The family-home environment and its association with the emergence, persistence, and remission of weight gain in mid-childhood

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Abbreviations

BAME	Black and Minority Ethnic
BCW	Behaviour Change Wheel
BMI	Body Mass Index
BMI-SDS	Body Mass Index Standard Deviation Score
CHES	Comprehensive Home Environment Survey
CHS	Child Health System
COM-B	Capability, Opportunity, Motivation and Behaviour
DHSC	Department of Health and Social Care
FNPA	Family Nutrition and Physical Activity Questionnaire
GAPH	Gloucestershire Association of Primary Headteachers
GDPR	General Data Protection Regulations
GHC NHS	Gloucestershire Health and Care NHS Foundation Trust
HRA	Health Research Authority
IMD	Index of Multiple Deprivation
IRAS	Integrated Research Application System
LSOA	Lower Super Output Area
OHID	Office for Health Improvement and Disparities
ONS	Office for National Statistics
OR	Odds ratio
NCMP	National Child Measurement Programme
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
PHE	Public Health England
P-value	Probability Value
SCT	Social Cognitive Theory
SD	Standard Deviation
SES	Socioeconomic Status
SPSS	Statistic Package for Social Science
TDF	Theoretical Domains Framework
WHO	World Health Organization

Definition of terms

Body mass index (BMI) - BMI is a tool that measures the ratio of a person's height to their weight to estimate the amount of body fat. For population monitoring purposes, a child's BMI is classified as overweight or obese where it is on or above the 85th centile or 95th centile respectively, based on the British 1990 (UK90) growth reference data. The population monitoring cut-offs for overweight, and obesity are lower than the clinical cut offs (91st and 98th centiles for overweight and obesity) used to assess individual children.

Chi-square goodness of fit test - a statistical hypothesis test used to determine whether a variable is likely to come from a specified distribution or not.

Overweight and obesity -abnormal or excessive fat accumulation that presents a risk to health (WHO 2023).

Correlation coefficients - the correlation coefficient is the specific measure that quantifies the strength of the linear relationship between two variables in a correlation analysis. Correlation coefficients smaller than 0.3 are considered as small, those between 0.3 and 0.5 as moderate and those larger than 0.5 as large (Cohen 1988).

Family home environment - the extent to which the characteristics of the home environment and the behavioural patterns of the adults in the family tend to promote unhealthy weight gain among its members.

Index of multiple deprivation (IMD) - a measure of deprivation which uses seven different domains including income including income, employment, education, skills and training. health and disability, barriers to housing and services, and crime and living environment (MHCLG 2019).

Logistical regression - a classification algorithm which is used to predict a binary outcome based on a set of independent variables.

Positive shift in weight status – a favourable change in the BMI amongst children determined by BMI z-score adjusted for sex and age between two different time points.

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Abstract

Background

The home environment is important in the aetiology of childhood obesity with parents and carers playing a significant role in socialising their children and navigating the obesogenic environment. Whilst research shows that the prevalence of obesity doubles between the ages of 4/5 and 10/11 years, evidence suggests that small proportion of children with excess weight return to a healthy weight status by the age of 10/11years. The purpose of this research was to investigate key home and family factors, motivations of parents and its relationship with the emergence, persistence, and remission of weight gain amongst children during mid-childhood.

Methods

This thesis adopted a mixed methods approach using a multi-method sequential explanatory design. Firstly, an online survey was distributed to parents in Gloucestershire whose children were measured in 2019/20 aged 10/11 years via the National Child Measurement Programme (NCMP). The Family Nutrition and Physical Activity (FNPA) questionnaire was used to assess the home environment. Associations between the descriptive data (deprivation, gender, age), total FNPA, FNPA subdomains and weight, was conducted using logistic regression and Pearson's correlation. Secondly, parents were identified for the qualitative component through purposive sampling where children had achieved a positive shift in weight status between the two time points (4/5 and 10/11 years). Five in-depth semi-structured interviews were conducted, with thematic analysis undertaken to map responses by parents against the Theoretical Domains Framework (Cane, 2012) to understand how their child's behaviour and weight outcomes may have been influenced within the context of the family home environment and wider community.

Results

A total of 719 participants were surveyed. Of those, 179 matched data records included biometric data for children at 4/5 and 10/11 years. A significant proportion of adults (64.7%) incorrectly perceived their overweight or obese child to be a healthy weight. The total FNPA score significantly predicted an increased risk for being obese at 10/11 age and weight gain between the two timepoints. When adjusting for independent variables, children with a total score in the lowest FNPA tertile (higher risk family environment and behaviours) had an odds ratio of 5.28 (95% CI=1.39–20.07) for being at risk of obesity and 3.39 (95% CI=1.10–10.43) for gaining significant weight (BMI z-score ≥ 0.6) between the two timepoints. Analysis of the FNPA subdomains revealed the sedentary/media domain predictive of excess weight at

10/11 years. From the qualitative study, 16 themes across 7 TDF were identified as potential positive influences on child behaviour and weight outcomes including physical activity levels, sibling influence, child involvement in food, child wellbeing and active school and community environments.

Conclusion

Whilst acknowledging the multiple levels of influence on child overweight and obesity, the home environment remains an important setting in children's development. The findings indicate that the family home environment is a key predictor of weight status and weight change in children aged 10/11 years old, which implies that preventative interventions should be implemented early in the life-course with a focus on the home environment. Further research should be undertaken to understand the underlying mechanisms for why some children manage to resolve their weight status to a healthy weight during mid childhood.

Chapter 1
Introduction

1.0 Introduction

1.1 Background and context

Obesity represents a significant global public health challenge and is one of the greatest long-term health challenges facing the UK (James 2018). Compared with historical trends, the last 30 years has seen a rapid rise in the prevalence of obesity with around two-thirds (63%) of adults overweight or obese , and of these half are living with obesity (Digital 2021). Between 1993 and 2019 the proportion of adults in England who were obese rose from 14.9% to 28.0%, while the proportion who were either overweight or obese rose from 52.9% to 64.3% (see figure 1). It is well known that people who are overweight or obese are at increased risk of a range of diseases that can have a significant impact on their health. These include type 2 diabetes, cardiovascular disease, liver and respiratory disease and cancer. Obesity can also have an impact on mental health.

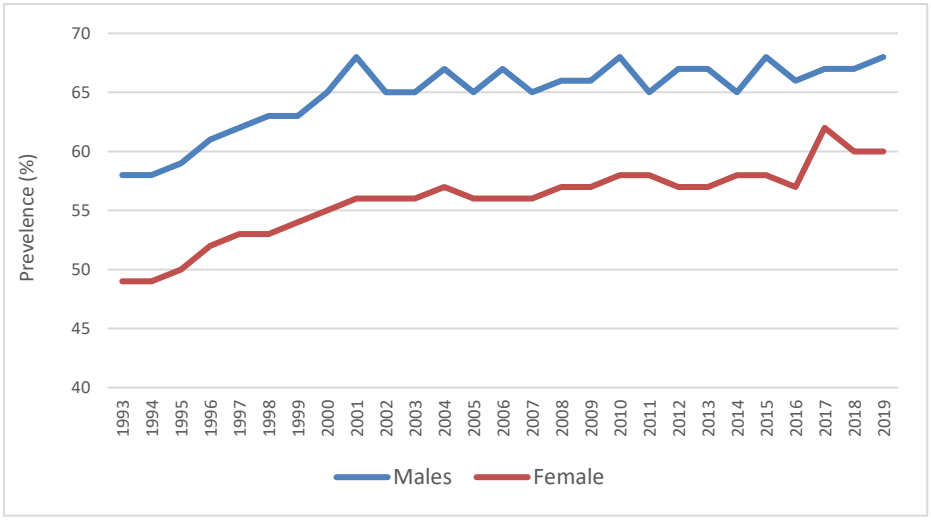

Figure 1. Prevalence of overweight and obesity for England 1993 to 2019

Evidence shows that growth in early life may be important to later risk of obesity and that many risk factors for developing obesity originate during childhood (Berenson 2002; Brisbois et al. 2012). The childhood obesity crisis has been described by the World Health Organization (WHO) as one of the most serious global public health challenges for the 21st century (WHO 2004). In England, programmes to identify and support overweight children are currently driven by data from a surveillance programme called the National Child Measurement Programme (NCMP). The NCMP was established by the Department of Health in 2005 and involves the annual weighing and measuring of children in Reception year and Year 6 at state-maintained primary schools. The NCMP has found that although most children in Reception (aged 4 to 5 years) and Year 6 (aged 10 to 11 years) are a healthy weight, data consistently shows that prevalence of obesity approximately doubles between

this period. Recent data found that in England, 9.2% among four and five-year-olds in reception classes were obese in 2022/23, with a further 12.2% overweight. At age 10/11 (year 6), 22.7% were obese and 13.9% overweight (see figure 2).

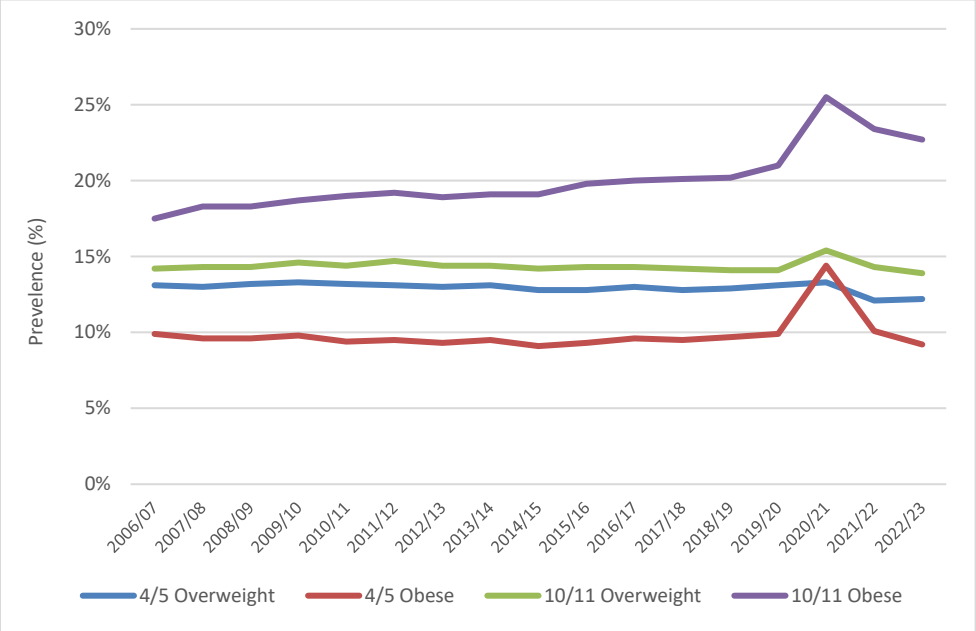

Figure 2. Trend of childhood overweight and obesity amongst 4/5- and 10/11-year-old children in England (NCMP Data)

It has been widely documented that obesity in children can lead to a number of health conditions including diabetes, asthma, psychosocial morbidity, orthopaedic and cardiovascular problems as well as increased risk of obesity persistence in adulthood (Abbasi 2017; Friedemann et al. 2012; Reilly 2007). In addition to these health risks, children who are obese have lower levels of physical fitness; suffer from discrimination; low self-esteem and a lower quality of life (Reilly et al. 2005). The health risks of obesity have been further amplified during the recent COVID-19 pandemic with obesity identified as one of the most prominent risk factors of severe COVID-19, increasing disease mortality, even in childhood (Stavridou et al. 2021). It has also been associated with a greater risk of long COVID amongst adults (Aminian et al. 2021).

Obesity prevalence is strongly correlated with socioeconomic status and between different children from different ethnic groups. Obesity in 4/5 year old children living in the most deprived areas (12.4%) in England are more than double those in the least deprived areas (5.8%). The prevalence of severe obesity was more than three times higher in the most deprived areas (3.8%) compared with those living in the least deprived areas (1.2%). Similarly, the prevalence of obesity among 10/11 year old children was 30.2% in the most deprived areas, compared with 13.1% in the least deprived areas. In both age groups,

the obesity gap between the most deprived and least deprived areas has increased in the last 15 years (Baker 2023). In terms of ethnicity, there is a higher proportion of black children who are obese for both 4/5 (13.6%) and 10/11 year olds (31.6%) (NHS Digital 2023). Inequalities also exist amongst people who are disabled and among people with no formal education qualifications. For example, the proportion of adults with a learning disability whom have severe obesity (BMI greater than 40 kg/m^2) is higher than the proportion of people without a learning disability (37% vs 30.1%) (NHS Digital 2022).

The rising levels of obesity have been attributed to several factors, but at its simplest, people are eating more and are less active, leading to prolonged positive energy balance. The rise in energy intake has been attributed to innovations in food manufacturing and distribution that has led to increased supply of cheap, palatable, energy dense foods that are accessible, convenient and intensely marketed (Swinburn et al. 2011). The rise of ultra processed food has also been identified as a key factor, with pre-packed, convenient and ultra-processed food making up 56.9 per cent of the average UK diet, although the evidence is unclear on its overall contribution to obesity risk (De Amicis et al. 2022; Fernanda et al. 2019; Harb et al. 2023).

Opportunities to obtain food and drink are plentiful, widely accessible, and convenient for most of the population, making it challenging for individuals to adopt healthy eating behaviours. This has been compounded by declines in energy expenditure through environments that has led to reduced work-time physical activity, combined with increasing levels of sedentary behaviour (Hall et al. 2012).

Recent data shows that a significant proportion of children and adults are not sufficiently active, with 36.9% of adults and 52.8% of children in England not meeting the UK Chief Medical Officers recommendations for physical activity (Sport England 2023). There is growing consensus amongst researchers that the current culture and environment around us is becoming increasingly ‘obesogenic’ (Jones et al. 2007). Whilst there is evidence on a range of societal and environmental factors which influence behaviour, the issues are unique with children, as parents or caregivers dictate the physical and social environments that children have access to.

To date, existing policies and interventions aimed at reducing levels of obesity amongst children have largely failed to yield lasting effects across all demographics, which suggests that alternative solutions are needed for obesity prevention and control (Fildes et al. 2015; Kong et al. 2022). This is reflected by weight management programmes for children having

limited impact on child obesity prevalence. Furthermore, research has found that recruiting to and retaining participants in child weight management programmes has proved challenging (Hastie 2012; Knowlden and Sharma 2012).

It is widely acknowledged that whole system approaches are needed to tackle the determinants of obesity, although due to the complex nature of obesity, evidence for the effectiveness of such approaches are limited (Bagnall et al. 2019). Whole system approaches recognise that the causes of obesity are multifactorial encompassing biology, human behaviour, all set within a cultural, environmental, and social framework (Omer 2020; Robertson et al. 2016). The premise of whole system approaches implies that there are multiple components, or drivers of obesity, with a system being composed of different components, that interconnect and interact with and affect one another (Lee et al. 2017). Any approach to address obesity therefore requires coordinated action across a diverse range of sectors, government levels, and actors; and operate throughout the life course.

Whilst recognising the multi-level influences of obesity, the family and the home environment has been identified as a critical component for whole system interventions (Tzou and Chu 2012). The home environment and family context are where children spend a significant proportion of their time (Kininmonth et al. 2021). The family home environment is important in the development of childhood obesity with parents playing an important role in socialising their children and controlling and navigating the obesogenic environment (Gerards and Kremers 2015; Golan and Crow 2004; Robertson et al. 2016). The influence of parents on childhood obesity starts from preconception and across the entire childhood to even early adulthood. In particular, behaviours of children under 12 years of age are under less volitional control than older children, and thus, parents likely play a key role in promoting or inhibiting opportunities for healthy living (A. Hamid and Sazlina 2019; Lindsay et al. 2006; Pyper et al. 2016; Sleddens et al. 2014). While adults make their own choices regarding their eating habits and physical activity, children do not have the opportunity to make this choice for themselves. Parents are therefore seen as important agents of change as they are likely to be the most effective mechanism to which influence the diet and physical activity habits of children (Knowlden and Sharma 2012).

Considering this, several reports and national guidance have called on parents to be integral for interventions to manage children's weight, given their highly influential role in supporting and managing the four behaviours that affect children's energy balance (diet, physical activity, media use and sleep) (NICE 2023; Public Health England 2018). This includes not only parenting practices and rules, but also the environments to which children are exposed,

and the adoption of parents' own habits by children (Ash et al. 2017). Research to date has highlighted the importance of numerous familial determinants such as, parenting style (e.g., authoritative, authoritarian indulgent and uninvolved), parent practices (e.g., context-specific restricting food) and parent modelling (e.g. parental physical activity levels) that all influence a child's health (Clark et al. 2007; Maccoby and Martin 1983; Shloim et al. 2015; Sleddens et al. 2011).

Recent draft UK guidelines on the prevention and management of overweight and obesity in children and adults has recognised the important role that families and parents play in caring for children. This includes encouraging and supporting children to be active at every opportunity (such as active play, travel, sport, or leisure activities), eating meals with children, avoiding using food as a reward or to manage behaviour and help and encourage them to get sufficient sleep. The guidance also includes a general principle for families to create a supportive environment at home and in other settings, such as schools, that helps a child or young person and their family or carers make behavioural changes (NICE 2023).

1.2 Gaps in research

Research has found that BMI Trajectories are mainly settled by early adolescence with the greatest amount of change in BMI occurred during early and middle-childhood, between the ages 5-11 (Vollmer and Mobley 2013). Early and mid-childhood therefore presents a critical time-period for intervening. It has been proposed that obesity prevention interventions should target children in early and middle-childhood, particularly those living in disadvantaged families (Dos Santos et al. 2020). Middle childhood is also a transitional period when children begin to have more autonomy concerning their food choices and therefore understanding how this impacts child behaviour is important (Galloway et al. 2010). Furthermore, previous research has highlighted that obesity emergence and persistence in school age children is high (Mead et al. 2016; Pearce et al. 2016). However, whilst evidence has found persistence of obesity in mid-childhood to be common between the ages of 4/5 years and 10/11 years, it has also found that just under a half of overweight children (BMI >85th percentile) and a sixth of obese children (BMI >95th percentile) manage to drop a weight category by the time they reached 10/11 years of age (Pearce et al. 2016).

Considerable attention has been given to studying children who are overweight and obese, however less research has been dedicated to understanding the behaviours amongst families who resist environmental and lifestyle factors that promote passive and gradual weight gain. Understanding why some children can lose weight may provide critical insights

to more sustainable and cost-effective approaches to both treating and preventing weight gain in mid-childhood. Whilst intervention research has increasingly highlighted the importance of parents and family involvement in child obesity treatment and prevention, there is scarce evidence on the effective strategies that parents may intentionally or unintentionally employ that create the conditions that lead to a positive shift in weight status. Given that the family is the primary social institution influencing young children, it is plausible that they may play a critical role in facilitating weight loss. Few studies have comprehensively assessed the family-home environment and the health behaviours of parents. Better conceptualisation and understanding of the home environment (including parental factors) and weight-related behaviours in children would facilitate more strategically focused interventions and prevention efforts.

The availability of the NCMP dataset provides a unique opportunity to assess the likelihood of children remaining or becoming overweight or losing weight during mid-childhood. This research will be the first to undertake an in-depth analysis on the NCMP and its association with the family home environment, it will enable a level of detailed analysis that has not been possible in previous studies.

1.3 Purpose of the research

The purpose of this study was to investigate the key home and family factors, motivations of parents and the relationship with the emergence, persistence, and remission of weight gain in mid-childhood.

1.4 Aims of the research

The aims were to identify risk and protective factors for childhood obesity through a two-phased incremental, mixed-methods, and longitudinal approach. The aims were twofold:

1) Understand the association between family-home factors and the emergence, persistent and remission of weight gain between children 4-11 years of age
2) Explore and understand why some children achieve a positive shift in weight status between 4-11 years of age.

1.5 Objectives of the research

The objectives of the research were as follows:

1) Invite parents' of 10/11 year-old children in Gloucestershire to complete a survey that assesses the family and home environment.
2) Analyse responses to the survey against the child's height and weight data from the NCMP for time periods.
3) Interview parents of children who have achieved a positive shift in weight status between 4/5 and 10/11 years.

1.6 Hypotheses

The research tested the following hypotheses:

1. Most parents of overweight or obese children will incorrectly identify their child's weight status or observation of any weight gain.
2. More favourable family environments are associated with healthy weight and less weight gain in children.
3. Less favourable family environments are associated with overweight/obesity and more weight gain in children.
4. Parents or carers who recognise their children as overweight put in place actions to promote healthy behaviours.
5. Parents or carers of children who recognise their children as overweight achieve a positive shift in weight status between the two time periods.

The following chapters set out a review of the scientific literature outlining previous research which has been undertaken around child obesity and the family home environment. This is followed by the methodology chapter which describes the techniques and methods employed to answer the research questions. The results chapter presents the key findings. Finally, the discussion and conclusion chapters, whereby we critically examine our findings in the context of research in the field and what has been learnt by the work.

Chapter 2
Literature Review

2.0 Literature Review

The literature review provides a background to childhood obesity, setting the context and complexity to childhood obesity, followed by an analysis and summary of current research pertaining to the topic under investigation. This includes setting out the overarching theoretical framework for child obesity and key factors associated with the family-home environment such as parenting styles and family practices that influence food and physical activity behaviours. The literature search was undertaken across two specific areas focusing on the family-home environment and its association with child weight, followed by parental perception of child obesity to instigate behaviour change. The search strategy can be found in appendix 1.

2.1 Understanding the obesogenic environment

It is widely accepted that obesity results from an imbalance between energy intake and expenditure, with an increase in positive energy balance being closely associated with dietary intake preferences (Sahoo et al. 2015). There is extensive evidence on the determinants of obesity with experts agreeing that the causes of obesity are extremely complex encompassing biology and behaviour, but set within a cultural, environmental, and social framework (Karnik and Kanekar 2012; Robertson et al. 2016). The pioneering Foresight report on tackling obesity identified a large number of determinants of overweight: biology, growth patterns early in life, behaviours around eating and physical activity, activity and food environments, and broader economic and societal influences (McPherson 2007). The factors that influence an individual's increase risk of obesity have been referred to as the 'obesogenic environment' (Egger and Swinburn 1997).

2.1.1 The obesogenic environment for children

A child's 'obesogenic environment' is complex and reflects numerous systems that have an impact on a child's health, including family, peers, school, wider community, as filtered through media, food and drinks advertising, and prevailing social norms (Ritchie et al. 2005). Understanding the complexity and multifactorial nature of childhood obesity can be best understood through a socio-ecological model that provides a broad framework for understanding the mediators and moderators of obesity (Brown et al. 2015; Egger and Swinburn 1997). Socio-ecological models conceptualise human development from an interactive contextual perspective and proposes that the development, or change in individual characteristics is determined by the context, or ecological niche, in which the person is embedded (Davison and Birch 2001).

The social ecological theory suggests that health behaviours, such as eating and physical activity are influenced by many and complex influences across multiple levels that interact at both the macro and micro-level environments (Rosenkranz and Dzewaltowski 2008). These include individual factors, interpersonal factors, institutional factors, community factors, and public policy factors (McLeroy et al. 1988). In the case of a child, this includes the family and the school, which in turn is embedded in larger social contexts such as the community and society in general. Micro-components consist of those most proximal to a child's home life, with macro-level components relating to wider community factors. Environmental factors influence behaviour in all segments of the population, but the issues are unique with children because parents or caregivers dictate the physical and social environments that children have access to (Johnson et al. 2012a). The numerous factors influencing obesity all come together in the home environment, where parents and caregivers mediate a child's interaction with the broader environment, community and society (Welfare 2021). Rosenkranz and Dzewaltowski (2008, p. 135) conceptualised the home environment as "overlapping interactive domains composed of built and natural, sociocultural, political and economic, micro-level and macro-level environments". A summary of the ecological model and evidence for predictors of childhood overweight can be found in figure 3.

Building on the ecological systems theory, the Family Ecological Model (FEM), also recognises the multiple levels of influence on a child's weight and weight-related behaviours. The theory recognises that the family environment is the most immediate and proximal level of influence on child health behaviours (knowledge/beliefs, modelling, accessibility, and shaping) which are influenced by contextual and environmental factors such as the community, organisations, policies, and media (Davison and Campbell 2005). Despite the determinants of childhood obesity operating at multiple levels, the family home environment plays a major role in every aspect of a child's health and development. It has been suggested that the family home environment explains the greatest variance in obesity compared with school and neighbourhood level influences, and is a prime context in which children's health behaviours emerge (Boswell et al. 2019). Golan (2006, p. 66) described the home environment as "undoubtedly the most important setting in relation to shaping children's eating and physical activity behaviours". Numerous models have been developed to conceptualise how different aspects of the home environment may influence children's growth and development (Gattshall et al. 2008; Pinard et al. 2012; Rosenkranz and Dzewaltowski 2008). Both observational and experimental studies support the persistent effect of early family environment on health behaviours and weight status, highlighting the central role of parents in childhood obesity (Dos Santos et al. 2020).

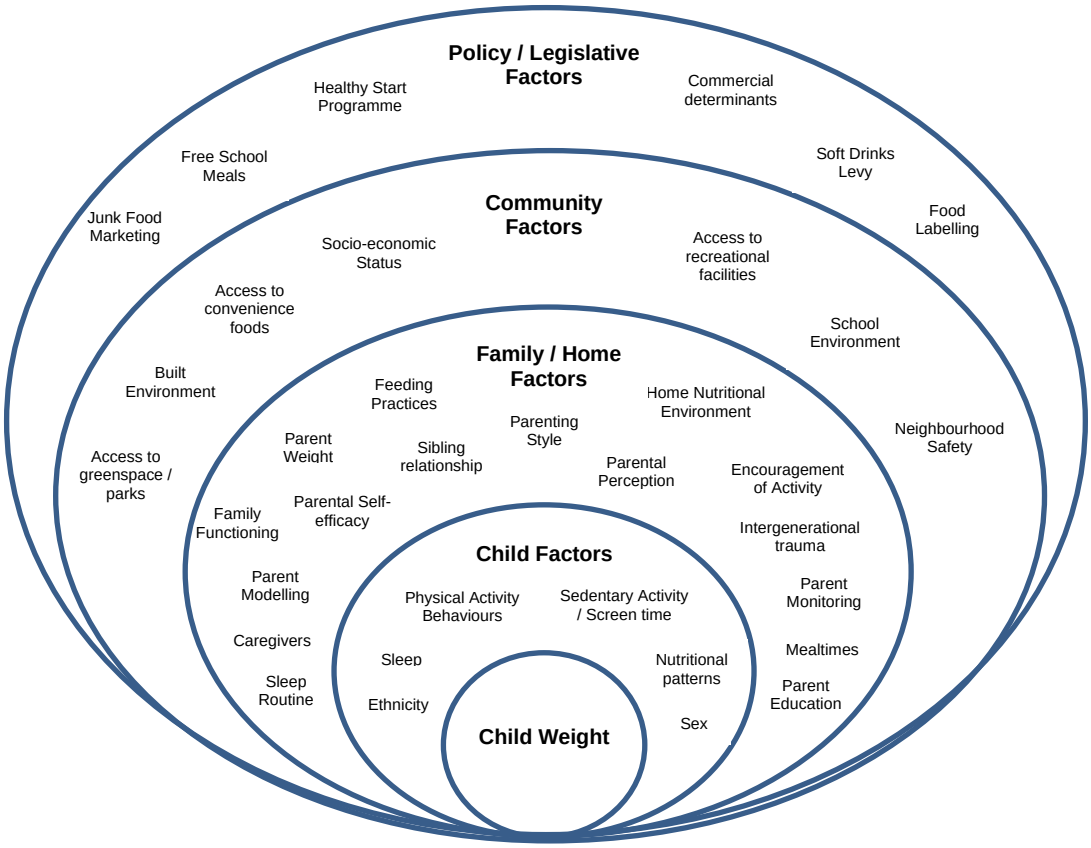

Figure 3. An adapted conceptual socio-ecological model of child obesity summarising key determinants of obesity (Berge et al. 2017; Brown et al. 2015; Davison and Birch 2001)

2.2 Child characteristics

The impact of child risk factors on the development of overweight is moderated by child characteristics such as age, gender, ethnicity and their susceptibility to weight gain (Davison and Birch 2001). A summary of these characteristics and the risk to obesity are set out below.

