, and challenge. However, it is essential to note that these terms were used in a much higher frequency in the second document of the plan compared to the first document. Furthermore, the prevalence rates of overweight and obesity were often merged to illustrate the urgent scope of childhood obesity as an issue facing the Government.

"Today nearly a third of children aged 2 to 15 are overweight or obese" *Plan for Action 1, Pg. 3*

"So, when more than one in three children are obese or overweight by the time they leave primary school, and with these numbers only getting worse" *Plan for Action 2, Pg. 4*

"We all have responsibility to work together to support young people in meeting this challenge" *Plan for Action 2, Pg. 4*

"Today, nothing threatens that more than childhood obesity" *Plan for Action 2, Pg.4*

"Every developed nation is facing up the problem of childhood obesity, this is an issue, eventually, no country will be able to ignore" *Plan for Action 2, Pg. 5*

"We need to be ambitious if we are to meet and beat the challenge of childhood obesity" *Plan for Action 2, Pg. 6*

"They are also far more likely to go on to become obese adults,[7] with a higher risk of developing life-threatening conditions such as some forms of cancer, Type 2 diabetes, heart[8] disease and liver disease." *Plan for Action 2, Pg. 6*

"In August 2016 we laid strong foundations for our fight against childhood obesity with our world leading Childhood obesity: a Plan for Action" *Plan for Action 2, Pg. 7*

"We aim to significantly increase the proportion of local authorities actively combatting childhood obesity over the next five years." *Plan for Action 2, Pg. 25*

"We all have a lot to gain by beating obesity and it is vital for us all to work together to achieve this" *Plan for Action 2, Pg. 30*

Some issues around language are linked to consistency within each document and between the two documents:

- For instance, the same sentence used to illustrate the increased rates of children with obesity discussed diseases that are associated with adulthood.
- There were several interventions and policies that were discussed in the first document which were missing from the second document, including the update to the nutrient profile model, and collaborative research and development competition.

- Finally, neither of the two documents provided a clear plan to the evaluation or assessment of the proposed interventions.

"Today nearly a third of children aged 2 to 15 are overweight or obese……Obese adults are seven times more likely to become a type 2 diabetic than adults of a healthy weight[4] which may cause blindness or limb amputation…" *Plan for Action 1, Pg. 3*

"Long-term, sustainable change will only be achieved through the active engagement of schools, communities, families and individuals." *Plan for Action 1, Pg. 3*

"We want to encourage the next generation of innovation in science and technology … To support this, Innovate UK ran a collaborative research and development (R&D) competition worth £10 million for research …." *Plan for Action 1, Pg. 5*

"Therefore, PHE is working with academics, industry, health Non-Governmental Organisations (NGOs) and other stakeholders, to review the nutrient profile model to ensure it reflects the latest government dietary guidelines." *Plan for Action 1, Pg. 6*

"……through its Change4Life and One You campaigns." *Plan for Action 2, Pg. 17*

*Table 6.1: Examples of each theme and sub-theme that emerged from the thematic analysis of "Childhood Obesity: a Plan for Action*

| | Theme | Sub-theme | Example |
|---|---|---|---|
| 1 | Where does responsibility of action lie? | Collaborative work | "We all have responsibility to work together to support young people in meeting this challenge. Whether we are parents, teachers, businesses, local leaders or health professionals, we must all play a role in helping to improve the health of our children and give future generations the best possible start in life." *Plan for Action 2, pg. 4* |
| | | Government | "The need for Government to act to reduce the amount of sugar our children consume is clear and formed the basis of our 2016 plan" *Plan for Action 2, pg. 13* |
| | | Industry | "I want to see the food and advertising industries using their world-leading talents to help all parents find the healthier choice the easier choice." *Plan for Action 2, pg. 5* |
| | | Parents and care givers | "Parents may not realise the extent to which their purchases are driven by prompts from children, but evidence suggests that twice as many purchases are triggered by children than parents are aware of…. We must act to support parents" *Plan for Action 2, pg. 22* |
| 2 | Weight-centrism | Determinisms and reductionism | "Obesity is a complex problem with many drivers…. However, at its root obesity is caused by an energy imbalance: taking in more energy through food than we use through activity. Physical activity is associated with numerous health benefits for children, such as muscle and bone strength, health and fitness, improved quality of sleep and maintenance of a healthy weight" *Plan for Action 1, Pg. 3* |
| | | One-size fits all | **"**Initiatives like this [Daily Mile] can improve the physical, social, and mental wellbeing of our children – regardless of age, ability or circumstance" *Plan for Action 2, Pg. 5* |
| | | Evidence-base | "Energy drinks are often high in sugar as well as caffeine, and may contain more sugar than full-sugar soft drinks[19], and are therefore a contributor to both obesity in children and dental problems." *Plan for Action 2, Pg. 15* |
| 3 | Think inside the box | It is management, prevention or cure of childhood obesity? | The different use of words within the document: reduce/protect/prevent/tackle halve/achieve and maintain |
| | | Language | People-first language: "…presents the opportunity to engage parents of overweight and obese children…" *Plan for Action 2, pg. 26*<br>Hyperbole language: "We need to be ambitious if we are to meet and beat the challenge of childhood obesity" *Plan for Action 2, Pg.* |

## 6.4 DISCUSSION

The discussion of this chapter will be separated into two sections. Based on the results of the analysis, the first section will answer the first four questions of the WPR approach. The second section will continue to answer the last two questions.

### 6.4.1 Section 1 (Q1-Q4)

Q1: What is the 'problem' represented to be in a specific policy?

Q2: What presuppositions or assumptions underlie this representation of the 'problem'?

Q3: How has this representation of the 'problem' come about?

Q4: What is left as unproblematic in this problem representation?

Two issues were found to be problematised through applying the first question of the WPR approach to the thematic analysis. Therefore Q1-4 will be applied to each problem, with a sub-section dedicated to each problem.

#### *6.4.1.1 Responsibility problematisation*

As mentioned earlier, the Department of Health stated that childhood obesity is the greatest threat to the future of children – "nothing threatens that more than childhood obesity" *Plan for Action 2, Pg.4*. It is presented as a significant burden on the National Health Service and the economy in the UK, and is linked to health and social inequalities (HM Government, 2018). Therefore, through the two documents of "Childhood Obesity: A Plan for Action", the UK Government recommended immediate action to address childhood obesity through different interventions and policies.

The issue of obesity is generally framed as a matter of shared responsibility in society. The documents present several strategies that consider everyone (i.e. Government, individuals, families, industry) to be a part of the 'problem', and accordingly involve them to be part of the 'solution'. In some instances, industry is often blamed for providing high sugar content food items and for promoting HFSS food through advertisements. In other

instances, healthcare practitioners share responsibility for not proving the required care for individuals with obesity to facilitate weight loss. Local communities and schools are highlighted as being central for not doing enough to promote health to children through education and physical activity. In addition, individuals are encouraged to take responsibility for the increase in their food consumption and for their sedentary lifestyle. This framework of shared responsibility justifies Government efforts to address the environmental and social factors on obesity through collective work.

It is intriguing that first sentence of the Prime Minister's Foreword in Plan for Action 2 appears to place the Government at the heart of the responsibility; "it cannot be a question of whether we [the Government] act to address this [childhood obesity], but rather how" *pg. 4.* Despite this, the issue of the Government's position is evasive throughout the rest of the document. Results of the current study demonstrated this fluid shift throughout the document in terms of responsibility for the 'problem', where the blame was placed almost fully on individuals. This is illustrated by charging individuals to be engaged in unhealthy behaviours (i.e. over eating or inactivity). In addition, individuals were blamed for not being able to act in their own best interest towards the proposed policies that are set to encourage and help them to maintain and improve their own health, and to overcome the influences of the surrounding obesogenic environment. In other words, the Government used language and explanations that place the 'problem' of obesity with individuals by implicitly stating that they are only reacting to help individuals control their actions with the support of healthcare professionals, industry and other stakeholders. This was most clearly stated in the following sentence: "We all have responsibility to work together to support young people in meeting this challenge" *Plan for Action, pg. 4*. This introduces the first identified 'problem' that is centred on responsibility problematisation.

There are two opposing perspectives of what contributes towards obesity, where the discussion is ongoing regarding whether individuals are responsible for their dietary and activity behaviours, or that social and cultural determinants play a larger role than individuals' actions (Arhire, 2015). Accordingly, this presents controversies in the matter

of obesity solutions, as some researchers argue that the current international approach in tackling obesity is based on an overly simplistic dichotomy. This manifests as personal vs. environmental responsibilities for action, translating to solutions focusing on individual control vs. governmental regulations of certain structural factors (Roberto et al., 2015). There is ongoing work on identifying the responsibility of different groups to act on obesity and to contribute to healthier environments and healthy eating. One study has classed food policies to be a governmental responsibility, the production of healthy food as the responsibility of manufacturers and the demand for healthy food as the responsibility of individuals (Swinburn et al., 2015).

Through examining the underlying assumptions of policies and approaches to reduce obesity rates worldwide, a study has grouped the proposed interventions into medical and public health models (Adler and Stewart, 2009). Whereas the medical model emphasises treating obesity by addressing individual behaviour and weight loss, the public health model focuses on regulating the environmental factors that lead individuals to engage in less healthy activities. Another study states that the individualistic approach in tackling obesity is embodied within the Government's plan for action, even if it does not appear to do so on a superficial level. This is mainly because the trend of blaming individuals is rooted into our social and political cultures (Brownell, 2010). Several examples demonstrate this theory, where policies focus on collective actions to encourage people to eat healthier, which in turn implies asking individuals to develop more responsible behaviours. This includes legislation to improve schools' canteens, regulation of advertisements and promotions, focusing on the presentation of nutrition labels, interventions related to industrial production and measures such as taxes (Arhire, 2015).

This distribution of responsibility is also associated with societal ethics, where political decisions are based on individualism and people's rational choices where their personal responsibility is the main thing that matters (Tronto, 2013). This may be due to the suggestion that it is easier to believe that illness is a personal responsibility than believing that people's suffering can be random and arbitrary (Puhl & Heuer, 2010). In addition, this

attitude towards public health issues can reinforce dynamic relations between citizens and governments (Ramos Salas et al., 2018). It is also suggested that framing responsibility as shared collectively between different parties in society, including government, industry, parents, schools and others makes it unclear as to who escapes the burden of responsibility (Gillies et al., 2017).

This theory of blurred responsibility was identified by another qualitative study conducted in 2019 to explore how parents, policymakers and implementers interact with policies related to childhood obesity (Noonan-gunning, 2019). Their outcomes demonstrated how some policymakers accused low-income communities and parents of having power, choice and control over fast food outlets. One policymaker considered local government to be powerless with no responsibility to control the availability of fast food shops. This lack of power perception indicates 'victim' blaming of families.

The results of the current study also revealed the policy documents blaming parents over their children's weight. This was presented in the documents through asking parents to pay more attention to their children's food consumption, supermarket purchasing and after-school physical activity. The use of mandatory calorie labelling and advertisements restriction strategies is another example of responsibility problematisation. The application of these policies may imply that parents and caregivers lack the competence to take care of their children; "We also want to put control back into parents' hands by making it clearer for them when and where HFSS adverts can and cannot be shown, so that they can make the best choices for their children." *Plan for Action 2, pg. 21.* Similar results were identified by Noonan-gunning, where she stated that policies construct caregivers as the 'problem' for their higher weight children by providing 'unhealthy' food that increases their health risks. Furthermore, health workers and the Government were seen as the experts to save the children (2019). Another study argues that parents are given the core responsibility for their children's health, where their children's large bodies are a visible marker of a lack of parental responsibility (Davis et al., 2018).

It can be argued that the main goal of these interventions is to help parents overcome environmental barriers to healthy eating, without carrying any underlying blaming messages. However these approaches ignore the core issues underpinning dietary behaviour, which are cultural and socioeconomic differences between families (Caraher, 2016). Financial commitments, work, time availability, skills and other lived experiences of caregivers are rarely considered in childhood obesity research and policies (Davis et al., 2018). In addition, researchers found that parents felt judged for their food choices (Noonan-gunning, 2019). From a caregiver's perspective, it is clear that the Government is transferring responsibility for children's weight into parents' hands, which is conveyed through the language of policy makers. For instance, the Government suggests "discipline," "monitor," "regulate," "reading labels" as words to convince parents to change their children's behaviour and manage their weight. In the same study, parents were of the opinion that the Government was irresponsible for only setting voluntary legislation to encourage food industry to reformulate or alter their products' advertisements' planning.

The concept of the "obesogenic" environment has recently become the centre of public health work to address weight-related issues like obesity, adding to extensive studies of the aetiology of obesity through exploring social and environmental factors and determinants. These theories and growing evidence base have emerged to shift the focus from the individualistic responsibility view to other environmental factors promoting unhealthy eating habits and weight gain (Greener et al., 2010). The association between eating behaviours and socioeconomic status, for example, has been studied thoroughly in terms of its effect on the prevalence of obesity, as different forms of social inequality significantly increase rates of obesity (Makowski et al., 2019). People with lower levels of education tend to have higher rates of obesity, especially among women (Mackenbach et al., 2008). This may explain why people from racial and ethnic minorities, and people in low-income groups are believed to be the main targets for food and drink industries' marketing strategies (Roberto et al., 2015). Roberto and her colleagues have highlighted that these connections underline the difficulty in blaming individuals for their food choices (2015). These explanations go beyond the suggestions that the availability of unhealthy

food and lifestyle changes are the main influencing factors for people's choices (Swinburn and Egger, 2004). Nevertheless, public health interventions tend to disregard this complexity, and default to a simple, univariate model based on individual responsibility (Glasgow and Schrecker, 2015). This approach is used in national policies to tackle obesity, where the focus on individual behaviour drives the attention away from the broader picture and factors involved.

Understanding this is essential when considering the focus of the Government on the importance of behavioural change in reducing obesity rates. When a government is faced with a complex policy goal related to a health issue, a potential approach to tackling it by Government can be to distil the issue down to the principles underpinning it, and converting these to tangible actions (Rein and Schön, 1993). Using this approach, lifestyle would be an important factor to address in childhood obesity, in that the right lifestyle choices can help individuals prevent the occurrence of 'avoidable illnesses'. Therefore, from a government perspective, individuals are expected to use advice and knowledge about the benefits of a particular lifestyle to change their behaviours to a better lifestyle, and consequently prevent 'avoidable illnesses' later in their lives.

Taking a closer look at the factors influencing lifestyle sheds light on the complexity of lifestyle behaviours change and the challenge for policies that aim to alter it. In basic terms, lifestyle is a set of behaviours that become habitual to individuals, where they follow existing habits and make minimal daily choices related to their diets. Although this does not mean that people make no choices or changes, their diets are limited to a specific selection of options that reflect their current lifestyle (Gardner et al., 2012). This gives a different angle to understanding the choices that individuals make, where people tend to repeat certain familiar behaviours. Accordingly, it is essential for policy makers to consider how individuals can adapt to a new set of behaviours that are ideal for a healthier lifestyle which are unfamiliar to them (Kriznik, 2015). This may indicate why previous public health approaches had limited impact on changing lifestyle for the majority of the public, as they did not consider different capabilities of individuals to make behavioural changes.

There is a strong evidence base in sociology and psychology to explain that the behaviours involved in the process of a "disease" formation – weight gain in this case – are different to the behaviours involved in the process of prevention (Kelly and Russo, 2018). Work in the field of sociology has also clarified that the mechanism of taking up a certain behaviour is very complicated and differs between individuals (Bell et al., 2011). This highlights the importance of considering the multifactorial nature of "obesity". It is stated that weight gain is an outcome of a group of interactions across biological, behavioural, psychological, cultural, genetic and other socioeconomic environments (Gregg and O'Hara, 2007). The role of genes in obesity is scientifically accepted to be strongly influential, with an extremely high level of heritability, where it is second only to height, compared to all other traits and diseases, including heart disease, diabetes and cancer (O'Hara and Taylor, 2018). In addition, evidence has shown that eating and physical activities are not as voluntary as they are generally regarded to be. In fact, they are mainly controlled by our biological system which is responsible for managing the metabolic rate that in turn drives eating and moving (Benton and Young, 2017). Although conscious changes in eating behaviour would lead to weight loss in the short term, our powerful unconscious biological system would eventually generate changes to reset the homeostasis where the body regains weight (Fothergill et al., 2016). In addition to these biological factors, some studies have found that social class and poverty are correlated with adiposity (O'Hara and Taylor, 2018).

The focus on lifestyle changes at times also implies that the responsibility of individuals to change their health behaviour goes beyond individuals' responsibility towards themselves. It extends to their responsibility towards healthcare services. This broader responsibility has consequences for individuals' own lives and more broadly on the efficiency of NHS services and resources (Kriznik, 2015). For this reason, lifestyle changes that are required of individuals have a critical role in preventing their own 'avoidable illnesses', reducing the demand on NHS services. This leads to healthier people and more efficient use of NHS resources. This theory is also linked to responsibility problematisation, as it puts

individuals under more pressure to take responsibility not just for themselves but for everyone else in the society too. Placing such responsibility on people's behaviours in light of the evidence that some of these behaviours are beyond their control may not be justified.