2.2.1 Ethnicity

Several studies have demonstrated ethnic inequalities in obesity risk in the UK (El-Sayed et al. 2011). However, literature has found that the prevalence of obesity among black children and adults compared to Caucasians, particularly amongst black girls who have found to have almost double the prevalence of overweight and obesity of white. Research has also found Chinese children to have lower risk for obesity than Caucasians in the UK (El-Sayed et al. 2011). For example, recent data for England suggested that 37.5% of adults from a Chinese ethnic group are overweight or living with obesity, compared with 64.5% white British adults and 72% of adults from black ethnic groups (OHID 2023).

Analysis of NCMP data has found ethnicity to have an independent effect on obesity prevalence in both 4/5 year olds and 10/11 year old boys and girls, after controlling for other explanatory variables such as age and deprivation (PHE 2019). Greater disparities have been found amongst 10/11 years old children than in 4/5 years old children. The underlying mechanisms for these differences are poorly understood, but there is some evidence to suggest that behaviours (e.g. fewer fruits and vegetables) associated with obesity are more prevalent among children from black ethnic groups than children from white ethnicity (Falconer et al. 2014a). Psychosocial stress and poor sleep, which is also associated with obesity, is also more common in ethnic minorities such as black people (Cuevas et al. 2020; Krueger and Reither 2015). The use of BMI may also explain some of the differences, as it has been found to underestimate body fat in South Asian children and over-estimate body fat in Black African children (Hudda et al. 2017).

2.2.2 Gender

Data across high income and middle-income countries tend to report a greater prevalence of obesity for boys than girls (Bindra et al. 2020). In the UK, both 4/5 year olds and 10/11 year olds boys are more likely than girls to be obese (NHS Digital 2023). It has been suggested that these differences are driven by biological influences and sociocultural influences. There is some evidence that girls may prefer foods that are lower in energy and are nutrient-dense, such as fruits and vegetables, whereas boys prefer more meat and calorie-dense foods (Bindra et al. 2020). Studies have also found that girls may have higher levels of weight-related concerns and body image dissatisfaction than boys, such as wanting to lose weight and guilt of overeating too much, although this more likely to be prominent during adolescence (Micali et al. 2014). To account for the growth patterns between boys and girls, children's BMI is compared with BMI centiles using growth charts (Cole 2000).

2.3 Family home factors

Given the role that parents have as ‘gatekeepers’ for promoting healthy behaviours, a significant volume of research has focused on the role of parents as primary socialising agents for children’s eating and activity patterns. This section explores the key factors and evidence pertaining to childhood obesity from parental and family home influences.

2.3.1 Parenting styles and parenting practices

The most prominent theoretical term used in the literature to describe the characterisation of parenting and its types, is parenting styles. Parenting styles provide a useful model for examining and explaining how parents navigate obesogenic environments (Baumrind 1966). Parenting styles are a function of the parent’s attitudes, beliefs and behaviours, generating

the emotional context for children (Philips et al. 2014). These underlying attitudes and beliefs of parents and carers influence their parenting style and includes the rules and expectations they use to shape children's behaviour within the home (for example, demonstrating and encouraging positive attitudes and healthy behaviours around food and exercise, eating meals together and screen time limitations) (Welfare 2021).

Parent-related health determinants and specifically parenting styles and parenting practices have received significant coverage within the literature (Shloim et al. 2015). Parenting style is generally referred to as a behavioural construct which sets the emotional and relational context within which parents and children interact (Darling and Steinberg 1993; Patrick et al. 2013). Levels of warmth and responsiveness compared with control and demandingness are used to categorise parents into one of four styles: authoritative (high warmth, high control), authoritarian (low warmth, high control), indulgent (high warmth, low control), and uninvolved (low warmth, low control) (Maccoby and Martin 1983) (see figure 4).

Parenting practices are behaviours which are context-specific actions (intentional or unintentional) performed by parents for child-rearing purposes that influence their children's attitudes, behaviours, or beliefs (Vaughn et al. 2016). Parenting practices refer to what parents do, whereas general parenting styles refer to the way they do it (Patrick et al. 2013). For example, parenting practices have been referred to as helping parents directly achieve health behaviour goals while the style alters the effectiveness of these practices (Darling and Steinberg 1993).

		Demandingness/control	
		High	**Low**
Responsiveness / nurturance	High	**Authoritative** Parents who encourage eating using supportive and non-directive behaviours; nurturing and high in structure; demanding but responsive to child needs e.g. parents negotiate with children to eat well using social praise.	**Permissive/indulgent** Parents who encourage eating with few requests, those they make are non-directive and supportive, so responsiveness but low demanding e.g. parents permit their child the freedom to eat when they wish and chose foods, they prefer.
	Low	**Authoritarian** Parents who encourage eating with directive, rule-based demands regardless of child preferences e.g. requires children to eat certain foods, to avoid others; to eat according to rules and expectations, punishing food related transgressions.	**Uninvolved/neglectful** Parents who make few demands on their child to eat but when demands are made this is unsupported e.g. unlikely to discipline food-related transgressions, disorganised or few meal routines.

Figure 4. Adapted from Baumrind's (1971) and Maccoby and Martin's (1983) Typology of Parenting Styles (need to tweak as all about food)

Research has often looked at parenting styles to explain a variety of child outcomes including behavioural factors such as healthy eating, physical activity and television watching. Research has found that children raised in authoritative homes were more likely to eat healthily, be more physically active, and have lower BMI scores compared to children who were raised with a different style, although findings amongst studies have been inconsistent (Sleddens, 2011). Some have argued that interventions that do not address underlying parenting styles are likely to be unsuccessful in reversing child obesity (Hubbs-Tait et al. 2008).

A review by Shloim et al. (2015) examined the specific modifiable aspects of parenting styles and feeding practices and their associations with child weight between the ages 4-12 years. Their review found that uninvolved, indulgent, or highly protective parenting was associated with higher child BMI, whereas authoritative parenting was associated with a normal BMI. Similarly, for feeding styles, indulgent feeding was consistently associated with risk of obesity. Specific feeding practices such as restriction and pressure to eat have often been linked to BMI, especially within cross-sectional studies (Shloim et al. 2015). While findings are not completely consistent across parenting style categories, the consensus is that authoritative parenting styles are associated with healthier behaviours and less obesogenic home environments (Gerards et al. 2011; Johnson et al. 2012a; Sleddens et al. 2011). This has also been reflected in general parenting interventions looking to prevent or treat childhood obesity, which have found that the promotion of authoritative parenting can be effective for a range of weight related outcomes measures (Gerards et al. 2011; Sokol et al. 2017).

Positive influences of general parenting outcomes have also been found amongst interventions that did not target weight as a primary outcome, suggesting that taking an holistic approach to improve parent–child relationships, rather than focusing on physical health, may be successful at lowering future risk of overweight and obesity (Kong et al. 2022). Despite the wealth of research on parenting styles and child behaviour, it has been contested that it is often difficult to distinguish among the different parenting styles since parents can exhibit elements of each parenting dimension, and they can change over time, and therefore styles are not discrete categories (Johnson et al. 2012a; Kim and Rohner 2002). Further, it has been argued that given the complexity of the determinants of obesity, it is difficult to isolate the impact of parenting style on behavioural factors, since behaviours are influenced by a range of social and environmental factors (Johnson et al. 2012a).

The role of parenting practices in children's eating behaviours (i.e., feeding practices) have been widely implicated in the development of weight gain and obesogenic eating behaviours (Rodgers et al. 2013). A systematic review by Clark et al. (2007) and Blaine et al. (2017) found that parents who restricted snack foods was associated with increased energy intake and weight gain in children, although findings have been mixed (Pham et al. 2023). Restriction in this context was defined as parents exerting control over the child's eating by restricting access to certain desired types and amounts of foods (Faith 2004). It has been suggested that increased caloric intake and weight gain may be due to the child's defiance of parental rules when restricted foods are available and self-control is not actively exercised (Pham et al. 2023). Other studies looking at food intake have found that 'covert' control of children's food intake by controlling the home eating environment to limit exposure to unhealthy foods (i.e. not buying unhealthy foods) lowers the intake of unhealthy snacks when compared with 'overt' control (i.e. buying the snacks but not allowing access) (Ogden et al. 2006).

In terms of child physical activity levels, the evidence concerning the influence of parenting practices is mainly supported by cross sectional, non-experimental studies. A review by Gustafson and Rhodes (2006) found that parental support is correlated with levels of physical activity in children. In contrast to research in other parenting domains (e.g. children's feeding practices), evidence suggests that more permissive approaches are associated with greater child engagement in physical activity (Hennessy et al. 2010; Jago et al. 2011). Until recently, the majority of research has primarily focused on diet and physical activity, neglecting the more recently established predictors of media use and sleep (Ash et al. 2017).

A systematic review undertaken by Xu et al. (2015) looked at associations of parental influences with both physical activity and screen time in young children. They reviewed 30 published papers that met their inclusion criteria and identified five important aspects of parenting: (1) parenting practices; (2) parents' role modelling; (3) parental perceptions of children's physical activity and screen viewing behaviours; (4) parental self-efficacy; and (5) general parenting style. They found that parents' encouragement and support can increase children's physical activity and that reducing parents own screen time can lead to decreased child screentime. This supports other research that has found parents who enforced rules about their child's screen time are more likely to report that their child meet screen time guidelines (Pyper et al. 2016).

2.3.2 Family structure and function

The ‘structure’ or ‘organisation’ of a child’s environment has been found to be protective against excess weight. Evidence has found that children thrive in structured environments, including routines by minimising stress and promoting positive and comforting parent–child interactions. The organisation in the home environment has been linked to a range of child health outcomes. Children living in ‘structured households’ that engage in regular family routines such as mealtimes, bedtimes and physical activity - demonstrate positive health outcomes, including better sleep and shorter duration of illness (Fiese, 2002). Conversely, disorganised households, with high levels of chaos and instability, have been shown to impact child health through associations with developmental delays, internalising and externalising disorders and poor physical health (Bates, 2018). The evidence focusing on the family rules and routines and their impact on child outcomes is vast and has been studied for over 50-years (Fiese et al. 2002). Most recently, this theory has been coined the ‘Structured Days Hypothesis’, whereby a structured day, defined as a pre-planned, segmented, and adult supervised compulsory environment, can provide a protective role for children against obesogenic behaviours (Brazendale, 2017).

A systematic review by (Bates et al. 2018) examined the degree of organisation and structure within households to understand the relationship with child overweight and obesity. Of the 15 studies that looked at elementary school age children (5-11 years), 14 studies found evidence for a relationship between the organisation of the family home environment and child weight. The review found that positive household behaviours, including adherence to sleep and meal routines, and healthy limitations around child screen time, may be protective against obesity. Studies examining sleep were found to have the strongest relationship with child weight (Bates et al. 2018). Longitudinal studies have showed that 3-year-olds who did not have a regular bedtime were more likely to be obese at age 11 relative to those who did (Anderson et al. 2017).

‘Family Function’ is another concept that has received attention in the literature. Whilst often confused with parenting styles, family functioning focuses on the importance of the interactions between various family members (such as a parent with their child or siblings relationships) and how those interactions influence the relationship and functioning of the family unit as a whole.(Halliday et al. 2014). Whilst parenting styles and family functioning variables most likely influence one another, they are different constructs that may influence the outcomes of children in different ways (Kitzman-Ulrich et al. 2010). Highly functioning families have been shown to have clearly determined roles with clear and open

communication. Good family functioning is associated with several health-related behaviours and outcomes including overweight and obesity in children (Kitzman-Ulrich et al. 2010).

2.3.3 The home environment

In its simplest terms, the 'obesogenic' home environment includes food and activity-related domains (Pinard et al. 2014; Vaughn et al. 2017), categorised into three primary domains including children's food intake, activity levels and sedentary behaviours (see figure 5) (Gattshall et al. 2008).

One of the major challenges in understanding the association between the home environment and children's behaviours has been inconsistencies in terminology and lack of clear definitions used to describe parenting behaviours (Patrick et al. 2013; Shloim et al. 2015; Vaughn et al. 2016). Furthermore, the complex nature of obesity has made it difficult to define the home environment and quantify the extent which it has on obesity (Kininmonth et al. 2021). For this study, we used the definition of the family home environment by Martinson et al. (2011) defined as the extent to which the characteristics of the home environment and the behavioural patterns of the adults in the family tend to promote healthy weight among its members.

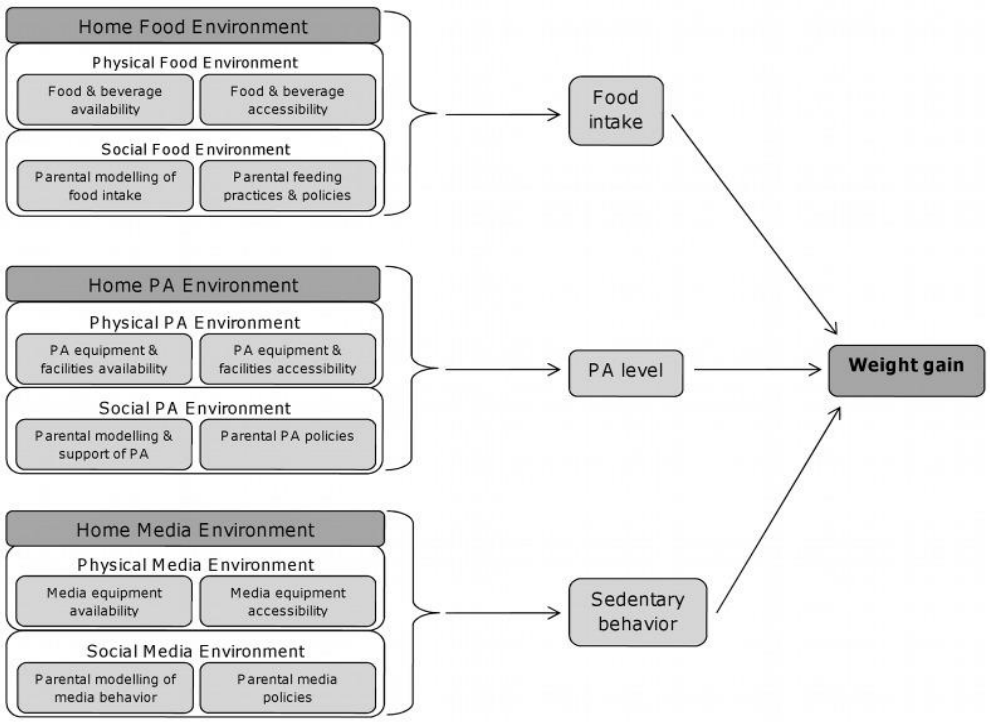

Figure 5. Conceptual model of home environment influences on diet, physical activity, sedentary behaviours, and weight (Schrempft et al. 2015)

Many studies have evaluated the home environment to understand its impact on child weight. An abundance of measurement tools have been developed that look at specific parenting styles and practices, but no single measurement strategy has been widely adopted in the literature which has contributed to inconsistent outcomes across studies (Bates et al. 2018). Most research has tended to examine only one domain or construct of the family-home environment, for example, the home food environment (Bjelland et al. 2014; Campbell et al. 2006; Gerards and Kremers 2015), the home media environment (Aftosmes-Tobio et al. 2016; Fang et al. 2019; Granich 2011), or the home physical activity environment (Hutchens and Lee 2017; Jago et al. 2011; Shloim et al. 2015; Trost et al. 2013).

Only a handful of studies have investigated the full constellation of family behaviours and their association with weight (Bryant et al. 2008; Gattshall et al. 2008; Golan and Weizman 1998; Ihmels et al. 2009a; Pinard et al. 2014). Whilst these instruments have provided more holistic and rounded measures of the overall home environment, they have been criticised for incorporating lengthy and time-consuming surveys (Ihmels et al. 2009a). This has led to calls for greater brevity in the development and use of tools that assess key components of the family home environment (Pinard et al. 2012). A recent review of instruments and questionnaires that evaluate the "familial obesogenic environment" found that no one questionnaire considered an exhaustive analysis of all the components of obesogenic environment for children and adolescents (Rendina et al. 2019).

There is some limited evidence for the cumulative impact of multiple home environment constructs on child weight. A study by Ihmels et al. (2009b) using a composite measure, found that the Family Nutrition and Physical Activity (FNPA) screening tool were associated with one-year BMI change, after adjusting for baseline BMI, parental BMI, and other demographic factors, in a sample of 6 to 7-year-olds (n=1030). However, a later study found no association between total FNPA score and child BMI in a sample of families from six rural communities in Oregon (Jackson et al. 2017). Further utilisation of the FNPA across studies has found positive associations with a range of outcomes including cardiovascular disease risk and child BMI (Yee et al. 2011), parental BMI (James et al. 2013; Williams et al. 2017a), child sleep quality (Williams et al. 2021), parenting styles (authoritative) (Johnson et al. 2012a), child smartphone use (Orhan KiliÇ et al. 2023), type 1 diabetes in children (Tarcin 2023) and severe obesity in children (Tucker et al. 2016).

A study by Pinard et al. (2014) of 150 of children from low-income households with a mean age 10 years (range = 5-17 years), undertook research to validate a multi-subscale measurement tool, the Comprehensive Home Environment Survey (CHES). This study found

an association between the home environment and BMI in a sample of older children, although the analyses were not adjusted for covariates. Higher scores (more favourable family-home environment) score of the CHES was more likely for lower BMIs in children ($r = -0.21$, $p < .05$) and lower BMIs in parents ($r = -0.24$, $p < 0.01$).

A cross-sectional study of UK preschool children aged 4 years analysed the overall physical and social aspects of the home environment across the three domains of food, physical activity and media environment (Schrempft et al. 2015). Whilst no relationship between a composite home environment score and child BMI change scores were observed, children in 'higher-risk' food environments consumed less fruit and vegetables and more energy-dense snacks and sweetened drinks than children in 'lower-risk' food environments. Children in 'higher-risk' activity environments were also less physically active than children in 'lower-risk' activity environments. Children in 'higher-risk' media environments also watched more TV than children in 'lower-risk' media environments. Neither the individual nor the overall composite measures were associated with BMI (Schrempft et al. 2015). There may be a range of reasons for why some studies have not been able to detect associations between the family home environment and BMI including, studies not being sufficiently powered, studies not including diverse enough samples, or tools not sufficiently capturing key risk behaviours.

A follow-up to the Schrempft et al. (2015) study by Kininmonth et al. (2022) tracked 298 UK children between the ages 4 to 12 years to assess the obesogenic home environment and associations with body weight. The home environment was measured using four composite scores capturing the food, activity, media environments, and the overall home environment (Kininmonth et al. 2022). The research found that a media composite score at age 4 was positively associated with child BMI-SDS at age 12, suggesting that living in a more obesogenic media environment predicted greater increases in child BMI from ages 4 to 12 years. The study also found that overall home environment was cross sectionally associated with child BMI at age 12 *(*$r = 0.21$, $p < 0.01$). There were also notable increases in the availability of energy-dense snacks and sugar-sweetened beverages in the home, as well as significant increases in electronic devices both in the home and children's bedrooms between ages 4 and 12 (Kininmonth et al. 2022).

A further review by Kininmonth et al. (2021) examined associations between physical and social aspects of the food, activity and media domains of the home environment with measures of adiposity in childhood (≤12 years) (Kininmonth et al. 2021). The review found that most consistent associations were observed for the physical aspects of the home media

environment, with greater availability and access to electronic media devices in the home, and specifically in the child's bedroom, associated with higher risk of adiposity. Findings from the research were less consistent for studies examining physical aspects of the home food or physical activity environments. 8/15 studies examining physical food environments reported null associations with adiposity. Findings were similarly mixed for physical activity environments; with 4/7 reporting null associations, 2/7 reporting negative associations and 1/7 reporting positive associations between access to physical activity equipment/garden space and adiposity (Kininmonth et al. 2021).

Research has also found the family home environment to be associated with weight status in adulthood. A longitudinal study covering a period of 21-years on Chilean children, found that home and family characteristics reflective of less supportive environments - such as father absence, family stress, maternal depression, an unappealing unstimulating home, and low parental warmth/acceptance were associated with a higher adult BMI or accelerated BMI growth (East et al. 2019).

Family meals have also received attention in the literature. A meta-analysis of family meal times and frequency found a significant relationship between frequent family meals and better nutritional health – in younger and older children, across countries and socioeconomic groups, and for meals taken with the whole family vs. one parent (Dallacker et al. 2018). A further review found that eating frequent family meals is associated with better psychological and social outcomes for children and adolescents with reduced risks for eating disorders, alcohol and substance use, violent behaviour, and feelings of depression or thoughts of suicide. There were also differences in outcomes for males and females, with females seemingly gaining more protective effects from frequent family meals than males do (Harrison et al. 2015).

2.3.4 Parental weight status

One of the most important components of family context is parental weight status, which has frequently been reported as a strong predictor of overweight and obesity in children and adolescents, although the underlying mechanisms are not well established (Lee et al. 2022). Having an overweight or obese parent is known to greatly increase a child's risk of obesity. While research suggests that a proportion of this risk can be attributed to genetics, much is believed to result from environmental factors and is therefore modifiable (Sylvetsky-Meni et al. 2015). It is suggested that as parents and children share a common family home environment through eating the same meals and engaging in similar physical activities, it may explain some of this relationship (Classen and Thompson 2016).

Whilst there is consensus around a link between parental weight status and childhood obesity, the evidence is mixed concerning same sex parent-child relationships. Several studies have investigated the strength of the relationship between father and mother BMI and their offspring. A cohort study by Perez-Pastor et al. (2009) looking at the BMI of 226 five-year-olds and their parents, found a strong relationship between the weight of a child and their same-sex parent. When assessing same sex parent-child relationships, the authors found that a mother's BMI had a significant effect on her daughter's BMI at four different ages (5,6,7 and 8 years), but found no significant relationship between the BMI of mothers and sons. Conversely, the researchers found a significant relationship between father and son BMIs at all four ages, but no significant relationship between fathers and daughters. Overall, the risk of a girl being obese at age eight was significantly raised (ten-fold increase) if her mother was obese. For boys, this increased six-fold if his father was obese. The researchers interpreted these findings as potentially reflecting gender specific role modelling, which would help in the design of parent-centric interventions to reduce child obesity. However, these findings may be confined to families where both parents are present and engaged, therefore research may be needed to observe single family households.

However, despite this finding, much larger studies have failed to observe a same-sex association between parents and their children (Davey Smith et al. 2007). One such study involved analysing data from the Avon Longitudinal Study of Parents and Children (ALSPAC) which utilised a large (n=4654) nationally representative sample of children aged 7.5 years. This study found no substantial differences in the strength of associations and that the BMI of both parents was associated with the BMI of the offspring, independent of the sex matching of parent and offspring. (Leary et al. 2010). An Australian Study by Freeman et al. (2012) also found that whilst parent BMI was significantly correlated with child BMI, there was no evidence of sex-specific associations between parent and child BMI correlations. More recently the Health Survey for England, which monitors trends in the nation's health, and surveys approximately 8000 adults and 2000 children about a variety of health behaviours, reported that 28% of children of obese mothers were also obese, compared with 8% of children whose mother was not overweight or obese. 24% of children of an obese father were also obese, compared with 9% of children where the father was not overweight or obese (Department of Health 2019).

Whilst the findings from studies investigating same sex parent-child relationships may vary, there is consensus that both genetic and shared environmental factors influence associations between the BMI of both parents and their offspring, rather than through an influence of intra-

uterine environment (Davey Smith et al. 2007). Parental weight status has also found to be an important predictor of perception of child weight (Lydecker and Grilo 2016; Rodrigues et al. 2020).

2.4 Community factors

Whilst less immediate to the influence of parents on child development, the environment to where a child lives and goes to school, can play a role on their health behaviours and weight status. These settings are briefly summarised below.

2.4.1 School setting

After the home environment, schools represent the second setting where children spend a significant amount of their time. Schools can influence child behaviours through a number of avenues including the provision of food (Driessen et al. 2014), physical activity provision - such as inter-curriculum and outer curriculum activities (Nga et al. 2019) and nutrition education (McNulty 2013). Whilst activities undertaken by children in school is not within the realm of parental control, where children live and what school they attend is largely determined by parents. In addition, parents may encourage children to participate and sign-up to after school clubs which may play a part in a child's physical activity levels (Mears and Jago 2016). For example, a systematic review by Hutchens and Lee (2017) found that logistic support (enrolling their child in sports activities or attending sports activities with the child) for physical activity showed the greatest promise as parenting practices that may influence children's physical activity levels.

In the UK, there have been several key initiatives introduced within the last 10-years that aimed to positively influence the behaviours and health of primary school children. This includes the PE and sport premium that was introduced in 2013 to improve the quality of the PE, sport and physical activity (DoE 2022). Since 2014, every child aged 4–7 years in state-funded schools receive a free school meal in addition to those children eligible through low household income (Parnham et al. 2022). There has been a large amount of research on tackling obesity in schools (Hendrie et al. 2012; Langford et al. 2015; Williams et al. 2013).

2.4.2 The built environment

The place we live in has increasingly been recognised as a key determinant of obesity. The built environment is often referred to as the physical infrastructure in which people live, learn, work, play, socialise, and travel. In the context of children, research has focused on the food and physical activity environment with most studies tending to be observational and therefore unable to prove causality.

A study by Pearce et al. (2017) examined NCMP data and found that children who have greater access to fast-food outlets, are more likely to gain significant amounts of weight between 4/5 and 10/11 years of age. A recent systematic review and meta-analysis also found that fast food outlets within a smaller buffer radius from residences or that provide unhealthy foods, may have a more significant influence on children's and adolescents' weight (Jiang et al. 2023). In terms of physical activity, research has examined a range of factors and their impact on obesity related behaviours such as neighbourhood walkability, availability and accessibility of parks, playgrounds and recreational facilities (Malacarne et al. 2022). A recent meta-analysis of environmental determinants of childhood obesity involving 457 studies, found consistent evidence for a range of environmental determinants to be negatively associated with childhood obesity, such as access to food venues, access to bike lanes, walkable neighbourhoods and access to green space (Jia et al. 2023).

2.4.3 Deprivation

The prevalence of childhood obesity has repeatedly been shown to be strongly correlated with socioeconomic status and is highest among children living in the most deprived areas (Perkins and DeSousa 2018). In the UK, deprivation is measured through the Indices of Multiple Deprivation (IMD) which use a set of relative measures covering a wide range of aspects of an individual's living conditions. It encompasses seven different domains including income, employment, education, skills and training, health and disability, barriers to housing and services, and crime and living environment (MHCLG 2019). The reasons why children from disadvantaged backgrounds are at greater risk of becoming overweight are likely to be multifaceted, however, in the context of the home environment, families in areas of deprivation are likely have lower incomes which may prevent them from purchasing healthy food or being able to afford to take part in physical activities (Dowler 2008; Jones et al. 2014).

2.5 Changes to child weight over time

The following section summarises the literature on key contributing factors to positive weight change in mid-childhood.

2.5.1 Theoretical perspectives to behaviour change

A key line of enquiry for this research is understanding the motivation of parents and wider influences on children's behaviour in the context of childhood obesity and positive shifts in weight. It is therefore important to understand the theory behind behaviour change (i.e. facilitators of and barriers to change); understand mechanisms of change, including how and in which contexts interventions could be effective (Atkins et al. 2017).

One framework that has gained prominence within the literature in understanding behaviour change, is the theoretical domains framework (TDF). The TDF brings together 33 models of behaviour and behaviour change and includes 128 separate constructs. The TDF has 11 theoretical domains that explain the potential determinants of behaviour (knowledge, skills, social/professional role and identity, beliefs about capabilities, beliefs about consequences, motivation and goals, memory attention and decision processes, environmental context and resources, social influences, emotion and action planning) (Michie et al. 2005). Subsequent development of the TDF led to validation with 14 domains where optimism, reinforcement and intentions were identified and added (Cane et al. 2012) (see figure 6 for summary of domains). The TDF is a theoretical framework rather than a theory; it does not propose testable relationships between elements but provides a theoretical lens through which to view the cognitive, affective, social and environmental influences on behaviour (Atkins et al. 2017). In 2011, Michie et al. (2011) drew on the Theoretical Domains Framework (TDF) to developed a Behaviour Change Wheel (BCW) designed to link from identification of determinants of behaviour to the mapping of appropriate behaviour change techniques (BCTs) to inform interventions. The model developed in 2011 by Michie and colleagues, synthesised 19 pre-existing frameworks of behaviour change into a single interface incorporating a theory of behaviour, intervention functions, and associated policy categories.