Another way in which responsibility is problematised within the Plan for Action documents is the focus on the provision of information. With the Government in a position to help individuals to choose better, individuals are considered as rational decision-makers who are encouraged to make the correct food decisions based on the information provided about nutrition and food. This enables them to improve the quality of their lives by preventing 'avoidable illnesses'. This is based on an assumption that providing the public with facts and opportunities to make informed decisions is vital to improving population health. The UK Government is therefore using different channels to deliver nutrition-related knowledge to people and give them access to information about behaviours that are harmful to their health. For instance, the Government is proposing calorie labelling for the out–of-home food sector, encouraging industry to use traffic light labelling and using different campaigns, as Change4Life. This method frames the issue in a way that reduces the role of Government to simply offering information and knowledge to the public so they take control over their daily food choices, while placing a high level of responsibility on individuals to protect their health. This may also be linked to parental responsibility as their food choices are the main driver of their children's health and, accordingly, applying nutrition knowledge is key to decreasing their risks of diseases, including childhood obesity.

Ultimately, this theoretical framework ignores the basis on which people, including parents, make their food-related decisions, which are strongly affected by their social, financial, economic and environmental circumstances. This may lead them to making poor choices for a variety of reasons including affordability, availability and time restrictions (Scaglioni et al., 2018). Providing nutrition information to help people make healthy food decisions is not intended to be a stand-alone intervention in a policy document; it is

intended to be complimented by other simultaneous strategies. Yet, this focus does indicate the view taken by the collective strategies that individuals are responsible for their food consumption and choices.

#### *6.4.1.2 Weight problematisation*

Governments around the world are using various types of interventions to help people change their behaviour, based on the arguments set out earlier in the thesis regarding behaviour change, including regulation, taxation, advertisements' restrictions, education and information provision, raising awareness and campaigns, nudging and other services such as counselling and weight loss management (Marteau et al., 2011). However, there is a large body of literature criticising this approach by discussing its limited effectiveness in the field of public health (Marteau et al., 2015). Researchers argue that this approach of considering individual behaviour as the most harmful contributor to non-communicable diseases like obesity is too simplistic (Kelly and Russo, 2018).

Many exercise and dietary behaviour change activities have been widely popular among populations across the world. These approaches are commonly used for weight loss, which is a predominant focus of discussions around health and wellbeing (O'Hara and Taylor, 2018). They are also extensively promoted through public health interventions and policies that are presented to address obesity. Investigating the literature has highlighted a significant increase in the critical analysis of this focus (Bacon and Aphramor, 2011, O'Hara and Taylor, 2018), which is defined as the weight-centrism paradigm or the weight-normative approach to health (Tylka et al., 2014).

Trends in many public health and health promotion policies around the world continue to focus on weight, particularly with the use of body weight categories to define health. This is also referred to as the medicalisation of weight, where "overweight" and "obese" have become proxy words for unhealthy (Sadler et al., 2009). This categorisation and the concept of the energy balance equation combined are also applied to provide a "rational solution", on both individual and population levels, to "combat" obesity. This "rational

solution" directs people to track their calorie consumption and expenditure to maintain healthy weight and a happy life (Arhire, 2015).

The results of this study indicate that there is a belief that individuals' role in losing weight is essential to reducing the overall rates of childhood obesity. This takes into account the part parents play in encouraging their children to lose weight. In other words, one of the main 'solutions' to childhood obesity in the UK is centred around weight loss.

In recent years, there has been increasing interest in understanding the use of such a simplistic narrative approach in public health work around obesity. Kelly and Russo established clear recognition of the history underpinning the use of this approach with different public health issues (Kelly and Russo, 2018). They analysed the historical use of this linear narrative in tackling infectious disease, where identifying the aetiology of these diseases provided a clear framework for prevention planning. One the other hand, they clarified that this assumption would only be effective in managing mono-causal health-related issues, which obesity is not. These authors created the following scenario to demonstrate the ineffective use of linear approaches in tackling obesity that are mainly used because clear relationships are difficult to ascertain:

> "If there were a precise correspondence between 'excess calorie consumption makes you put on weight' (the risk and the cause) and 'eating less will make you lose weight' (the solution and the outcome), it would be possible to make an accurate prediction of the effectiveness of said intervention. But of course there isn't an exact correspondence, and therefore that prediction is not very secure"

This scenario is presented to highlight the complexity of obesity. Both communicable and non-communicable diseases are extensively documented to be highly complex and multifactorial. There are different interactions between biological, socioeconomic, psychological and other factors to determine individuals' weight and health (Gordon-Larsen and Heymsfield, 2018). This strong focus on individual responsibility to change behaviours can divert attention away from the bigger picture and solely consider how to

enable individuals to control their weight. This not only disregards the complexity of obesity, it may lead to weight problematisation.

The root of this proposed simplistic intervention is adapted from the success of previous approaches addressing infectious diseases, where providing vaccines (the solution) was a clear, direct framework to tackle the mono-factorial aetiology of the infectious disease. It is further supported by that human behaviour is one of the factors that can impact obesity. Yet as mentioned earlier, weight gain and weight loss are not necessarily influenced by the same mechanisms (Ochner et al., 2013). Therefore, focusing predominantly on body weight may not reduce the 'burden' of obesity. There is a growing body of literature that critically analyses the focus on weight loss to tackle obesity (Bacon and Aphramor, 2011, Campos et al., 2005, O'Hara and Taylor, 2018). Researchers argued that while this limited way of thinking may provide a simple answer to managing obesity, it is ultimately inaccurate and disregards the complications associated with it (Kahneman, 2011). This is also referred to as reductionism (Fardet and Rock, 2015).

This also related to the one-size-fits-all approach found within this qualitative study with examples included, where there is little acknowledgement of differences between people in terms of cultural background, ethnicity, family structure and socioeconomic status. For this reason, it is suggested that comprehensive consideration of all the available evidence would greatly enhance understanding of the wider implications of public health issues like obesity. This would consequently increase effectiveness of the proposed interventions (Chou, 2013).

In addition to people who are directly involved in the process of decision-making of policies and public health interventions, there are other parties which contribute significantly to the weight-centrism paradigm. The engagement in this paradigm may vary across parties involved, where one study argued that healthcare professionals are one of the main supporters of this approach, focusing on weight through their direct interactions with individuals. Another study stated that the responsibility for sustaining this approach falls

on everyone's participation, including healthcare professionals, weight-loss industry, campaigning organisations and other institutions (O'Hara and Taylor, 2018).

Finally on the discussion of weight in the policy documents, there was very limited use of people-first language to address extra weight, despite international efforts to promote its use. However, from the Government's perspective, they consistently used the medicalised terms of body mass index (BMI) to address weight in all policy documents. There is a global trend in public health work and health promotion policies to categorise body weight into four groups; 'underweight', 'healthy weight', 'overweight', 'obesity'. It is assumed that this classification of body weight may facilitate addressing weight and may add to the need for urgent action by people.

Despite the medicalisation of obesity and the focus on the energy balance equation for the past five decades, there has been no clear effect of reducing obesity rates (Wells and Siervo, 2011). The effectiveness of this approach can be examined on both population and individual levels. At a population level, there is no evidence that the focus on weight loss has achieved any progress in reducing rates of obesity (O'Hara and Taylor, 2018). In addition, setting different interventions and policies in obesity relied heavily on modelling studies and comparative assessments where not all causative factors are taken into account (Briggs et al., 2016). Regarding its effectiveness at an individual level, extensive research has established that individuals are unable to sustain weight loss in the long-term (Cooper et al., 2010) Furthermore, their weight loss process strongly predicts extra weight gain in the long run (Neumark-Sztainer et al., 2012). Beyond measurement of weight, many studies have argued that losing weight does not result in significant improvements in the risk of morbidity and mortality for individuals with obesity (Mann et al., 2007). Therefore, there is no enough evidence to support the positive use of the medicalised terms. This is especially true when such policy documents lack a specified audience, which was the case for the UK policy documents that were analysed in the present study.

#### *6.4.1.3 Issues around evidence*

This leads to an important point regarding the general use of evidence in this analysis. The results show that multiple statements in the policy documents of "Childhood Obesity: A Plan for Action" lacked supporting evidence, despite a high demand for evidence-based policies. The concept of Evidence-Based Public Health approaches (EBPH) has become central to the discipline of public health, as the demand is growing for informed scientific decisions concerning policy development (Chou, 2013). Effective data communication and interpretation are a key part of developing evidence-based public health programmes. Researchers stated that this can be achieved by using analytic tools, policy surveillance and evaluating the outcomes of previously used interventions (Brownson et al., 2009).

The MRC epidemiology unit developed a translational framework for public health research through their population health science research network, which acknowledges the vital role of evidence synthesis and the importance of non-linear interactions with public life experiences. This framework combines epidemiological perspectives with social sciences, to recognise the role of different research fields in shaping health-related policies, in addition to their practice and future. The main goal of this framework is to translate evidence into effective interventions that improve individual and collective determinants of a health issue (Ogilvie et al., 2009).

However, as argued by a political scientist, it is difficult for policymakers to consider all evidence relevant to a particular issue (Cairney, 2016). This usually leads them to use two shortcuts. First, known as 'rational', they clarify the ultimate goal of any policy and prioritise sources of information accordingly. Second, known as 'irrational', they draw policies by referring to gut feelings, deep beliefs and habits, which will allow them to make decisions faster (Cairney and Oliver, 2017). It should be noted that policymakers are under a considerable pressure to enact quick and correct policies to provide a visible and clear action to the public to demonstrate their response to a 'problem'. This may provide an explanation for the use of the soft drinks industry levy (SDIL) as a quick response to the issue of childhood obesity in the UK.

Nevertheless, the following are examples obtained from the "Childhood Obesity: a Plan for Action" documents to shed light on two issues that were mentioned without enough justification or evidence:

> "Today, nothing threatens that [children's well-being and health] more than childhood obesity" *Plan for Action, pg.4*

It is interesting to highlight that this non-referenced sentence neglects several other critical public health issues in the UK related to children's health and wellbeing. Child poverty is one example, as 4.1 million children, accounting for 30% of all children in the UK, were in relative low income after house costs (McGuinness, 2018). This is in comparison to 16% of children aged 2 to 15 who were with obesity in 2017/2018 (Health Survey of England, 2019). It can be debated that the use of this sentence was to indicate importance and urgency, however it may lead to negative consequences. This will be discussed in the next section.

The focus on energy drinks was also unjustified; a ban on energy drinks was listed as an approach to tackle childhood obesity due to their high caffeine and sugar content, despite the fact that there is no clear connection between caffeine content of energy drinks and childhood obesity. This is especially true as the sugar content of energy drinks is comparable to other SSBs, which means they could be included in the SDIL. The following table demonstrates the similarities in sugar content.

| **Product** | **Can size (ml)** | **Calories (kcal/100 ml)** | **Sugar (g/100 ml)** | **Caffeine (mg/100 ml)** |
|---|---|---|---|---|
| Red Bull | 250/355/473 | 45 | 10 | 30 |
| Monster | 500 | 42 | 11 | 32 |
| Coca-Cola | 250/330/375/500 | 42 | 10.6 | 9.69 |
| Pepsi | 330/500 | 41 | 11 | 10.7 |

The results of the present study are consistent with those of Ramos Salas et al., who conducted the WPR to identify the dominant narratives within the Canadian obesity prevention policies. The five main narratives were 1) childhood obesity threatens the health of future generations and must be prevented; 2) obesity can be prevented through healthy eating and physical activity; 3) obesity is an individual behaviour problem; 4) achieving a healthy body weight should be a population health target; and 5) obesity is a risk factor for other chronic diseases, not a disease in itself (Ramos Salas et al., 2018). In other words both responsibility and weight problemitisation were common themes between Canadian and English obesity-related policy document.

### 6.4.2 Section 2 (Q5-Q6)

Q5: What effects are produced by this representation of the problem?

Q6: How/where is this representation of the 'problem' produced, disseminated and defended?

Answering the first four questions of the WPR approach highlighted a set of 'problems' that were presented within the two policy documents of childhood obesity. These included responsibility and weight problematisation. The last two questions address what potential consequences are associated with the presentation of these 'problems'.

With regards to first issue of responsibility problematisation, there is a considerable body of literature that has been published on the effect of placing responsibility on individuals. Policies are usually framed to blame individuals for lack of willpower and inactivity, and people with larger bodies are linked to certain negative or unflattering stereotypes (Kirk et al., 2014). Similar to the current study, one research inventory analysed 60 policies and action programmes to tackle obesity worldwide, in which they identified several ethical concerns related to the nature and content of these interventions (Ten Have et al., 2011). For example, they claimed that some individualistic approaches may trigger negative psychological consequences such as fear, obsession, guilt and uncertainty. Other research

has identified that these approaches would increase inequality, even if policies are designed for the exact opposite reason (Kriznik et al., 2018).

Negative stereotypes may be correlated with a judgmental view from society towards people who are considered 'overweight' or 'obese'. This can include passing judgment on their lack of self-control and discipline or for their inability to take responsibility for their behaviours and lifestyle (Salemonsen et al., 2018). This is similar to the concerns associated with weight problematisation. Attention should be drawn to the possible unintended harmful effects of the weight-normative approach used by public health policies in many obesity-related issues, in which weight is viewed as a proxy for health (Latner and Stunkard, 2003). The weight-normative approach, also known as weight-centrism, focuses on weight loss and weight management to address obesity, where individuals are expected to have 'normal weight' to be healthy and avoid illnesses. This is largely connected to the belief that people with larger bodies have less commitment to their health, causing them to fail to make the right decisions to lose weight and be more active. They are therefore held responsible for becoming ill.

An increasing number of researchers are interested in discussing and addressing potential harms that would arise from continuing the weight-centrism approach. Bacon and Aphramor identified serious ethical and moral concerns that may occur within current practice (2011). These psychological and social harms may have an effect both at an individual and population level, and they may include weight bias, discrimination, and body dissatisfaction among other effects (Bell et al., 2011, Catling and Malson, 2012, Puhl and Heuer, 2010). Furthermore, it is argued that weight-centrism also creates an adipophobicogenic environment as it generates fat phobia among people and sustains it through beliefs around weight gain and obesity (O'Hara and Taylor, 2018).

#### *6.4.2.1 Weight-bias and stigmatisation*

This negativity around individuals with obesity is detrimental. They not only face negative judgment from members of the public, but they may also face weight-bias, stigma,

discrimination, and other kinds of oppression that are observed across different populations (Monaghan et al., 2010).

Internal and external stigmatisation are the two types of stigma that affect the life experiences of people with obesity. These individuals tend to agree with the judgments and negatives stereotypes that they are subjected to from the surrounding environment (Greener et al., 2010, Puhl and Latner, 2007). Internalised weight stigma is linked to poor body image, lower self-esteem, higher risks of depression and anxiety and, counter to the very aims of obesity-related policies, undesirable dietary behaviours and eating disorders (Neumark-Sztainer et al., 2012, Puhl and Brownell, 2001). These internalised negative feelings are then reflected in their beliefs, behaviours and values associated with body weight (Rees et al., 2011). Based on the results of the current study on responsibility problematisation, parents of children with obesity are also likely to be dealing with both kinds of stigma, internal and external. One study found that mothers were engaged in a cognitive struggle as they worry about neighbours and family members' judgments on their parenthood skills. This stems from comparing themselves to other 'good mothers' who can control their children's weight. This indicates self-blame and self-stigmatisation for their perceived lack of control over their children's diet (Noonan-gunning, 2019). In addition, this study sheds light on parents' fears about their children experiencing stigmatising feeling when the word 'obese' was used around them.

In regards to external stigmatisation, evidence shows that weight stigma is a demonstration of social inequity and cultural imperialism. People who belong to the 'higher weight' social group are treated unequally to those belonging to the 'smaller weight' social group, across different sectors of society (Alberga et al., 2016). Individuals with extra weight are susceptible to external stigmatisation that may be presented as weight-based bullying and violence, and social, cultural, economic and political discrimination (Puhl and Heuer, 2010). This includes, but is not limited to, workplaces and job opportunities, healthcare services and educational chances (Puhl and Heuer, 2010). Unequal social positions also convey unequal probabilities of exposure to various health risks (Graham,

2004). Furthermore, researchers have found that being overweight or obese and from a lower socioeconomic status is associated with having higher levels of negative attitudes and weight-bias compared to individuals from a higher socioeconomic status, regarding individual self-esteem, self-control, weakness and insecurity (Makowski et al., 2019). Puhl and Heuer indicated that dealing with the negative health outcomes linked with stigma is more challenging than dealing with the excess weight itself (2010).

It is important to state that stigmatising feelings are not exclusive to adults, as children and adolescents were found to face similar feelings from educators, parents, and healthcare professionals (Puhl and Latner, 2007). This has negative psychological, physical, social and academic performance effects (Pont et al., 2017).

The incidence of these harms, particularly weight bias, are increasing as the rates of obesity increase. Ciao and Lanter have described this as the "shadow epidemic" of obesity in the technical report: "From Weight to Well-Being: Time for a Shift in Paradigms" (Provincial Health Services Authority, 2013). Puhl and her colleagues concluded that weight-related discrimination is more common than race discrimination (2008). In a systematic review, researchers identified that a quarter of a representable sample of the population in the US and Germany showed stigmatising attitudes towards people with higher weights (Sikorski et al., 2011). Similarly, the United Kingdom has experienced an increase in stigmatisation and shaming discourse (Bissell et al., 2016, Tyler and Slater, 2018).

Based on the aforementioned negative consequences of weight stigma, there is a call to exchange the weight-normative approach for the weight-inclusive approach in addressing health related issues, such as obesity. The latter focuses on health access and highlights the importance of healthy eating regardless of body weight (Tylka et al., 2014). One paper claimed that participants were more motivated to respond to public health messages that promoted healthy eating behaviours without any reference to weight (Puhl et al., 2012). This also applies to individuals' engagement with healthcare professionals. One study showed that participants were more motivated by messages that made no mention of the word 'obesity' but focused on healthy behaviours without relating them to body weight

(Alberga et al., 2016). Furthermore, multiple studies explored the impact of the Health At Every Size (HAES) approach on several health and well-being indicators. One randomised control trial and other systematic reviews identified the positive influence of the HAES programme, where it was found to be more effective in improving physiological, psychological and behavioural factors of individuals compared to other treatment programmes (Bacon and Aphramor, 2011, Mensinger et al., 2016). The inclusion of HAES concept in schools' and universities' curricula may lead to improved body image, self-esteem, and eating attitudes in children (Niide et al., 2013).

#### *6.4.2.2 Language consequences*

All the aforementioned bias and negative stereotypes may be reinforced by the use of hyperbolic language in policy documents (Evans, 2006). It is suggested that hyperbolic language may include 'urgency' words to emphasise the need for immediate action. This was one of the findings of a critical analysis conducted on Canadian policy documents. The authors described the language as 'hard' in order to 'warn' individuals, and to justify the need for an immediate action (Ramos Salas et al., 2018). However, this type of language may underpin harmful social ideas and stereotypes surrounding obesity and people with extra weight (Wells and Siervo, 2011).

A considerable amount of literature has been published on how simple documents can invoke feelings, especially with the issue of obesity. One piece of research investigating public emotions towards the policies for obesity preventions claimed that some regulations lead individuals to feel that these policies are framed for discrimination directed at obese people (Farrell et al., 2016). Another study stressed the significance of using transferable language and images across cultures, where the wrong use of specific language and images when describing a "problem" can distort it (Ralston et al., 2018). Furthermore, the British Psychological Society thoroughly discussed the impact of language that is used by policy makers to present different interventions in Government documents and reports around obesity, on public discourse and responses towards obesity (BPS, 2018). They argued that the language used in these documents has played a role in masking the

complexity of determinants related to the development of obesity. This link between language and emotions is also supported by the majority of psychological models (Lindquist et al., 2015).

The discussion around obesity is frequently linked with the diseases for which it is a risk factor (Monaghan et al., 2013). This serves to express the future harm for people with obesity as "risky", which thereby facilitates provoking fear about it (Farrell et al., 2016). The language used in the conversation of obesity as the "epidemic" and "the war on obesity" may allow the presentation of obesity as an imminent public health crisis that requires an intense response (Holland et al., 2011). This is similar to the interpretation of language used in the presentation of childhood obesity, where it is linked to unidentified future harm and unmanageable chronic diseases, and consequently increasing health care costs, which justifies the urgent call for action (Evans, 2010, Ramos Salas et al., 2018).

On a final note, results of this study highlighted that there is limited use of people-first language. There is wide recognition of the vital role of using people-first language in promoting positive attitudes and reducing stigma (Crocker and Smith, 2019). One study described the use of people-first language as the first step towards less stigmatising language experienced by children and adolescents (Pont et al., 2017). The American Academy of Pediatrics has also focused on the value of using sensitive language in addressing weight with children and family (McPherson et al., 2018). Linquist and her colleagues illustrated how language is an essential component of the process of individuals' emotional experience and perceptions (2015). Another study suggested that emotions, including fear, motivation and stress are fundamental to behaviour change and decision making (Ferrer and Mendes, 2018). This correlates with another argument in the same study, in which exercise and dietary changes, which are considered health promoting behaviours, may be compromised under negative and chronic emotional circumstances.

## 6.5 STRENGTHS AND LIMITATIONS

A key strength of this study is the application of the WPR approach on the childhood obesity policy documents in the UK. It is the first time that this analysis approach has been used to explore the possible unintended consequences of interventions and strategies that are proposed in these documents. This may present an opportunity for policymakers to consider the identified concerns around the current approach in tackling childhood obesity, and to work on improving subsequent policies by avoiding simplistic approaches and addressing a wider range of health-related determinants.

Taking the complexity of childhood obesity into consideration, however, it is perhaps challenging for the Government to act fast and at the same time set interventions that are effective, acceptable and not associated with negative consequences. This was one of the reasons why this study did not aim to provide any recommendations or 'solutions', as this approach only aims to critically analyse policies without creating the 'correct' interventions. Finally, the reader should bear in mind that the qualitative methodologies employed here cannot be separated from the researcher's own bias and perspective. In addition, the analysis only tackled two policy documents for childhood obesity. Although they are considered the main policy documents for tackling childhood obesity in the UK, they may not ensure a comprehensive understanding of the entire Government perspective of the issue.

There is still a need for researchers to understand the effect of such policies on the daily experiences of people living with obesity. Moreover, it is essential to investigate the change in 'problems' presentations in health-related policy documents over time, which would be useful to identify why certain problematisations were identified at a particular time for a specific health issue and explain the shifts if any were found.

## 6.6 CONCLUSION

The "What's the Problem Represented to be?" (WRP) approach was employed in the current research study to analyse the two main childhood obesity policy documents in the UK, "Childhood Obesity: a Plan for Action" parts 1 and 2 (HM Government, 2016, 2018). This study was based on a problem-questioning technique instead of the traditional problem-solving technique that is usually used in health-related policy analysis (Bacchi, 1999). Two main issues were identified to be problematised in these documents: responsibility and weight. The analysis also explored how and why these 'problems' were presented in a specific manner in the documents, through the process of examining the language and supporting evidence that were used to reflect the values and assumptions underlying the proposed interventions. The effects and possible unintended consequences of these representations were also considered. In particular, this research highlighted some negative effects that are correlated with the simplistic approach in tackling childhood obesity through focusing on individual behaviour and individuals' control over their lifestyle for weight loss. These consequences include weight-bias, stigma, discrimination and cultural imperialism. For these reasons, health policies should be analysed comprehensively to increase their potential effectiveness and decrease associated concerns and negative unintended consequences.

# CHAPTER 7: DISCUSSION

The aim of this PhD thesis is to investigate the effect of current strategies being used in the UK to tackle childhood obesity, with a particular focus on the single-nutrient approach. Four mixed-methodology studies were conducted to explore various relevant aspects of this aim.

The objectives of the PhD was therefore to first of all assess whether there is use of the single nutrient approach in England's Childhood Obesity strategy. From there, it identified the intended outcomes of this approach as it is used for Childhood Obesity, as well as the barriers to the effectiveness of this approach. It investigated whether this could also be associated with unintended consequences, and if so, what the source of these potential consequences could be. For example, unintended consequences could be as a result of the policy design, the implementation of policy, or the language that is used to present and frame policies.

The Choice-Based Conjoint analysis (CBC) survey was conducted to provide insight into how people weigh up information about multiple nutrients from traffic light labels (TLL). This study demonstrated that when deciding upon the healthiness of three food items (biscuits, sandwiches and cereal), participants placed the highest importance on sugar, which was significantly more important than other nutrients. Across all macronutrients, a red label was significantly more influential than a green one. The supporting cross-sectional online survey revealed that most of the participants could not identify the correct information regarding the recommendations underpinning the TLL.

In the second study, the Hierarchical Agglomerative Clustering (HAC) approach was applied to a cross-sectional dataset from the NDNS for the first study, to explore the characteristics of children who consume SSBs. The analysis produced six different clusters of children with varying proportions of SSBs drinkers in each. The results illustrated that the behaviour of drinking SSBs is not specific to children with higher body weight, and increased SSB drinking was not associated with a higher BMI or other macronutrient intake in any particular group of children.

The third study was a population-based survey, which was carried out to understand the perception of a representative sample of UK laypeople around the interventions and policies presented in the "Childhood Obesity: a Plan for Action" documents. This analysis indicated that there was widespread consensus across most participants and groups as to which interventions proposed in the documents are appropriate and effective. However, people's political orientation and parenthood status played a significant factor in determining their support for certain strategies. Furthermore, the results showed that participants' characteristics may interfere with whether they placed responsibility for weight gain and obesity on parents and individuals, or whether they focused on the role of environmental and social factors.

The final study applied a thematic analysis to the "Childhood Obesity: a Plan for Action" documents 1 and 2, in order to answer the six questions of Bacchi's "What's the Problem Represented to Be?" (WPR) approach. Three themes emerged from the thematic analysis and two main issues were identified to be problematised in these policy documents: responsibility and weight. Answering the six questions of the problem-questioning technique led to a deeper understanding of the representation of obesity in the documents, exploring the assumptions that underlie this representation and examining the possible effects that may result from this presentation including weight bias stigma and discrimination.

The main mutual outcome of these studies is that the focus on sugar reduction in tackling childhood obesity in the UK needs reconsideration with regards to the multiple health determinants related to obesity. In other words, the results shed light on the potential unintended consequences of the single-nutrient approach (i.e. sugar reduction).

The evidence base pointing to excess sugar intake in the UK population and its correlation with childhood obesity provide justification for the policies adopted by the Government aiming to reduce sugar intake to tackle childhood obesity. There is the added potential benefit of reducing the consumption of SSBs, which are widely recognised as a source of empty calories. These interventions are also likely to increase nutrition-related health

literacy and health consciousness of the public which may lead to improvements in individuals' diets. However, there are many potential unintended consequences related to this approach. The most important is lack of effectiveness at reducing childhood obesity rates in an equitable way, due to the policies not accounting for complex determinants of childhood obesity and a lack of understanding of the needs and characteristics of different target groups. This may lead to policies and outcomes not being inclusive. Some of the policies and language used may also risk harmful consequences such as internal and external stigma, and discrimination. The potential negative consequences may be mitigated or partially reduced by taking a broader view of the determinants of childhood obesity and a deeper look at the needs and characteristics of all target groups. These strengths, weaknesses, opportunities and threats presented by the use of the sugar reduction strategy to tackle childhood obesity will each be explored in more detail in the rest of this chapter.

## 7.1 THE EVIDENCE USED TO DESIGN SUGAR REDUCTION INTERVENTIONS

As mentioned earlier in the introduction chapter, it is common for public health institutions in the UK to identify a particular nutrient with the highest consumption, which is correlated with an increased incidence of any certain disease. This commonly leads the Government to focus on reducing the intake of this specific nutrient to reduce the incidence of the related disease through what is known as the single-nutrient approach.

Several diseases have been tackled through a set of interventions that address the consumption of one nutrient. For instance, the consumption of processed meat (fat and trans-fat) has been highly associated with certain cancers (Michels et al., 2018). Dairy products (calcium) have been linked to positive bone health (NHS, 2014), and fish consumption (Omega-3) has been linked to reduced cardiovascular diseases (CVDs) (NICE, 2007). Similarly, non-energetic nutrients have been at the centre of addressing some diseases, such as the focus on fibre for colorectal cancers, or antioxidants for CVDS

(Tapsell et al., 2016). Most recently, soft drinks, including fruit juices (with high sugar content) have been the main focus due to their association with obesity, and particularly, childhood obesity (PHE, 2015b).

It is important to emphasise that the focus on any of the targeted nutrients was based on an extensive evidence base. The most common method in the studies backing these approaches has been model-based analysis, as this study design is believed to provide governments with a starting point to tackle health issues (Garnett et al., 2015). Experimental evidence is not always feasible for many diseases due to the time it can take and the ethical considerations. Model-based studies allow the exploration of the potential impact of hypothetical interventions. These can predict cost-effectiveness, political sensitivity, potential acceptability by the public and industry, and other related factors. In addition, models allow researchers to modify these strategies to improve outcomes and increase effectiveness (Contento, 2007). Garnett and her colleagues described models as speaking the language of policy (Garnett et al., 2015).

Clearly, modelling studies can play an essential role in assessing the impact of modifying the consumption of one nutrient on a specific disease, independent of the overall diet. Demonstrating the important role of modelling studies, folate intake has been proven, through both models and experiments, to help prevent neural tube defects (Willett, 2012). This is a perfect illustration of how, for some conditions, a single nutrient is the principal aetiological dietary component, and modelling research can facilitate the provision of tailored recommendations for such diseases. This also demonstrates that modelling studies can be vital for diseases that are related to populations who are at particular risks, including older people and pregnant women (Tapsell et al., 2016).

Although limited in number, there are some real-life studies that have been conducted to evaluate the effect of a nutrient or a food item on the incidence of a disease. Recently, research was conducted to assess the role of taxes on SSBs consumption, and their effect on obesity and sugar intake. These interventions involved experimental study design (Teng et al., 2019). This kind of study may be very informative and can contribute to the

evidence base to influence current interventions, but there are drawbacks. First, each study has its own methodological shortcomings (Tapsell et al., 2016). Second, and crucially, neither modelled nor experimental studies are designed to assess interactions between different health related determinants and a disease (Braveman and Gottlieb, 2014). This leads to the modelling and experimental studies being set and suitable to test linear relationships between a nutrient and a disease, but makes them insufficient to consider the complexity of diseases and their determinants. This is emphasised by their inability to examine the interactions between different food components (Fardet and Rock, 2014). Furthermore, models in particular are inherently simplistic and cannot capture the full multifactorial nature of health-related issues. Therefore, they are more suited to act as pointers rather than precise predictors to the effectiveness of fiscal measures and other policies (Garnett et al., 2015).

The use of modelling studies can guide governments to intensify their work towards a single nutrient that is assumed to play a role in health status on a population level, in regard to a specific disease. This reductionist approach is dangerous as it fails to consider that addressing one nutrient is inadequate to "fix" a complex health issue. Most chronic diseases are complex health issues (Jacobs Jr et al., 2009). Moreover, this over-simplistic one-nutrient approach is associated with multiple negative consequences. When labelling a nutrient as related to or a cause of an increase in the incidence of a disease, national efforts to reduce the consumption of this nutrient may lead to it being demonised. This is also linked to an overemphasis on the benefits of the exclusion of this nutrient (Scrinis, 2013). In addition, this shorthand way of thinking focuses on individual consumption of a nutrient, which leads to placing the responsibility on individuals and implying personal misconduct (Mansfield and Rich, 2013). This unitary mechanism of epidemiological investigation does not capture the complex interconnections between nutrients, foods and dietary patterns, and other social and environmental factors (Shao et al., 2017).

Tackling obesity within UK health policies is another example in a pattern of public health focus on the single-nutrient approach. There is a growing body of literature that argues

that the dominant narrative of current public health strategies is the over-simplistic heuristic approach, which is based on simple linear methods of obesity prevention (Kelly and Russo, 2018, Walls et al., 2011). The next section will address several potential negative consequences of the single focus on sugar reduction to decrease the rates of childhood obesity.

## 7.2 POTENTIAL NEGATIVE CONSEQUENCES OF THE SINGLE-NUTRIENT APPROACH

Figure 7.1 illustrates some of the possible questions that may arise for the application of the interventions proposed to tackle childhood obesity in the UK as part of "Childhood Obesity: a Plan for Action". These strategies were described comprehensively in the introduction chapter, and two out of four studies of this PhD analysis focused specifically on two interventions; SDIL and TLL. The results of the four studies highlighted various unintended consequences. However, this section will cover other potential negative outcomes related to the context of the sugar reduction plan in the UK.

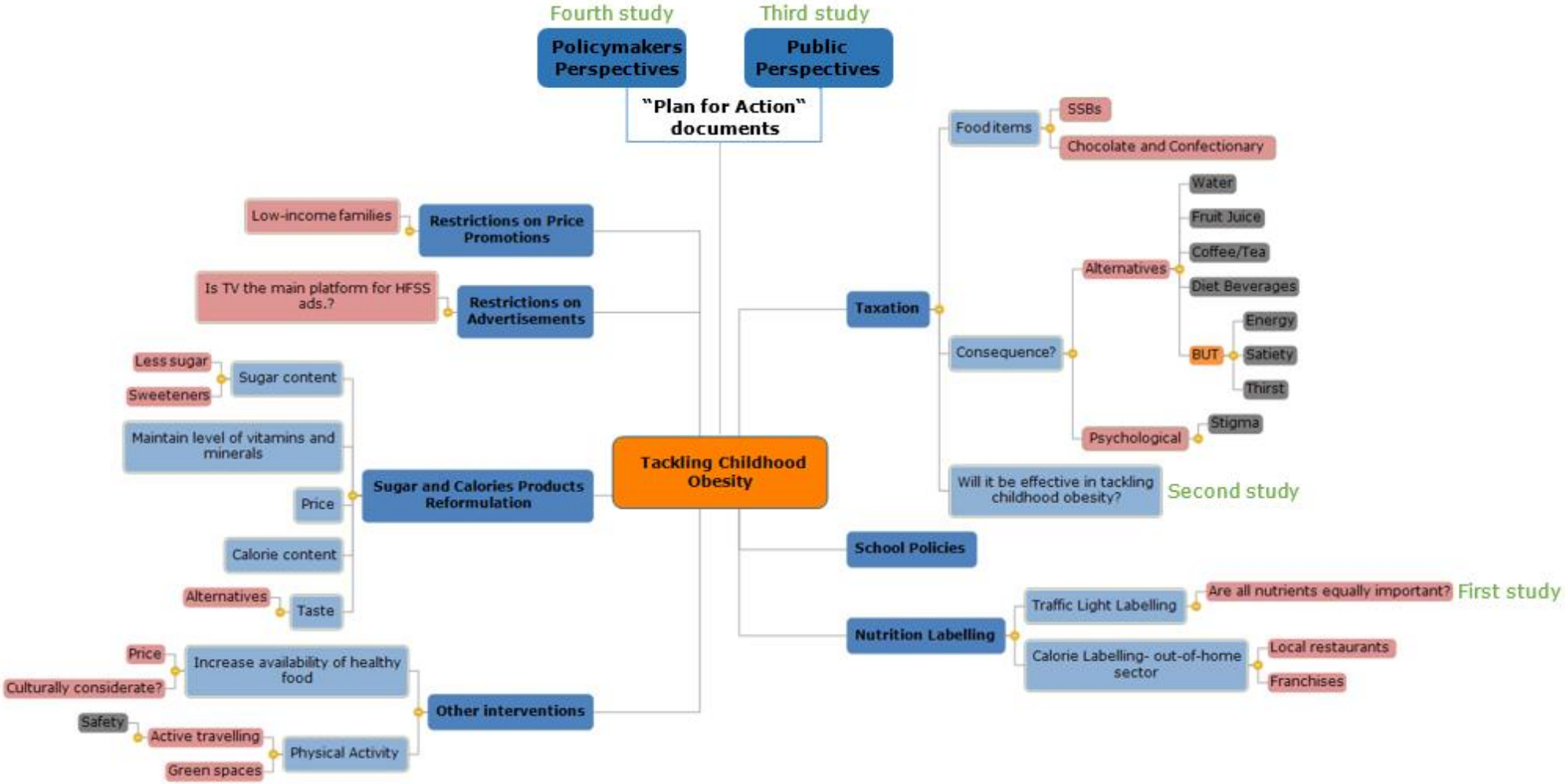



*Figure 7.1: Potential questions related to the application of the interventions proposed in "Childhood Obesity: a Plan for Action" documents.*

**The studies undertaken that are done within this PhD are highlighted in green*

### 7.2.1 Nutrition Labelling

Starting with the intervention of out-of-home sector calorie labelling, it is suggested that the application of calorie labelling on restaurants, cafes and takeaways menus would lead to a significant reduction in the total calories consumed per purchased meal (HM Government, 2018). A meta-analysis was presented to the Health and Social Care Committee to support this intervention (Crockett et al., 2018) (Health and Social Care Committee, 2019). This analysis included a set of experimental studies on the effect of calorie labelling on people's buying decisions under different real-life settings. The next paragraph will outline the individual studies included within the meta-analyses and then discuss their implications.