Through exploring the motivations and drivers for behaviour ('intentions domain'), the Social Cognitive Theory (SCT) is notably inherent within research that has focused on parent and family behaviours (Bandura 1986; Bronfenbrenner 1979). Bandura's SCT is focused on the interpersonal level and emphasizes the dynamic interaction between people (personal factors), their behaviour, and their environments. Given that parents are ultimately responsible for the physical and social environment of their children, research has largely focused on the child-parent relationship within this theoretical context. Within the social cognitive framework, the self-efficacy construct represents an individual's confidence in his or her ability to engage in a specific behaviour to achieve a desired outcome (Bandura 1986). In this regard, a parent's self-efficacy to engage in behaviours that will prevent his or her child from developing obesity (i.e. providing healthy meals, ensuring sufficient sleep, and encouraging physical activity) is affected by their ability to overcome obstacles across the levels and carry out these health enhancing behaviours (Bandura 2004).

Several health behaviour theories suggest that recognition of and intention to change an unhealthy behaviour are important steps towards change (Park et al. 2014). The Health Belief Model (Janz & Becker 1984) proposes that individuals will only engage in health-related behaviours if someone perceives themselves as susceptible to illness and that the illness is

sufficiently serious. The application of this model provides a basis for recognising barriers to preventing and treating childhood obesity. It has therefore long been hypothesised that parents are more likely to take action on a child's weight if they feel that their children are susceptible to developing obesity in the future (perceived susceptibility) and/or believe that those problems will have a highly undesirable impact (perceived severity) (Woods 2018).

TDF domain	Constructs	Description
Knowledge	Knowledge (including knowledge of condition/scientific rationale), procedural knowledge knowledge of task environment	An awareness of the existence of something.
Skills	Skills, skills development competence, ability, interpersonal skills, practice, skill assessment	An ability or proficiency acquired through practice.
Social/professional role and identity	Professional identity professional role, social identity identity, professional boundaries professional confidence group identity, leadership organisational commitment	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting.
Beliefs about capabilities	Self-confidence, perceived competence, self-efficacy, perceived behavioural control, beliefs, Self-esteem, empowerment, professional confidence	Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use.
Optimism	Optimism, pessimism unrealistic optimism, identity	The confidence that things will happen for the best, or that desired goals will be attained.
Beliefs about consequences	Beliefs, outcome expectancies characteristics of outcome expectancies, anticipated regret	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation.
Reinforcement	Rewards (proximal/distal, valued/not valued, probable/improbable), incentives, punishment consequences, reinforcement contingencies, sanctions	Increasing the probability of a response by arranging a dependent relationship or contingency, between the response and a given stimulus.
Intentions	Stability of intentions, stages of change model, transtheoretical model and stages of change	A conscious decision to perform a behaviour or a resolve to act in a certain way.
Goals	Goals (distal/proximal), goal priority, goal/target setting, goals (autonomous/controlled) action planning, Implementation intention	Mental representation of outcomes or end states that an individual wants to achieve.
Memory, attention and decision processes	Memory, attention, attention control, decision making, cognitive overload/tiredness	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives.
Environmental context and resources	Environmental stressors resources/material resources organisational culture/climate salient events/critical incidents /environment interaction barriers and facilitators	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour.
Social influences	Social pressure, social norms, group conformity, social comparisons, Group norms, social support, power. intergroup conflict, alienation, group identity, modelling	Those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours.
Emotion	Fear, anxiety affect, Stress Depression, positive/negative affect burn-out	A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event.
Behavioural regulation	Self-monitoring breaking habit, action planning	Anything aimed at managing or changing objectively observed or measured actions.

Figure 6. Summary of Theoretical Domains Framework

2.5.2 Perception of childhood obesity and weight status

Parents' ability to accurately classify their child's weight status is regarded as an important enabler for behaviour change. If parents are unable to recognise that their child is overweight, or are not concerned about their child's excess weight, they may lack the motivation or knowledge to address the problem or prevent them from fostering healthy dietary and activity related behaviours (Lundahl et al. 2014). This is important, as many studies have found that parents seldom identify excess weight in their children (Lundahl et al. 2014; Marks 2017; Parkinson et al. 2017; Parry et al. 2008; Rietmeijer-Mentink et al. 2013).

Research has consistently found that parents fail to correctly identify their child's weight status with as much as 62.4% of parents misperceiving their child's weight status (Rietmeijer-Mentink et al. 2013). A recent systematic review and meta-analysis, synthesising evidence from 87 studies between 2000 and 2018, involving 24,774 children, found that over half (55%) of parents underestimated the degree of overweight in their children, whilst over a third (34%) of children and adolescents also underestimated their own weight status (Alshahrani et al. 2021). Studies in the UK which have analysed the NCMP and compared measurements to parent recognition of childhood obesity, have also found a disparity between perception and actual weight.

A study by Black et al. (2015) compared parental perceived and objectively derived assessment of underweight, healthy weight, and overweight in approximately 3,000 English children using NCMP data. The study found that parents were more likely to classify their children as underweight when they are at the 0.8th centile or below, and overweight at the 99.7th centile or above. These values differ greatly from the BMI centile cut-offs for underweight (2nd centile) and overweight (85th) used widely in the literature. The study also aimed to identify sociodemographic characteristics that predict parental under- or overestimation of a child's weight status. This found that parents were more likely to underestimate a child's weight if the child was black or South Asian (versus white), male, more deprived, or the child was older (age 10–11 years versus 4–5 years). The study found that only a small number of parents overestimated their child's weight status. Other studies have found that parents who misperceived their child's weight were more likely to have an unhealthy diet compared to parent to children whose parents correctly perceived their weight (Almoosawi et al. 2016).

Since the inception of the NCMP in 2006, several studies have explored the impact of providing feedback to parents about their child's weight status. Routine feedback is

considered a key component of the NCMP with the opportunity to improve awareness and health literacy (OHID 2022). It is also seen as an opportunity for direct engagement with families to support and encourage behaviour change where it will help a child achieve a healthy weight (Sallis et al. 2019). Whilst the NCMP aims to raise awareness of childhood obesity amongst parents', evidence regarding the impact of NCMP feedback and its effectiveness in engaging parents in behaviour change is mixed (Gainsbury and Dowling 2018). A study by Falconer et al. (2012) found that while NCMP feedback led to a modest increase in both parental recognition and knowledge regarding overweight and associated health risks, this did not necessarily lead parents to acknowledge the health risk posed to their own child. A later study by Park et al. (2014) found that after receiving NCMP feedback, most parents (72%) reported an intention to change health-related behaviours and just over half of parents (55%) reported positive behaviour change for their children, including improved diet, less screen-time, health service use and increased physical activity.

Whilst parents often plan behavioural changes after being made aware of their child's weight status these intentions may not translate into behaviour change (Mooney et al., 2010). This is often referred to as the intention-behaviour-gap. Reasons put forward to explain the intention-behaviour gap is the changing social norms surrounding weight (Hansen et al., 2014). Robinson (2017) referred to this as 'visual normalization', whereby evaluations about weight status are made relative to visual body-weight norms which are shaped by the size of bodies a person is frequently exposed to in his or her environment. For example, since 1993 adult obesity prevalence in the UK has increased from 14.9% to 28.7% whilst the proportion of adults who are overweight or obese is now 64.3%, reflecting that being a healthy weight is no longer the norm (Baker 2023).

Research has also explored whether providing feedback to parents on weight status leads to an increase in uptake of child weight management services. An RCT study undertaken by Sallis et al. (2019) investigated whether 'enhanced' feedback letters to parents incorporating body image scales, social norm messages and behaviour change prompts would increase the number of families contacting, enrolling or attending weight management services. Whilst the study showed that the intervention letter approximately doubled enrolment in weight management services (2.19% vs. 4.33%), compared to the national template letter, the absolute increase was small (2.14%).

Whilst research in relation to the NCMP has shown that parents want to receive their child's NCMP results, evidence suggests that parents often disregarded overweight feedback as they deemed the process to lack credibility and considered 'health and happiness' more

important than weight (Falconer et al. 2014b; Syrad et al. 2015). Other studies have found that feedback can cause emotional distress amongst parents, harm their child's self-esteem and potential stigmatisation amongst peers, trigger disordered eating, surpassed concerns regarding excess weight (Gillison et al. 2014; Nnyanzi et al. 2016).

The negative responses reported in the literature from parents receiving feedback about their child's weight status has been attributed to several reasons including the negative attributes society holds towards overweight and obesity and parents. A recent study by Cullinan and Cawley (2017) examined the extent of parental misclassification of child weight status by socio-economic determinants and specifically parental education. They found that non-obese parents, who were better educated reported their child's weight status more accurately. However, this was not reciprocated among obese parents, whereby better-educated obese parents were 18% more likely than parents with lower secondary education to give a false negative report of their child's overweight/obesity. They concluded that it was difficult to know whether parents are poorly informed about their children's weight status or well-informed but knowingly underreport it (social desirability bias). Other researchers have suggested that there could also be a genuine inability among parents and carers to distinguish overweight and obesity from normal weight among children and that when parents receive the news of their children being overweight/obese they are surprised, as they previously thought that their children were ideal weight. (Nnyanzi et al. 2016).

Despite a number of studies finding that parental recognition of overweight in children is a predictor of behavioural intentions, research investigating its relationship to weight gain and weight loss over time is less clear (Neumark-Sztainer et al. 2009; Robinson and Sutin 2016). Some studies have examined parenting behaviours of parents who correctly classified their children's weight status. A study by Neumark-Sztainer et al. (2009) on American teenagers explored whether parental behaviours differed across parental perceptions of their child's weight status and whether this predicted adolescent weight status five years later. They found that even if parents correctly identified their children as overweight, they were no more likely than parents who did not correctly classify their children as overweight to engage in helpful behaviours such as having more fruits/vegetables and fewer soft drinks, salty snacks, candy, and fast food available at home, having more family meals and watching less television. Furthermore, longitudinal analysis did not find that accurate parental classification of their child's weight predicted better adolescent weight outcomes five years later.

A more recent study in Australia by Robinson and Sutin (2016) which used comparable age-ranges to this study (4-5 years and 12-13 years) over an 8-year follow-up, found that parental

perceptions of overweight measured at age 4/5 years predicted increases in BMI change scores at 12/13 years. Whilst all children in their sample gained weight, parents who perceived their child's weight status as "overweight" had children who gained more weight across the 8-year follow-up compared with children whose parents perceived their weight as being "normal". These findings suggest that simply informing parents that their child is overweight is unlikely to have a positive impact and may lead to parental behaviours that are counterproductive to a healthy weight (Neumark-Sztainer et al. 2009).

Other studies have also found that a parent identifying his or her child as overweight was not protective against further weight gain (Robinson and Sutin 2016). A number of theories have been proposed that might explain reasons for this including parents adopting parenting styles and practices that are known to be counterproductive i.e. restrictive feeding (Swyden et al. 2015). The study by Neumark-Sztainer et al. (2009) also found that parents who accurately perceived their children as overweight were more likely to encourage them to diet in order to manage their weight which resulted in an increased risk of overweight at the 5-year follow-up.

Most of the studies linking parental control strategies with child weight have been cross sectional which has meant that direction of causality has often been uncertain (Webber et al. 2010a). The majority of research has focused on the causal pathway running from parent to child, with parental feeding practices assumed to affect the child's weight status. However, a number of studies have examined whether a child's characteristics - or parents' perceptions of those characteristics - influence the way the parent feeds their child as part of their effort to maximise the child's health and well-being (García-Blanco et al. 2022). This approach has been referred to as the "child-responsive" model whereby the parents feeding practices are influenced by their child's weight status rather than causing subsequent weight gain (Webber et al. 2010b).

A study by Grimmett et al. (2008) looked at the psychological impact of weight-screening that included feedback to parents of 7/8 and 10/11-year-old children in England. Their research found that parental restriction was higher in families with overweight than healthy-weight children at baseline with restriction increasing significantly for overweight girls from baseline to follow-up. A later study by Webber et al. (2010a) also found that parental practices change in response to child weight. At the 3-year follow-up they found that higher child BMI at baseline predicted increased use of monitoring and lower use of pressure to eat over a 3-year period. These results suggest that child adiposity can lead to controlling parental practices.

Maternal concern about child overweight was also associated with a linear increase in restriction across weight groups, and this maternal concern about overweight mediated the association between child adiposity and restriction (Webber et al. 2010a), suggesting that parents use restriction in response to child's perceived weight status. In another study with a large cohort of preschool children, Jansen et al. (2012) reported significant cross-sectional associations between restrictive feeding and child weight. Noor et al. (2012), in a study of Malay children, also found that parents of overweight children controlled their child's intake by restricting amount of food given. This suggests that restriction is applied to heavier children across different contexts and cultures (Shloim et al. 2015).

2.5.3 Changes to parental weight status

Research has found that parental weight change is associated to child weight change (Epstein et al. 1980; Wrotniak et al. 2004). Some studies have found this association to be strongest amongst mothers which may reflect their roles as primary caregivers and predominantly responsible for shaping the food and activity environments within homes (Andriani et al. 2015). Parent BMI change, via child weight management programmes, has also been found to be a significant predictor of child weight, in that a reduction of 1 BMI unit in the parent has been found to be associated with a 0.25 reduction in child BMI (Boutelle et al. 2012). Therefore, it is has been argued that special emphasis should be placed on parental weight loss as a focus in family based behavioural weight control programmes (Boutelle et al. 2012).

Studies have examined whether children of parents who are participating in weight management programmes are more likely to use the same weight control practices as their parents (Brown et al. 2016). Weight control practices include healthy behaviours (e.g. exercising and increasing fruit and vegetable intake) and unhealthy behaviours (e.g. dieting, skipping meals, and using a food substitute). Whilst children of parents attending weight management programmes commonly utilise weight control practices, these have tended to apply to older children with higher BMI, and likely reflect the greater autonomy that they have over younger children (Brown et al. 2019). Other studies have found parent participation in a commercial weight loss programmes to positively impact on child weight loss alongside reductions a fat intake and reductions in the family eating out in a restaurant or eating ready-made fast food (Song et al. 2018).

Given the role that parents have in shaping the home environment, it has been suggested that to curb childhood obesity, weight management interventions should target the weight

status of parents as a strategy to improve the dietary and physical activity behaviours of their children. The rationale is that the skills and knowledge learnt by parents as part of adult weight management intervention, my lead to a change in environmental restructuring, to create an environment that facilitates the acquisition and maintenance of healthier eating and activity for the whole family (Pham et al. 2023). This is achieved through incorporating stimulus control, an authoritative parenting style, modelling of healthy behaviours, and behavioural reinforcement techniques designed to increase the chances that the child will adopt and maintain behaviours to facilitate weight loss (Boutelle et al. 2012).

2.5.4 Positive changes to child weight status

Nearly all studies investigating the family-home environment have done so through the lens of exploring associations between factors and weight gain. There is a scarcity of studies that have explored reasons for weight loss in children in mid-childhood, beyond that of children being enrolled onto a weight management programme. A study by Gillison et al. (2017) conducted participatory research in England with parents of children who had achieved a positive shift in weight between 4/5 and 10/11 years olds. Like this study, the research identified children through the NCMP to understand how weight loss between 4/5 and 10/11 years were successfully achieved. Due to challenges with recruitment, the study only interviewed four parents and therefore the insights collected provided limited insight into the views of parents on their child's weight. Whilst the sample was small, three themes were identified: whole family action, support (sources and importance of), and protecting childhood.

The first theme identified a whole family approach as having a positive influence over their child's weight. Parents reported changes that had been made to their child's diet and/or physical activity levels had been made consciously by the parent, and for the whole family, and not just for the overweight child. Furthermore, parents mostly reported the 'trigger' for these changes being the parents' decision to change their own diet or activity levels, not changes instigated for the sake of the overweight child. This suggests that the trigger to lasting positive weight change had not come from an awareness of the child's weight status, or the influence of advice from health professionals. The research suggests that the parents' assertion that their child's weight status was not a trigger for change, despite recognising that their child was overweight during early childhood, and that parents believed that the excess weight would not persist into adulthood and therefore did not feel the necessity to act on it. For example, several parents reported considering body size as largely a family trait. Parents also emphasised the importance of long-term behaviour change and that making

changes for their own sake came as a necessary condition to improve the whole family lifestyle.

The second theme focused on social support which was found to be important for parents in maintaining healthy behaviours. Whilst the study found that the level of social support varied, three out of four parents identified commercial weight management programmes (Weight Watchers/Slimming World) as important support mechanisms in managing their own weight. Some parents had taken their children along to the adult programmes and suggested that this had a positive influence on the children's health behaviours. This may align with previous research suggesting a link between parents attending commercial weight management programmes and weight loss in children (Song et al. 2018). Parents also identified child weight management programmes helpful in providing peer support for their children who were overweight, although they felt that the support was too short term and not focused on what was important to parents.

The third theme identified by the researchers was 'protecting childhood' and primarily focused on parents looking to protect their children from the stigma or poor self-esteem that is often suffered by children who are overweight (Tomiyama et al. 2018). They wanted their child to be treated like any other child without any labelling and able to have treats like any other child. Parents referred to their experiences of childhood and that they did not want their child to be obsessed with their weight as this could be 'soul destroying' and potentially lead to eating disorders and other mental health issues. These findings align with other research which has found that children's happiness and wellbeing is frequently reported by parents as being more important than a healthy body weight (Syrad et al. 2015).

Whilst not directly looking at positive shifts in weight status, a phenomenological study by Downey and Gudmunson (2022) looked at 12 mothers who scored high on the FNPA screening tool and how they positively shaped their children's eating, physical activity, and screen related behaviours. The research identified four themes in how parents promoted healthy home environments. The first was childhood and family history, where parents spoke about their past experiences, upbringing and events that had shaped them into the type of parent they were today. This included the importance of family history and family members that suffered or died from ill health, because of obesity. The second theme focused on mothers valuing engaging in healthy behaviours and the physical, mental, and emotional benefits this provided for their children. The third theme recognised the role of parents in shaping the health outcomes of their children and the acknowledgement of their responsibility for educating their children on how to make informed healthy choices. The fourth theme

concerned mothers having to go the extra effort to model appropriate behaviours, as well as providing the environment to enable their children to practice health behaviours. For example, transporting children to activities to participate in physical activity, planning for healthy family meals around activities, and the constant juggling of the busy schedules of multiple children.

Most of the literature focusing on weight-loss in children has come from extensive research examining the impact on structured interventions (weight loss programmes) on child weight. These generally include parents and their children/families being referred into a programme by a professional to improve behaviours around diet and physical activity and take place in a range of settings including schools and community venues. Given the role of parents in shaping their children's health behaviours, the development of interventions that target young children in the context of the home and family environment and parents as the 'agents of change' has developed over time.

Evidence has shown that engaging family members through whole family approaches as part of an intervention can produce positive effects on weight related outcomes (A. Hamid and Sazlina 2019). Research comparing parent-only intervention versus an intervention including the child for overweight or obese children aged 5-12 years, have found that parent-only interventions are as effective as parent-child interventions in changing the degree of overweight (Ewald et al. 2014; Loveman et al. 2015). This suggests that parents have the autonomy to make changes that influence their children's behaviours and the home environment. One of the challenges with the evidence around child weight management programmes is that they are complex interventions, and their effects can be moderated by many factors, including the context and the characteristics of the people targeted and those involved in service delivery. There is also variation in the different components that they incorporate and unravelling the key factors that lead to weight loss can be difficult (Burchett et al. 2018). This can mean that understanding the critical factors for success can be problematic.

A Cochrane review looking at children aged six to eleven years across 70 studies found that parents were a key factor in most interventions, given their influential role in providing healthy meals and helping their children to be more active and spend less time watching TV and playing on the computer (Mead et al. 2017b). The study also found that interventions consisting of diet, physical activity, and behavioural change components for the treatment of overweight or obese achieving small, short-term reductions in BMI (Mead et al. 2017a).

In an updated Cochrane review examining the effectiveness for interventions for preventing obesity in children, it found that physical activity interventions which targeted children aged 6-12 years, showed the most promise in reducing BMI, with interventions solely focusing on diet interventions having little effect (Brown, 2019). However, the authors noted that given the variation in studies, it is likely too simple to categorise interventions by discrete categories such as 'diet' or 'physical activity' or a combination of both. However, it has been acknowledged that there are currently few randomised controlled trials testing the efficacy of family-based childhood obesity nutrition interventions aiming to improve children's dietary behaviours (Perdew et al. 2020). Where dietary interventions have shown some benefit, this has been through the inclusion of components such as family-based goal setting, modifying the home food environment, hands-on approaches to teaching nutrition (games, group-based activities) and fruit and vegetable vouchers (Perdew et al. 2020).

An analysis of seven Cochrane systematic reviews between 2011 and 2017 on the effectiveness and risks of interventions to treat overweight and obesity in children and adolescents found that behavioural interventions more effectively reduced weight compared with no intervention, usual care, or another behavioural treatment (three reviews, low-to-moderate certainty). Parent child lifestyle and behavioural interventions more effectively reduced BMI change-score compared with no intervention (one review, low certainty). There is low-certainty evidence that behavioural interventions are effective in weight management for children with overweight and obesity (Gates et al. 2020). It also worth acknowledging that interventions aimed at weight loss in children have largely been focused on short term outcomes with inconsistent evidence of positive long-term impacts (Knowlden, 2012).

A UK study looking at lifelong trajectories of BMI from early childhood to adolescence to assess their early individual and family predictors, found that unhealthy BMI trajectories were defined in early and middle-childhood, and disproportionally affected children from disadvantaged families. The study also found that household routines, self-regulation, and child-parent relationship are possible areas for family-based obesity prevention interventions. Lack of sleep and eating routines, low emotional self-regulation, child-parent conflict, and low child-parent closeness in early childhood were significantly associated with unhealthy weight trajectories, alongside poverty, low maternal education, maternal obesity, and prematurity (Dos Santos et al. 2020).

2.6 Summary and conclusion

Whilst the review of the literature has reflected the multi-facet nature of obesity, it has identified key home and family factors that are recognised as playing some part in health-related behaviours and health outcomes. Research has often conceptualised the family home environment through parenting practices focusing on diet, physical activity and media, although this is often set within the social context of parenting styles, role modelling and family structuring (Kininmonth et al. 2022; Sleddens et al. 2011). The evidence on the overall impact of individual factors is unclear with a lack of consensus regarding how to evaluate the overall obesogenic home environment, which in itself reflects the complex determinants of obesity (Pinard et al. 2012).

Research investigating the home environment and child obesity has primarily focused on single domains e.g. diet, physical activity or sedentary/media) and its relationship with weight (Schrempft et al. 2018). Of the few studies that have assessed a full constellation of obesogenic behaviours within the family-home context, the results have been mixed (Kininmonth et al. 2021). There is dearth of evidence that have looked at weight loss amongst overweight children outside of formal weight management programmes. Behaviour change theory suggests that the recognition of child weight by parents, is an important stimulus for families to actively engage in health-related behaviours. However, the literature has consistently shown that accurate recognition of child weight remains poor (Alshahrani et al. 2021).

Chapter 3
Methodology

3.0 Methodology

This chapter provides an outline of the research philosophy and methods that were followed in the study. It summarises the theoretical assumptions underlying different research methodologies and the need to examine the paradigms upon which the choice of methodological approaches for studies are based.

The term methodology has been defined by Kara (2015, p. 27) as a "contextual framework for research, a coherent and logical scheme based on views, beliefs, and values, that guides the choices researchers make. It involves the philosophical assumptions and the rationale underpinning a particular approach taken in any inquiry. Creswell (2009) outlined three interrelated components that form the design of research; the intersection of philosophy, strategies of inquiry and specific methods or procedures that that translate the approach into practice (see figure 7).

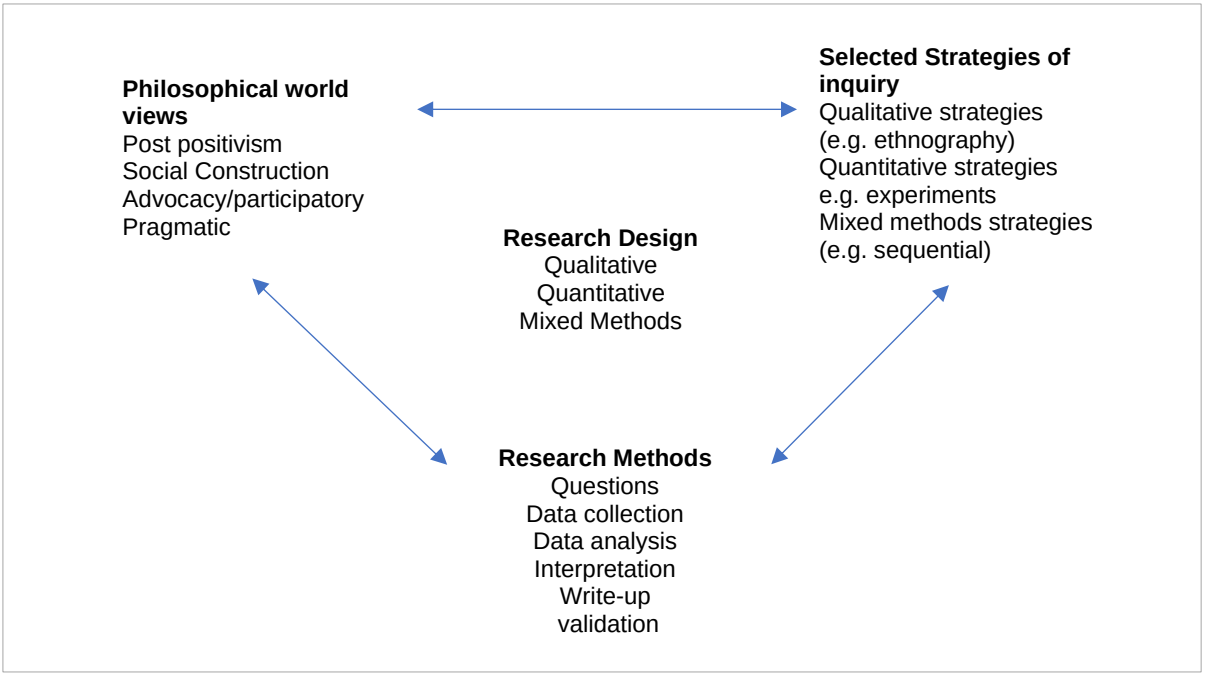

Figure 7. A framework for design— the interconnection of worldviews, strategies of inquiry, and research methods (Creswell 2009)

3.1 Philosophical assumptions in research methodology

The nature of knowledge within a piece of work is detailed and explored within a research project's paradigm. Researchers are required to understand and articulate beliefs about the nature of reality in terms of what can be known about it and how they go about attaining this knowledge. Creswell (2009) referred to these beliefs as 'world views', whereby they reflect a general orientation about the world and the nature of research that a researcher holds.

Guba and Lincoln (1994) suggested that no researcher should go about the business of inquiry without being clear about what paradigm informs and guides their approach (Guba and Lincoln 1994). Paradigms represents a shared belief system that defines, for its holder, the nature of the "world" the individual's place in it, and the range of possible relationships to that world and its parts (Guba and Lincoln 1994). A paradigm also influences the types of knowledge researchers seek and how they interpret the evidence they may collect (Morgan 2007).

It is widely acknowledged that a paradigm constitutes four categories of interrelated views that underpin our conceptions of knowledge and knowing: *ontology* - is concerned with the nature of reality in the world and what exists; *epistemology* - relates to beliefs (and assumptions) about the ways in which one should generate and understand knowledge; *methodology* - is the approach to the construction of knowledge; and *axiology* – the influence of values on knowledge that is acquired and how it is acquired. A coherent set of views in relation to these four considerations is said to constitute a paradigm position (Guba and Lincoln 1994; Haigh et al. 2019; Scotland 2012).

We all hold ontological assumptions, even if we do not explicitly consider or detail them (Creswell 2007). Reflecting upon these assumptions allows researchers to identify a paradigm that aligns with their beliefs regarding the nature of reality and their perceptions of how things really are and how things really work (Bunniss and Kelly 2010). It is about how we can produce knowledge about the world and how reliable our knowledge is. Guba and Lincoln (1994) explain that epistemology asks the question, what is the nature of the relationship between the would-be knower and what can be known?