The first study demonstrated that displaying the numeric values of calories on menus did not affect food choices of 1,532 observations across a 19-week period in an upscale restaurant, which is located on a university campus, compared to other restaurants in that city,. The effectiveness of the strategy was however significantly enhanced by adding the TLL symbol to the calorie values (p-value= <0.01) (Ellison et al., 2014). The second study revealed a significant but small impact of nutrition labels on the food choices of students in university halls (Cioffi et al., 2015). The third study found that labels reduced total lunch calories by approximately 10%. The study was conducted through the introduction of calorie labelling and TLL on different menus, and investigated the ordering decisions of 1,440 employee at a health insurance company, of whom a third wanted to lose weight, and the average income among participants was high (VanEpps et al., 2016). The fourth study demonstrated that over one year, there was almost no eventual change on the calories of purchased beverages at a coffee shop from the introduction of calorie labelling. The observational study started collecting data for a full year from the point calorie labelling legislation came into force in the USA. The purchase of higher-calorie items increased over time (Bollinger et al., 2011). The fifth study found no significant impact of calorie labelling and TLL on the total calorie intake across 138 participants, of whom 60% of them were students. However, they had a larger effect of reducing calorie consumption

for participants who identified themselves as having lower levels of health consciousness in terms of their knowledge and awareness of health and nutrition issues (p-value= 0.0002) (Ellison et al., 2013). This PhD's study investigating people's interactions with TLL illustrated that individuals tend to overestimate their nutrition-related knowledge, which is not necessarily reflected in their food buying decisions. The final study in the meta-analysis explored the impact of three different nutrition labels on children's meals and demonstrated no effect on total calories or fat purchased by families (Holmes et al., 2013).

There are two important implications when looking at these studies individually. Although the conclusions of the meta-analysis or other reviews may well be correct, it is vital to draw attention to the different components of buying decisions. These include income, educational level, nutritional literacy, age, personal needs and other determinants. The impact of the policy in one context may not necessarily translate in a different one. In addition, when considering making policy recommendations, researchers and policymakers should consider short- and long-term effects of interventions, as the application of calorie labelling on menus may only have a short-term but not a long-term impact.

Considering how to apply calorie labelling also has implications for equality. One of the aims of the 2018 Government consultation for introducing legislation to mandate consistent calorie labelling for the out-of-home sector was to consider the inclusion of micro-businesses (those with fewer than 10 employees) in this legislation. UK national statistics showed that there are five times more fast food outlets in deprived areas compared to the most affluent and these are mostly micro-businesses (PHE, 2018b). Studies demonstrate the correlation between exposure to fast food outlets and weight gain (Seliske et al., 2013, Burgoine et al., 2018). This links to the statistics that children from poorer areas in the UK have double the risk of being overweight or obese (PHE, 2018d). Although results of the previously mentioned Government consultation on mandated calorie labelling are not out yet, it is essential to explore the bigger picture of this

legislation, in order to avoid widening the existing inequality in obesity rates across different socio-economic communities.

As found in the first study of the present PhD, that assessed the use of TLL on the perception of food items' healthiness levels, the single focus on sugar reduction may be associated with disregard for the other nutrients. There was a high level of importance placed on the sugar content compared to other nutrients. The unintended consequence of the use of TLL during this global focus on sugar could have a higher impact on individuals with health concerns or poor nutritional knowledge.

### 7.2.2 Sugar and Calories Product Reformulation

There is a need for better evidence with regards to the effectiveness and cost effectiveness of reformulation policies (Federici et al., 2019). There are important concerns to highlight with regards to the effect of biological factors, such as how reformulation would affect intake of nutrients and people's diet overall, technical aspects for the industry, as well as marketplace dynamics and consumer reactions to new products (Caro et al., 2014).

From the perspective of industry, the focus on one particular sensitive nutrient may create difficult challenges, dilemmas, or undesirable effects. There is a need for industry to maintain the taste, appearance and texture of existing products, as not doing so may affect consumer behaviour towards such products (Temme et al., 2011). It is suggested that reformulation may change the sensory attributes of food products and impact consumer liking which could be because manufacturers balance taste profiles when adjusting fat, sugar, and sodium levels in food (Muth et al., 2019). For example, a study of yogurts demonstrated that consumers favoured products with 10% added sugar compared to reduced sugar ones, as the reduced sugar yogurts were perceived to negatively affect aroma and sweetness (Chollet et al., 2013).

There is also general pressure to display desirable or acceptable nutrient labels, which can present the possibility of introducing poorly understood solutions. For instance, there is a lot of confusion around the possible sugar substitutes which may be used. In addition,

each has its own limitation and the evidence around the use of alternative sweeteners is still limited. Use of food additives carries its own risk too. The use of polyols, which are often used to replace sugar for their effects on sweetness and texture, can increase risks of gastrointestinal issues (Buttriss, 2013). Any nutrient substitution is also associated with different potential drawbacks in terms of its impact on people's dietary behaviour which in turn is linked to their food intake and health (Federici et al., 2019). Therefore, substitution may not necessarily lead to the desired public health effects. To ensure positive impacts of reformulation, there is a need for governments to provide more clarity and detailed recommendations. Instructing industry to reduce calorie and sugar content in products for example is not enough. Industry would need more detailed guidance on what those components should be substituted with to avoid undesirable consequences.

The overall accessibility of products may also be affected by industry reformulation. Healthier items are, in general, more expensive per serving for industry to produce than less healthy items in the same food category (Muth et al., 2019). Therefore, manufacturers have the option of increasing costs with the potential risk of reduced purchase of more expensive and healthier products, or maintaining costs at the risk of reducing the overall quality of products. The latter is counterproductive to the benefits of reformulation, as it pushes individuals to choose less healthy items. A model investigating the potential impact of increasing the price of SSBs predicted a reduction in total calorie intake but an increase in sodium and fat intake in people's diets due to product substitution (Zhen et al., 2014). Another Danish study, evaluated the effect of reformulation on total calorie intake over a period of a 52 weeks. The study showed that reformulation did not lead to a reduction in total calorie intake, and that consumers maintain their usual calorie intake despite reformulation to lower calorie products through product substitution (Jensen and Sommer, 2017).

Finally, the one-nutrient approach may offer an opportunity for industry to increase marketing opportunities by highlighting the desirable reduction of a particular macronutrient which is put under the public spotlight. Companies can create more

attractive packaging for their new reformulated products with misleading messages (Scrinis and Parker, 2016). Such marketing strategies may present more desirable products to the public in response to public health campaigns. However, such promotions may draw attention away from the overall quality of products and be associated with increased sales of food items of a lower quality.

### 7.2.3 Taxation

There are plenty of studies exploring the relationship between taxes on SSBs and childhood obesity. However, many studies have made their conclusions based on an assumption that consumption of SSBs as an output is expected to have a linear effect on the outcome of children's weight, through reducing the intake of NMES. That is to say that they assume that a reduction in SSBs consumption would necessarily lead to weight loss, neglecting the potential interaction between a tax on SSBs with many other factors which influence children's weight. No association was found between children's SSBs consumption and weight in the second study conducted and reported in this thesis.

It is therefore important to consider the potential long-term interaction between SSBs' intake and childhood obesity. Ebbeling et al. demonstrated that a reduction in the intake of SSBs was associated with a significant decrease in 14 to 16 year old adolescents' bodyweight after one year of their intervention. However, the results they demonstrated lasted only for the first year, whereas participants' BMI increased during the follow-up year. At the end of the follow-up year, the BMI of the study participants did not significantly differ when compared to the beginning of the study (Ebbeling et al., 2012).

A systematic review carried out by Powell et al. considered the interaction between a tax on SSBs and demand, price and weight. Although there were interactions to explore between these factors, the review found no association between state-level soda taxes and the BMI of adolescents (Powell et al., 2013). Fitts and Vader studied the effect of soda taxes on adult levels of obesity and they too found no effect. They however found a trend of negative correlation between BMI and the effect of the tax (Fitts and Vader, 2013).

Two studies may provide an explanation for the lack of long-term effects of taxation of SSBs on BMI. One of these studies found that people compensate for the calorie reduction from cutting SSBs by getting more calories from other meals (Berkey et al., 2004). Similarly, Fletcher et al. (2010) considered the effect of soda taxes on soda consumption and body weight among children and found a "moderate reduction in soft drink consumption" but no impact on weight because "this reduction in soda consumption is completely offset by increases in consumption of other high-calorie drinks." The case of Mexico is another example on the long-term effect of the tax on SSBs consumption. In January 2016, researchers revealed that after one year of implementation, the tax led to 6% reduction in the consumption of SSB across 6253 households (Colchero et al., 2016). However, months later, Mexico's National Institute of Public Health (MNIPH) published actual sales data illustrating that SSBs consumption did not decrease, but had actually slightly increased. In addition, researchers at the MNIPH emphasised the importance of considering all associated factors during the process of tax evolution as public health policy. These factors include changes in population age structure, economic activity, weather or seasonal changes, marketing and production of new products (GOB, 2016).

In short, there is not enough research on how individuals would react to a tax on SSBs, including whether it would alter their behaviour towards replacement drinks, to safely conclude that reducing SSB intake would necessarily lead to weight loss. The concern with regards to any kind of tax on unhealthy foods is that their substitution may not be desirable (Mytton et al., 2012). The swapped food may undermine or even cancel out the intended or expected health benefits of the proposed tax (Cornelsen et al., 2015). (Figure 7.2).

A tax on SSBs, or any other product, should consider the possible drivers behind the consumption of such products. In the case of SSBs, children and consumers in general may choose them as sources of energy, satiety or to quell thirst. A tax on SSBs does not take these potential drivers into account, even though these factors will likely determine or play a role in what consumers choose as alternatives.

The first potential alternative is fruit juice. As a result of the previous UK campaign to reduce obesity rates through reduction of dietary fat, pre-schoolers, children and adolescents had already shifted their drink consumption from high-fat dairy products to fruit juices and reduced fat milk (Ng et al., 2012). Fruit juice is considered a nutrient-dense drink, referring to its content of vitamins and minerals, while every 150 mL of it contains 12 grams of free sugar (BNF, 2017). Fruit juice is a possible replacement for SSBs, especially as it is perceived as a healthy option and a good source of nutrients (Bucher and Siegrist, 2015). However, within the context of reducing sugar intake to tackle childhood obesity, it may be reconsidered as a potential significant contributor to NMES intake (Ensaff et al., 2015). Another possible substitution is towards a greater intake of low-calorie SSBs. The results of the second study of this PhD demonstrated that the number of children who are drinking low-calorie versions of SSBs has increased noticeably in recent years. These drinks are connected to a high level of exposure to artificial and natural sweeteners with an intense sweetness, which is aimed at enhancing the appetite and preference to sweet taste (Brown et al., 2010). The consumption of artificially sweetened beverages may enhance the appetite and preference to sweet taste, which in turn could affect the energy balance and increase NMES intake leading to paradoxical results in the form of weight gain (Borges et al., 2017). In addition, consumption of sweeteners may have negative effects on glucose tolerance and alterations to the composition of the intestinal microbiota (Ruiz-Ojeda et al., 2019). However, there is not sufficient evidence on the short- or long-term health effects of increasing children's exposure to the artificial and natural sweeteners used in the reformulation of SSBs.

It has been argued that both artificially sweetened beverages and fruit juice were unlikely to be healthy alternatives to SSBs (Pereira, 2014). One systematic review, which included six cohort studies and four RCTs, concluded that alternatives to SSBs are associated with long-term lower energy intake and less potential for weight gain, yet the evidence was not sufficient to make conclusions related to other possible health outcomes of different substitutions. This made it complicated to identify the most suitable drink alternative to

SSBs (Zheng et al., 2015). Consequently, research recommends continued caution in considering which drink options should be promoted as healthy alternatives to SSBs, other than water or unflavoured milk options (Welsh et al., 2013).

Finally, there is little evidence on the interaction between the intake of other nutrients and sugar reduction. One study revealed a relationship between salt intake and total drinks intake and consumption of SSBs (He et al., 2008). One experiment highlighted the possibility of increased intake of fat and salt as a result of product substitution (Zhen et al., 2014).

All the concerns outlined above with regards to a tax on SSBs, and its possible long-term effects and potential substitutions, are also valid for other food items that are considered for taxation, including chocolate and confectionary.

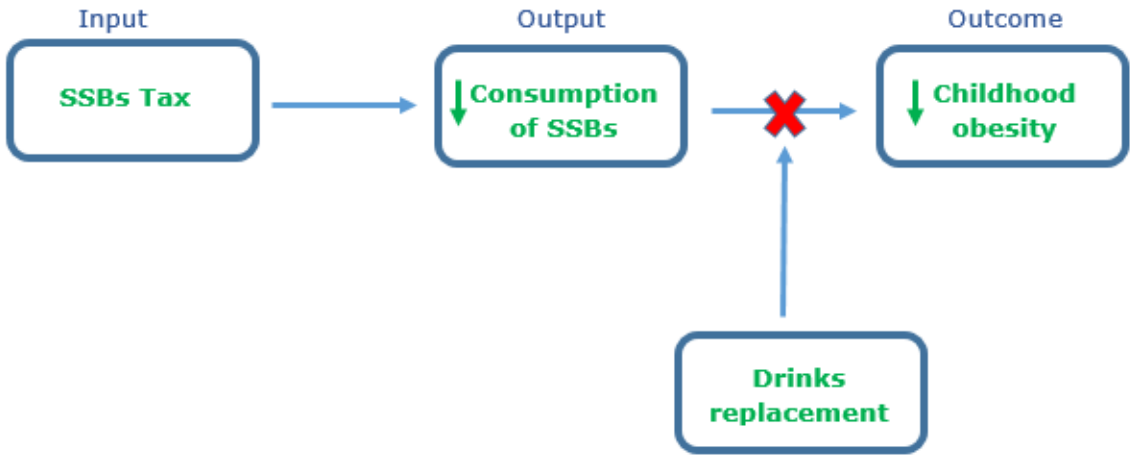



*Figure 7.2: The potential effect of drinks replacement on reducing rates of childhood obesity*

### 7.2.4 Restrictions on Price Promotions

Although banning promotions on unhealthy food may improve the population's diet overall, it may not reduce health inequalities related to diet. The shift towards energy-dense food instead of nutrient-dense options, such as fruits and vegetables, is related to the cheaper price of the former (Ntouva et al., 2013). As was discussed in the reformulation section, products that are higher quality and healthier are generally more expensive to produce. As price and familiarity of food are the main drivers behind people's food selection, lower income households are therefore more likely to have a higher intake of energy-dense, nutrient-poor foods. "Healthy" foods, such as fruits and vegetables, are often more expensive, and are certainly perceived as being more expensive, therefore price is a barrier to such healthy items for people with less purchasing power (Konttinen et al., 2013).

Attempts to limit or ban promotions on less-healthy food items, such as high sugar or high fat, sugar and salt foods, may increase their prices and improve the population's diet overall by reducing their total intake. However, with the barriers of availability and price preventing significant increases in healthy food intake among people in low socioeconomic groups, such interventions are unlikely to be enough to significantly change their diet away from energy-dense foods. This therefore would not reduce health inequalities related to dietary behaviours and may in fact exacerbate them (Nakamura et al., 2015).

### 7.2.5 Other Interventions – Availability of Healthy Food

Many national strategies aimed at improving the population's diet have tried to do so by increasing the availability and accessibility of healthy food, and consequently supporting families to eat better. Examples include providing vouchers or meals to low-income families, through Healthy Start, School Fruit and Vegetables, the Nursery Milk schemes, and the Universal Infant Free School Meal.