When considering what philosophical position is appropriate for a research question, it is important to understand its philosophical underpinnings, including its epistemological and ontological bases, among other practical characteristics (Schiller 2016). The following section summarises the different research world views and explores the philosophical underpinnings of three predominant social science paradigms: positivism, interpretivism / constructivism, and critical realism. It details how each of these paradigms have their own unique ontological and epistemological perspective and examines how the beliefs held by researchers inform the design of both quantitative and qualitative research. We also examine a fourth paradigm – pragmatism, due to its relevance within the context of this study. Understanding these paradigms, their origins and principles has informed which paradigm is appropriate for this research and therefore informed the research design, methodology and analysis.

3.1.1 Positivism/post-positivism

The term positivism refers to a branch of philosophy that emerged in the late eighteenth and early nineteenth centuries following the work of the French philosopher Auguste Comte (Morgan 2007). Positivism assumes that the world is made up of facts that can be observed and measured, with the main aim of research to describe the phenomena. Positivism takes a objectivist stance whereby it assumes the world consists of real objects that are guided by universal laws. Researchers who hold this assumption aim to remove their biases and values through undertaking research that is objective, empirical or controlled. These assumptions have tended to represent the 'traditional' forms of research with quantitative approaches being the dominant form of methodology across the literature and consequently, quantitative research has been prioritised over other forms of enquiry, and other epistemologies, methodologies and methods (DeCarlo 2018).

Although positivist paradigms are invaluable frameworks for studying natural objects, the experimental design research methods (e.g. randomised controlled trials) have been criticised as not suitable when they are applied to social phenomena that involves complex, unstable and non-linear social change (Berwick 2008). This is particularly relevant within the context of obesity which is increasingly recognised as a multifactorial, context-driven problem, which has led to calls for new models of evidence that consider complex systems and their interrelated parts (Rutter et al. 2017).

During the 20th century, post-positivism emerged from positivism. Post-positivism has similar ontological and epistemological beliefs as positivism; however, it challenges the traditional notion of the absolute truth of knowledge, recognising that we cannot be "positive" about our claims of knowledge when studying the behaviour and actions of humans (Creswell 2009). Post-positivists aim to identify and assess the causes that influence outcomes. It is often considered a reductionist viewpoint whereby it is centred on reducing complex phenomena into their many parts - such as variables, which can be used to test hypothesis or research questions. Positivists look at the issue in a predetermined way through certain measurable instruments (e.g. survey, questionnaire etc) to confirm or reject the hypothesis.

3.1.2 Interpretivism and (social) constructivism

Interpretivism came about through the critique and over-dominance of positivism (Gruber 2009). Interpretivism is closely related to social constructivism, in that they both share the aim of understanding the world of lived experience (Martens 2012). Interpretivism rejects the notion that a single, verifiable reality exists independent of our senses (Abdul Rehman and Alharthi 2016). Interpretivism takes a realist and subjectivist stance. In other words, it denies

that a single reality exists and sees knowledge production as fallible and theory dependent. It refuses “to adopt any permanent, unvarying (or foundational) standards by which truth can be universally known” (Guba and Lincoln 2005). Instead, interpretivists believe in social interactions across multiple realities or perceptions. This suggests that truth and reality are created and not discovered. It is not possible to know reality as it is, because it is always mediated by our senses.

Those who adopt Interpretivism and/or social constructivism as a philosophical viewpoint tend to employ qualitative research methodologies that explore and understand the meaning of individuals or groups and how they ascribe to a social or human problems (Creswell 2009). Subjective meanings are often formed through interaction with others and through historical and cultural norms that operate in individuals’ lives. The focus is on the specific contexts in which people live and work, in order to understand the historical and cultural settings of the participants (Creswell 2009). A key aspect of interpretivism is the need for researchers to recognise their own backgrounds and how this shapes their interpretation based on their personal, cultural, and historical experiences.

Social constructivism is often criticised for its subjective nature and the inherent bias that is likely to arise through interpretation of the researcher. Therefore, it presents challenges around generalisability of findings as data may have been heavily influenced by personal viewpoint and values. On the other hand, it has been argued that interpretivism research can be associated with a high level of validity because data in such studies tends to be trustworthy and honest (Scauso 2020).

3.1.3 Critical realism

Critical realism is a relatively new philosophical perspective that was originally developed by Roy Bhaskar in the 1970s and offers a radical alternative to the established paradigms of positivism and interpretivism and seeks to bridge the long-standing divisions between the two world views (Schiller 2016).

Critical realism is primarily concerned with ontology and begins with questions about what exists. Bhaskar (1978) proposed a unique stratified ontology to distinguish between three different levels of reality. These are: the empirical (those aspects of reality that can be experienced either directly or indirectly); the actual (those aspects of reality that occur, but may not necessarily be experienced); and the real or ‘deep’ structures and mechanisms that generate phenomena (Bhaskar 1978). Critical realism embodies a constructivist

epistemology that believes in a world that is constructed through our individual standpoints and perceptions (Creswell 2007).

For research that is based on critical realism, the aim is not to identify generalisable laws (positivism) or to identify the lived experience or beliefs of social actors (interpretivism); it is to develop deeper levels of explanation and understanding (McEvoy and Richards 2006). It looks for causal mechanisms and how they act as tendencies to influence the world we observe. In other words, it asks the question 'how can we best explain the phenomena?' or 'what are the causal mechanisms that caused this phenomenon and under what conditions did they occur?' Critical realism is often best described as the world operating as a multi-dimensional open system, whereby effects arise due to the interaction between social structures, mechanism and human agency (McEvoy and Richards 2006). Like pragmatism (see below), critical theorists propose that the choice of methods should be dictated by the nature of the research problem. In light of this, critical realists often use a combination of quantitative and qualitative methods or techniques through a mixed methods approach (Schiller 2016).

3.1.4 Pragmatism

Pragmatism epitomizes John Dewey's idea of finding what works in building knowledge among those who seek to advance scientific truth (Creswell 2007). Creswell (2009) describes pragmatism as a worldview that arises out of actions, situations, and consequences. One of the key features of Pragmatism is that it rejects the distinction between truth and realism and proposes that there can be single or multiple realities that are open to empirical inquiry (Creswell and Clark 2011).

Pragmatist philosophy holds that human actions can never be separated from the past experiences and from the beliefs that have originated from those experiences. Morgan (2007) suggested that ontological and epistemological assumptions should be disassociated with choice of methods in any inquiry. While positivism and interpretivism are deductive and inductive respectively, pragmatism is abductive; it combines deduction and induction. Through induction, theories are established and then tested through deduction. The pragmatic approach does not require the researcher to be either exclusively objective or subjective but rather intersubjective, meaning partly objective and partly subjective (Morgan, 2007). The focus is on what works to answer research questions. Instead of focusing on single scientific methods, researchers use all approaches available to understand the problem (Rossman and Wilson 1985). Pragmatism and its philosophical assumptions Often

therefore sees mixed methods as the preferential approach to arrive at knowledge of greater completeness (Szyjka 2012)

3.1.5 Implications for this study

From reviewing the different underlying philosophical positions that have been debated throughout this section, the overall position for this study was a pragmatist one. My belief is that there is no one superior research approach within the research paradigms; all are valid and informative when used sensitively in context to answer an appropriate research question.

The choice of a methodological approach had been shaped by a process of reflection on my own life, beliefs, past learning, and experiences. My professional status as a public health professional and associated values have shaped how the study has been conducted. It is widely acknowledged within public health, that people's health is influenced by the determinants of health or the causes of the causes. These are the social, cultural, political, economic, commercial, and environmental factors (Marmot 2010). Understanding the environment and context is essential when exploring how people live their lives which lends itself to public health research given its emphasis on problem solving, practice and interest in individual-environment interactions (Tashakkori and Teddlie 2010). Pluye and Hong (2014) highlight the value of mixed methods in public health research:

> "Mixed methods combine the power of stories and the power of numbers. In public health, stories have the power to change policies, and statistics traditionally provide a strong rationale to make changes (Pluye and Hong 2014, p. 30)."

It is on the basis of this reflection that this study is premised on the ideas of pragmatism.

3.2 Methods

The following section presents the methods that were used in the study. Firstly, they set out the detail for the research design for the study and then provide a detailed overview of the two components of the study - the quantitative and qualitative component. This includes an overview of the samples, sampling strategy, data collection study procedures, data management strategies and data analysis. The section concludes with a discussion of the ethical considerations for the research.

3.2.1 Mixed methods

The ability to combine quantitative and qualitative methods in social science research has gathered momentum in recent years. Johnson et al. (2007) defines mixed methods as combining elements of qualitative and quantitative research approaches (e. g. using qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration. Therefore, in mixed methods research, investigators use both quantitative and qualitative data because they work to provide the best understanding of a research problem. Tashakkori and Creswell (2007) referred to mixed methods research as where the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or programme of inquiry. Mixed methods is more than simply collecting and analysing both kinds of data; it also involves the use of both approaches in tandem so that the overall strength of a study is greater than either qualitative or quantitative research (Creswell and Clark 2007).

Through taking a pragmatic approach to this research it was concluded that a mixed-methods approach would be best employed within the current study to answer the research question. Tashakkori and Teddlie (2010) suggest that the choice of a mixed approach is seen as one that should be driven by the very questions that research seeks to answer. The research aims and objectives indicated a need to look at children's weight status and the relationship between various family home environment factors, but also a need to explore further how factors may have been shaped over time by parents. This would provide the opportunity to corroborate findings across methods and expand the depth and breadth of findings (Halcomb 2019).

3.2.2 Historical perspective of mixed methods research

Understanding the historical context of mixed methods and how it evolved is important for researchers. During the late 1980's and early 1990's a number of researchers were advocating a research approach beyond simply using quantitative and qualitative methods as standalone strands in studies (Creswell and Clark 2011). Several reasons have contributed towards the emergence of mixed methods and its popularity amongst researchers. In particular, the growing recognition of 'complexity' and that our health is affected by numerous social, economic and environmental interactions, has led to a need for research to go beyond the realms of quantitative and qualitative approaches. Campbell and Fiske (1959) are often credited as formalising the practice of using multiple research methods. They introduced the concept of triangulation in which more than one method is

used for validation process that ensures that the explained variance is the result of the underlying phenomenon or trait and not of the method (Johnson et al. 2007). Adab et al. (2018) date the beginnings of mixed-methods research back to the mid-to-late 1980s when experts and scholars were working on similar ideas regarding the combination of quantitative and qualitative methods.

3.2.3 Challenges in mixed methods research

Whilst mixed methods research has grown in popularity over the last 40-years there are well-documented challenges this methodology. The most frequently cited challenge is the ability to combine different methodologies. Mixing or integrating methods is complex because each paradigm has different epistemological and philosophical frameworks. In particular, the variable typologies for common mixed methods designs (described further in section 3.2.4) present a number of key considerations for researchers. This includes the degree of interactions between methods; the implementation sequence; priority given to qualitative and quantitative data and the timing of integration.

Whilst the paradigmatic debate on mixed methods remains, there are a number of practical issues in carrying out mixed methods research (Halcomb 2019). The collection of two different types of data often leads to generating large volumes of data and therefore the resources for data collection, management and analysis are significant (Andrew 2009). The large volume of data generated by mixed methods research can also create challenges in analysis and dissemination.

3.2.4 Mixed methods typologies

Research designs are procedures for collecting, analysing, interpreting, and reporting data in research studies (Creswell 2007). Having rigorous research designs are critical to not only guide the methods that researchers make, but also to ensure rigorous studies. Having selected a mixed methods approach for the study, there is a need to outline the specific design that best addresses the research problem (Creswell 2007).

Several typologies for mixed methods have been identified in the literature that attempt to standardise how mixed methods research is undertaken. In identifying an appropriate research design it is important that researchers understand the underpinnings and implications of the various designs before embarking on the research (Halcomb and Hickman 2015). Creswell and Clark (2011) identified several commonly used designs in mixed methods that are summarised in table 1.

Whilst there is an abundance of different typologies, mixed methods research tends to consist of four main characteristics that influence the design of a mixed methods study. The first is the degree to which qualitative and quantitative data will interact with each other or be kept independent. This considers whether one data set informs the other or if the two data sets collected independently and links to the second design factor (Halcomb 2019).

The second design factor is the implementation sequence or timing, of collecting data and whether it will be in phases (sequentially) or gathered at the same time (simultaneous/concurrent). Sequential approaches involve quantitative and qualitative data being collected separately which are often informed by the objectives of the researcher. Deciding whether qualitative or quantitative phases precede one another, will depend on whether the investigator desires to explore the problem under the study before or after the collection of quantitative data.

Typology/taxonomy	Process	Purpose	Level of interaction	Priority
Convergent parallel design Quantitative and qualitative strands of the research are performed independently, and their results are brought together in the overall interpretation.	Qual Quant	To obtain different but complementary data to answer a single research question	Data collected & analysed independently	Equal
Explanatory sequential design A first phase of quantitative data collection and analysis is followed by the collection of qualitative data, which are used to explain the initial quantitative results.	QUANT → qual	Qualitative data are collected to explain the quantitative findings	Quant data frames qualitative data collection	a collection Quantitative dominant
Exploratory sequential design First phase of qualitative data collection and analysis is followed by the collection of quantitative data to test or generalize the initial qualitative results.	QUAL → quant	Quant data builds on qualitative findings to provide generalizability	Qualitative data frames quant data collection	Qualitative dominant
Embedded design In a traditional qualitative or quantitative design, a strand of the other type is added to enhance the overall design.	Qual (quant) Or Quant (qual)	To obtain different data to answer a complementary research question	Embedded dataset provides answers to a complementary research question.	Can be either Qualitative or Quantitative dominant
Transformative design A transformative theoretical framework, e. g. feminism or critical race theory, shapes the interaction, priority, timing and mixing of the qualitative and quantitative strand.	Qual (quant) Or Quant (qual)	Conduct research that is change orientated and seeks to advance social justice		Can be either Qualitative or Quantitative dominant
Multiphase design More than two phases or both sequential and concurrent strands are combined over a period of time within a program of study addressing an overall program objective.	Qual (quant) Or Quant (qual)	To address a set of incremental research questions that advance research objective	Alternates quant and qual across three phases	Can be either Qualitative or Quantitative dominant

Table 1. Overview of the main typologies identified from the literature (Creswell and Clark 2011)

Thirdly, designs vary in the priority that is given to the qualitative and quantitative data, often referred to as 'weighting'. In some studies, the qualitative and quantitative component might be treated equally, whilst other studies might emphasis one component or the other. Explanatory studies tend to focus more on qualitative data if little is known. However explanatory studies which seek complementarity often prioritise quantitative data. (Halcomb and Hickman 2015).

Finally, mixed method designs vary in the point at which the qualitative and quantitative are integrated or 'mixed'. The integration phase can occur at any point in the research process,

the data collection, the data analysis, interpretation, or at all three phases. Creswell (2009, p. 207) described mixing as qualitative and quantitative data being “merged on one end of the continuum, kept separate on the other end of the continuum, or combined in some way between these two extremes.” For example, in an explanatory sequential design, the research begins with the quantitative phase, with the potential for the data and analysis going on to being used to identify participants for qualitative data collection in a follow-up phase. This approach is referred to as ‘connecting’ where the two components are connected between data analysis of the first phase of the research and the data collection at the second phase of research. Despite researches attempting to categorise and define these typologies, Schoonenboom and Johnson (2017) argue that researchers should construct their study based on their research question/s. This will often result in a combination or “hybrid” design that goes beyond basic designs found in typologies, and the methodology outlined above.

3.2.5 Research design

This study adopted a mixed methods approach that involved a multi-method sequential explanatory design (Andrew 2009) (see figure 8). The multi-method sequential approach involved a three phase approach, whereby the design began with the collection and analysis of quantitative data, followed by the identification of a purposive sample and the subsequent collection and analysis of qualitative data (Ivankova et al. 2006). The purpose of this design was threefold:

1. To understand the key home and family factors that may contribute to the emergence, persistence, and remission of weight gain in mid-childhood.
2. To utilise the quantitative component to establish a purposive sample to understand the phenomenon of interest (Bloomberg and Volpe 2012).
3. Analyse the qualitative data to help contextualise, explain, interpret or build upon initial quantitative results (Creswell 2007).

By utilising a purposive sampling method, the study presented an opportunity to provide detailed contextual description of the knowledge and belief systems of a select group of parents on how they may have shaped their children’s eating, physical activity, and screen-related behaviours that contributed to a positive shift in weight related outcomes. The qualitative and quantitative component was integrated during the interpretation phase through a triangulated approach, with the purpose of gaining a better understanding of the likely factors and motivations for those children who achieved a positive shift in weight status for children between the ages of 4/5 and 10/11 years.

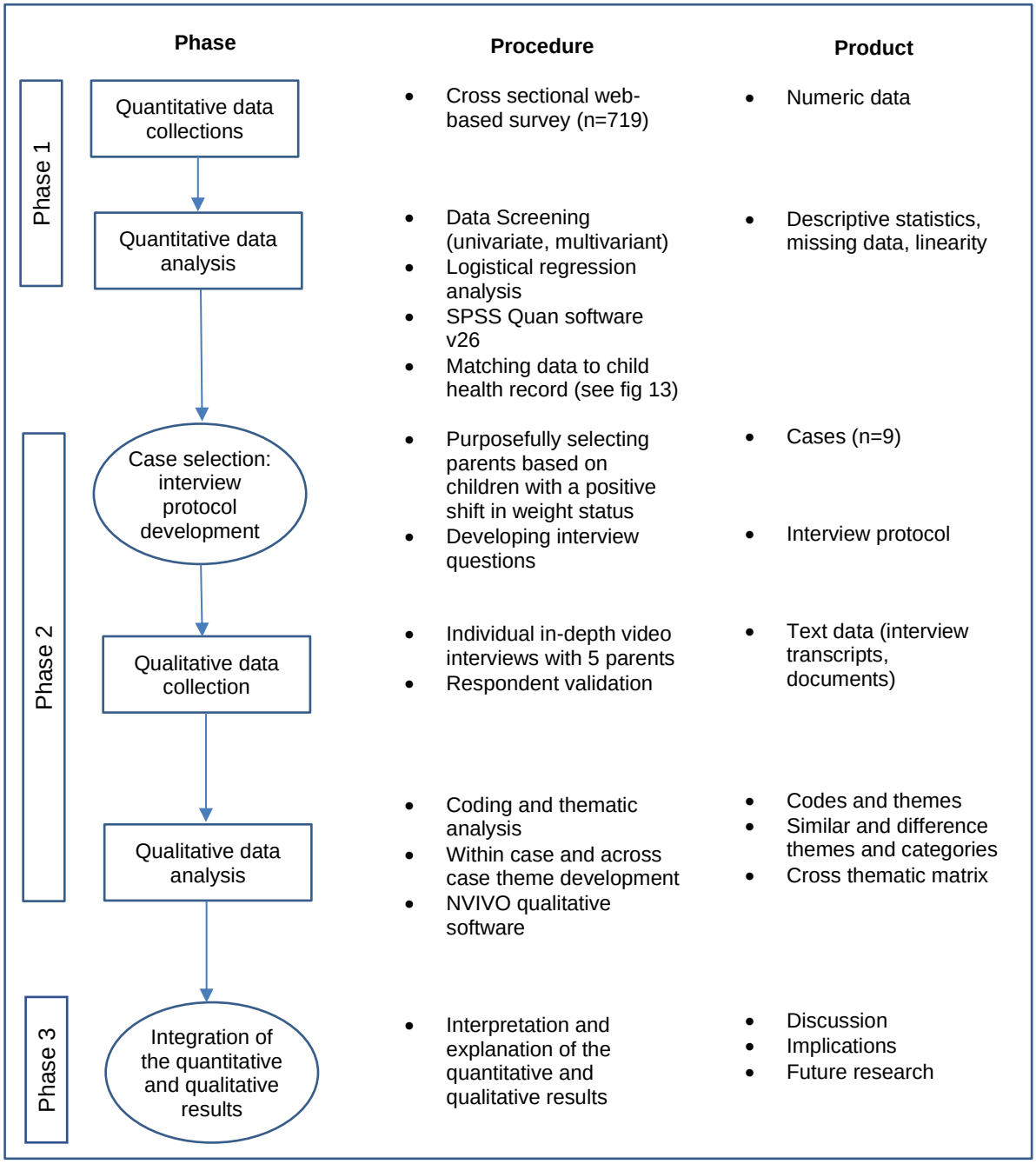

Figure 8. Diagram outlining research design using explanatory design (adapted from Creswell and Clark (2011)).

3.3 Quantitative component

The quantitative component was split into two phases. The first phase involved inviting parents of children who were measured in 2019/20 aged 10/11 years across mainstream secondary schools in Gloucestershire, to complete a survey to understand the family home environment and association with the emergence, persistence, and remission of weight. The second phase involved the extraction and matching of data from the NCMP from the Child Information System in Gloucestershire, to establish the purposive sample.

The NCMP is recognised internationally as a world-class source of public health intelligence and holds UK National Statistics status (Public Health England, 2016). The NCMP measures the height and weight of all children in Reception (4/5 years of age) and Year 6 (10/11 years) in mainstream maintained primary and middle schools in England. The NCMP data set is useful as it measures children at the beginning and at the end of primary school and therefore provides the only objective measure in the UK between these two-time points. It is operated on an opt-out basis, in which parents can withdraw their children, but participation remains high across England with approximately 95% of eligible children measured in anyone year, amounting to 1.1 million children nationally (HSCIC 2014).

3.3.1 Study site

The study was conducted in Gloucestershire in the southwest of England. Gloucestershire is part of a two-tier local government (see figure 9) structure consisting of one county council (Gloucestershire) and six district councils (Cheltenham, Cotswolds, Gloucester, Forest of Dean, Stroud, Tewkesbury). According to the Office of National Statistics (ONS) 2019 mid-year estimates (released June 2015), there were 637,070 residents of Gloucestershire, of which 72,693 were aged under 19. The health of people in Gloucestershire is generally better than the England average. Gloucestershire is one of the 20% least deprived counties/unitary authorities in England, however about 12.7% (14,467) of children live-in low-income families (see figure 10). Life expectancy for both men and women is higher than the England average Life expectancy is 8.4 years lower for men and 5.4 years lower for women in the most deprived areas of Gloucestershire than in the least deprived areas (Public Health England 2020).

Gloucestershire is characterised by a comparatively small Black and Minority Ethnic (BAME) population. According to the 2011 Census, 95.4% of Gloucestershire's population is white. Gloucestershire has a small BAME population (4.6%) compared to England (14.1%); however, there are variations between districts, with Gloucester having the highest BAME population (10.9%).

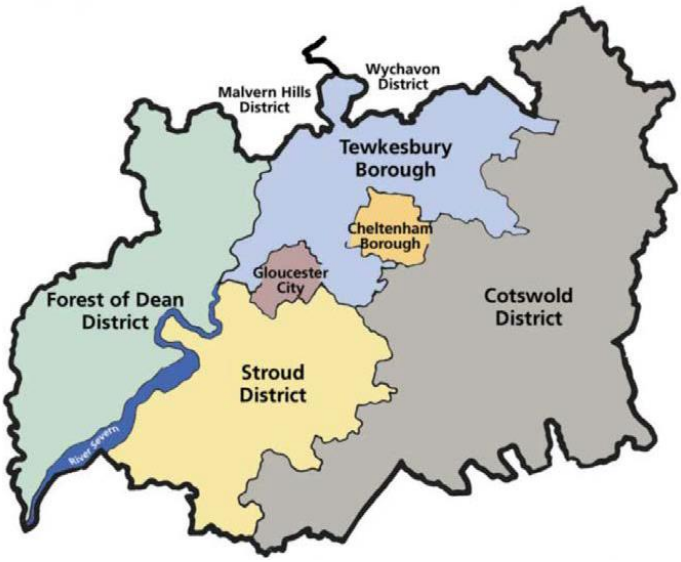

Figure 9. Map of Gloucestershire showing the six districts

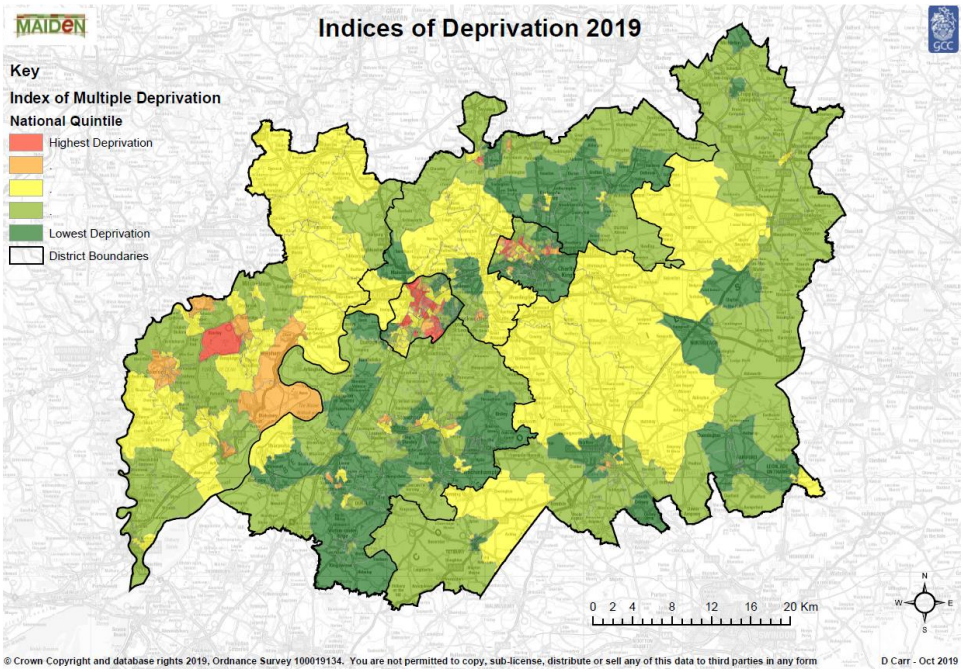

Figure 10. Map showing indices of deprivation in Gloucestershire

In 2022/23, the proportion of overweight and obese children aged 4/5-year-olds and 10/11-year-olds in Gloucestershire was 21.1% (1340 children) and 34.1% (2315 children) which were both higher than the southwest average of 20.5% and 32.9% respectively (NHS Digital 2023).

3.3.2 Study population

The sample was children who were aged 10/11 years old (Year 6) during the 2019/20 academic school year. These children were chosen as they would have had their height and

weight measured during the 2013/14 academic year and would therefore have provided two longitudinal points in time by 2019/20 where their height and weight had both been measured. Gloucestershire was identified as area of interest due to it being coterminous with key public sector organisations (e.g. council, NHS) and variable socio-economic demographic.

Due to the COVID-19 pandemic and resulting school closures, children's measurements in the NCMP were ceased early on in March 2020 following instructions by NHS England (see appendix 2). As a result of the programme coming to an end prematurely, 48 out of 246 (19.5%) local authority mainstream schools in Gloucestershire did not provide measurements, resulting in a participation rate for Year 6 children in Gloucestershire of 73.9%. Information provided from Gloucestershire Health and Care Foundation Trust suggested that 105 parents of Year 6 children measured in 2019/20, also opted out of the programme for 2019/20. Table 2 summarises the NCMP data for 2013/14 and 2019/20 and the corresponding participation rates.

Year	Underweight	Healthy Weight	Overweight	Obese	Total children measured	Participation rate
2013/14 (4/5 years)	31 (0.5%)	4652 (74.8%)	915 (14.7%)	622 (10%)	6,220	98.6%
2019/20 (10/11 years)	50 (1.0%)	3245 (66.6%)	640 (13.1%)	935 (13.1%)	4,870	73.9%

Table 2. Gloucestershire NCMP Data for 2013/14 and 2019/20 (HSCIC, 2014 and 2020)

3.3.3 Development of the survey

An online survey (see appendix 3) was developed to understand how factors, perceptions and motivations within the home and family environment were associated with child body weight. A questionnaire is a well-established tool within social science research. For this study an online questionnaire was developed. Evans and Mathur (2018) identified several advantages and disadvantages to using online questionnaires:

Advantages

- Convenience - convenience is one of the main reasons for people incorporating online surveys into their research. This has been helped in recent years by the increasing variety of mobile devices that people are able to you go online e.g. tablets, smartphones.

- Ease of data entry and analysis - online surveys enable respondents to enter data that can be used for immediate analysis. Many online software platforms also offer built in analytic tools.
- Question diversity - online surveys provide the ability for researchers to add a range of question formats that also often includes reformatting a survey to suit the device the respondents to connect to the internet.
- Large samples - although low response rates continue to be an important issue for online researchers, it is possible to obtain large samples at a fraction of the cost of traditional mail or telephone surveys.
- Required or forced completion of survey questions - whilst this can be viewed as a disadvantage and lead to users existing the survey early, it can prevent. skipping or jumping to the next question without answering the question (Sischka et al. 2022).
- Logical trees - online surveys provide the capability for researcher to direct respondents to specific sections of the surveys/questions based on their responses to previous questions.

Disadvantages

- Perception as junk mail - the perception of email invitations to participate in junk mail continues to be a significant problem with online surveys. This was mitigated via a range of strategies outlined in section (3.3.7) with many parents being invited to take part in the survey by schools with the intention of giving legitimacy to the research.
- Sampling - concerns remain about the skewed attributes of the internet population, sample selection and implementation, some respondents lack of online experience/expertise/digital literacy and technological variations. However, schools now utilise email and e-newsletters as the primary mechanism to engage and communicate with parents.
- Unclear answering instructions - while unclear answering instructions have been a weakness in the past and continue to be a disadvantage for poorly designed questionnaires, most research has been conducted via online questionnaire design.
- Impersonal - online surveys can often feel impersonal and present a problem with privacy.
- Privacy issues - well publicised data breaches have meant that people are more concerned about their privacy and security of information, particularly considering the enormous amounts of data details profiles of individuals. This can prevent respondents off from participating surveys.

- Low response rates - despite online surveys able to reach a large sample, evidence consistently shows that online surveys often result in low response rates.

3.3.4 Development and testing

An online cross sectional survey was designed according to the CHERRIES checklist (Eysenbach 2004). The framework provided a systematic approach to designing and reporting for online surveys *(*appendix 4). The survey that was based on a review of literature and encompassed the following domains:

1. **Parent and family characteristics**

   This part of the questionnaire collected key data that were known as potential confounding variables and included information on the person who completed the questionnaire (i.e. mother, father, carer), family characteristics including parent/carer and child details e.g. marital status, parent weight category status, socio-economic data (postcode/IMD), age and caring duties.

2. **Parent perception of child's weight**

   This involved several questions exploring the parent/carers perceptions around their child's current weight status. The rationale for gathering this information was that if parents are unable to accurately classify their own child's weight, they may not be willing or motivated to enact the changes to the child's environment that promote healthy weight maintenance. Misperception about weight is likely to have direct implications on people's perception of risk and therefore influence any behaviour to mitigate that risk.

   Research has consistently shown that the term "obesity" often elicits an undesirable response and can potentially stigmatise individuals or cause offence (Ames et al. 2020; Puhl and Heuer 2009). Considering this, the term overweight and very overweight were used to be more neutral and non-judgmental (Rees et al. 2011; Volger et al. 2012).

3. **Awareness of child weight status**

   This aspect of the survey explored whether parents/cares had ever been informed about their child's weight at any point during the primary school years i.e., via NCMP feedback letter, health professional, peer/family. A question was also included asking whether parents had taken any action because of being made aware of their child's weight status. Categories for this question were drawn from the literature that had identified a range of mechanisms on how parents had found out about whether or not their child had a weight issue (Ames et al. 2020).

4. Assessment of home environment

The Family Nutrition and Physical Activity (FNPA) screening tool was used to assess the home environment and family environmental and behavioural factors (Ihmels et al. 2009a). The tool consists of 20 items which are designed to capture 10 factors that evidence has shown to be associated with children's risk of becoming overweight and has been used by researchers to identify home environments that may predispose youth to obesity. These 10 factors include:

1) Breakfast consumption and family meals together.
2) Modelling of healthy nutrition.
3) Consumption of nutrition dense foods.
4) Consumption of high calorie beverages.
5) Use of restriction and reward.
6) Parents modelling physical activity.
7) Child's physical activity behaviour.
8) Screen time watched.
9) Television use in the bedroom.
10) Sleep schedule.

Given that any one aspect of the home environment likely has limited influence on weight-related outcomes, Researchers have suggested that composite indicators incorporating all domains should be utilised to capture the overall level of risk for weight gain more effectively (Schrempft et al. 2015). Composite measures also provide a mechanism to account for different aspects of the home environment that may enhance or counteract one another. For example, a home may have access to lots of media equipment, but also be supportive of physical activity.

A review of instruments and questionnaires found that the FNPA questionnaire included the most 'items' from an obesogenic environment out of all the available instruments (Rendina et al. 2019). It was also identified as having been standardised and validated, have a solid internal structure even at test-retest and have an excellent articulation of the questions in relation to the prefixed objectives of the questionnaire (Ihmels et al. 2009a). The FNPA has also been identified in a recent systematic review as one of two home environment questionnaires/tools that includes the three primary domains for the home environment (home food environment, home physical activity environment and home media environment) (Kininmonth et al. 2021). Finally, the FNPA was selected as being brief and easy to use and therefore it would also help with completion. The items on the

FNPA tool have been shown to load on a single factor and have good internal reliability (alpha = 0.72) (Ihmels et al. 2009a). As the FNPA has never been employed in the UK, some items and terminology were adapted to make them applicable to the UK. The FNPA has also shown construct validity by relating to a more comprehensive measure of the home environment - the CHES (Pinard et al. 2014).

5. Study overview and participant consent

The study adopted two different consent processes for the quantitative and qualitative components. For the quantitative component, a summary of the research was included as part of the online survey. Implied consent was assumed for those who completed and returned the questionnaire. An additional section was included in the questionnaire that sought explicit consent from parents for the researcher to access their child's height and weight data from their child's health record stored by Gloucestershire Health and Care NHS Foundation Trust. For the qualitative component, parents were given an option in the online survey to express an interest in being contacted for interviews. Parents who agreed to be interviewed and were selected, were then asked complete a participation sheet and consent form (see appendix 5). Given the sensitivity around obesity and the risk of the research eliciting negative feelings, the participant consent form included contact information on where parents could seek support and advice from local services, such as local weight management services. Parents who were interviewed were also reassured that the interview could be stopped at any point, should they find any lines of enquiry distressing.

3.3.5 Pre-testing the questionnaire

A key part of the research design process, is the need for questionnaires to undergo a pilot phase during which the acceptability, validity, and reliability of the measure can be tested. Creswell (2009) advocates the importance of pilot testing or field-testing surveys as important to establish the content validity of an instrument and to improve questions, format, and scales.

The original intention of the research was to pilot the survey with small focus group consisting of 8-10 parents who were not part of the statistical population. Parents would be invited from one or two primary schools in Gloucestershire following conversations and recommendations with local head teachers. The session was intended to provide an overview of the study including the rationale and methodology and then inviting parents to review the draft survey to assess item clarity and validity. Given the COVID-19 pandemic and the interruption to the NCMP and school closures, a decision was made not to pilot the survey.

Deploying a survey that had not been piloted presented several risks around validity and reliability. The decision to not undertake a pilot was based on a pragmatic decision balancing the risks and benefits to the research and completion of the PhD within the specified timescales. The following factors were considered in making this decision:

1. Due to the acute phase of the pandemic in March 2020, it was unclear when or if the NCMP would be reinstated. With the 2019/20 NCMP ending in March 2020, it was anticipated that a significant amount of the measuring would already have taken place in schools. This was later confirmed by the School Nurse Service who indicated that approximately 70% of 10/11-year-old children had been measured.
2. Delaying the deployment of the questionnaire at a much later date, would likely have resulted in recall bias whereby parents may not have accurately remembered events or experiences in the past that involved their family home environment and behaviours of their children (Althubaiti 2016).
3. The questionnaire that assessed the family home environment had already been standardised and validated for use within the United States. A review of the questionnaire by the researcher identified minor grammatical amendments from American English to British English and changes to terminology such as ‘soda pop’ to ‘fizzy sugary drinks’ and ‘candy’ to ‘sweets’. It was thought that these modifications would not significantly alter the validity and reliability of the questionnaire.
4. Additional questions within the questionnaire, primarily addressed key data that were known as potential confounders. Many of these questions have been incorporated into other studies undertaking research in child obesity. For example, questions around parental weight status and perceived weight status in children have been used in numerous studies and every effort was made to ensure questions reflected the wording used in these studies. However, modifications to the term ‘obese’ were made in line with the Department of Health wording e.g. underweight, normal weight, overweight and very overweight which is communicated to parents as part of the NCMP feedback letters (Public Health England 2020).

- Questions within the questionnaire were assessed for their ‘readability’ according to the Flesch-Kincaid Grade Level test and Flesch Reading Ease test. The Flesch–Kincaid readability tests are tests designed to indicate how difficult a passage in English is to understand (Klare 1976). The questionnaire scored 8.7 which implies that an 8th Grader (13-14-year-old in the UK) can understand it. For most documents, it is recommended that the score should be 7.0 to 8.0. The Flesch Reading Ease test

resulted in a score of 59.7, slightly lower that the recommended 60 but felt to be acceptable.

On balance, it was felt that the benefits for not piloting the survey outweighed the risks to the research not being undertaken. The limitations resulting from this decision are discussed within the discussion chapter.

3.3.6 Administering the survey

The original intention of the research was to administer the online survey to all parents of Year 6 children (aged 10/11 years) in primary school who would have been measured during the 2019/20 academic year. However, due to the acute phase of the COVID-19 pandemic and the first national lockdown between March and June 2020, a decision was made to postpone the circulation of the survey.

The reasons for this were threefold:

1. The lead researcher's role as a public health professional meant that they were responsible for leading the COVID-19 pandemic response in Berkshire and that they needed to ensure that their time focussed on protecting and saving as many lives as possible. Therefore, a request for interruption of study was approved by Cardiff University between (16/3/20 – 16/6/20).
2. Schools were under pressure to support vulnerable children and provide online learning for all school children and therefore their research would unlikely have been a priority for schools or parents.
3. The behaviours of children were likely to have changed during lockdown compared to pre-COVID levels. Emerging evidence suggests that children's dietary habits changed, with one small study indicating that the average intake of fruit in 9-12 years fell from just over one portion a day to half a portion a day (Defeyter and Mann 2020). There have also been concerns around rising food poverty and lower physical activity levels amongst children, as well as significant increases in screen time amongst primary age children (Baraniuk 2020; Sport England 2021; Trott et al. 2022).

Following the return to schools in September 2020 contact was made with the Gloucestershire Association of Primary Headteachers (GAPH) to enquire whether primary schools were still able to contact parents of Year 6 children, as these children had since left to move to secondary school. The response from primary school headteachers was mixed, but it was felt that primary schools should be contacted in the first instance given all the engagement work that had been primarily undertaken with primary schools in preparing for

the research and seeking their support for the research. However, it subsequently become apparent that primary schools were unwilling to contact ex-primary school children due to General Data Protection Regulations (GDPR) and therefore secondary schools were contacted to seek their support and circulate the questionnaire to parents of students who were measured in 2019/20 but were now in Year 7.

The questionnaire was made available online through the 'Online Survey' software (previously Bristol Online Survey) and a link was shared with schools to the survey along with a covering email and a template email for schools to send to parents (see appendix 6). The online survey was proofread by the school nurse lead at Gloucestershire NHS Health and Care Trust. The survey was made available as an "open survey" from the 21 September 2020 to 21 February 2021.

3.3.7 Increasing response rate

Evidence has shown that childhood obesity is a sensitive area with research often citing that parents feel judged, blamed, and stigmatised (Eli et al. 2014; Falconer et al. 2014a; O'Dea 2005). A key challenge with the research was the ability to gain trust from parents so that they would complete the survey and give permission to allow access and linkage of their child's health record. Numerous studies have demonstrated that school-based recruitment is challenging (Bartlett et al. 2017). In order to reach parents (or caregivers) through schools, it is recommended that researchers should engage a variety of stakeholders including, but not restricted to local policy makers, head teachers, teaching staff and administrative staff (Charles et al. 2014).

Wolfenden et al. (2009) examined the effectiveness of strategies for enhancing parent participation rates through schools. Their review of their literature identified the following approaches to enhance uptake:

1. Promoting the research to school principals, teachers, parents and students.
2. Dissemination of study information using methods allowing direct rather than mediated communication (i.e., face-to- face contact with parents was more effective than receiving information via students).
3. Offering incentives to teachers, peers and individual participants.
4. Providing follow-up reminder contacts to parents who have not decided regarding participation.
5. Ensuring that a dedicated member of the research team co-ordinates and closely monitors the recruitment process.

The response rate is generally defined as the number of completed units divided by the number of eligible units in the sample (Fan and Yan 2010). Fan and Yan (2010) found that online survey response rates were influenced by a range of factors such as the sponsoring organisation, survey topic, survey length, question wording, question order, question display (such as screen-by-screen or scrolling, backgrounds, logo display, graphics and progress display, navigational instructions and question format), sampling methods, contact delivery modes, pre-notification, design of invitation and incentives.

Based on the evidence a range of strategies were employed to increase response rate. A summary of these can be found in table 5 The following approaches were employed to increase response rate:

1. **Employing a short and validated instrument (FNPA) that assessed the 'home environment**

   The FNPA was selected due to its brevity and its ability to include most 'items' from an obesogenic environment out of all the available instruments. Evidence from a meta-analysis on response burden and questionnaire length has shown that there is a greater chance of response when people are presented with a comparatively shorter questionnaire (Galesic and Bosnjak 2009; Rolstad et al. 2011).

2. **Providing incentives for completing the questionnaire**

   The ethical appropriateness of using incentives in research is the subject of much debate and has been widely documented. Whilst there are arguments for and against the use of incentives, research has shown that providing incentives to people to take part in research can have a positive impact on response rates (Brueton et al. 2014).

   Zutlevics (2016) suggested that a point of agreement amongst scholars is that financial incentive is permissible when the risk of harm to the individual is low. He concluded that in the absence of harm to the individual, encouraging more people to participate in research is likely a good thing as it will lead to statistically more robust research outcomes, which can then lead to improvements in healthcare practice. Given that the research was not a clinical trial and that the risk to individuals taking part was low, it was felt that using incentives to encourage parents to complete a survey was appropriate and potentially increase responses from low-income families. The two research ethics committees (Cardiff University and HRA) approved the strategy for incentivisation being employed.

To encourage participation, council commissioned leisure providers and local attractions across Gloucestershire were contacted to ask if they were able to offer prizes (see table 3). All but one of the main leisure providers agreed to provide a prize and therefore represented good coverage and accessibility to families across the county (see appendix 7). A summary of the prizes is summarised below:

Organisation	Prize
Cattle Country	Adult admission tickets x 2
Cheltenham Leisure Centre	One month membership x 1
Cotswold Leisure Centre	Family swim pass x 2
Forest of Dean (Freedom Leisure)	Family swim pass x 2
Gloucester Leisure (GL1)	One month gym membership x 1
Stroud Leisure Centre	Family swim pass x 3

Table 3. Summary of incentives for survey

All respondents who completed the survey and provided their contact details, were included in the prize draw which took place in April 2021, with winners notified by email and prizes send via post.

3. Support from School Nurse Service to schools and parent

Informing parents about research projects prior to requests for active consent has been identified as a useful strategy to increase response rate (Wolfenden et al. 2009). There is also evidence that endorsement of research may also increase uptake, particularly from a credible source, trusted brand and sponsoring organisation such as the NHS (Fan and Yan 2010). A brief introduction to the research was therefore included in the vision and screening invitation letter that went out to all parents (approximately 6,000) of Year 6 in children in Gloucestershire (see appendix 8). This included a summary of the aims of the research and encouraged parents to take part once they had received the survey.

4. Seeking support from local primary schools

Evidence has shown that participation rates in research that involved parents can be enhanced by engaging with school teachers and parents (Wolfenden et al. 2009). In particular, consent and support from school headteachers is likely to be important to influence parents to take part given their trustworthy position. The researcher worked with the Gloucestershire Association of Primary Headteachers (GAPH) to ask primary schools to actively promote the research and gain their support. This involved attending the GAPH countywide meeting of headteachers to present an overview of

the research (see appendix 9). This also included outlining the importance of the study and the benefits of participation to the school, students and staff. The engagement also discussed possible barriers to the recruitment and ideas to overcome them. The researcher subsequently attending district wide GAPH meeting for individual localities (see table 4) across Gloucestershire although some of these were cancelled due to the COVID-19 pandemic.

Locality / meeting	Date of meeting	Attendance
Countywide Meeting	20th September 2020	Attended
Cheltenham	7th February 2020	Attended
Stroud	7th February 2020	Attended
Gloucester	16th February 2020	Attended
West Gloucestershire	24th February 2020	Attended
Tewkesbury	17th March 2020	Cancelled due to pandemic
North Cotswolds	3rd March 2020	Cancelled due to pandemic
South Cotswolds	28th April 2020	Cancelled due to pandemic

Table 4. Summary of school locality partnerships

5. Follow-up emails and telephone calls with schools

The third strategy identified by Wolfenden et al. (2009) was the need to provide ongoing follow-ups to parents and schools regarding the questionnaires. Several follow-up emails and telephone calls were made to secondary schools to request or check that the online survey had been circulated to parents. This often involved speaking with the school administrators, Year 7 leads or head teachers (see appendix 10).

6. Social media targeting

Facebook is a free social networking website whereby users create profiles, share content, and connect with other users. It remains one of the most popular social media platforms globally, with over 2.8 billion active monthly users and 50.36 million (Statista 2023). Facebook is the main social media platform used by parents (Thornton et al. 2016). Whilst there is limited research on the effectiveness of using paid social media advertising to increase response rates, emerging evidence suggests that Facebook provides a feasible, rapid method to recruit parents for health research (Bennetts et al. 2019). A systematic review involving 54 Facebook recruitment studies found the social media platform to an effective and cost-efficient recruitment method with particular utility in accessing hard-to-reach populations (Thornton et al. 2016).

For this study, targeted Facebook advertising was utilised to increase response rate. Each paid advertising campaign was designed using Facebook's Ads Manager, for which the researcher selected the intended audience, schedule, format, and budget. Advertisements were displayed to users whose profiles indicated that they lived in Gloucestershire and were aged 25-55 years, parents with preteens (9-12 years) (see appendix 11). A high-resolution stock image was used in the advertisements to reflect the focus of the research. Images showing obese children were avoided to reduce the risk of stereotyping and disenfranchising people the researchers were seeking to engage. Evidence has found that images of overweight individuals likely lead to negative feelings and therefore it is possible that people would not engage with the post (Johnstone and Grant 2019).

Utilising paid social media presents several limitations. One of the main limitations highlighted in the literature is the ability to accurately track participants and the inability to track if parents from the same family had completed the study. However, this issue could apply to any study using an online recruitment method and could be addressed by removing duplicates. Another limitation is that by promoting the survey via a public social media platform and thus be 'open', it was possible for individuals to complete the questionnaire who did not meet the sample criteria. Seeking response rates through social media may have been perceived as marketing or spam and unlikely to provide the personal touch that was frequently referenced in the literature to support response rates (Fan and Yan 2010). A further concern for online surveys is that respondents fill in the same questionnaire multiple times or they return and experiment with the results of their modified entries. (Eysenbach 2004).

Facebook metrics were collected through the Facebook Ads Manager, including reach (i.e. the number of users who saw the adverts in their News Feed at least once), link clicks (i.e. The number of clicks on links within the ad that led to advertiser-specified destinations, on or off Facebook) and cost per click (i.e., average cost per link click). The post reached 10,916 people with 141 people engaging with the advert and a further 136 people clicking on the link. Of the 10,916 people reached, 78.9% were Women and 21.1% Men. Most people reached were between the ages of 35-54 years, which was toward the upper end of the intended age range and not reflective of the largest audience of Facebook, whereby 25 to 34 years olds accounts for 24.2% of all users (Statista 2023). Paid advertising was supplemented with free 'advertising' through posting the link to the survey onto several 'Facebook community

chat groups' covering the seven local authorities in Gloucestershire with a potential to reach over 53,000 people.

Challenges/issues	Strategies to improve engagement / response rate
Design of questionnaire	
Length of questionnaire	• The number of questions were kept to a minimum • A short, validated questionnaire to assess the family home environment was utilised.
Readability / understandability	• The questionnaire scored fairly on the Flesch-Kincaid Grade Level test and Flesch Reading Ease test. • School nurses reviewed questions
Accessibility	• Online survey was suitable for a range of mobile platforms e.g. mobile, iPad, PC • Simple logical trees directed respondents to specific sections of the surveys/questions based on their responses
Language	• Avoided using terms such as obesity to avoid stigmatising or disengaging respondents. Focus was on healthy living • Questionnaire was converted from American English to British English
Engagement with community and partners	
Support from schools and teachers	• Meetings held with local schools (and district wide forums) to present overview of research • Follow-up calls to head teachers
Sponsorship	• Customised logo on questionnaire • Research highlighted by school nurses within screening letter to all Year 6 pupils • Local NHS trust and local authority supportive of research • Utilised and reference researchers professional title e.g. consultant in public health
Security / Data Protection	• Clear Privacy notice • Survey software certified to ISO 27001, and GDPR compliant • Reassured respondents that ethics approval had been received

Table 5. Multi-level approach to improving response rates

3.3.8 Impact of the COVID-19 pandemic on data collection

The response rate to the survey was likely to have been severely impacted because of the COVID-19 pandemic. In particular, the constant changes to national and local restrictions meant that schools had to frequently adapt and deal with new government guidance and non-pharmaceutical interventions (see figures 11 and 12). This led to pressure on school resources and therefore the ability to contact headteachers proved challenging. Schools were also asked to deploy COVID-19 testing in schools in early January 2021.

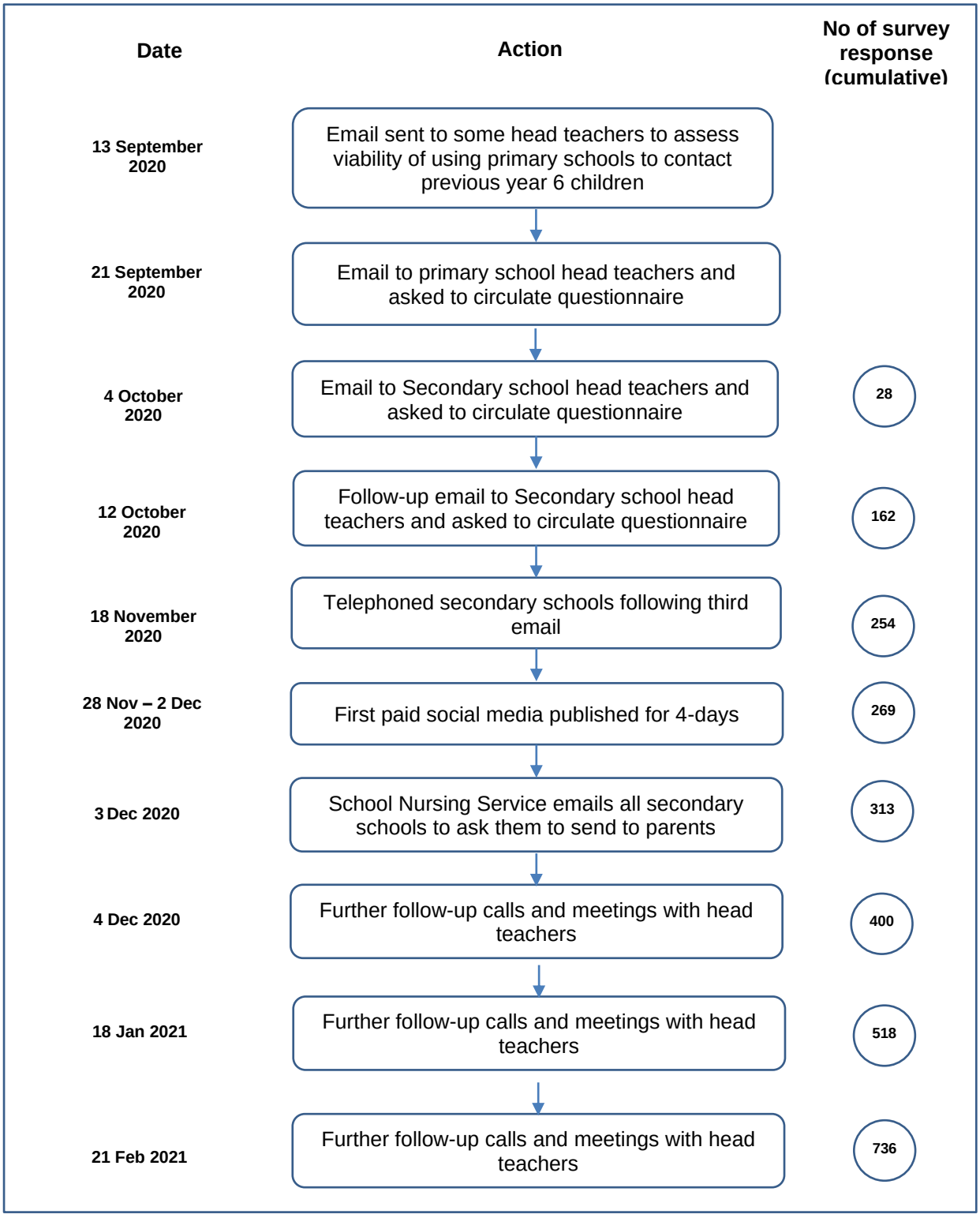

Figure 11. Decision making tree showing engagement with schools and impact on response rate

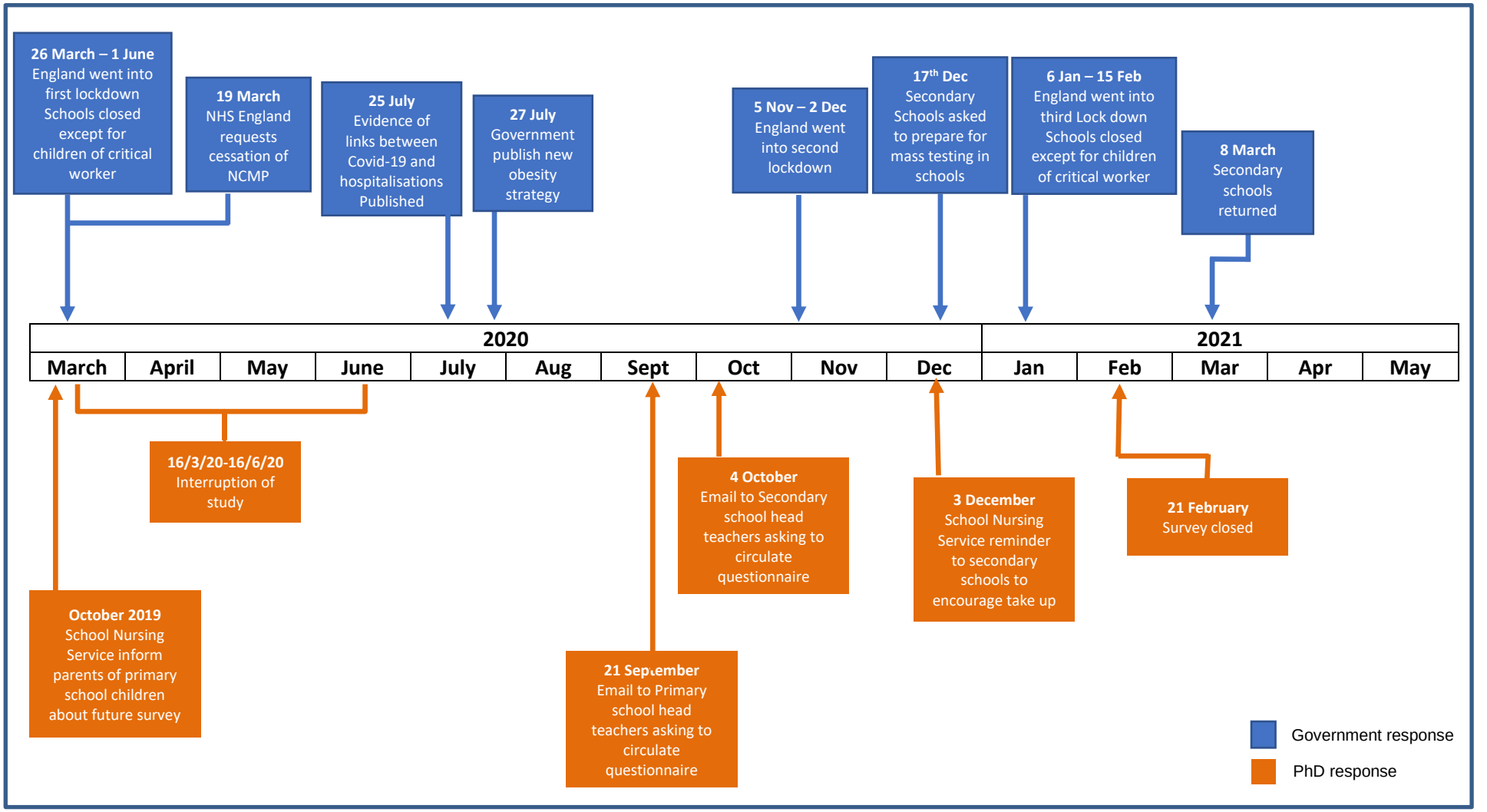

Figure 12. Timeline of government COVID-19 response and key dates for data collection

3.3.9 Extracting and matching the NCMP data

3.3.10 Data extraction

For those parents or carers who consented to sharing their child details and biometric data, NCMP Data was extracted from Gloucestershire Health and Care NHS (GHC NHS) who were the custodians and Providers of the NCMP in Gloucestershire. The following data from the 19/20 Year children were requested to be extracted;

- Age
- Weight
- Height
- Body Mass Index (BMI)
- Postcode – which can inform IMD (2016)
- Ethnicity (unable able to be extracted as not sufficiently coded)

The LMS Growth tool (Cole 1990), was used to calculate the BMI, the BMI standard deviation (z score) and the BMI percentile based on gender, date of birth, date of measurement and height and weight values. Clinical and population classifications were allocated based on the UK90 BMI reference curves (see table 6). Utilisation of population classifications enable both international comparisons and the identification of children who are at high risk of moving into the clinical overweight or clinical obesity categories.