The Healthy Start voucher is a programme for low-income pregnant women and young children. The vouchers provided by the campaign, at £3.10 - £6.20 per week, can be

exchanged for fruits and vegetables, plain cow's milk or infant formula. The implicit assumption of the programme is that women will use these vouchers to purchase target foods, ideally in greater quantities than they did prior to using the vouchers, leading to dietary improvements. The vouchers can be seen as a financial incentive for dietary improvements. The Healthy Start vouchers also offer free vitamins for eligible women and children (Ohly et al., 2017).

One study aimed to understand the effects and challenges of the scheme and suggested that the programme is not effective enough for the most vulnerable families (Lucas et al., 2013). The study explored the views and experiences of women and professionals on Healthy Start vouchers and vitamin use. One of their main findings was that sign-up to the Healthy Start vouchers scheme among entitled beneficiaries was high, at 72-86% estimated up-take across research sites, but that the uptake was slightly lower in more deprived areas. Professionals reported that the uptake of Healthy Start vitamins was low overall, which was mainly perceived to be due to difficulties families face in accessing them. Among service users, families reported that although health professionals gave advice regarding the vouchers and how to access them, professionals' advice regarding diet and nutrition overall were somewhat limited. One of the conclusions of the study was that the diet of children in some of the most vulnerable families may not be protected by Healthy Start. The challenges discussed were around access, knowledge and navigating the administrative burden. These were faced by families as well as frontline professionals, midwives, health visitors, nursery nurses and Children's Centre staff (Lucas et al., 2013). Overcoming such challenges would be important to maximising the effectiveness of such interventions for those who need them most.

The Universal Infant Free School Meal (UIFSM) programme is another example where improvements can be made to increase the effectiveness and equity of an intervention. The programme provides funding for all government-funded schools to offer free school meals to pupils in reception, year 1 and year 2. Although this is readily available for children at schools, in Leicester, 23.5% of children did not take up the meals. Researchers

explained that there are multiple reasons which may be associated with the low rate of UIFSM uptake. These include parents worrying about the quantity and quality of food consumed, involving the child in the decision-making process of taking these meals, the child's first language and parents work status, education level, ethnicity and culture (Goodchild et al., 2017). This highlights the importance of tailoring the implementation of policies to match local needs and dietary-related factors that would facilitate the process of individual behaviour change (Carels et al., 2007). Involvement of local service users and stakeholders in the policy design and implementation would increase the chance of such policies succeeding, and reduce potential inequalities.

### 7.2.6 Stigma

It is finally essential to discuss the psychological and related consequences of public health messaging around obesity. As discussed in chapter five, the language used in such campaigns highlights obesity as the riskiest health issue. This increases pro-thinness culture, along with the perception of increased weight as a problem. This may increase the prevalence of body dysphoria, even among children and adolescents. Adolescent girls are recognised as being at most risk of body dissatisfaction, regardless of their actual body weight and, alarmingly, some children start attempting to lose weight at a very young age, sometimes as early as 9 years old (Flynn, 2004). These trends and perceptions may increase the acceptance of some restrictive and other unhealthy patterns of eating to achieve an ideal or desirable weight. One of the main potential negative health consequences is a higher incidence of eating disorders (Puhl and Latner, 2007).

Little attention is given to the issue of underweight despite its significant and lasting negative health impacts (Dereń et al., 2018). Weight dissatisfaction has also been linked with multiple health issues, such as higher blood pressure, higher blood glucose levels and greater risk of metabolic diseases and disordered eating (Bacon and Aphramor, 2011). The same study reported generally diminished quality of life for those with body dissatisfaction. Another study found that men and women with greater weight dissatisfaction reported more dieting, yo-yo dieting, snacking, consuming fewer meals,

being less active, and having to eat outside of the recommendations to maintain their weight regardless of their weight status. Individuals who were both overweight or obese, and dissatisfied with their weight, had the poorest health outcomes (Blake et al., 2013).

These findings and associations are especially alarming as negative stereotypes around weight are associated with prejudice and discrimination (Puhl and Brownell, 2001). Such stigma not only causes suffering but also leads to the opposite effect on diet to what policies promoting healthy diets set out to achieve. Weight stigma is associated with poor body image, lower self-esteem and higher risks of depression and anxiety, leading to negative life experiences in general (Emmer et al., 2020). It is further associated with undesirable dietary behaviours and eating disorders (Neumark-Sztainer et al., 2012, Puhl and Brownell, 2001). Puhl has argued that dealing with the negative health outcomes related to stigma is more challenging than dealing with the excess weight itself (Puhl and Heuer, 2010).

Emphasising the importance of moving away from such negative messaging around weight, research has claimed that participants are more motivated to respond positively to public health messages that promoted healthy eating behaviours without any reference to weight (Noonan-gunning, 2019, Puhl et al., 2012). By contrast, the focus on weight and the language around obesity leads to reduced commitment and motivation to weight loss and health behaviour programmes. Such focus exacerbates the pervasive weight stigma, as it fails to highlight the importance of healthy eating regardless of body weight (Tylka et al., 2014). In these ways, public health policies can perpetuate a bias, including weight bias, if not sensibly thought out (Pearl, 2018). Such significant negative health impacts cannot justify a public health tactic to address childhood obesity (Puhl and Heuer, 2010). Although the results of the current PhD studies do not directly measure stigma or its associated consequences, outcomes of each of the studies were directly linked to potential increase in weight-bias and stigma.

Finally, the unintended perpetuation and exacerbation of social inequity must be addressed. Evidence has demonstrated weight bias as a form of social inequity, as people

who belong to the "higher weight" social group are treated unequally to the "lower weight" social group in different sectors of society (Alberga et al., 2016). Unequal social positions also confer unequal probabilities of being exposed to various health risks (Graham, 2004). It has been discussed that obesity and its associated health burdens disproportionately affect people in low socioeconomic groups. Consequently, the potential negative consequences of public health policies around obesity are therefore much more likely to affect those who already suffer the inequality related to obesity.

This is particularly concerning considering the desired impact of public health policies around obesity to reduce social and health inequity. For example, it is often quoted that children with higher body weight perform worse at school, and that this is a potential driver for social inequity for those with higher body weight. However, a study of 6000 children from the South West of England found that such disparity in scores at school was not explained by IQ score (Booth et al., 2014). It suggested that this disparity is more likely to be caused by stigma, peer pressure or bullying, or other social factors. This highlights the importance of investigating the issue of stigma around bodyweight further, particularly as neglecting it risks implementing counterintuitive measures to deal with a health issue, and exacerbating the problems associated with obesity rather than solving them.

## 7.3 WHAT NEXT?

The findings of the studies and the discussion in this thesis, highlighting the possible negative consequences of the public health approach around obesity in the UK, are not sufficient to make firm recommendations for how to design a public health intervention. More precise research around the possible impacts of various policies and approaches would be needed. However, there is plenty here that can guide research and policy to mitigate or avoid some of those negative consequences (Figure 7.3).

### 7.3.1 Bigger Picture

One of the main flaws of the current public health strategy is its narrow focus. This includes the focus on the one-nutrient approach, specifically on sugar, to reduce obesity rates. The narrow focus is also apparent when considering that policies have often been designed and implemented without consideration of differing needs for people from different income, education and ethnic backgrounds, among others.

A public health strategy that takes into account the bigger picture when considering policies would therefore be more effective. The narrow focus on reducing sugar through reducing SSB consumption is challenged by the study on SSB consumption among children. The study found that there was no association between SSB consumption and children's weight. One possible solution is through the approach proposed by researchers from the University of Sydney's Charles Perkins Centre. They have proposed a radical rethinking of human nutrition science through a new framework called "Nutritional geometry" (Raubenheimer and Simpson, 2016). This approach considers the interaction between nutrients and other dietary components to lead to health outcomes and disease. It looks beyond any one nutrient in isolation. It is hoped that this new model will assist health professionals, dietitians and researchers to better understand and manage the complexities of obesity, by exploring all potential factors and determinants.

This is similar to the conclusions of a paper by Whitehead (2007), which aims "to help broaden the understanding of the range of different interventions available and their potential effectiveness for the task in hand, and to avoid the tendency to focus on one type of intervention neglecting the others." It was argued that the aim of policies should be to tackle the environmental and social determinants of a particular outcome, based on how a particular action is expected to bring desired changes. The public perception study demonstrated that political orientation, parenthood and other factors may interfere with how people perceive and interact with policies. Therefore, taking a comprehensive and broad view is vital for places with diverse populations, such as the UK, as nutritional and

other health messages are highly affected by individuals' specific circumstances and culture.

The importance of such a comprehensive approach has been identified by the Health and Social Care Select Committee in the UK parliament. A former Chair of the Committee referred to the whole systems approach applied in Amsterdam to deal with obesity as "the sandbag wall". "If any of the sandbags were missing, the whole system did not work as effectively" (Health and Social Care Committee, 2018). In 2015, PHE commissioned Leeds Beckett University to deliver a report on the whole systems approach to obesity programme (PHE, 2019a). In 2019, the report, "Whole Systems Approach to Obesity: A Guide to Support Local Approaches to Promoting a Healthy Weight and Resources", was published (PHE, 2019b). This report was set to support and enable local areas to launch programmes to address obesity on a local level. It provided a six-phase process that included key elements and concepts of systems thinking, engagement of leaders and stakeholders, mapping and action planning, implementing and reviewing throughout the whole process.

Considering the wider determinants of a particular outcome and implications of a particular policy would also reduce the chance of the exacerbation or neglect of social inequity. One study which researched the implementation of obesity-related policies in California found population-level improvements in the prevalence of childhood overweight and obesity that coincided with the period following implementation of these policies across the state. However, it also found that these improvements were greatest at schools in the most advantaged neighbourhoods. The authors concluded that while state policies may help prevent child obesity, the degree of their effectiveness is likely to depend on socioeconomic and other contextual factors. They recommended that to reduce disparities and prevent obesity, school policies and environmental interventions must address relevant contextual factors in school neighbourhoods (Sanchez-Vaznaugh et al., 2015). These findings are consistent with many of the consequences highlighted in the discussion in this thesis such as the possibility of increasing social and health inequalities due to the policy of banning

promotions, the price effect of the reformulation process, or the effect of not including micro-businesses in the mandatory calorie labelling policy.

Finally, many of the public health messages around obesity are targeted in a way that assumes that the messages only reach or affect individuals with overweight or families with overweight children. However, considering that everyone regardless of their health and weight status mainly receives nutritional information from mass media, as revealed by the pan-European survey (Margetts et al., 1997), clearly the same public health messages are reaching everyone. This is particularly important for children with increasing exposure and reliance on mass media to connect with the world (Matyjas, 2015). As discussed in the stigma section, the strong focus on bodyweight and obesity, which is reaching all children, may lead children and adolescents of any weight to have weight dissatisfaction, which leads to a range of dangerous health issues.

In summary, one-size-fits-all policies for complex issues can have significant negative consequences. Various factors, including culture, socioeconomic status and prior health status, among others, have different interactions with policies. Taking as broad a view as possible when designing such interventions is vital.

### 7.3.2 Positive Nutrition Messaging

Many of the potential negative consequences of the current public health approach around obesity can also be mitigated by reframing the way discussions, strategies and policies are presented. There are many potential social and health harms which stem from the way obesity, weight and diet are problematised. These include stigma, inequality, ineffective policies and body dissatisfaction leading to disordered eating. Furthermore, the disproportionate focus on sugar has led to the neglect of other nutrients.

Presenting nutrition messages positively rather than negatively would increase their potential effectiveness. Strategies that emphasise the value of eating healthily are more successful at decreasing the weight of children with obesity than those that focus on reducing their high intake of energy-dense food. A study investigated this by randomly

assigning forty-one 8-12 year-old children with BMI >85$^{th}$ percentile to one of two options for a family-based behavioural treatment for 24 months. One arm targeted increasing the intake of fruits, vegetable and low-fat dairy, while the other aimed at reducing the intake of energy-dense foods. The children in the first arm showed greater reduction in zBMI than the children in the second group both after 12 and 24 months follow-ups (12 months: (−0.30 zBMI units vs. −0.15 zBMI units, p-value = 0.01) and 24 months: −0.36 zBMI units vs −0.13 zBMI units, p-value = 0.04). Their results suggest that family-based treatment, in general, is associated with a reduction in parental restriction over child eating. They also demonstrate that focusing on healthy eating had the additional benefit of greater weight loss and greater reductions in concerns over children's weight (p-value= 0.007) (Epstein et al., 2008).

Another study demonstrated similar findings around the importance of positive nutrition messaging as described above. Families with parents with obesity and have normal weight children were randomised to groups in which parents were encouraged to increase their intake of fruits and vegetables in one arm, or decrease their intake of high-fat/high-sugar foods in the other. This prevention study demonstrated that targeting an increase in fruit and vegetable intake improved weight loss in parents of youth who are at risk of developing obesity after a 12-month period. The average weight lost in that group was 12.0± 11.05%, compared to 3.9± 4.17% loss in the other group who decreased their fat and sugar intake. These values were obtained by calculating the percentage of each individual's BMI, as a proportion of the 50$^{th}$ BMI percentile for their gender and age, and comparing this value at the beginning and end of the study period. Very importantly, during the 2-year follow-up period, this group was associated with no relapse in weight regain from the initial 6-month intensive treatment (Epstein et al., 2001).

On a population level, in Finland, strategies focusing on positive reinforcement have proven effective at reducing obesity rates, as well as related negative health outcomes. The strategy adopted in Finland started with the assumption that people knew how to improve their diet and other parts of their lifestyle related to health. The strategy therefore

focused on providing much more motivation than education to the general public. The Director General of the National Institute for Health and Welfare stated "the biggest innovation was massive community-based intervention. We tried to change entire communities" (Puska, 2016). The main focus was to do this through positive incentives rather than campaigns to deter what are perceived to be negative behaviours. These included "quit and win" competitions in villages for smokers, offering prizes to those who abstained from smoking for a month. Towns held competitions to reduce cholesterol levels. These initiatives were supported by nationwide changes in legislation.

In summary, it is both more likely to be effective, and less likely to cause unintended serious harm, to adopt an obesity reduction strategy that promotes positive health behaviours over one which stigmatises negative health behaviours.

### 7.3.3 Framing

The interventions set out in the Government strategy to reduce rates of childhood obesity are aimed at reducing weight of individuals. As discussed above, weight loss alone is not necessarily the only best solution to the rising rates of childhood obesity. In addition, some policies may be better framed as aiming at improving health or reducing harm to health in general, rather than focusing solely on the goal of weight loss. For example, reducing SSB consumption is an important part of reducing the intake of empty calories and the harms associated with SSB consumption in general. Therefore, framing the SDIL as a policy aimed at improving child health may increase the potential benefits of this policy and decrease the potential negative consequences, compared to framing it as tackling childhood obesity.

## 7.4 FUTURE RESEARCH

As discussed extensively in this PhD thesis, it would be vital to gain a comprehensive understanding of the needs and characteristics of each target group for each policy and

intervention. This would maximise the effectiveness and reduce potential unintended consequences and inequity as a result of interventions. Therefore, to expand this body of knowledge, it would be vital to carry out research to explore the target groups for each intervention in "Childhood Obesity: a Plan for Action", and investigate the potential effectiveness and limitations of each, such as banning promotions and restriction of HFSS advertising.

The second body of research which I would be interested in exploring is the impact of positive reinforcement on health-related behaviours. There are some studies potentially indicating that positive reinforcement of healthy behaviours may lead to more consistent and longer lasting health improvements than campaigns aiming to discourage negative health behaviours. However, experimental studies investigating this effect have generally been limited to specific behaviours. Broader and more up-to-date experimental studies could give clearer indication as to the effectiveness of such positive messaging on healthy behaviour.

## 7.5 STRENGTHS AND WEAKNESSES OF THE PHD

### 7.5.1 Strengths

This PhD thesis made use of novel mixed-methodologies to analyse public health interventions in the UK Government's strategy to reduce childhood obesity rates. This includes Hierarchical Agglomerative Clustering to analyse the characteristics of children who drink SSBs, Choice-Based Conjoint analysis to investigate the public's attitudes towards TLLs and the perceived healthiness of food items, and the "What-is-the-Problem-Represented-To-Be?" approach to investigate the underlying assumptions in "Childhood Obesity: a Plan for Action". While research often investigates the effect of language on negative consequences of policies such as stigma, this PhD thesis also highlighted such negative consequences through the lens of the policies themselves.

### 7.5.2 Weaknesses

Each study within this PhD has its own limitations, which have been individually discussed in detail in the relevant chapter of each study. The aim of the PhD thesis, and aims of the studies, are potentially too broad. This has meant that while I have been able to make broad suggestions with regards to the childhood obesity reduction strategy, I cannot give specific policy recommendations. Finally, it is important to recognise that, going into the PhD, I had my own bias with regards to the use of the single-nutrient approach.