Weight Category	Population cut-offs	Clinical cut-offs (based on official IC NCMP tools)
Underweight	≤2	≤2
Healthy Weight	>2 and <85	>2 and <91
Overweight	≥85 and <95	≥91 and <97
Obese	≥95	≥98

Table 6**.** Clinical and population BMI classifications for children (Cole et al., 1998; Reilly, 2007)

Of the surveys competed 82.5% of respondents gave permission for the researcher to access their child's health record. A list of the children's names (whose parents had permitted survey responses to be linked to NCMP data) was generated and securely transferred to GHC NHS via a secure Cardiff university email account.

3.3.11 Matching strategy

NCMP data for the two-time points (2013/14) and 2019/20) was matched by GHC NHS. The following process was undertaken (see figure 13):

1) Link to online survey and information on study distributed to parents via schools as– consent implied if online survey completed.
2) Researcher extracted responses with consent to access NCMP data.
3) The researcher sent the child details (child first name, date of birth and gender) over secure email (@cardiff.ac.uk) to GHC NHS
4) GHC NHS extract data (child BMI z-score at 4/5 years and 10/11 years and gender) from the child health system for the parents who have consented for their child's weight data to be shared with researcher
5) GHC NHS securely send information to researcher
6) Researcher matches NCMP data to questionnaire responses for analysis and removes all identifying information.

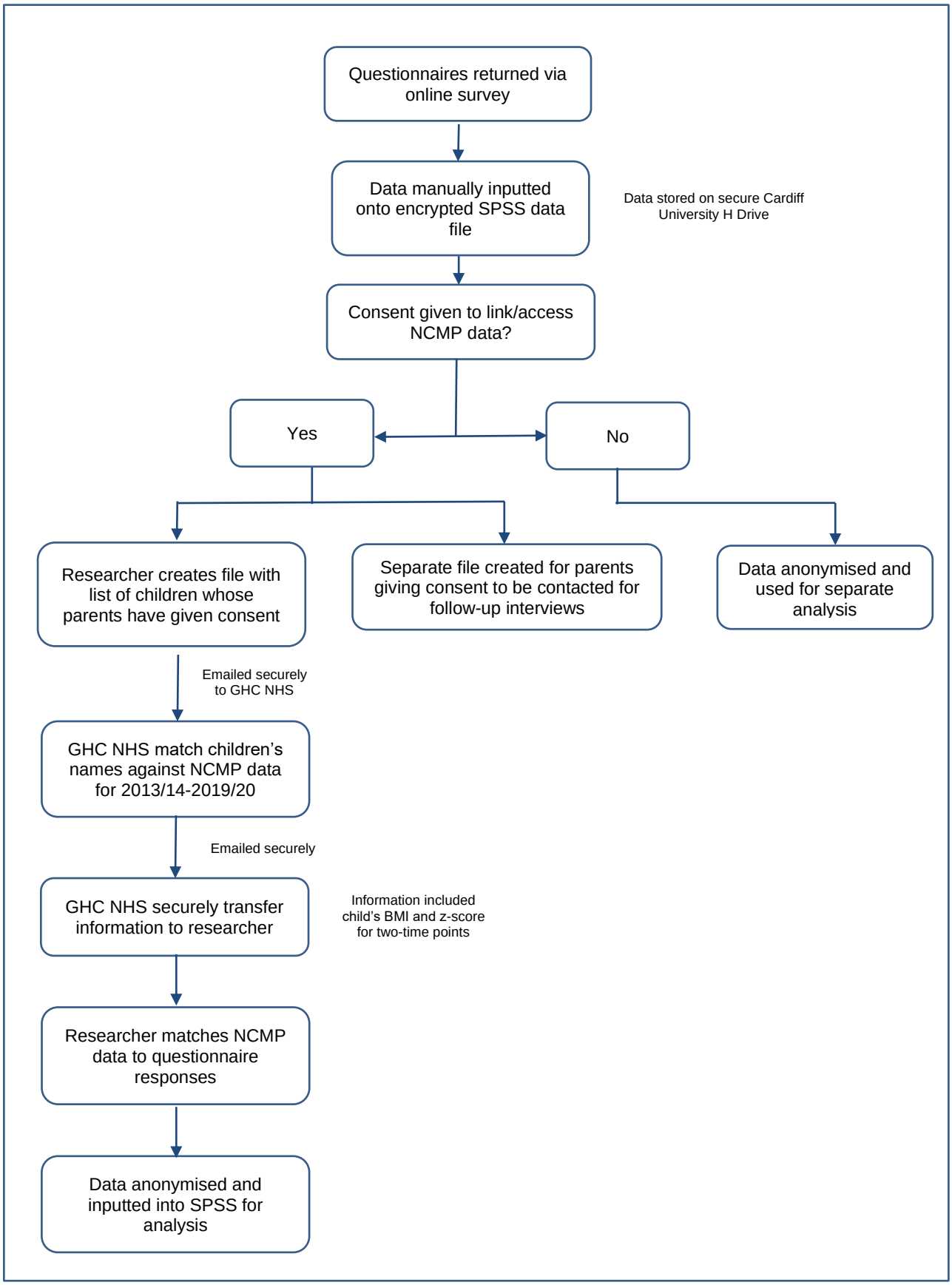

Figure 13. Data input and matching process

3.3.12 Confidentiality and information governance

As the study involved sensitive data, information was Classified as 'C1 Highly Confidential' in line with Cardiff Universities Information Classification and Handling Policy**.** Surveys were completed online using the 'Online Survey software' which is fully compliant with UK data protection laws and meets UK accessibility requirements. Responses from the online survey were entered onto an encrypted SPSS Data Sheet and stored securely on Cardiff University's H Drive.

Parents who completed the questionnaire and consented for their responses to be matched with their child's NCMP data, the researcher sent their child details (child first name, date of birth and gender) over secure email (cardiff.ac.uk) to GHC NHS who then extracted the data from the child health system.

As GHC NHS is a statutory body, they were required to adhere to a range of legislation and guidance which ensured that the matching process and the transfer of data was done accurately and to ensure confidentiality. These include:

- Data Protection Act 1988
- The Caldicott Report, 1997
- Freedom of Information Act 2000
- NHS Confidentiality Code of Practice 2003
- NHS Records Management Code of Practice 2006

3.3.13 Statistical analysis

3.3.14 Descriptive statistics

Descriptive statistics were undertaken to determine means and standard deviations for continuous variables and frequencies for categorical variables. Pearson's correlations were calculated to test associations among continuous key variables and constructs. This method was chosen due to its ease of implementation, and its use within research previously undertaken on the FNPA to enable comparisons to be made (Ihmels et al. 2009a; Janse et al. 2021). Based on the work of Cohen (1988) correlation coefficients smaller than 0.3 were considered as small, those between 0.3 and 0.5 as moderate and those larger than 0.5 as large (Cohen 1988). Chi-Square Goodness of Fit Test was performed to determine whether the relative proportions of IMD and weight distribution were the same between the sample and the Gloucestershire population.

3.3.15 Analysis of the family home environment

Further evaluation of the association between the descriptive data (indices of multiple deprivation, gender), total FNPA (home environment - exposure of interest) and individual constructs, weight status and degree of weight change (outcome of interest) were evaluated using logistic regression. Odds ratios were calculated to examine contributing factors and predictive probabilities of being normal, healthy weight, overweight, obese. Logistical regression was used to understand the predictive probabilities of weight gain between the two-time points (2014/15-2019/20) and weight status. Analysis of the home environment (via FNPA) and relationship with body weight included associations with the 'total score' representing the family environment and behaviours and individual constructs.

The total score on the FNPA scale varied between 20 and 80. No cut off points or threshold have been established for determining healthy vs unhealthy home environments within the FNPA. Therefore, the total FNPA score from all the respondents was divided into tertiles (Altman and Bland 1994) to test for differences in BMI between families with high total scores (more favourable family environment and behaviours) versus those of middle (moderate family environmental and behavioural risk) or low total scores (high risk family environment and behaviours). This also enabled comparisons to be drawn with previous research (Ihmels et al. 2009a).

Several items on the FNPA were reverse scored with "very often/always" being the less desirable options, so that higher scores on all items were indicative of healthier practices or environments. Items which were reverse scored included question 3 - family eating practices, question 4 - family eating practices, question 5 - food choices, question 7- beverage choices, question 10 - restriction/reward and question 13 - healthy environment. Individual questions were summed to create a continuous score for each construct, and then all construct scores were summed to create one composite total FNPA score. Subdomains of FNPA were created, using a sub-composite measure across the domains of physical activity, nutrition and sedentary behaviour. Sedentary behaviours were defined as screen-based behaviours such as TV and computer use in line with research (Pearson and Biddle 2011). Cronbach's Alpha coefficient was undertaken to assess the internal consistency of the FNPA items, which in this study was found to be 0.77, which is comparable to other research incorporating the FNPA which has ranged from 0.72-0.79 (Ihmels et al. 2009a; Jackson et al. 2017; Öztürk and Kolcu 2023).

Deprivation, gender, and parental weight, were used as covariates as these are known risk factors for obesity. Confounding due to age and gender were mitigated by BMI percentiles

being used from gender and age specific 1990 growth charts. Analysis of weight change (outcome of interest) was measured using changes in weight status (i.e. healthy weight to obese etc) and by BMI change z-score. Research has found that a BMI-SDS reduction of as little as ≥0.25 can improve body composition and cardiometabolic risk, although recent research has found a reduction of 0.6 BMI-SDS to provide meaningful changes in adiposity as percentage body fat (Birch et al. 2019; Ford et al. 2010). In addition, given that BMI varies with age and sex amongst children and as they are still growing, the desired outcomes vary from person to person and might indicate either weight reduction or deceleration of weight gain (Must and Anderson 2006).

3.4 Qualitative component

3.4.1 Sample

This component involved interviewing parents of children who had completed the questionnaire and consented to being contacted and interviewed. In particular, it aimed to expand on the quantitative findings to provide a deeper and richer understanding on those children who achieved positive shifts in weight status between 4/5 years and 10/11 years of age (Creswell 2007).

3.4.2 Selecting participants for the interviews / inclusion criteria

Participants for the qualitative part of the study were selected using purposive sampling, whereby parents of children who achieved a positive shift in weight status were selected for interview. This was defined as a change in weight category i.e. obese/overweight to healthy weight or and BMI z-score (i.e. ≥−0.6) between the ages of 4/5 and 10/11years of age, identified through the NCMP data (Birch et al. 2019). Purposive sampling is an intentional non-random process of sampling that aims to study a group of people or setting with a particular characteristic (Carter and Henderson 2010). A summary of study enrolment and analysis process can be found in figure 14.

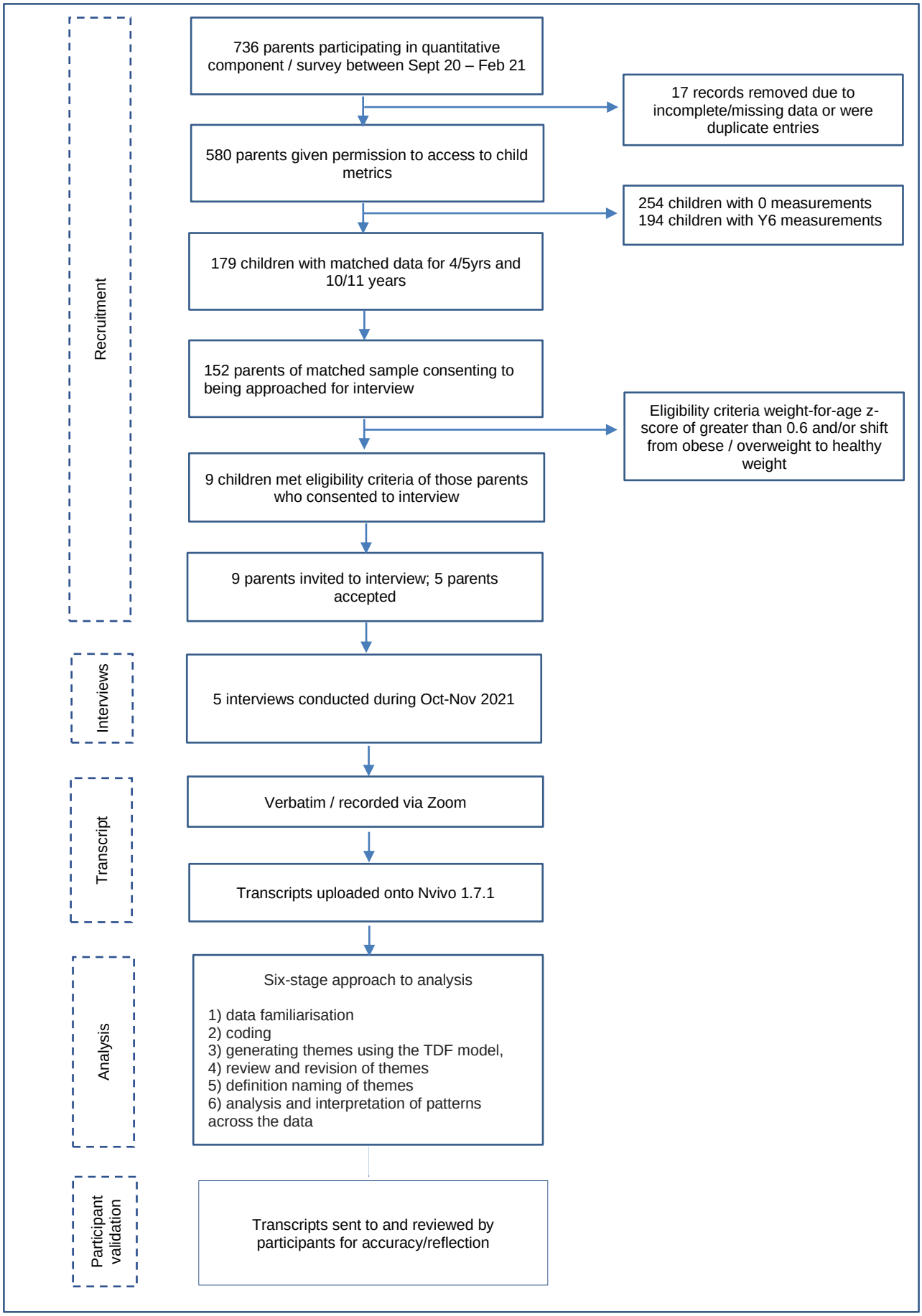

Figure 14**.** Flow diagram summarising the study enrolment and analysis process

3.4.3 Data collection - interviews

Parents were contacted using the contact details which they provided on the online questionnaire. Five in-depth semi-structured one-to-one interviews were conducted online via Zoom, using questions based on common themes identified from within the survey responses and structured around the TDF explore facilitators and barriers to parents' in supporting their children to lead healthy living. The TDF provided a theoretical lens through which to view the cognitive, affective, social and environmental influences that may have influenced a child's weight (Michie et al. 2011).

It was recognised that the guidance set-out by Michie et al. (2005) for investigating the implementation of evidence based practice, was highly structured, and therefore posed a risk to qualitative TDF-based studies becoming entirely theory-driven and factors that do not fit within domains could have been overlooked. The TDF was therefore applied flexibly to optimise its use in exploratory qualitative research. This enabled a line of questioning that allowed participants to respond with views and opinions that did not necessarily fit within the specified theoretical domains and gain a deeper understanding of participants perspectives (McGowan et al. 2020).

Decisions on sample size are important and closely connected with the way in which the data are collected and analysed (Daly et al. 1997). However, to allow an in-depth exploration, it is acceptable that a small number of participants are recruited (Polit et al. 2001). The rationale for this is that in-depth interviews can provide a large amount of rich data, but more significantly, a detailed understanding of potential reasons for weight loss (King 2010).

The advantages of using face-to-face interviews, is that the researcher was able to probe fully for responses and clarify any ambiguities with more complicated and detailed questions around childhood obesity and the home environment (Carter and Henderson, 2010). This included the ability to ask parents to think back to potential triggers or factors that may have influenced their child's weight. The interviews also provided the opportunity to check or clarify inconsistencies or any misinterpretations, which enhances validity.

A semi-structured interview schedule was designed focused on the outcomes of the quantitative analysis. A small number of questions based on the TDF guided the interview, however there was no fixed order to ensure participants were able to expand on areas of particular salience to them.

Examples include the following:

1. Say in your own words what you understand by the term ‘healthy living’
2. What kinds of actions have you taken to actively promote healthy living for your child?
3. Have you as parents/carers actively try to lose weight? If so, what worked for you?
4. Can you identify any key times or opportunities in your child’s life when you realised you could help them to understand being healthy?
5. Tell me what you see as some of the challenges to helping your child live healthily

3.4.4 Interview data management

In accordance with Cardiff University Research Integrity and Governance Code of Practice (2015), audio recordings, transcripts of the interviews, notes taken were filed electronically on password protected computers at Cardiff University for the length of the project. Good qualitative data management involves a high degree of organisation. This was achieved by keeping a clear track record of the number of interviews conducted. A clear file naming system was developed and followed to avoid confusion, a clear data tracking system was also developed to ensure maximum coherence, transcription procedures were developed and documented to ensure optimal consistency, quality control procedures were developed and implemented to establish a high degree of accuracy and lastly a realistic timeline was put in place to ensure accountability in terms of time and commitment to completion of the analysis.

3.4.5 Quality assurance

There is a continued desire for researchers of qualitative studies to maintain and demonstrate quality in research processes and outcomes (Reynolds et al. 2011). Whilst no standardised guidance for assuring quality in qualitative research currently exists, several areas of best practice have been identified that can improve or assure its quality. The first involves the researcher conducting an audit or decision trail to document all decisions and interpretations made at each stage of the research. During the study the researcher kept an audit trail in a diary that reflected their own assumptions and biases throughout the process. This involved a simple log in excel record key decision throughout the process. The second is transparency and the ability for others to replicate the research, in order to avoid challenges around the legitimacy and credibility of research (Tuval-Mashiach 2017). This was achieved by documenting the process step-by-step alongside and detailing the process.

Other processes that were put in place to ensure quality included the transcribing being done by the interviewer; this was important as it enabled the ability to recall some of details that had not been recorded clearly, thus enriching the dataset. Respondent validation was also conducted whereby, interviewees were provided with the transcripts after the interview to

check for accuracy and resonance with their experiences. This involved an email to each participant and asking for their comments. Raw data in form of transcripts was also securely kept after the analysis and could be referred to whilst interpreting the findings.

3.4.6 Qualitative analysis

Responses were audio recorded, transcribed into NVivo (version 1.7.1) to facilitate data management. A six-stage approach to analysis was implemented (Braun and Clarke 2022); data familiarisation, coding, generating themes using the TDF model, review and revision of themes, definition and naming of themes, analysis and interpretation of patterns across the data. An inductive approach was undertaken to analysis, particularly during the initial coding of data, to ensure that non-TDF-related factors were not overlooked, and nuance and context not lost.

3.5 Ethics approval

Ethical considerations are important when undertaking research, particularly when children are involved. Researchers have a duty to 'protect the life, health, dignity, integrity, right to self-determination, privacy and confidentiality of personal information of research subjects' (World Medical Association 2013). Our research followed the Economic and Social Research Council framework for research ethics and its six principles for research:

1. Research should aim to maximise benefit for individuals and society and minimise risk and harm.
2. The rights and dignity of individuals and groups should be respected.
3. Wherever possible, participation should be voluntary and appropriately informed.
4. Research should be conducted with integrity and transparency.
5. Lines of responsibility and accountability should be clearly defined.
6. Independence of research should be maintained and where conflicts of interest cannot be avoided, they should be made explicit (Economic and Social Research Council 2021).

As the research involved the handling of identifiable information, ethics clearance was sought from several bodies. Given that the study was using secondary data that was collected under the auspices of the NHS, HRA approval (Ref. 19/HRA/4178) using the Integrated Research Application System (IRAS) (see appendix 12) was sought. Ethical clearance was also sought from Cardiff University School Research Ethics Committee (see appendix 13) and research assurance was also provided by Gloucestershire County Council (see appendix 14). This ensured that the research met national and locally agreed research governance standards.

3.6 Summary and conclusion

This chapter has outlined the methodological considerations and philosophical underpinnings for the research and how the research was conducted. Through a mixed method multi-method sequential explanatory design, it provided a systematic approach that aimed to understand the home and family factors that influence child weight and understand why some children either gain or lose weight. The next chapter details the analysis process and describes the findings of the research.

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Chapter 4
Results

4.0 Results

This section presents a summary of the findings from the research. Firstly, the chapter provides an overview of the quantitative data, setting out the characteristics of the sample under investigation and analysis of the various factors and variables from the family home environment and their relationship with BMI. This is followed by the findings of the qualitative section that details the key themes that arose during the interviews that may have influenced child behaviour and mapped against the TDF.

4.1 Quantitative component

The quantitative section explores the various characteristics of the family home environment for parents within Gloucestershire and informed the selection of the sample for the qualitative component of the research.

4.1.1 Sample characteristics

A total of 736 participants were surveyed, of which 17 records were duplicates or had missing / incomplete FNPA data, leaving a total sample of 719 records. The survey was completed by parents' of 10/11 year-old children, of which 90.1% of respondents were mothers. 304 children were male and 303 female with 112 undisclosed. The most frequently reported age demographic of respondents was 40-49-year-olds (62.3%), followed by 30-39-year old's (23.8%). Most respondents were either married (74.7%) or in a long-term relationship (11.4%) with 13.3% of respondents either single or divorced (see table 7).

Analysis of survey respondents by deprivation and geography show a broadly similar pattern of deprivation compared to the Gloucestershire population, although data were skewed with more responses coming from affluent areas and less from more deprived areas (figure 15). A Chi-Square Test Goodness of Fit test confirmed that observed frequencies for Index of Multiple Deprivation (IMD) did not match well the expected proportions (x^2 = 4, 67.72, p<0.01). 6.4% (n=46) proportion of respondents lived outside of Gloucestershire (see figure 16). Responses across the six local authorities showed a higher proportion of responses from the Districts of Stroud (30.2%) and Cheltenham (25.1%) compared to the proportion of 4/5 year olds across these districts of 19.6% and 17.9% respectively (see table 8).

Characteristics	Number (n)	Proportion (%)
Person completing survey	719	100
Mother	648	90.1
Father	66	9.2
Care giver	4	0.6
Not disclosed	1	0.1
Age		
26 to 29 years	5	0.7
30 to 39 years	171	23.8
40 to 49 years	448	62.3
50 or older	92	12.8
Not disclosed	3	0.4
Marital Status		
Married	537	74.7
Single	44	6.1
Long term relationship	82	11.4
Divorced	52	7.2
Not disclosed	4	0.6
Child Sex		
Male	304	42.3
Female	303	42.1
Not disclosed	112	15.6
Deprivation Quintile (IMD)		
Quintile 1 (most deprived)	13	1.8
Quintile 2	35	4.9
Quintile 3	133	18.5
Quintile 4	155	21.6
Quintile 5 (least deprived)	251	35
Not disclosed	132	18.2

Table 7 Socio-demographic characteristics

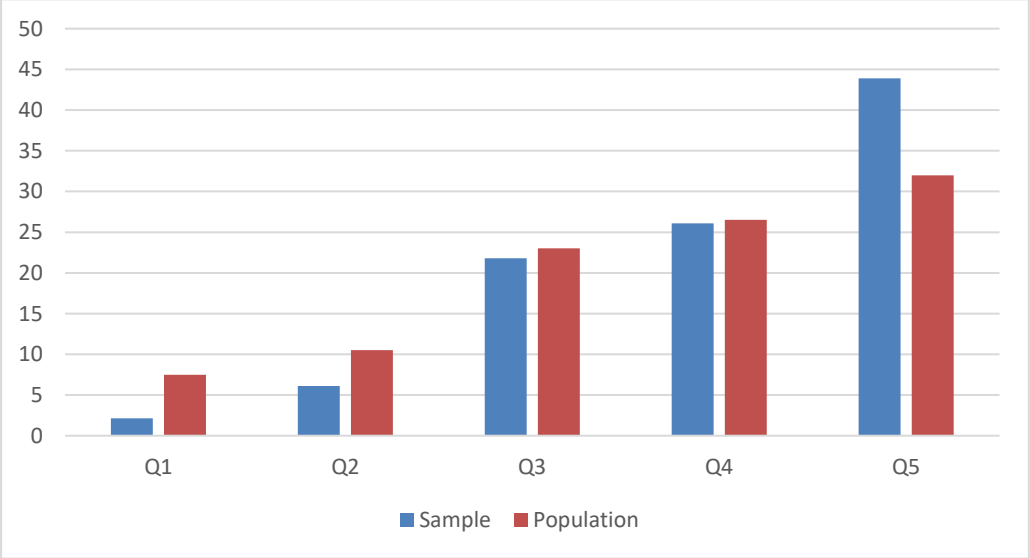

Figure 15. All survey responses with deprivation score (n=597) by Index of Multiple Deprivation (IMD) vs actual Gloucestershire population (mid-2017 population estimates). Quintile 1 = most deprived, Quintile 5 = least deprived)

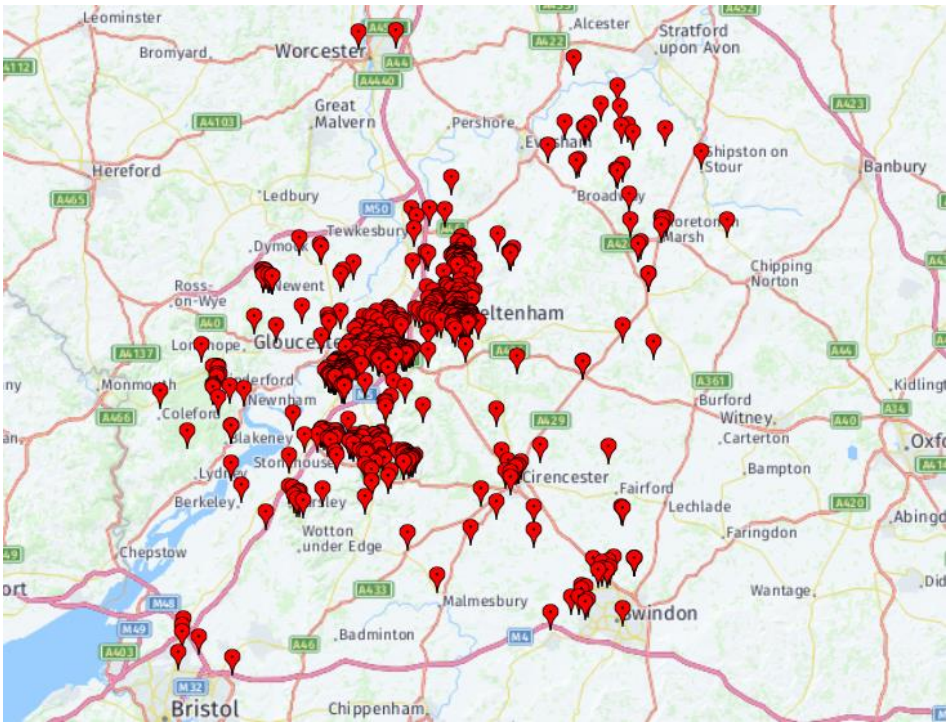

Figure 16 Map showing geographical spread of all survey responses

District	Survey Response (n = 719)	Linked Data (n = 179)	Gloucestershire Population 10/11-year-olds (n= 7505)
Cheltenham	123 (17.1%)	45 (25.1%)	1,343 (17.9%)
Cotswold	42 (5.8%)	16 (8.9%)	999 (13.3%)
Forest of Dean	34 (4.7%)	18 (10.1%)	948 (12.6%)
Gloucester	105 (14.6%)	30 (16.8%)	1,587 (21.1%)
Stroud	126 (17.5%)	54 (30.2%)	1,471 (19.6%)
Tewkesbury	117 (16.2%)	16 (8.9%)	1,155 (15.4%)
Unknown or out of county	172 (23.9%)	0 (0%)	0

Table 8. Respondents by District compared to Gloucestershire population (Gloucestershire and Districts Mid-Year population estimates, 2020)

Data were collected on risk factors associated with overweight and obesity (see table 9). Most parents self-reported as being a healthy weight (58.7%), 36.7% were overweight and 3.6% obese (40.3% overweight or obese). This differs to the modelled prevalence of overweight and obesity amongst adults in Gloucestershire which is 61.7% (PHE, 2021). However, evidence shows that adults underestimate their weight and therefore the true prevalence of adult overweight and obesity amongst this sample is likely to have been higher (Elgar and Stewart 2008). Of those parents who indicated whether they had tried to lose weight over the last 7-years, 65.9% had reported that they had been successful, while 33.4% had not. 12.7% of children were looked after by their grandparent/s either before or after school for more than one day per week.

Adult perceived weight (self)	Number	Average
Underweight	6	0.8
Healthy weight	422	58.7
Overweight	264	36.7
Very overweight	26	3.6
Not disclosed	1	0.1
Adult tried losing weight		
Yes	474	65.9
No	240	33.4
No disclosed	5	0.7
Successfully lost weight		
Yes	309	43.0
No	224	31.2
Not disclosed	186	25.9
Child perceived weight (child)		
Underweight	19	2.6
Healthy weight	633	88.0
Overweight	59	8.2
Very overweight	5	0.7
Not disclosed	3	0.4
Informed child has a weight issue		
Yes	41	5.7
No	676	94.0
No disclosed	2	0.3
Informed child weight status by		
Health professional	27	52.9
Family member	8	5.9
Friend	3	15.7
Other	13	25.5
Grandparent caring		
1-2 days	64	8.9
3-4 days	16	2.2
5+ days	11	1.5
None	626	87.3

Table 9. Survey Data on risk factors (sample n=719)

4.1.2 The family home environment

Figure 17 shows the mean responses for the 10 constructs of the FNPA. Each of the constructs on the FNPA were made up of two questions (20 questions in total) with scores on a scale of 1 to 4 with higher scores indicating healthier parenting practices (e.g. eating fruit and vegetables often or very often) and lower scores indicate unhealthy or less healthy practices (e.g. eating fruit and vegetables never or sometimes). Health promoting behaviours were highest for family meals (3.71: SD 0.68), family schedule/sleep routines (3.46, SD 0.69) and food choices (3.40, SD 0.68) and lowest for beverage choice (2.39, SD 1), screen time (2.54, SD 0.97) and child activity (2.73, SD 0.99).

When breaking this down further to the 20 FNPA sub-domains (Figure 18), health promoting behaviours were highest for families eating at least one meal together a day (3.77, SD 0.60), regularly eating breakfast (3.64, SD 0.75) and a regular family sleep routines (3.52, SD 0.68)

and lowest consuming milk regularly (1.75, SD 0.98), screen time less than 2 hours per day (2.21, SD 0.90) and taking part in organised sport or activity (2.72, SD 1.11).

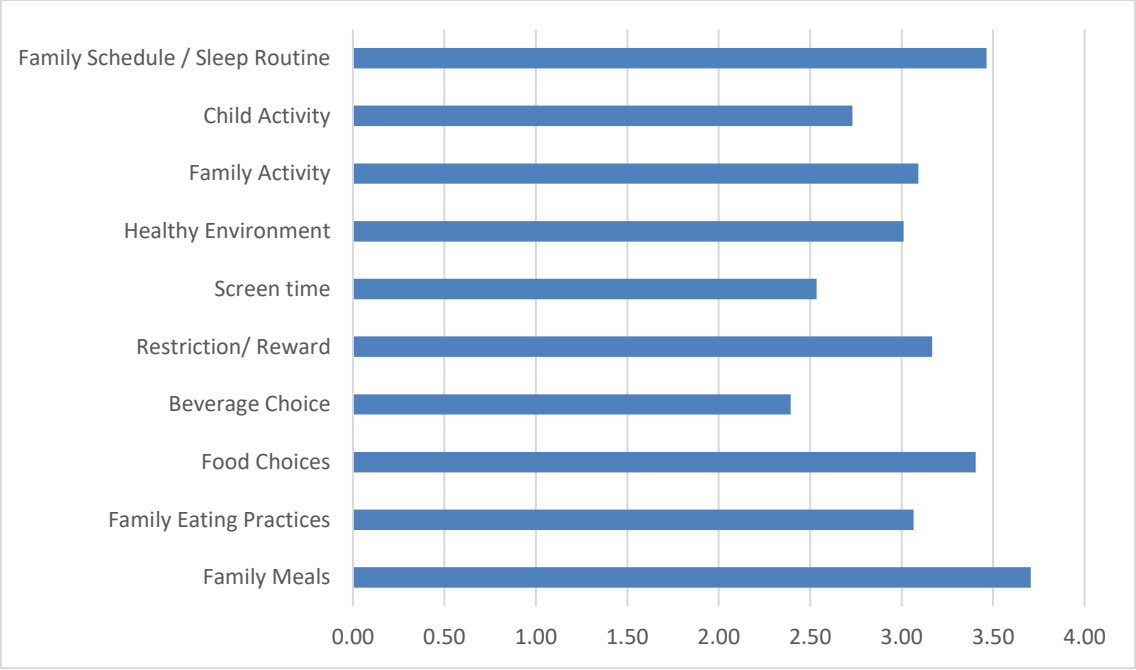

Figure 17. Mean responses to questions on the FNPA 10 constructs (1 = almost never, 2 = sometimes, 3 = usually, 4 =almost always) (N=719)

To further explore the responses, frequency distributions were computed for each question (Figure 19). For the family meal item, nearly all parents (84.08%) chose 4 (almost always) as their response. However, for the low-fat milk consumption item only 8.84% chose 4 as their response. Along with family meals, breakfast, fruit and vegetable snacks, bedtime routine and physical activity encouragement all had a response of 4 for at least 50% of parents. A response of 1 was the modal number for the question around low-fat milk. A score of 2 was the most common response for screen time amount. A score of 3 was the most common response for eating with TV, eating fast food, eating prepared food, physical activity opportunities and Consuming sugary drinks. A score of 4 was the most popular response for breakfast, family meals, fruit and vegetable snacks, reward, bedtime route, and amount of sleep.

Frequency distributions were also undertaken for the three FNPA domains of nutrition, physical activity and sedentary/media domain to enable comparisons to other studies. More favourable scores were found amongst the nutrition and media/sedentary domains (see figure 20).

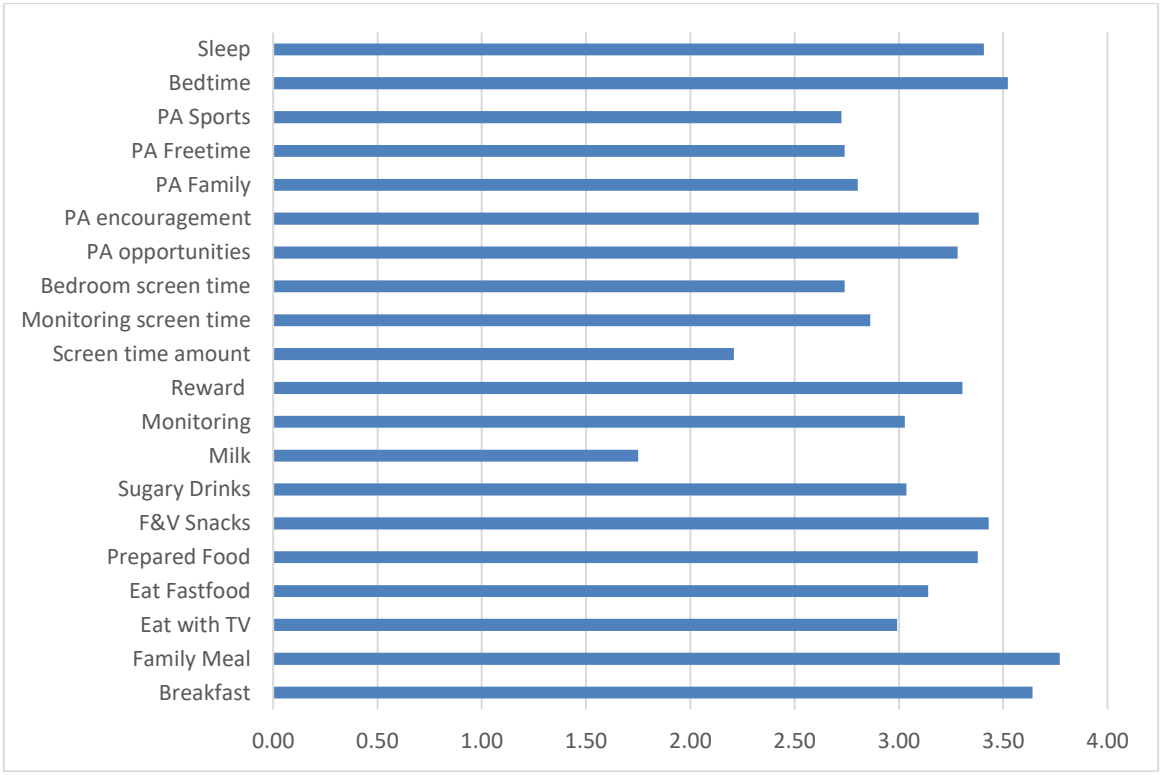

Figure 18. Mean responses to questions on the FNPA 20 subdomains (1=almost never, 2=sometimes, 3=usually, 4=almost always) (N=719)

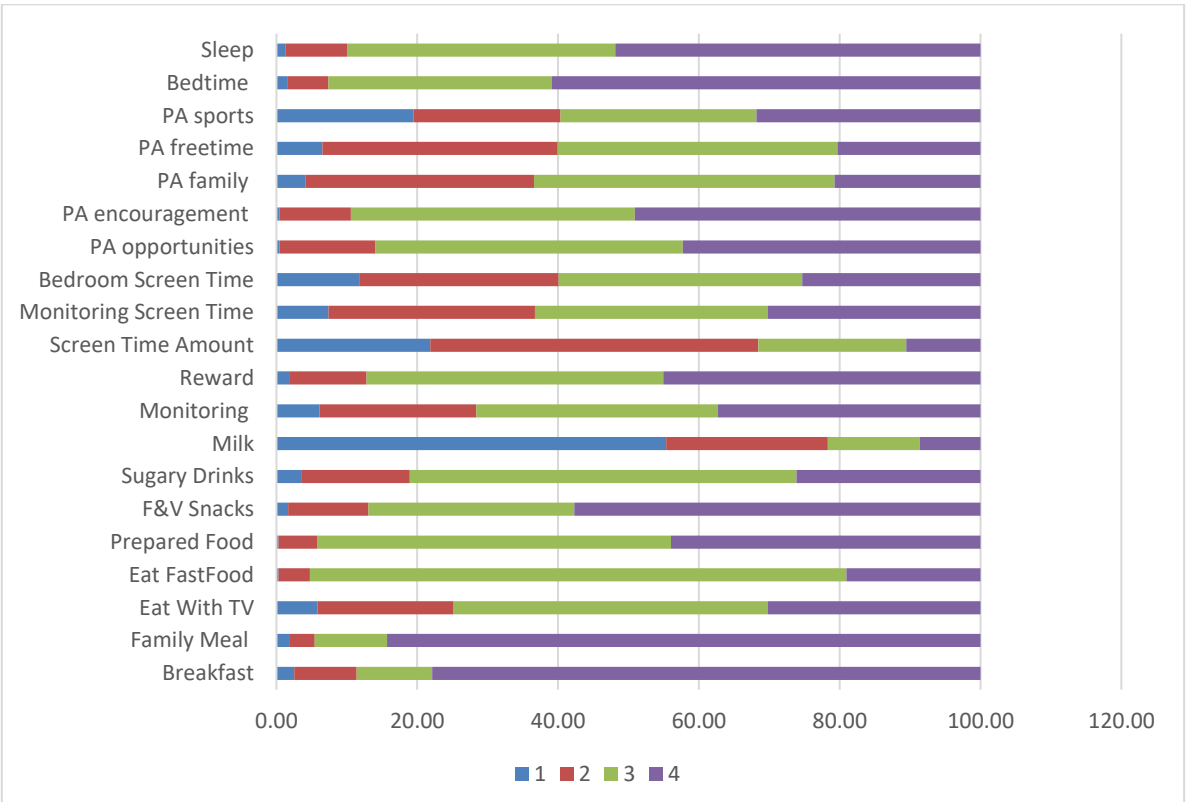

Figure 19. Frequency of responses within the FNPA 20 sub-domains (1=almost never, 2=sometimes, 3=usually, 4=almost always) (N=719)

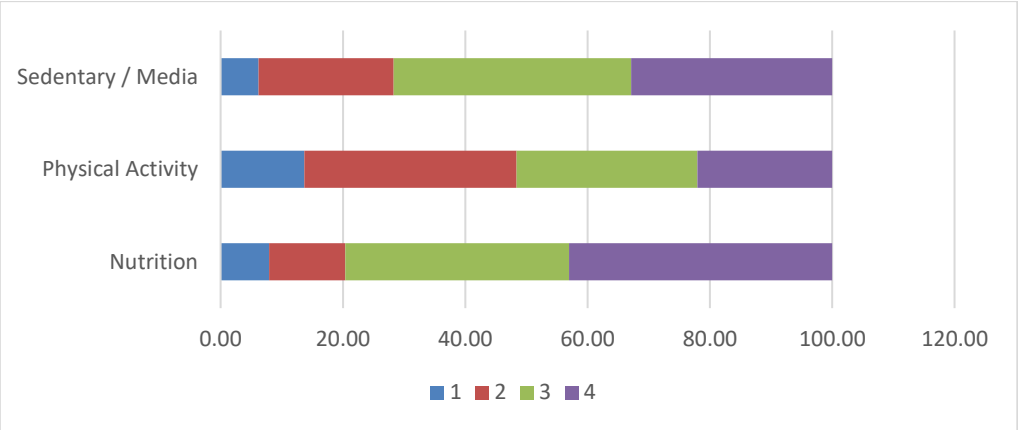

Figure 20. Frequency of responses within the three FNPA subdomains of sedentary/media, physical activity and nutrition (1 = almost never, 2 = sometimes, 3 = usually, 4 =almost always) (N=719). Note sedentary/media domain reverse scored so high scores represent more favourable home environment.

The nutrition FNPA composite score was the sum of the individual construct scores: family meals, family eating practices, food choices, beverage choices and restriction/reward. The physical activity FNPA score was the sum of individual construct scores: healthy environment (opportunities to be active), family activity and involvement, and child activity and involvement. Sedentary/media sub-domain included screen time and healthy environment (screen time in bedroom). Constructs around sleep were not included within the sedentary/media domain, as sleep is recognised as providing health benefits (Morrissey et al. 2020). Pearson correlations were calculated between the composite FNPA score, and the individual FNPA constructs (see figure 21). Moderate to strong correlations were observed between all the constructs and the composite FNPA score, except for beverages, restriction and reward.

	FNPA Score	Family Meals	Family Eating Practices	Food Choice	Beverage Choice	Restrict /Reward	Screen Time	Healthy Environment	Family Activity	Child Activity	Family Schedule
FNPA Score	1.00	0.53**	0.50**	0.60**	0.29**	0.38**	0.70**	0.70**	0.70**	0.64**	0.47**
Family Meals	0.53**	1.00	0.21**	0.28**	0.11**	0.18**	0.30**	0.29**	0.22**	0.20**	0.35**
Family Diet Practices	0.50**	.211**	1.00	0.33**	0.09*	0.27**	0.33**	0.26**	0.17**	0.11**	0.17**
Food Choice	0.60**	0.28**	.33**	1.00	0.08*	0.24**	0.35**	0.34**	0.31**	0.27**	0.29**
Beverage Choice	0.29**	0.11**	0.09*	0.08*	1.00	-0.01	0.15**	0.09*	0.02	0.0	0.11**
Restriction / Reward	0.38**	0.18**	0.27**	0.24**	-0.01	1.00	0.32**	0.17**	0.15**	0.09*	0.24**
Screen Time	0.70**	0.30**	0.33**	0.35**	0.15**	0.32**	1.00	0.41**	0.38**	0.26**	0.30**
Healthy Environment	0.70**	0.29**	0.26**	0.34**	0.10*	0.17**	0.41**	1.00	0.52**	0.41**	0.26**
Family Activity	0.70**	0.22**	0.17**	0.31**	0.02	0.15**	0.38**	0.52**	1.00	0.63**	0.23**
Child Activity	0.64**	0.20**	0.11**	0.27**	0.00	0.09*	0.26**	0.41**	0.63**	1.00	0.15**
Family Schedule	0.47**	0.35**	0.17**	0.29**	0.11**	0.25**	0.30**	0.26**	0.23**	0.15**	1.00

(* Indicates significance at p < 0.05, ** indicates significance at p <0.01)

Figure 21. Pearson Correlation among the 10 FNPA Constructs, Total FNPA and weight outcomes (matched sample n=719)

A Pearson's correlation coefficient test was also undertaken between deprivation score and the total FNPA score amongst the large sample where IMD was provided (n = 597), found a weak significant positive association (r=0.26, p<0.01). Similar results were found amongst the matched sample whereby there was also a weak significant positive association between deprivation and FNPA total score (r=0.32, p<0.01). This suggest that families from more affluent areas, lived in more favourable home environments.

4.1.3 Parental weight status and the family home environment

When analysing the total FNPA score and its association with self-identified parental weight, parents with a higher BMI had 3.15 times the odds (95% CI 2.16–4.48) of having low FNPA scores (less healthy home environment) compared to a high FNPA score (healthier home environment) (see table 10).

	Odds ratio of overweight & obesity at 10/11yrs			
Variable	Exp(B) (N=719)	Lower CI 95%	Upper CI 95%	P-value
FNPA high tertile	(ref)	(ref)	(ref)	(ref)
FNPA middle tertile	1.58	1.07	2.32	0.02
FNPA low tertile	3.15	2.16	4.58	0.00

Table 10. Odd ratio's (β and 95% CI) of self-reported parental weight by tertile of FNPA score

4.2 Linked dataset

A total of 179 surveys were completed by parents which included biometric weight data for children for the two points e.g. 2013/14 and 2019/20. Of these, most respondents were mothers (93.2%). 92 (51.4%) children were male and 87 (48.6%) female. The most frequently reported age demographic of respondents was 40-49 years (65.9%), followed by 30-39 years (21.2%). Most respondents were either married (78.2%) or in a long-term relationship (10.6%). Similar to the total sample of respondents to the survey (n=719), the data were skewed with more responses coming from affluent areas and less from more deprived areas (see table 11).

Characteristics	Number (n)	Proportion (%)
Total Matched	179	100%
Mother	167	93.2
Father	10	5.6
Care giver	2	1.1
Age		
26 to 29 years	0	0
30 to 39 years	38	21.2
40 to 49 years	118	65.9
50 or older	23	12.8
Marital Status		
Married	140	78.2
Single	10	5.6
Long Term Relationship	19	10.6
Divorced	9	5.0
Child Sex		
Male	92	51.4
Female	87	48.6
Deprivation Quintile (IMD)		
Quintile 1 (Most deprived)	3	1.7
Quintile 2	8	4.5
Quintile 3	46	25.6
Quintile 4	42	23.5
Quintile 5 (Least deprived)	80	44.7

Table 11. Socio-demographic characteristics for matched sample

At the first childhood measurement (4/5 years), the mean age for all children was 4.77yrs (SD 0.32), 4.77 (SD 0.33) for boys and 4.77 (SD 0.31) for girls. At the follow-up measurement (10/11 years), the mean age was 10.81yrs (SD 0.32), 10.78 (SD 0.32) for boys and 10.84 (SD 0.32) for girls. The mean BMI percentile at 4/5 years was 59.57 (SD 25.97) and 57.09 (SD 29.62) at 10/11 years. The mean percentile score was higher for boys, than for girls at both measurement points, which may reflect the higher prevalence of obesity amongst boys in national data (see table 12 and 13) (NHS Digital 2023).

	Males (n=92)	Females (n=87)	Total (n=179)
Age (yrs)	4.77 (0.33)	4.77 (0.31)	4.77 (0.32)
Height (cm)	108.62 (4.09)	106.69 (4.59)	107.68 (4.44)
Weight (kg)	19.27 (2.00)	18.26 (2.00)	18.78 (2.06)
BMI Percentile	62.39 (27.10)	56.79 (24.46)	59.67 (25.93)
BMI SDS	0.49 (0.91)	0.28 (0.77)	0.39 (0.85)
% Underweight	1.09	0	0.56
% Healthy weight	69.57	82.76	75.98
% Overweight	21.74	14.94	18.44
% Very overweight	7.61	2.30	5.03

Table 12. Descriptive characteristics by sex and total matched sample ages 4/5 years

	Males (n=92)	Females (n=87)	Total (n=179)
Age (yrs)	10.78 (0.32)	10.84 (0.32)	10.81 (0.32)
Height (cm)	144.65 (5.17)	143.57 (6.51)	144.13 (5.87)
Weight (kg)	38.34 (8.31)	37.33 (6.99)	37.85 (7.69)
BMI Percentile	60.11 (30.66)	56.05 (28.69)	58.14 (29.62)
BMI SDS	0.36 (1.25)	0.12 (1.03)	0.25 (1.15)
% Underweight	3.26	0.00	1.68
% Healthy weight	66.30	78.16	72.07
% Overweight	10.87	10.34	10.61
% Very overweight	19.57	11.49	15.64
FNPA Score	61.86	62.92	62.37

Table 13. Descriptive characteristics by sex and total matched sample ages 10/11 years

4.2.1 Analysis by weight status

At 4/5 years age 0.56% [95% CI 0.1, 3.1] of the children were reported as underweight, 75.98% as healthy weight [95% CI 69.1, 81.5], 18.44% [95% CI 13.5, 24.9] as overweight and 5.03% [95% CI 2.7, 9.5] were obese (total overweight and obese = 23.43%). At 10/11 years, 1.68% [95% CI 0.1, 3.1] of the children were underweight, 72.07% were healthy weight [95% CI 65.5, 78.5], 10.61% [95% CI 6.9, 16.1] were overweight and 15.64% [95% CI 10.6, 21.1] were obese (total overweight and obese = 23.6%).

Figure 22 shows that the linked dataset was broadly representative of the Gloucestershire weight prevalence across the four weight categories (prevalence of underweight, healthy weight, overweight and obesity) when the children were measured in 2013/14 and 2019/20. During 2013/14 the prevalence of underweight and healthy weight children at age 4/5yrs was 0.5% and 74% which compares to the sample of 0.6% and 76%. However, the sample includes slightly more overweight children (18%) than the recorded prevalence at the time (14%), although there were less obese children in our sample (5%) compared to 10% population prevalence.

Figure 22. Comparing the matched sample to the Gloucestershire weight categories prevalence (NCMP data 2021)

During 2019/20 the prevalence of underweight and healthy weight children at age 4/5yrs was 0.7% and 75% which compares to the sample in this study of 1.6% and 72%. However, the sample includes slightly less overweight children (10%) than the recorded prevalence at the time (13%), although there were more obese children in the sample (15%) compared to 10% population prevalence.

4.2.2 Emergence and remission of overweight/obesity

To inform the purposive sample, analysis was undertaken on the matched sample (n=179) to understand the emergence, persistence, and remission of childhood obesity between the two time points. Of those children who were obese at 4/5 years (n=9), 88.9% (n=8) remained obese, 11.1% (n = 1) had become overweight and no children became a healthy weight at 10/11 years. Of those children who were overweight at 4/5 years, 21.2% (n=7) remained overweight, 24.2% (n=8) had become obese and 5.9% (n=18) became a healthy weight at 10/11 years (see table 14).

Baseline (4/5 years)	Follow-up (10/11 years)							
	underweight		healthy weight		overweight		Obese	
	n	%	n	%	n	%	n	%
Underweight	0	0.0	1	100.0	0	0.0	0	0.0
Healthy Weight	3	2.2%	110	81.0%	11	8.1%	12	8.7%
Overweight	0	0.0	18	54.5%	7	21.2%	8	24.2%
Obese	0	0.0	0	0.0	1	11.1%	8	88.9%

Table 14. Change in weight category between 4/5 years and 10/11 years using British 1990 (UK90) growth reference charts and population BMI cut-offs

Of those children who were a healthy weight at 4/5 years age, 81% (n=110) remained a healthy weight, 8.1% (n=11) had become overweight and 8.7% (n=12) became obese at 10/11 years. No children who were initially categorised as overweight or obese at 4/5 years of age became underweight at 10/11 years. Equally, no children who were underweight at 4/5 years age went on to become overweight or obese at 10/11 years. No children identified as obese at 4/5 years in this sample went on to become a healthy weight at 10/11 years, although 18 (5.9%) children successfully achieved a positive shift in weight category e.g. overweight at 4/5 years to a healthy weight at 10/11 years.

4.2.3 Predicting childhood obesity

This analysis examined odds ratios for overweight and obese children at 10/11 years based on a child's BMI percentile at 4/5 years. A logistic regression was run using weight status at 10/11 years as the dependent variable and earlier weight status from the children at 4/5 years and IMD as the independent or predictor variables. A dose-response relationship between the odds of obesity at 4/5 years and weight status at 10/11 years was evident (see table 15).

Variable	All (N=179)	Lower CI 95%	Upper CI 95%	P-value
BMI ≤1.9	-*	-*	-*	-*
BMI 2-49.9	(referent)	(referent)	(referent)	(referent)
BMI 50-74.9	4.36	0.46	41.03	0.20
BMI 75-84.9	17.68	1.81	172.77	0.01
BMI 85-94.9	18.02	2.12	153.00	0.08
BMI 95+	482.89	26.94	8754.37	0.00
Deprivation Score	0.79**	0.63	1.00	0.09

* No children who were ≤1.9 percentile for BMI at 4/5 years were obese at 10/11 years; thus, ORs could not be calculated for the 4/5-year period.

Table 15. Odd ratio's (β and 95% CI) of 10/11 years BMI >95th (obese) as a function of 4/5 years BMI ranges

Those children whose baseline measurement was between the 85th-94.9th percentile (overweight) were 18 times more likely to become obese at follow-up compared to those whose baseline measurement was within 2nd-49.9th percentile range ($p<0.05$). Those children whose baseline measurement was between the 75th-84.9th percentile (upper healthy weight range) were 17 times more likely to become obese at follow-up compared to those whose baseline measurement fell within the 2nd-49.9th percentile ($p<0.05$).

4.2.4 Perceived weight status of children

Based on clinical BMI cut-offs, of the 178 children with responses by parents on perceived child weight (no data on perceived weight status for one record), most children who were a healthy weight, were correctly perceived to be a healthy weight by their parents (96%). However, of those children who were overweight or obese, a significant proportion (64.7%) of parents misperceived their child to be healthy weight (see figure 23).