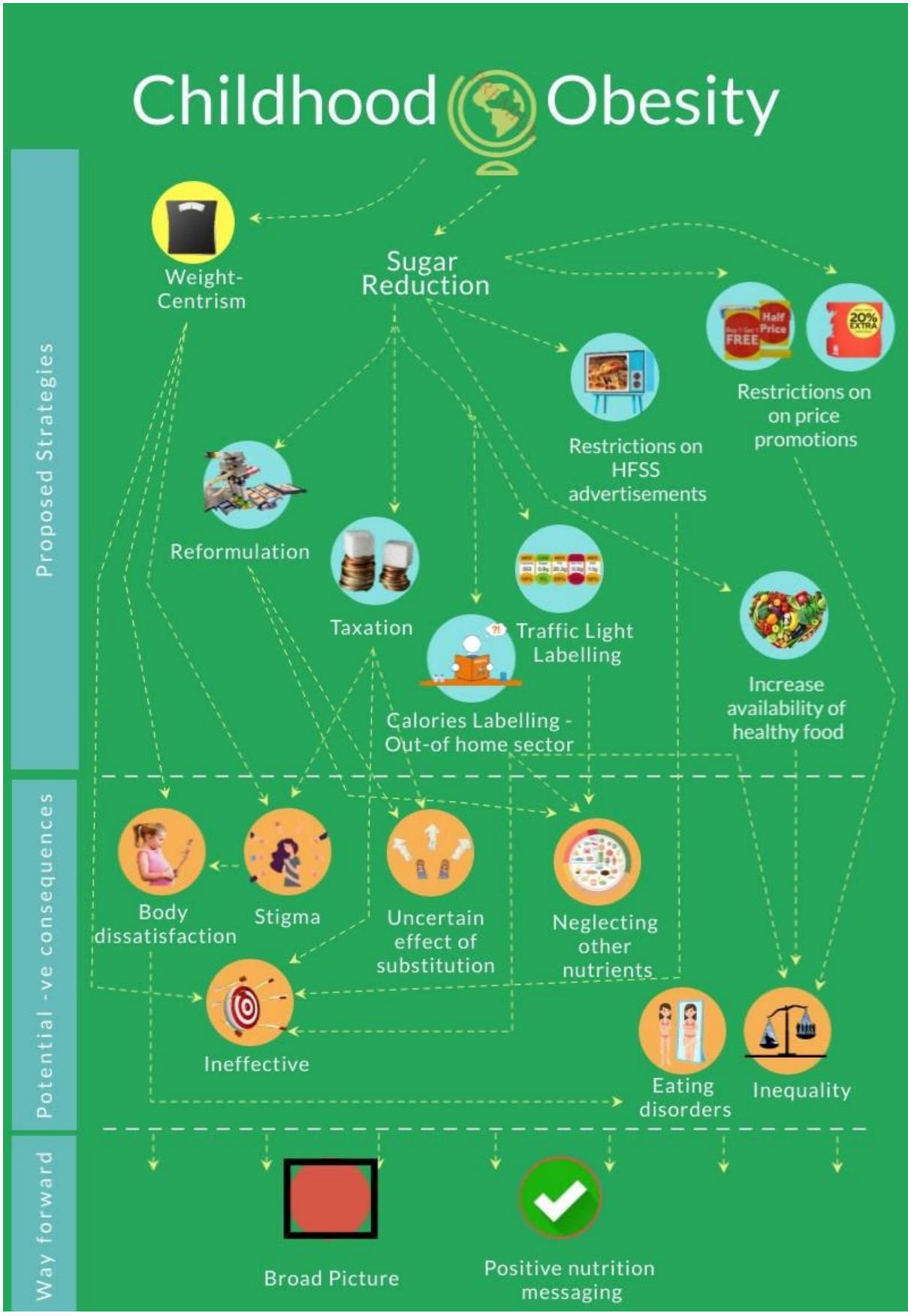



*Figure 7.3: A summary diagram of proposed childhood obesity strategies, their potential consequences and recommendations for a way forward*

## Conclusion

Childhood obesity has been at the centre of UK public health efforts in recent years. This focus has led to an increase in research into its potential causes, determinants, consequences and solutions. It has also led to a very public effort to introduce Government policy to address childhood obesity, with input, campaigning and lobbying from a variety of people with different levels of interest. This PhD thesis set out to investigate these policies, as well as the attitudes, causes and determinants around childhood obesity. Much of the research around childhood obesity has focused on one determinant, cause, policy or solution at a time, and there has been little work on looking at the combination of or interaction between different factors. Therefore, this thesis aimed to take a more holistic approach into the policies, and their shared focus on sugar as a single macronutrient; this has been identified in the literature as the single-nutrient approach. This led to the exploration of the single-nutrient approach and the potential unintended consequences of the UK Government strategy to reduce the rates of childhood obesity.

There were four mixed-methodology studies in this thesis, using quantitative methods to assess various interventions, and qualitative analysis to investigate the policies which define these interventions. The first study found that sugar plays the most important role in influencing people's perceptions of the healthiness of three food items, based on a Choice-Based Conjoint survey. A cross-sectional survey in this study found that participants overrated their nutritional knowledge. The second study found no association between children who drink SSBs and bodyweight, after analysing NDNS data using a novel machine-learning non-biased technique called Hierarchical Agglomerative Clustering. The third study found that individual characteristics influenced people's attitudes regarding the appropriateness and effectiveness of Government policies around childhood obesity and where they placed responsibility for children's weight. This was investigated using a population-based survey. The final study found three main themes in the "Childhood Obesity: a Plan for Action" policy documents, which identified two issues

as being problematised; weight and responsibility. This thematic analysis was conducted using Bacchi's "What's-the-Problem-Represented-to-be?" (WPR) approach.

Each study individually, and the analysis of the studies and literature review combined, demonstrated that the main strategies to reduce the rates of childhood obesity in the UK focus on reducing sugar intake. This is unsurprising because the research supporting the policies has focused on individual interventions, determinants and causes. This focus has led to the identification of sugar as the single most likely nutrient to contribute to childhood obesity, which has in turn translated into each Government policy or intervention addressing one contributing factor to sugar intake. This linear and simplistic approach has not taken into account the complexity of the determinants and the interactions between them. The other significant issue is the pervasive theme of weight problematisation and sugar demonisation, both of which carry negative framing. This framing, as well as the complexities and interactions mentioned, have potential negative consequences. These include not achieving the desired outcomes; social, economic and health inequality; and stigma. This may lead to another set of nutrition-related issues, due to the neglect of other nutrients; substitution which may carry other health risks; and health problems due to body dissatisfaction and disordered eating.

The current strategies would be improved by first considering the bigger picture when designing policies and interventions, taking into account the complexity and multifactorial nature of childhood obesity. They should also frame nutrition messages positively, focusing on how to enhance positive aspects of the population's diet, behaviour and health, rather than problematise negative aspects of people's lifestyles. Adopting these changes could improve the national strategy to reduce childhood obesity, which should aim to maximise the potential effectiveness of policies and interventions, and minimise their potential negative consequences.

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## Appendices

### Appendix one

Study one part two (TLL) - SurveyMonkey™ – Cross-sectional survey questions:

Thank you for taking part in this anonymous survey about food label traffic light knowledge. Labelling traffic lights (green, amber and red) are used to show you 'at a glance' whether food is low, medium or high in different nutrients – fat, saturates, sugar and salt. We want to know more about the knowledge people have about what this information means and how they might use it. This work could help people working in the food and health sector to better inform consumers and ultimately improve the health of the nation.

There are no right or wrong answers! We would be grateful for your honest views. The survey should only take 5 minutes to complete. Responses to this survey are anonymous. No information will be required that can personally identify you.

You are eligible to take part if you are 18 years of age or over. Your participation in this research is voluntary. You may choose not to participate. If you do choose to participate, you may withdraw at any time by simply not completing the questionnaire. If you do decide to withdraw, any data that you have provided will be included in the research.

Data will be anonymized, stored and backed up on a restricted access University hard drive. The results of this questionnaire will be used for scholarly purposes only and may be shared with the University of Nottingham for this purpose. I understand that while information gained during the study may be published, any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party. No identifiable personal data will be published. I agree that extracts from the interview may be anonymously quoted in any report or publication arising from the research.

If you have any questions or concerns regarding the research study, please contact:

Dr Carol Raaff, Project Supervisor: carol.raaff@nottingham.ac.uk

Dr Judy Swift, Project supervisor: judy.swift@nottingham.ac.uk

This research study has been approved by the Research Ethics Committee of the School of Biosciences, University of Nottingham.

**Consent:** *Clicking "agree" below indicates that you have read and understood the above information and you voluntarily agree to participate. If you do not wish to participate in this research study, please decline participation by closing the browser or clicking "disagree".*

To start, some information about you:

Q1: Age: < 18 years

*(If this option is selected, the participant is exited from the survey with an explanation that they are too young to participate)*

18-24 years

25-29 years

30-39 years

40-49 years

50-59 years

60+ years

Q2: Gender: Male

Female

Non-binary

Prefer not to say

Q3: What is the highest level of education that you have completed?

No formal qualifications

GCSE or equivalent

A-level or equivalent

Undergraduate degree or equivalent (e.g. BSc, BA, etc.)

Post-graduate degree or equivalent (e.g. PGCert, MSc, PhD, etc.)

Q4: Do you have any health targets that you are working towards?

I am trying to *(please tick as many as are appropriate)*:

Lose weight

Gain weight

Manage my diabetes

Lower my blood pressure

Lower my blood cholesterol

Manage a food intolerance/allergy: *(insert a drop box, i.e. lactose intolerance, gluten intolerance/allergy, etc.)*

Follow a healthy diet

Q5: What priority is given to buying food in your household? Please rate.

High
Medium
Low

Q6: Do you use front of pack traffic light labels to decide whether or not to buy a product?

Never

Occasionally
About half the time
Mostly
Always

Q7: On a scale of 0 to 10 (with 0 being not confident to 10 being extremely confident), please rate how confident do you feel when using traffic light information?

Q8: Do you find the traffic labelling information helpful in making food decisions?

Never
Occasionally
About half the time
Mostly
Always

Q9: ow would you rate your traffic light labelling knowledge?

Poor
Reasonable
Good
Very good

Q10: Which is the most important information to you, when making food choices? (Please rank)

Total Energy (calories)
Fat
Saturated fat
Sugar
Salt
Price
Allergy information

Current recommendations:

Q11: How much salt should an adult in the UK be having **each day**?

≤ 1g
2-4g
3-5g
≤ 6g
≤ 8g

Q12: What is the recommended maximum total fat intake for a UK adult each day?

50g
70g
100g
120g
150g
I don't know
Other (please specify)

Q13: What is the recommended maximum total saturated fat intake for a UK adult each day?

10g
20g
35g
50g
55g
I don’t know
Other (please specify)

Q14: What is the recommended maximum **total sugar** intake for a UK adult **each day**?

30g
45g
90g
100g
125g
I don’t know
Other (please specify)

Q15: What is the recommended maximum **free sugar** intake for a UK adult **each day**?

5g
10g
25g
30g
45g
90g
I don’t know
Other (please specify)

Q16: Does the traffic light relating to sugar on food labels display information on total sugars or free sugars?

Free sugars
Total sugars
I don’t know

Q17: What is more important for health, total sugars or free sugars?

Total sugar

Free sugar

I don’t know

**Thank you for taking the time to complete this survey.**

**Appendix two**

Study one part two (TLL) - SurveyMonkey™- Ethical approval

**UG / PGT for the School of Biosciences**

**(Modified from School of Sociology & Social Policy for Staff and Students)**

**Research ethics checklist for students**

The University of Nottingham's Guidance on Ethical Review states: "Ethical review (and approval) is required for all projects where the research involves participation of human subjects, their data and/or their tissue (even where the applicant indicates that there is only minimal risk)."

This form must be therefore be completed for all research projects, research assignments or dissertations/theses which are conducted within the School and involve human participants or data that are sensitive or protected. You must not begin data collection or approach potential research participants until you have completed this form, received ethical clearance, and submitted this form for retention with the appropriate staff.

If the study is based only on a review of documentary sources already in the public domain and involves NO fieldwork of any sort, then this form does not need to be completed.

Completing the form includes providing a brief summary of the research in Section 2 and ticking some boxes in Section 4. Ticking a shaded box in Section 4 indicates that the study is above minimal risk and requires further action by the researcher. Two things need to be stressed:

- Ticking one or more shaded boxes does not mean that you cannot conduct your research as currently anticipated; however, it does mean that further questions will need to be asked and addressed, further discussions will need to take place, and alternatives may need to be considered or additional actions undertaken.
- Avoiding the shaded boxes does not mean that ethical considerations can subsequently be 'forgotten'; on the contrary, research ethics need to be informed - for everyone and in every project – an ongoing process of reflection and debate.

The following checklist is a starting point for an ongoing process of reflection about the ethical issues concerning your study.

For further information on ethical issues, please consult the University pages or the School of Sociology and Social Policy's Ethics webpage: http://www.nottingham.ac.uk/sociology/research/research-ethics.aspx or the School of Biosciences Research Ethics Officer (Dr Kate Millar).

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SECTION 1: THE RESEARCHER(S)

**To be completed in all cases**

Title of project: TRAFFIC LIGHT LABELING AND PERCEPTIONS OF HEALTH

Name of principal researcher: Dr Carol Raaff / Dr Judy Anne Swift

Status:
- x Undergraduate students
- □ Postgraduate taught student
- x Postgraduate research student
- x Staff

Email address: carol.raaff@nottingham.ac.uk / judy.swift@nottingham.ac.uk

Names of other project members: Ola Anabtawi, Lisa Gertson, Sarah Hemmings, Harriet Nixon

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**To be completed by students only:**

**NAME IN CAPITALS**

OLA ANABTAWI, LISA GERTSON, SARAH HEMMINGS, HARRIET NIXON

Student ID number:

Degree programme: MNutr / PhD

Module name/number: Research Project

Supervisor/module leader or tutor: Dr Judy Swift, Dr Carol Raaff

## SECTION 2: RESEARCH WITHIN OR INVOLVING THE NHS OR SOCIAL CARE

**Does this research involve the recruitment of patients, staff, records or other data through the NHS or involve NHS sites or other property?**

□ Yes

**x** No

If you have answered **YES** to the above question, ethical approval **MUST** be sought from the relevant NHS research ethics committee. Evidence of approval from such a committee **MUST** be lodged with the School office prior to the commencement of data collection.

**Does this research involve the recruitment of users, staff, records or other data through social service authorities (children and adult services) or involve social service sites or other property?**

□ Yes

**x** No

If you have answered **YES** to the above question, then you must check whether or not the relevant social service authority has its own ethical scrutiny procedures. If appropriate, evidence of approval from such an authority **MUST** be lodged with the School office prior to the commencement of data collection.

Even where external ethical approval has been obtained from an NHS committee or social service authority, completion of this form is mandatory.

## SECTION 3: THE RESEARCH

Please provide brief details (100-200 words) about your proposed research, as indicated in each section

**1. Research question(s) or aim(s)**

This anonymous online survey, delivered via the Sawtooth software, is designed to answer a number of research questions and will support three UG student projects and contribute to a year 1, PhD sub-study.

Aims and hypotheses:

1. to investigate the impact of traffic light information (red, amber, green) about fat, saturated fat, salt, and sugar on perceived product healthiness.

$H_1$: Red traffic light information on sugar will be significantly more likely to be perceived as unhealthy compared to red traffic light information on other nutrients.

$H_0$: There is no significant effect of red traffic light information on sugar on perceived product healthiness.

2. To investigate the impact of information about the price (low, medium, high) and nutrient content (traffic lights for fat, saturated fat, salt, and sugar) on perceived product healthiness.

$H_1$: High price will be a significantly more important predictor of perceived healthiness compared favourable nutrient content (as indicated by green traffic lights for fat, saturated fat, salt, and sugar).

$H_0$: There is no significant difference between price and nutrient content in terms of predicting perceived product healthiness.

3. to investigate the impact of information on gluten content (gluten free, contains gluten) and nutrient content (traffic lights for fat, saturated fat, salt, and sugar) on perceived product healthiness.

$H_1$: Gluten-free will be a significantly more important predictor of perceived healthiness compared information on nutrient content (traffic lights for fat, saturated fat, salt, and sugar).

$H_0$: There is no significant difference between information on gluten content and information on nutrient content (traffic lights for fat, saturated fat, salt, and sugar) in terms of predicting perceived product healthiness.

Why is the research work valuable / important?

Sugar reduction is a widely advertised key target for public health in the UK to address childhood obesity. The literature to-date deals with some of the concerns regarding effectiveness and ethical implications but has not considered how consumers are negotiating this new information in the context of their existing notions of healthy food. This study aims to empirical test some of the notions proposed in the literature around wisdom of nature, the good-bad dichotomy, and the privilege of calorie control over nourishment. This study will also use a method (computer-assisted choice-based conjoint analysis) that has not been widely used in the area of food choice outside of work investigating consumer preferences of product attributes.

**2. Method(s) of data collection**

**What method are you using?**

An anonymous online survey using the Sawtooth software. Data will be collected in person, face-to-face with the participant via hand-held tablets.

At the beginning of the survey, participants will provide some basic demographic information:

(1) Age (NB <18years old will be identified and explained that they are unable to participate)

(2) Gender (male, female, non-binary)

(3) Educational attainment

(4) Rate the priority given to spending on household food, over other costs

(5) Indicate whether they are currently modifying their food intake in any way for health reasons.

Following this, they will be presented by a 7 choice scenarios, automatically created by the software, based upon one of three products: a sandwich, a biscuit/cereal bar, and a breakfast cereal. Each choice scenario provides the respondent with combinations of the various attributes (listed in the aims). In each scenario the respondent is asked to select the product that they consider most healthy. See here for more information on the software http://www.sawtoothsoftware.com/products/conjoint-choice-analysis/conjoint-analysis-software and a worked example of the user-interface www.sawtoothsoftware.com/baseball

**How have you defined your research group, is it robust (e.g. statistically)?**

Participants will complete the conjoint-based choice programme (delivered by the Sawtooth software) on a computer. Please follow the URLs above to see the interface.

The sample size of 200 for each of the 3 versions (based upon the three different products: a sandwich, a biscuit/cereal bar, and a breakfast cereal) is considered sufficient as recommended in the Sawtooth software guidelines. The feasibility of data collection has been proven by a similar project run in 2016 which successfully collected ~600 responses in the same timeframe.

**How are you gaining / recording your data, e.g. digital voice recording or participant completion?**

Participant completion of the online survey. Data will be downloaded from Sawtooth for analysis in the form of an SPSS data file.

**How will you gain consent?**

Consent will be implied by completion of this anonymous online survey although agreement to proceed will be the first question asked in the survey. Participants are free to refuse to complete but, to ensure that no one feels pressured in the face-to-face encounters, participants can easily skip to the end of the survey by selecting 'no' to the first question (and without entering any details) with no obvious sign to the researcher.

**Will the participants be quoted, will you name your participants, will they be anonymised?**

Participants will not be required to nor will be able to provide any identifiable information (as there are no qualitative responses).

**How will the data be stored (e.g. anonymised, coded, protected, names kept separately from the data, etc)**

Electronic data will be stored in password protected SPSS file(s) in University systems.

The anonymous data from each participant will be given a unique identifier number.

**3. Proposed site(s) of data collection**

**Be specific, include details of who and how many 'collections' will be made, etc**

Permission will be sought from bus stations, shopping malls and other similar locations with high footfall in the centre of Nottingham. Members of the research team will approach persons and ask permission to speak about the study. Both verbal and written information (in the form of the information sheet) will be available. Verbal information will be in the form of a script to ensure standardisation between researchers. If interested, participants will be passed a tablet and invited to complete the choice scenarios (as outlined above). On completion of the tasks, the participant will be thanked and invited to contact the research team with any questions and if they would like to be informed as to the results of the study.

**Are there any safety issues associated with the choice of collection site; e.g. for face-to-face interviews, are you interviewing in a public place, during working hours, etc?**

A risk assessment will be completed before the research team collect data on location.

At no time will researchers work outside of working hours, alone, or in a situation that is not public. Security staff at the locations will be notified of the research taking place and all researchers will carry a personal alarm.

**4. How will access to participants be gained?**

**You need to be specific and clear about different types of access / sampling; different 'access' methods require different approaches and raise different issues for informed consent; Need to consider the identification of the appropriate types of participants to approach, based on what you are trying to achieve, etc, etc**

Opportunistic sampling will be used but different locations at different times of the week and day will be accessed to improve the representativeness of the sample. Previous studies using the same methods produced a heterogeneous group in terms of sociodemographics.

As noted above, the participants will be considered to have consented to the research if they complete the survey. Participants will be prompted as to whether they would like more time to consider their participation, and the right to withdraw at any time will be emphasised.

Exiting the survey at any time will mean that the person's data cannot be entered into the conjoint analysis. However, upon submitting the complete survey it will not be possible to remove a person's data (due to the anonymous nature of the data). These issues will be communicated to the participants in both the verbal and written information.

**Do you need to go through an 'access' person?**

Permission from gatekeepers will be sought before recruiting at face-to-face locations.

**All your participants must be fully aware of how the data will be stored and used, e.g. will the data only be used by you or will you make the data available to other research teams?**

All potential participants will have access to an information sheet which clearly outlines how the data they provide will be stored and used. All potential participants will also have the opportunity to speak with a member of the research team to query any aspect of the project. The data will be used for the purposes laid out in the information sheet only but analysis may be conducted by researchers from outside of the named research team.

**Are you offering an incentive?**

No incentives are being offered.

**SECTION 4: ETHICAL CONSIDERATIONS**

Please answer each question by ticking the appropriate box. All questions in section 4 **must** be answered.

### 4.1 General issues

| | Yes | No |
|---|---|---|
| Will this research involve any participants who are known to be vulnerable due to: | | |
| Being aged under 18? | | X |
| Residing in institutional care (permanently or temporarily)? | | X |
| Having a learning disability? | | X |
| Having a mental health condition? | | X |
| Having physical or sensory impairments? | | X |
| Previous life experiences (e.g. victims of abuse)? | | X |
| Other (please specify)… | | X |
| Will this research expose participants to any significant risk of physical or emotional harm? | | x |
| Will this research involve any physically invasive procedures or the collection of bodily samples? | | X |
| Will this research expose the researcher to any significant risk of physical or emotional harm? | | X |
| Will this research involve deception of any kind? | | X |
| Will this research involve access to personal information about identifiable individuals without their knowledge or consent? | | X |
| I will inform immediately the School's Ethics Officer if I change the method(s) of data collection, the proposed sites of data collection, the means by which participants are accessed, or make any other significant changes to my research inquiry | X | |

### 4.2 Before starting data collection

| | Yes | No |
|---|---|---|
| I have read the *Research Code of Conduct* guidelines of the University of Nottingham, particularly section 4 on Data, and agree to abide by them:<br>http://www.nottingham.ac.uk/ris/local/research-strategy-and-policy/Code_of_Conduct(Version_3_January_2010).pdf | x | |
| For those intending to work with children and/or vulnerable adults: I have read the University's *Guidance on arrangements for Protection of Children and Vulnerable Adults*<br>http://www.nottingham.ac.uk/wideningparticipation/downloads/Guidance%20on%20the%20Protection%20of%20Children%20and%20Vunerable%20Adults.pdf | N/A | |

| | | |
|---|---|---|
| My full identity will be revealed to all research participants | x | |
| All participants will be given accurate information about the nature of the research and the purposes to which the data will be put | x | |
| All participants will freely consent to take part, and this will be confirmed by use of a consent form. (An example of a consent form is available for you to amend and use.) | | x |
| One signed copy of the consent form will be held by the researcher and another will be retained by the participant | | x |
| It will be made clear that declining to participate will have no negative consequences for the individual | x | |
| It will be made clear that participation is unlikely to be of direct personal benefit to the individual | x | |
| Participants will be asked for permission for quotations (from data) to be used in research outputs where this is intended | N/A | |
| Incentives (other than basic expenses) are offered to potential participants as an inducement to participate in the research. (Here any incentives include cash payments and non-cash items such as vouchers and book tokens.) | | x |
| For research conducted within, or concerning, organisations (e.g. universities, schools, hospitals, care homes, etc) I will gain authorisation in advance from an appropriate committee or individual. (This is in addition to any research ethics procedures required by those organisations, particularly health and social care agencies – see Section 2.) | x | |

### 4.3 During the process of data collection

| | **Yes** | **No** |
|---|---|---|
| I will provide participants with my University contact details, and those of my supervisor, so that they may make get in touch about any aspect of the research if they wish to do so | x | |
| Participants will be guaranteed anonymity only insofar as they do not disclose any illegal activities | x | |
| Anonymity will not be guaranteed where there is disclosure or evidence of significant harm, abuse, neglect or danger to participants or to others | x | |
| All participants will be free to withdraw from the study at any time, including withdrawing data following its collection | x | |
| Data collection will take place only in public and/or professional spaces (e.g. in a work setting). If fieldwork takes place in the respondent's home please outline in Section 6 what steps will be taken to ensure your safety. You may wish to consult the SRA researcher safety guidelines: http://www.the-sra.org.uk/guidelines.htm#safe | x | |
| Research participants will be informed when observations and/or recording is taking place | x | |
| Participants will be treated with dignity and respect at all times | x | |

### 4.4 After collection of data

| | Yes | No |
|---|---|---|
| Where anonymity has been agreed with the participant, data will be anonymised as soon as possible after collection | x | |
| All data collected will be stored in accordance with the requirements of the Data Protection Act 1998 | x | |
| Data will only be used for the purposes outlined within the participant information sheet and consent form | x | |
| Details which could identify individual participants will not be disclosed to anyone other than the researcher, their supervisor and (if necessary) internal and/or external examiners without their explicit consent | x | |
| I will inform my supervisor and/or the School's research ethics officer and (if necessary) statutory services of any incidents of actual or suspected harm of children or vulnerable adults which are disclosed to me during the course of data collection | x | |

### 4.5 After completion of research

| | Yes | No |
|---|---|---|
| Participants will be given the opportunity to know about the overall research findings | x | |
| Data must be submitted to the School office and will be retained (in a secure location) for 7 years from the date of any publication based upon them, after which time it will be destroyed. | x | |
| All hard copies of data collection tools and data which enable the identification of individual participants will be destroyed | N/A | |

SECTION 5: ETHICAL APPROVAL

**Declaration of ethical research**

1. **Undergraduate dissertation students who intend to conduct fieldwork** should include **one hard copies** of the checklist with their dissertations.
2. **By signing this form you are agreeing to work within the protocol which you have outlined and to abide by the University of Nottingham's Code of Research Ethics.** If you make changes to your protocol which in turn would change your answers to any of the above questions then you **must** complete a new form and submit a copy to your supervisor and the research ethics officer, Kate Millar.

Signed ……DR JUDY ANNE SWIFT…….. Date ……27/07/17……..

***3. If you ticked any of the shaded boxes in section 4 of this form, then you must complete SECTION 6 (overleaf). You must then discuss all ethical issues arising, record the outcome, including the supervisor's or REO's response, and have this form countersigned (see below)***

---

**4. All forms should be countersigned by the REO.**

**Authorisation**

This section **must** be completed in **all** cases – by type of investigator the form must be countersigned by the following personnel:

Undergraduate student → project / dissertation supervisor

Postgraduate taught student → project / dissertation supervisor

This form must then be sent to the internal SB e-mail address: SB-Biosciences-Ethics (SB-Biosciences-Ethics@nottingham.ac.uk) and Kate Millar (kate.millar@nottingham.ac.uk) by the supervisor (as the formal submission from a University e-mail address). If you make changes to your protocol which in turn would change your answers to any of the above questions then you **must** complete a new form and submit a copy to your tutor/supervisor and the ethics officer.

All forms should be countersigned (electronically confirmed) by the REO

Having reviewed the ethical issues arising from the proposed research:

- □ I am happy for the research to go ahead as planned.
- □ I have requested that changes be made to the research protocol. The principal researcher must complete and submit a revised form which integrates these changes
- □ This project must be referred for more detailed ethical scrutiny. A copy will be sent to the SSP REO for expert ethical review or this is to be referred to full SB REC Committee / School Management Group for consideration

Signed …… Date ……

Designation ……..

School REO…… Date ……

Note: **any** research protocols lodged with the School office may be subject to review by the School's Research Ethics Officer

SECTION 6: FURTHER INFORMATION & JUSTIFICATION OF METHODOLOGY

One box should be completed for **each** shaded box ticked in section 4 of this form.

Ethical issue: No consent forms

Rationale for chosen methodology and/or how ethical issue is to be addressed:

Informed consent is a vital part of any research conducted with human participants. Potential participants recruited face-to-face will be given an information sheet plus a verbal explanation (according to a standard 'script'). They will be asked to confirm whether they have had enough time to consider and whether they have any questions.

The first question on the survey asks the participant to confirm their participation. If they select 'no' they will be directed to the end of the survey. The final screen will look identical if the participant completes and submits their data, or not. In this way, it 'masks' the decision from the researcher and helps to alleviate any perceived social pressure.

It should also be noted that the researchers have all received communications skills training and have worked in healthcare settings where they have been required to gain verbal consent.

Supervisor/REO's response (including whether ethical issue has been satisfactorily addressed):

Ethical issue:

Please note that the title on the information sheet (i.e. How healthy are these products? A study investigating different product types) is not exactly the title of the study given at the beginning of this form. This is to avoid orientating the respondent to our overarching interest in sugar. However, the description of the study given in the information sheet does not contain any deception.

**Appendix three**

Study three (Public Perception) - SurveyMonkey™ – Cross-sectional survey questions:

Thank you for taking part in this anonymous survey about childhood obesity in the UK. We want to know more about public's beliefs about the causes and solutions of childhood obesity, and their perception on the appropriateness for the proposed policies. This work could help people working in the healthcare and public health sectors to understand public's support for the current approaches, in which is the key to determine the effectiveness of these interventions.

There are no right or wrong answers! We would be grateful for your honest views. The survey should only take 10-15 minutes to complete. Responses to this survey are anonymous. No information will be required that can personally identify you.

You are eligible to take part if you are 18 years of age or over. Your participation in this research is voluntary. You may choose not to participate. If you do choose to participate, you may withdraw at any time by simply not completing the questionnaire. If you do decide to withdraw, any data that you have provided will be included in the research.

Data will be anonymized, stored and backed up on a restricted access University hard drive. For more information on data issues and other aspects of the study, please read the full study information sheet here [URL to information sheet inserted here].

If you have any questions or concerns regarding the research study, please contact:

Dr Judy Swift, Project supervisor: judy.swift@nottingham.ac.uk

Ola Anabtawi, PhD student: ola.anabtawi@nottingham.ac.uk

This research study has been approved by the Research Ethics Committee of the School of Biosciences, University of Nottingham [add reference when available].

**Consent:** *Clicking "agree" below indicates that you have read and understood the above information and you voluntarily agree to participate. If you do not wish to participate in this research study, please decline participation by closing the browser or clicking "disagree".*

Q1: Age

< 18 years

*(If this option is selected, the participant is exited from the survey with an explanation that they are too young to participate)*
18-24 years
25-29 years
30-39 years
40-49 years
50-59 years
60-69 years
70+

Q2: Gender

Male
Female
Non-binary
Prefer not to say

Q3: What of the following best describes your ethnicity?

White (White British, Irish, other White)
Black and Black British (Black Caribbean, Black African, Other Black)
Mixed (White and Black Caribbean, White and Black African, White and Asian, Other mixed)
Asian and Asian British (Indian, Pakistani, Bangladeshi, Gujarati, Tamil, Other Asian), Chinese and Other Ethnic Groups (Chinese, Korean, Other ethnic group)
Other/Rather not say

Q4: What is the highest level of education that you have completed?

No formal qualifications
GCSE or equivalent
A-level or equivalent
Undergraduate degree or equivalent (e.g. BSc, BA, etc.)
Post-graduate degree or equivalent (e.g. PGCert, MSc, PhD, etc.)

Q5: Which region of the country do you live in?

East Midlands
East of England
London
North East
Northern Ireland

North West
Scotland
South East
South West
West Midlands
Wales
Yorkshire and the Humber

Q6: Regarding your political orientation, can you locate yourself on the following scale?

1-100 scale

Q7: How would you describe yourself?

Too thin or underweight
Recommended or healthy weight
Overweight
Very overweight or obese

A8: A. Are you a parent?

Yes / No

B. Do you have, or have you had, a child which you think is overweight or obese?

Yes/ No

Q9: A. Are you a grandparent?

Yes / No

B. Do you have, or have you had, a grandchild which you think is overweight or obese?

Yes/ No

Q10: How much are parents responsible for their children's body weight (100% is most responsible)

Q11: To what extent is childhood obesity a health priority in the UK?

Q12: Do you think the Government is doing enough about childhood obesity?

Q13: Have you heard of the UK government's "Childhood Obesity: a Plan for Action" document?

Yes
No

No: The UK government's "Childhood Obesity: a Plan for Action" has two chapters – the first published in August 2016 and the 2nd June 2018. They both include government's plan for action towards halving childhood obesity rates and reducing the gap in obesity between children from the most and least deprived areas by

2030, through proposing wide range of interventions and policies to tackle the issue.

Q14: The policies that the UK government has adopted as part of the "Childhood Obesity: a Plan for Action" are listed below. How appropriate do you think each policy is? (N.B. these options will be presented in a random order)

- Introducing a soft drinks industry levy
- Introducing a 9pm watershed on TV advertising of high fat sugar salt (HFSS)
- Challenge the manufacturers to decrease the sugar content in cereals and confectionary by at least 20% by 2020
- Motivate the drink industry to reformulate
- Investigate opportunities to bring forward a suite of applications that enable consumers to make the best use of technology and data to inform eating decisions (ex. Change4life mobile app)

Q15: The policies that the UK government is considering as part of the "Childhood Obesity: a Plan for Action" are listed below. How effective do you think each policy will be if implemented? (N.B. these options will be presented in a random order)

- Sugary milk drinks may be included in the soft drinks industry levy if insufficient progress on the voluntary sugar reduction has been made.
- Challenges all food and drink companies - whether they are manufacturers, retailers, restaurants or takeaways - to reduce the calories by 20% in a range of everyday foods consumed by children by 2024
- Introduce legislation to mandate consistent calorie labelling for the out of home sector
- Ban price promotions (1+1, multi-buy, unlimited refills) on unhealthy foods and drinks in the retail and out of home sector
- Develop a new framework that will consider how schools build knowledge across the whole curriculum and how they support pupils' personal development more broadly, including in relation to healthy behaviours.
- Promote a national ambition for every primary school to adopt an active mile initiative to increase children's physical activity (ex. the Daily Mile)
- Introduce legislation to end the sale of energy drinks to children (<16 years old) by all retailers.

Q16: To be able to explore more in this issue, please indicate the likelihood of each of the following factors to be the contributor to childhood obesity in the UK: (N.B. these options will be presented in a random order)

Biological (e.g. genetics, hormone levels, slow metabolism, etc.)

Psychological (e.g. low-self-esteem, weight stigma, depression, anxiety, etc.)

Behavioural (e.g. large food portion sizes, snacking and grazing throughout the day, sedentary lifestyle, etc.)

Social (e.g. low income, low levels of education, poor cooking skills, etc.)

Structural (e.g. the food industry, easy availability of high-calorie food, lack of sport centres, etc.)

Q17: Please indicate the likelihood of these solutions to be suitable for tackling childhood obesity in your opinion: (N.B. these options will be presented in a random order)

Biological solutions (e.g. drug treatments, weight loss surgery, gene therapy, etc.)

Psychological solutions (e.g. counselling, mental health treatment, support groups, etc.)

Behavioural solutions (e.g. parents should change their children's lifestyle to eat less and exercise more)

Social solutions (e.g. cooking lessons in schools, campaigns to educate parents about obesity, etc.)

Structural solutions (e.g. strict rules on advertising of unhealthy food, cheaper fees for sports centres, taxes on high-calorie food)

Q18: Finally, listed here are some possible strategies to help reduce the number of obese and overweight children. Please indicate if you would you be in favour to adopt any in the future government childhood obesity plans: (yes/ No?) (N.B. these options will be presented in a random order)

- Provide more NHS weight loss operations for children to lose weight
- Provide weight loss medication to help children control their appetite/weight gain?
- Increase the number of free weight management courses for children who want to lose weight
- City councils to limit the number of fast food outlets near schools
- Force manufacturers to reformulate unhealthy food.
- Increase health education campaigns about the threats associated with childhood obesity
- Educate parents to take a better care of children's healthy eating
- Ban unhealthy food in schools (ex. confectionery, pastry, fizzy drinks)
- Increase the availability of healthy food in restaurants and cafes
- Subsidize the cost of healthy food for children
- Subsidize access for children to sports centres, swimming pools, etc.
- Tax all unhealthy food
- Provide more emotional support for overweight children at schools through a specialist
- Equip parents with the skills, knowledge and confidence to provide a healthy family lifestyle and nurturing home environment
- Regulations to reduce weight stigma (i.e. bias towards larger people due to their size)

**Appendix four**

Study three (Public Perception) - SurveyMonkey™ – Ethical approval

**UG / PGT for the School of Biosciences**

**(Modified from School of Sociology & Social Policy for Staff and Students)**

**Research ethics checklist for students**

The University of Nottingham's Guidance on Ethical Review states: "Ethical review (and approval) is required for all projects where the research involves participation of human subjects, their data and/or their tissue (even where the applicant indicates that there is only minimal risk)."

This form must be therefore be completed for all research projects, research assignments or dissertations/theses which are conducted within the School and involve human participants or data that are sensitive or protected. You must not begin data collection or approach potential research participants until you have completed this form, received ethical clearance, and submitted this form for retention with the appropriate staff.

If the study is based only on a review of documentary sources already in the public domain and involves NO fieldwork of any sort, then this form does not need to be completed.

Completing the form includes providing a brief summary of the research in Section 2 and ticking some boxes in Section 4. Ticking a shaded box in Section 4 indicates that the study is above minimal risk and requires further action by the researcher. Two things need to be stressed:

- Ticking one or more shaded boxes does not mean that you cannot conduct your research as currently anticipated; however, it does mean that further questions will need to be asked and addressed, further discussions will need to take place, and alternatives may need to be considered or additional actions undertaken.
- Avoiding the shaded boxes does not mean that ethical considerations can subsequently be 'forgotten'; on the contrary, research ethics need to be informed - for everyone and in every project – an ongoing process of reflection and debate.

The following checklist is a starting point for an ongoing process of reflection about the ethical issues concerning your study.

For further information on ethical issues, please consult the University pages or the School of Sociology and Social Policy's Ethics webpage: http://www.nottingham.ac.uk/sociology/research/research-ethics.aspx or the School of Biosciences Research Ethics Officer (Dr Kate Millar).

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SECTION 1: THE RESEARCHER(S)

**To be completed in all cases**

Title of project: Public perceptions of Childhood Obesity Policy in the UK

Name of principal researcher: Ola Anabtawi

Status: □ Undergraduate students

□ Postgraduate taught student

x Postgraduate research student

x Staff

Email address: ola.anabtawi@nottingham.ac.uk

Names of other project members: - Judy Swift (judy.swift@nottingham.ac.uk)

---

**To be completed by students only:**

| **NAME IN CAPITALS** |
| --- |
| OLA ANABTAWI |

Student ID number: 4304901

Degree programme: PhD

Module name/number:

Supervisor/module leader or tutor: Dr Judy Swift

## SECTION 2: RESEARCH WITHIN OR INVOLVING THE NHS OR SOCIAL CARE

**Does this research involve the recruitment of patients, staff, records or other data through the NHS or involve NHS sites or other property?**

□ Yes

**x** No

If you have answered **YES** to the above question, ethical approval **MUST** be sought from the relevant NHS research ethics committee. Evidence of approval from such a committee **MUST** be lodged with the School office prior to the commencement of data collection.

**Does this research involve the recruitment of users, staff, records or other data through social service authorities (children and adult services) or involve social service sites or other property?**

□ Yes

**x** No

If you have answered **YES** to the above question, then you must check whether or not the relevant social service authority has its own ethical scrutiny procedures. If appropriate, evidence of approval from such an authority **MUST** be lodged with the School office prior to the commencement of data collection.

Even where external ethical approval has been obtained from an NHS committee or social service authority, completion of this form is mandatory.

## SECTION 3: THE RESEARCH

Please provide brief details (100-200 words) about your proposed research, as indicated in each section

**5. Research question(s) or aim(s)**

This anonymous online survey, delivered by Survey Monkey, is designed to answer a number of research questions that will contribute to PhD student work.

**Aims and Research Questions:**

Aim: To understand public beliefs about current childhood obesity policy in the UK.

Research Question 1: Do public beliefs about the causes and solutions to childhood obesity align?

Research Question 2: How do members of the public evaluate the current and proposed policies outlined by the Government's Childhood Obesity Plan?

Research Question 3: Do public beliefs about solutions to childhood obesity and policy preference align with political persuasion?

**Why is the research work valuable / important?**

Recently, the focus on reducing childhood obesity rates in the UK has become one of the main public health priorities. Efforts made by the government have consequentially also grown and proposals include a wide range of interventions to tackle the issue. However, public support is key in determining the effectiveness of the approaches.

Only few studies, done in the UK have reviewed the public's beliefs about this issue, with the limitation of solely exploring the views of specific groups of people, such as parents and GPs, and 10+ years ago. This study will be based on a large sample, population-based survey, which will aim to investigate the perception of a diverse group of lay people on the causes of childhood obesity and the effectiveness of several suggested interventions, in turn, this will help policy makers when considering the most appropriate approaches to be implemented in the future.

**6. Method(s) of data collection**

**What method are you using?**

The survey will be hosted by SurveyMonkey and will be distributed to a stratified sample of 2000 people via SM's paid platform, Audience.

At the beginning of the survey, participants will provide basic demographic information:

Age (should be >18 years), gender, ethnicity, educational level, political orientation. In addition to other information regarding their weight and parenthood.

This will be followed by a selection of question to assess their knowledge around the "childhood obesity: plan for action" documents, that are the current governmental policy documents to tackle childhood obesity in the UK, including their perception on the implemented and suggested policies proposed in the documents.

Participants will also be presented with a selection of factors and solutions related to childhood obesity (biological, psychological, behavioural, social, structural) and asked to indicate the likelihood of each factor to contribute to the issue and accordingly be effective to be used as an approach to tackle it.

**How have you defined your research group, is it robust (e.g. statistically)?**

The sample will be stratified by age and gender, and data will be collected from 2000+ participants to ensure representation. Previous published research has used this strategy successfully.

**How are you gaining / recording your data, e.g. digital voice recording or participant completion?**

Participant completion of the online survey. Data will be downloaded from Survey Monkey for analysis in the form of an SPSS data file.

**How will you gain consent?**

Consent will be implied by completion of this anonymous online survey although agreement to proceed will be the first question asked in the survey. Participants are free to refuse to participate and there is no direct request (or refusal) to the participant from the research team.

**Will the participants be quoted, will you name your participants, will they be anonymised?**

Participants will not be required to provide any identifiable information although there is the possibility that some may include such information in the last question, which has an "other, please state" option. Any such information will be removed from the raw data file.

**How will the data be stored (e.g. anonymised, coded, protected, names kept separately from the data, etc)**

Electronic data will be stored in password protected SPSS file(s) in University systems. The data from each participant will be given a unique identifier number.

**7. Proposed site(s) of data collection**

**Be specific, include details of who and how many 'collections' will be made, etc**

SurveyMonkey's paid service, Audience. Cost is calculated on the basis of how many questions the survey contains and stratification requirements.

**Are there any safety issues associated with the choice of collection site; e.g. for face-to-face interviews, are you interviewing in a public place, during working hours, etc?**

No

**8. How will access to participants be gained?**

**You need to be specific and clear about different types of access / sampling; different 'access' methods require different approaches and raise different issues for informed consent; Need to consider the identification of the appropriate types of participants to approach, based on what you are trying to achieve, etc, etc**

As noted above, the participants will be considered to have consented to the research if they complete the survey. Participants will have the right to withdraw at any time.

Exiting the survey at any time will mean that the person's data up to that point will be collected but will not be entered into any analysis.

Upon submitting the complete survey it will not be possible to remove a person's data (due to the anonymous nature of the data). These issues will be communicated to the participants in the provided written information.

**Do you need to go through an 'access' person?**

No

**All your participants must be fully aware of how the data will be stored and used, e.g. will the data only be used by you or will you make the data available to other research teams?**

All potential participants will be provided with a detailed information at the first page of the survey, which clearly outlines how the data they provide will be stored and used. All potential participants will also have the opportunity to contact with a member of the research team to query any aspect of the project. The data will be used for the purposes laid out in the information sheet only.

**Are you offering an incentive?**

Participation is voluntary, 50 cents are paid to charity for each complete response

## SECTION 4: ETHICAL CONSIDERATIONS

Please answer each question by ticking the appropriate box. All questions in section 4 **must** be answered.

### 4.1 General issues

| | Yes | No |
|---|---|---|
| Will this research involve any participants who are known to be vulnerable due to: | | |
| Being aged under 18? | | X |
| Residing in institutional care (permanently or temporarily)? | | X |
| Having a learning disability? | | X |
| Having a mental health condition? | | X |
| Having physical or sensory impairments? | | X |
| Previous life experiences (e.g. victims of abuse)? | | X |
| Other (please specify)… | | X |
| Will this research expose participants to any significant risk of physical or emotional harm? | | x |
| Will this research involve any physically invasive procedures or the collection of bodily samples? | | X |
| Will this research expose the researcher to any significant risk of physical or emotional harm? | | X |
| Will this research involve deception of any kind? | | X |
| Will this research involve access to personal information about identifiable individuals without their knowledge or consent? | | X |
| I will inform immediately the School's Ethics Officer if I change the method(s) of data collection, the proposed sites of data collection, the means by which participants are accessed, or make any other significant changes to my research inquiry | X | |

### 4.2 Before starting data collection

| | Yes | No |
|---|---|---|
| I have read the *Research Code of Conduct* guidelines of the University of Nottingham, particularly section 4 on Data, and agree to abide by them:<br>http://www.nottingham.ac.uk/ris/local/research-strategy-and-policy/Code_of_Conduct(Version_3_January_2010).pdf | x | |
| For those intending to work with children and/or vulnerable adults: I have read the University's *Guidance on arrangements for Protection of Children and Vulnerable Adults*<br>http://www.nottingham.ac.uk/wideningparticipation/downloads/Guidance%20on%20the%20Protection%20of%20Children%20and%20Vunerable%20Adults.pdf | N/A | |
| My full identity will be revealed to all research participants | x | |
| All participants will be given accurate information about the nature of the research and the purposes to which the data will be put | x | |
| All participants will freely consent to take part, and this will be confirmed by use of a consent form. (An example of a consent form is available for you to amend and use.) | | x |
| One signed copy of the consent form will be held by the researcher and another will be retained by the participant | | x |
| It will be made clear that declining to participate will have no negative consequences for the individual | x | |

| | | |
|---|---|---|
| It will be made clear that participation is unlikely to be of direct personal benefit to the individual | x | |
| Participants will be asked for permission for quotations (from data) to be used in research outputs where this is intended | N/A | |
| Incentives (other than basic expenses) are offered to potential participants as an inducement to participate in the research. (Here any incentives include cash payments and non-cash items such as vouchers and book tokens.) | x | |
| For research conducted within, or concerning, organisations (e.g. universities, schools, hospitals, care homes, etc) I will gain authorisation in advance from an appropriate committee or individual. (This is in addition to any research ethics procedures required by those organisations, particularly health and social care agencies – see Section 2.) | N/A | |

### 4.3 During the process of data collection

| | **Yes** | **No** |
|---|---|---|
| I will provide participants with my University contact details, and those of my supervisor, so that they may make get in touch about any aspect of the research if they wish to do so | x | |
| Participants will be guaranteed anonymity only insofar as they do not disclose any illegal activities | x | |
| Anonymity will not be guaranteed where there is disclosure or evidence of significant harm, abuse, neglect or danger to participants or to others | x | |
| All participants will be free to withdraw from the study at any time, including withdrawing data following its collection | | x |
| Data collection will take place only in public and/or professional spaces (e.g. in a work setting). If fieldwork takes place in the respondent's home please outline in Section 6 what steps will be taken to ensure your safety. You may wish to consult the SRA researcher safety guidelines: http://www.the-sra.org.uk/guidelines.htm#safe | x | |
| Research participants will be informed when observations and/or recording is taking place | x | |
| Participants will be treated with dignity and respect at all times | x | |

### 4.4 After collection of data

| | **Yes** | **No** |
|---|---|---|
| Where anonymity has been agreed with the participant, data will be anonymised as soon as possible after collection | x | |
| All data collected will be stored in accordance with the requirements of the Data Protection Act 1998 | x | |
| Data will only be used for the purposes outlined within the participant information sheet and consent form | x | |
| Details which could identify individual participants will not be disclosed to anyone other than the researcher, their supervisor and (if necessary) internal and/or external examiners without their explicit consent | x | |
| I will inform my supervisor and/or the School's research ethics officer and (if necessary) statutory services of any incidents of actual or suspected harm of children or vulnerable adults which are disclosed to me during the course of data collection | x | |

### 4.5 After completion of research

| | Yes | No |
|---|---|---|
| Participants will be given the opportunity to know about the overall research findings | x | |
| Data must be submitted to the School office and will be retained (in a secure location) for 7 years from the date of any publication based upon them, after which time it will be destroyed. | x | |
| All hard copies of data collection tools and data which enable the identification of individual participants will be destroyed | N/A | |

SECTION 5: ETHICAL APPROVAL

## Declaration of ethical research

5. **Undergraduate dissertation students who intend to conduct fieldwork** should include **one hard copies** of the checklist with their dissertations.

6. **By signing this form you are agreeing to work within the protocol which you have outlined and to abide by the University of Nottingham's Code of Research Ethics.** If you make changes to your protocol which in turn would change your answers to any of the above questions then you **must** complete a new form and submit a copy to your supervisor and the research ethics officer, Kate Millar.

Signed ……DR JUDY ANNE SWIFT…….. Date …14.02.19…..

***7. If you ticked any of the shaded boxes in section 4 of this form, then you must complete SECTION 6 (overleaf). You must then discuss all ethical issues arising, record the outcome, including the supervisor's or REO's response, and have this form countersigned (see below)***

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## 8. All forms should be countersigned by the REO.

## Authorisation

This section **must** be completed in **all** cases – by type of investigator the form must be countersigned by the following personnel:

Undergraduate student → project / dissertation supervisor
Postgraduate taught student → project / dissertation supervisor

This form must then be sent to the internal SB e-mail address: SB-Biosciences-Ethics (SB-Biosciences-Ethics@nottingham.ac.uk) and Kate Millar (kate.millar@nottingham.ac.uk) by the supervisor (as the formal submission from a University e-mail address). If you make changes to your protocol which in turn would change your answers to any of the above questions then you **must** complete a new form and submit a copy to your tutor/supervisor and the ethics officer.

All forms should be countersigned (electronically confirmed) by the REO

Having reviewed the ethical issues arising from the proposed research:

□ I am happy for the research to go ahead as planned.

□ I have requested that changes be made to the research protocol. The principal researcher must complete and submit a revised form which integrates these changes

□ This project must be referred for more detailed ethical scrutiny. A copy will be sent to the SSP REO for expert ethical review or this is to be referred to full SB REC Committee / School Management Group for consideration

Signed …… Date ……

Designation ……..

School REO…… Date ……

Note: **any** research protocols lodged with the School office may be subject to review by the School's Research Ethics Officer

SECTION 6: FURTHER INFORMATION & JUSTIFICATION OF METHODOLOGY

One box should be completed for **each** shaded box ticked in section 4 of this form.

Ethical issue: No consent forms

Rationale for chosen methodology and/or how ethical issue is to be addressed:

Informed consent is a vital part of any research conducted with human participants. Potential participants will have ready access to an information sheet. The first question on the survey will ask them to confirm whether they have had enough time to consider and whether they have any questions. If they select 'no' they will be directed sources of support (should they need/want it).

The opt-in nature of the data collection minimises the potential for perceived social pressure to participate.

Supervisor/REO's response (including whether ethical issue has been satisfactorily addressed):

Ethical issue: Incentives are provided

Rationale for chosen methodology and/or how ethical issue is to be addressed:

There is a standard fixed rate of payment offered by Survey Monkey. Cost is calculated on the basis of how many questions the survey contains and stratification requirements.

Supervisor/REO's response (including whether ethical issue has been satisfactorily addressed):

Ethical issue: Withdrawing the data

Rationale for chosen methodology and/or how ethical issue is to be addressed:

As noted above, the participants will be considered to have consented to the research if they complete the survey. Participants will have the right to withdraw at any time.

Exiting the survey at any time will mean that the person's data up to that point will be collected but will not be entered into any analysis.

Upon submitting the complete survey it will not be possible to remove a person’s data (due to the anonymous nature of the data). These issues will be communicated to the participants in the provided written information.

Supervisor/REO's response (including whether ethical issue has been satisfactorily addressed):