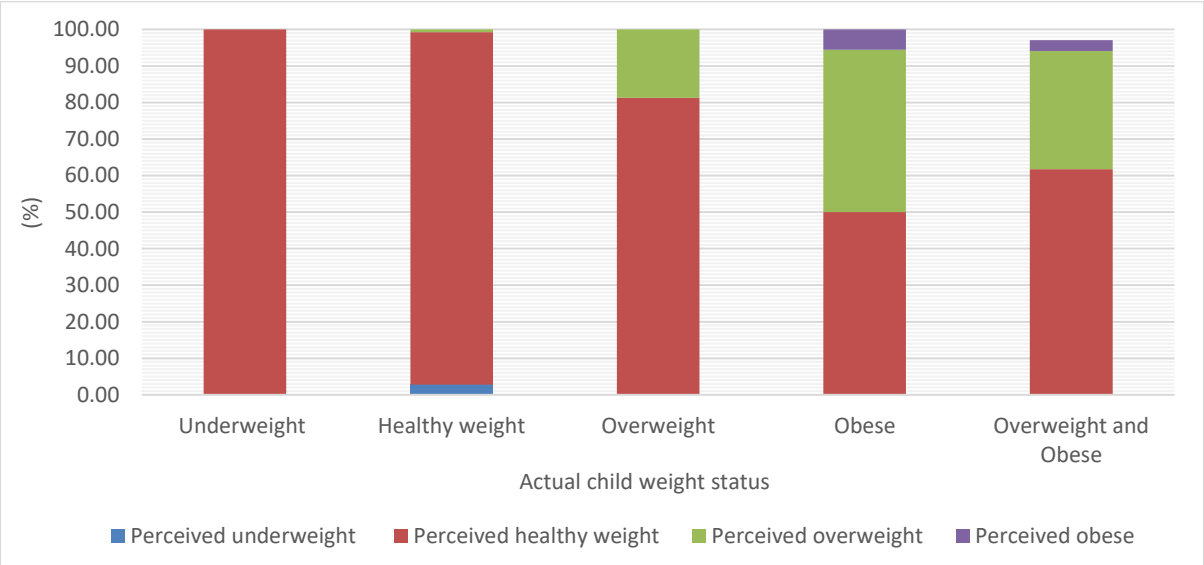

Figure 23. Parental perception of the body weight status of their child per actual weight status (based on clinical BMI cut-offs)

For girls, who were overweight or obese (n=14) at 10/11 years, 78.57% (n=11) of parents viewed their daughters' weight as healthy. For boys who were overweight or obese (n=20), 55% (n=11) of the parents viewed their sons' weight as a healthy weight. Whilst the numbers are small, this may suggest that parents of boys are more likely to correctly perceive their child as overweight or obese, compared to parents of girls.

4.2.5 Informed of children's weight status

From the matched data, 15 (86.6%) parents/caregivers stated that they had been informed by someone that their child had a weight issue. Of these, eight were informed by a health professional, two from a family member and five were by someone else. Of those that were

informed that their child had a weight issue, 13 (86.6%) children were categorised as either overweight or obese for 4/5 years or 10/11 years. Of those informed that their child had a weight issue, 7 parents (47%) incorrectly perceived their child to be a healthy weight (see table 16).

The person identified as informing parent the child has a weight issue	Parental perception of child weight	10/11 years weight status
Health professional	Healthy weight	Healthy weight
Other	Overweight	Obese
Other	Overweight	Obese
Family member	Healthy weight	Obese
Other	Healthy weight	Obese
Other	Overweight	Healthy weight
Health professional	Overweight	Obese
Other	Healthy weight	Obese
Health professional	Healthy weight	Obese
Health professional	Healthy weight	Obese
Health professional	Healthy weight	Overweight
Health professional	Healthy weight	Healthy weight
Family member	Healthy weight	Obese
Health professional	Very overweight	Obese
Health professional	Overweight	Obese

Table 16. Type of person informing their parents that their child had a weight issue, parental perception of child weight and objective measured weight status as 10/11 years.

4.2.6 Family home environment and weight status

Data comparing the FNPA score between healthy children and those above the overweight threshold shows that children who were a healthy weight at 10/11 years old scored favourably across 18 of the 20 subdomains. Only the subdomain of regularly drinking milk and getting sufficient sleep scored higher amongst overweight and obese children. On average children who were either overweight or obese at 10/11 years old, had a lower FNPA total average score and domain average score of 60 and 3.08, compared to 63.20 and 3.17 for children of healthy weight (see table 17).

FNPA Sub Domain	Children who were a healthy weight - average FNPA Score (n=132)	Child who was overweight/obese - average FNPA Score (n=47)
Breakfast	3.86	3.76
Family Meal	3.86	3.81
Eat With TV	3.15	2.80
Eat Fast Food	3.18	3.09
Prepared Food	3.42	3.33
F&V Snacks	3.59	3.28
Sugary Drinks	3.08	3.04
Milk	1.61	1.84
Monitoring	3.07	2.96
Reward	3.37	3.33
Screen Time Amount	2.39	2.07
Monitoring Screen Time	3.00	2.67
Bedroom Screen Time	2.92	2.67
PA opportunities	3.45	3.20
PA encouragement	3.48	3.24
PA family	2.88	2.72
PA free time	2.88	2.63
PA sports	2.98	2.91
Bedtime	2.63	2.54
Sleep	3.45	3.50
Average Total Score	63.20	60.00
Average FNPA Domain Score	3.17	3.08

Table 17. Average scores for FNPA sub domains for children of healthy weight vs children identified as overweight or obese at 10/11 years (green cell denotes preferable score)

Correlations among the main outcome variables of child's BMI at 4/5yrs, BMI at 10/11yrs and weight change, are shown in Table 18. The total FNPA score was moderately negatively associated with BMI at 10/11 years ($r = -0.29$, $p<0.01$) and change in BMI z-score between the two time points ($r = -0.35$, $p<0.01$). Several constructs of the FNPA were predictive of BMI and weight change. Nine of the ten constructs were weakly or moderately negatively associated with change in weight between the two time periods. Family meals and screen time demonstrated the strongest, negative, association. The healthy environment construct ($r = 0.30$, $p<0.01$) was most strongly correlated with BMI at 10/11 years. There were moderate and significant correlations among the various FNPA constructs showing some clustering of behaviours within the home environment.

	FNPA Score	Family Meals	Family Eating Practices	Food Choice	Beverage Choice	Restrict / Reward	Screen Time	Healthy Environ-mint	Family Activity	Child Activity	Family Schedule
FNPA Score	1.00	0.50**	0.55**	0.67**	0.17*	0.41**	0.67**	0.68**	0.49**	0.62**	0.49**
Family Meals	0.50**	1	0.32**	0.33**	-0.04	0.20**	0.31**	0.25**	0.23**	0.12	0.26**
Family Diet Practices	0.55**	0.32**	1	0.41**	0.09	0.23**	0.41**	0.29**	0.17*	0.13	0.09
Food Choice	0.67**	0.33**	0.41**	1	0.05	0.21**	0.40**	0.35**	0.39**	0.37**	0.25**
Beverage Choice	017*	-0.04	0.09	0.05	1	-0.18*	0.03	0.16*	-0.01	0.00	-0.12
Restriction / Reward	0.41**	0.20**	0.23**	0.21**	-0.18*	1	0.25**	0.07	0.07	0.12	0.33**
Screen Time	0.67**	0.31**	0.41**	0.40**	0.03	0.25**	1	0.41**	0.35**	0.16*	0.26**
Healthy Environment	0.68**	0.25**	0.30**	0.35**	0.16*	0.07	0.41**	1	0.54**	0.37**	0.25**
Family Activity	0.69**	0.23**	0.17*	0.39**	-0.01	0.07	0.35**	0.54**	1	0.63**	0.23**
Child Activity	0.62**	0.12	013	0.37**	0.00	0.12	0.16*	0.37**	0.63**	1	0.21**
Family Schedule	0.49**	0.26**	0.10	0.25**	-0.12	0.33**	0.26**	0.25**	0.23**	0.21**	1
4/5 years BMI	-0.10	-0.13	-0.15*	0.04	0.03	0.08	0.02	-0.19*	-0.14	-0.05	-.005
10/11 years BMI	-0.29**	-0.22**	-0.18*	-0.16*	0.01	-0.07	-0.18*	-0.30**	-0.20**	-.017*	-0.11
Weight Change	-0.35**	0-.26**	-0.15*	-0.32**	-0.01	-0.15*	-0.29**	-0.21**	-0.20**	-0.19**	-0.13

(* Indicates significance at p < 0.05, ** indicates significance at p <0.01)

Table 18. Pearson correlation among the 10 FNPA constructs, total FNPA and weight outcomes (matched sample n = 179)

The FNPA total score from all the respondents was divided into tertiles to test for differences in BMI between families with high total scores (more favourable family environment and behaviours) versus those of middle (moderate family environmental and behavioural risk) or low total scores (high risk family environment and behaviours). The total FNPA score significantly predicted an increased risk for being obese (above the 95th percentile for BMI) at 10/11 age. When adjusting for independent variables (IMD, parent weight status and gender), children with a total score in the lowest tertile (higher risk family environment and behaviours) had an odds ratio (OR) of 5.28 (95% CI = 1.39 - 20.07) compared to children with a total score in the highest tertile (lower risk family environment and behaviours) for being at risk of obesity (see table 19).

	Odds ratio of overweight & obesity at 10/11yrs				Odds ratio of obesity at 10/11yrs			
Variable	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value
FNPA high tertile	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
FNPA middle tertile	1.52	0.60	3.94	0.38	3.46	0.87	13.69	0.07
FNPA low tertile	2.22	0.88	5.58	0.09	5.28	1.39	20.07	0.02
Deprivation Score	0.73	0.61	0.87	0.01	0.85	0.69	1.04	0.11
Parent Weight	1.00	0.47	2.12	0.99	1.54	0.64	3.68	0.33
Gender	1.63	0.79	3.39	0.19	1.84	0.76	4.45	0.18

Table 19. Adjusted odd ratio's (β and 95% CI) of overweight and obesity by tertile of FNPA score in 10/11-year-old children using population BMI cut-offs

When using BMI clinical cut-offs, children with a total score in the lowest tertile (higher risk family environment and behaviours) continued to have higher risk of obesity with an odds ratio (OR) of 4.07 compared to children with a total score in the highest tertile (lower risk family environment and behaviours) for being at risk of obesity, although this was found not to be significant (P≥0.05) (see table 20).

	Odds ratio of overweight & obesity at 10/11yrs				Odds ratio of obesity at 10/11yrs			
Variable	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value
FNPA high tertile	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
FNPA middle tertile	1.37	0.34	5.51	0.66	3.38	0.34	33.86	0.49
FNPA low tertile	2.40	0.67	8.67	0.18	4.07	0.37	44.16	0.25
Deprivation Score	0.82	0.65	1.02	0.07	1.13	0.74	1.70	0.25
Parent Weight	0.84	0.40	3.06	0.84	1.65	0.29	9.32	0.58
Gender	3.18	0.79	3.39	0.19	.401	0.07	2.17	0.57

Table 20. Adjusted odd ratio's (β and 95% CI) of overweight and obesity by tertile of FNPA score in 10/11-year-old children using clinical BMI cut-offs

To understand the independent contribution of individual aspects of the home environment, a further breakdown of the FNPA composite was undertaken by dividing into the three sub-domains of sedentary, nutrition and physical activity to observe how FNPA outcomes related to specific health-related behaviours. Correlations among the main outcome variables of child's BMI at 4/5yrs and 10/11yrs and the three subdomains can be found in table 21. There were strong positive correlations amongst the total FNPA score and the three sub domains. Weak to moderate correlations were observed between child BMI at 10/11 years and the three sub-domains.

	FNPA	PA composites	Food composites	Media composite	4/5 years BMI	10/11 years BMI
FNPA	1	0.73**	0.80**	0.69**	-0.12	-0.29**
PA composite	0.73**	1	0.30**	0.25	-0.12	-0.23**
Food composite	0.80**	0.30**	1	0.50**	-0.04	-0.21**
Media composite	0.69**	0.25	0.50**	1	-0.22**	-0.22**
4/5 years BMI	-0.10	-0.12	-0.04	-0.14	1	
10/11 years BMI	-0.29**	-0.23**	-0.21**	-0.22**		1

(* Indicates significance at p < 0.05, ** indicates significance at p <0.01)

Table 21. Pearson Correlation among the three composite scores for nutrition, physical activity and media

The scores from the composite subdomain of nutrition, physical activity and media were tested for associations with overweight and obesity. All three domains suggested increased risk of overweight and obesity, although only data amongst the sedentary domain were statistically significant. When adjusting for independent variables (IMD, Parent weight status and gender), children with a total score in the lowest tertile of the sedentary subdomain (higher risk sedentary behaviour and media time) had a higher risk of obesity with an odds ratio (OR) of

4.12 (95% CI = 1.43 - 11.86) compared with children with a total score in the highest tertile (lower risk family environment and behaviours) for being at risk of obesity (see table 22). The association remained when utilising clinical BMI cut-off (see table 23).

	Physical Activity				Nutrition				Media			
Variable	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value
FNPA high tertile	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
FNPA middle tertile	0.84	0.32	2.21	0.72	0.57	0.21	1.53	0.27	4.64	1.60	13.47	0.01
FNPA low tertile	2.19	0.89	5.40	0.09	1.56	0.66	3.66	0.31	4.12	1.43	11.86	0.01
Deprivation Score	0.73	0.61	0.87	0.00	0.71	0.59	0.84	0.00	0.72	0.60	0.86	0.00
Parent Weight	0.99	0.46	2.14	1.00	0.90	0.40	1.83	0.69	0.99	0.47	2.15	0.99
Gender	0.53	0.25	1.11	0.09	0.61	0.29	1.27	0.19	0.55	1.60	1.15	0.11

Table 22. Adjusted odd ratio's (β and 95% CI) of overweight and obesity by nutrition, physical activity and media composite scores in 10/11year old children using population BMI cut-offs

	Physical Activity				Nutrition				Media			
Variable	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value
FNPA high tertile	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
FNPA middle tertile	3.28	1.04	10.36	0.04	.38	0.14	1.06	0.06	3.56	.90	14.10	0.07
FNPA low tertile	2.20	0.69	7.08	0.19	.32	0.11	0.89	0.03	7.26	1.95	27.05	0.00
Deprivation Score	0.74	0.61	0.89	0.00	.76	0.63	0.92	0.01	0.76	0.63	.92	0.01
Parent Weight	0.490	0.21	1.12	0.09	.57	0.25	1.32	0.19	0.55	0.24	1.27	0.16
Gender	0.69	0.30	1.57	0.37	.58	0.25	1.35	0.21	0.64	0.28	1.48	0.30

Table 23. Adjusted odd ratio's (β and 95% CI) of overweight and obesity by nutrition, physical activity and media composite scores in 10/11year old children using clinical BMI cut-offs

4.2.7 Family home environment and weight change

To assess whether the family home environment was associated with weight change between ages 4/5 years and 10/11 years, a change in weight-for-age z-score of greater than 0.6 and 1.0 was chosen as the dependent variable. When adjusting for independent variables (IMD, parent weight status and gender), children with a total score in the lowest tertile (less healthy home environment) had a higher risk of gaining weight (z-score ≥1.0) between the two time points with a reduced OR of 9.91 (95% CI 1.20–81.97) compared with children with a total score in the highest tertile (healthier home environment). A higher OR was also evident for weight gain of >0.6 (3.39, 95% CI 1.10-10.43) (see table 24).

	Odds ratio of weight change (z-score ≥ 0.6) between aged 4/5 and 10/11				Odds ratio of weight change (z-score ≥ 1.0) between aged 4/5 and 10/11			
Variable	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value	Exp(B) (N=179)	Lower CI 95%	Upper CI 95%	P-value
FNPA high tertile	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
FNPA middle tertile	1.48	0.44	5.03	0.53	4.32	0.46	41.03	0.20
FNPA low tertile	3.39	1.10	10.43	0.03	9.91	1.20	81.97	0.03
Deprivation Score	0.85	0.70	1.04	0.11	0.74	0.57	0.95	0.01
Parent Weight	1.40	0.58	3.29	0.45	0.70	0.23	2.08	0.51
Gender	3.18	1.07	9.45	0.03	0.77	0.26	2.31	0.64

Table 24. Adjusted odd ratio's (β and 95% CI) weight change (z-score ≥ 0.6 and ≥ 1.0) by tertile of FNPA score in 10/11-year-olds

4.2.8 Analysis by deprivation

Analysis by deprivation showed a more profound downward trend in overweight and obesity amongst 10/11-year-olds compared with 4/5 years olds, with a higher proportion of overweight and obese children in poorer areas compared with more affluent areas, although this was found not to be significant as the confidence levels did not overlap (see figure 24).

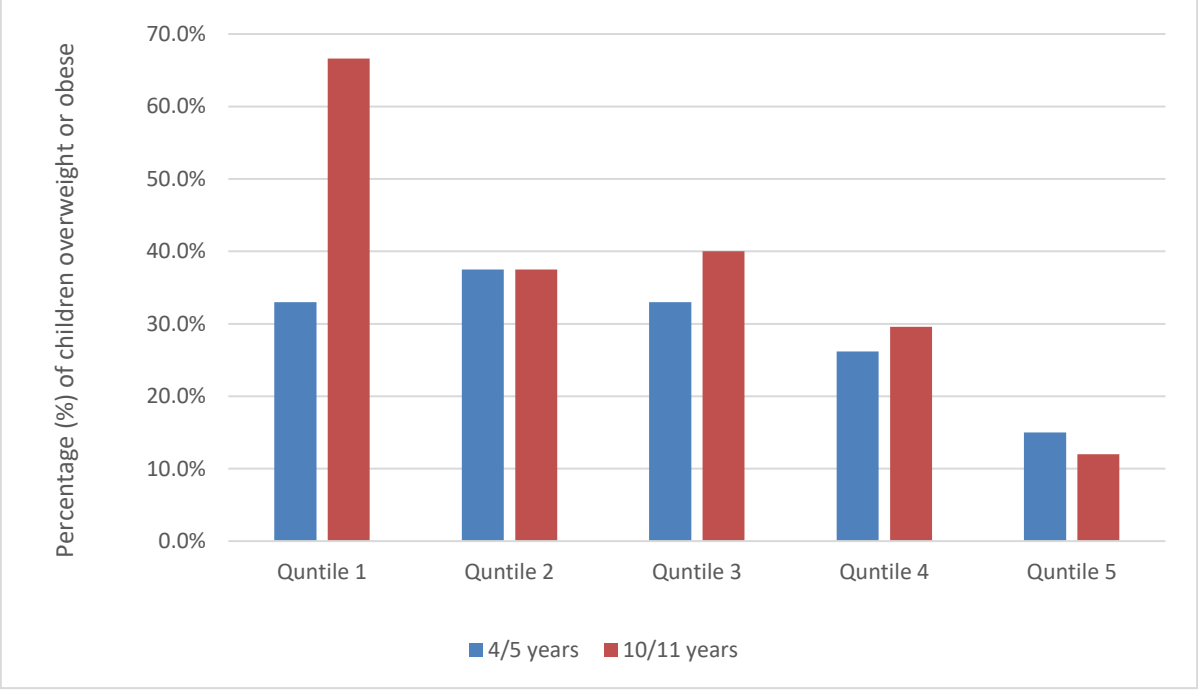

Figure 24. Proportion of overweight and obese 4/5 years and 10/11 years children by deprivation quintile (1 = most deprived, 5 = most affluent)

A Spearman's Rank Correlation was undertaken to establish whether the relationship between deprivation score, 4/5-year BMI scores, 10/11-year BMI scores and the change in BMI values between 4/5 years and 10/11 years was linear. The results indicate a significant ($p<0.01$) association between all three BMI variables and deprivation (see table 25).

	Deprivation (IMD)	p-value
4/5 years BMI	-0.22	0.00
10/11 years BMI	-0.36	0.00
Change in BMI	0.21	0.006
FNPA Total Score	0.32	0.00

Table 25. Result of Spearman's rank correlation coefficient between deprivation and 4/5 years BMI, 10/11 years BMI and Change in BMI

A Chi-Square Goodness of Fit Test was performed to determine whether the proportion of people with deprivation scores within the matched sample reflected that of the Gloucestershire population. Table 26 shows the deprivation quintiles from the sample compared to the observed frequencies for the population and the residuals (difference between observed - expected frequencies).

	Observed (N)	Expected (N)	Residual
Quintile 1 (Most Deprived)	3	14.3	-11.3
Quintile 2	8	21.5	-13.5
Quintile 3	46	39.4	6.6
Quintile 4	43	46.5	-3.5
Quintile 5 (Least Deprived)	79	57.3	21.7
Total	179		

Table 26. Observed and expected deprivation distribution. Expected frequencies based on Indices of Deprivation 2019

Data were skewed with more children from affluent areas and fewer from deprived areas in the sample with the Chi-Square showing that observed frequencies did not match well the expected proportions ($X^2 = 4$, 27.03, $p<0.01$) with a disproportionately high number of children from more affluent areas and low number from deprived areas.

4.3 Qualitative component

This section provides the findings from the semi-structured interviews of parents exploring potential causes of weight loss amongst a sample of five children in Gloucestershire and the strategies parents may have used to create a healthy home environment.

4.3.1 Sample characteristics

Participants for the qualitative component were selected based on a positive shift in weight status defined as either a change in weight category i.e. overweight to healthy weight and/or a reduction in −0.6 BMI z-score between the ages of 4/5 and 10/11years of age. Of the 179 children with matched biometric data between the two points, nine children met the criteria to be interviewed with five of these parents responding to an invitation to be interviewed. Of those interviewed, four children were boys and one were a girl. All children had been identified as being overweight at year 4/5 years by the clinical BMI cut off's and had achieved a healthy weight status by 10/11 years and had reduced their BMI-score by 0.6, with four children achieving a reduction in their BMI z-score of ≥1.0 between 4/5 and 10/11 years (see table 27).

Child Information	**Child 1**	**Child 2**	**Child 3**	**Child 4**	**Child 5**
Child sex	Male	Male	Male	Male	Female
BMI 4/5yrs	93	92	91	93	92
Weight category 4/5yrs	Overweight	Overweight	Overweight	Overweight	Overweight
BMI 10/11yrs	37	56	54	46	81
Weight category 4/5yrs	Healthy weight	Healthy weight	Healthy weight	Healthy weight	Healthy weight
BMI difference	-38	-36	-37	-47	-11
BMI z-score difference	-1.88	-1.41	-1.37	-1.12	-0.60
FNPA total Score	76	59	64	66	55

Parent Information	**Parent 1**	**Parent 2**	**Parent 3**	**Parent 4**	**Parent 5**
Mother / father	Mother	Mother	Mother	Mother	Mother
Age range	40-49yrs	40-49yrs	40-49yrs	40-49yrs	30-39yrs
Marital status	Married	Married	Married	Married	Married
Child perceived weight	Healthy weight	Healthy weight	Healthy weight	Healthy weight	Healthy weight
Parent perceived weight	Healthy weight	Overweight	Overweight	Overweight	Overweight
Informed child has weight issue	No	No	No	No	No
Parent tried losing weight	No	Yes	No	Yes	Yes
Successfully lost weight	N/A	No	No	Yes	Yes
Looked after by grandparents	No	1-2 days	No	No	1-2 days
Deprivation quintile	7	8	10	10	3

Table 27. Demographic information of child and parent interview sample

All interviews were conducted via Zoom with each interview lasting between 45-60mins. All five parents interviewed were mothers, married and aged 30-49years. Three of the parents lived within the least deprived quintile, one with the second least deprived quintile and one within the second most deprived quintile. All parents perceived their children to be of a healthy weight at 10/11 years and none had been informed that their child was overweight or obese.

Four of the five parents reported being overweight with three parents having tried to losing weight previously. Two parents reported that they had been successful and sustained the weight loss. The FNPA composite score from the five interviewees ranged from 59 to 76 with a mean score of 63.80 (SD 7.60), which was slightly higher than the average FNPA score (62.37, SD 6.67) across the matched dataset (n=179). A one sample t-test between the mean FNPA score of the interview sample (n=5) and the matched sample (n=179) suggested insufficient evidence ($p>0.05$) that the expressed means were not statistically different (see table 28).

	P1	P2	P3	P4	P5	Avg score Qual sample (n=5)	Avg score sample (n=719)
Family Meals							
1. How often does your child eat breakfast, either at home or at school?	4	3	4	4	4	3.8	3.76
2. How often does your child eat at least one meal a day with at least one other family member?	4	3	4	4	4	3.8	3.82
Family Eating Practices							
3. How often does your child eat while watching TV?	4	2	4	3	1	2.8	3.07
4. How often does your family eat “fast food?”	3	3	4	3	3	3.2	3.16
Food Choices							
5. How often does your family use packaged “ready--to--eat” foods?	4	3	4	3	3	3.4	3.40
6. How often does your child eat fruits and vegetables at meals or snacks?	4	3	4	3	4	3.6	3.50
Beverage Choices							
7. How often does your child drink fizzy drinks or sweetened beverages?	4	4	4	4	3	3.8	3.07
8. How often does your child drink low-fat milk for meals or snacks?	1	3	2	2	1	1.8	1.67
Restriction/Reward							
9. How often does your family monitor the amount of sweets, chips, and biscuits your child eats?	4	3	2	4	3	3.2	3.04
10. How often does your family use sweets, ice cream or other foods as a reward for good behaviour?	4	3	4	4	3	3.6	3.36
Screen Time							
11. How often does your child have less than 2 hours of “screen time” in a day?	4	3	4	3	2	3.2	2.30
12. How often does your family monitor the amount of “screen time” your child has?	4	3	2	3	2	2.8	2.91
Healthy Environment							
13. How often does your child engage in screen time in his/her bedroom?	4	3	4	2	2	3	2.85
14. How often does your family provide opportunities for physical activity?	4	3	3	3	3	3.2	3.37
Family Activity							
15. How often does your family encourage your child to be physically active?	4	3	2	3	3	3	3.41
16. How often does your child do physical activities with at least one other family member?	4	2	2	3	2	2.6	2.83
Child Activity							
17. How often does your child do something physically active when he/she has free time?	3	3	2	3	3	2.8	2.82
18. How often does your child participate in organized sports or physical activities with a coach or leader?	4	3	3	2	3	3	2.96
Family Schedule/Sleep Routine							
19. How often does your child follow a regular routine for your child’s bedtime?	4	3	4	4	3	3.6	3.61
20. How often does your child get enough sleep at night?	4	3	4	4	3	3.6	3.45
Average	**3.75**	**2.95**	**3.3**	**3.2**	**2.75**	**3.19**	**3.14**

Table 28. Overview of FNPA responses from interview sample compared to overall matched sample (n=719) (negative questions on FNPA reverse scored) (1=almost never, 2=sometimes, 3=usually, 4=almost always)

4.3.2 Thematic analysis

A series of themes were identified through inductive coding of the interview transcripts which were then mapped and considered against the individual constructs within the TDF (Braun and Clarke 2022). The TDF provides a theoretical lens through which to view the cognitive, affective, social and environmental influences on behaviour. The TDF simplifies 33 theories and 128 constructs, which may explain behavioural change, into 14 domains underpinned by psychological theory. The inductive approach to the analysis, ensured that non-TDF-related factors were not overlooked, and nuance and context not lost.

Analysis of the manuscripts identified 16 themes across 7 TDF concepts suggestive of how their child's behaviour may have been influenced within the context of the family home environment and wider community. The theoretical domains relevant to the TDF that were identified included knowledge, skills, beliefs about capabilities, beliefs about consequences, reinforcement, environmental context and resources and social influences. The themes identified through thematic analysis included references made by parents to both positive and negative health behaviours. Where themes emerged that were associated with the constructs and responses to the FNPA, these were drawn together to provide further context to participants responses. Many of the themes identified were interrelated and overlapping within and between categories and could have fitted within multiple domains. Therefore, the TDF framework provided a useful method to categorise behaviours theoretically and to potentially inform the development of future health behaviour change interventions. An overview of the themes, concepts and commonly discussed topics is provided in table 29.

4.3.3 Knowledge

The knowledge construct within the TDF concerns people's knowledge about a condition or their knowledge about specific guidelines and/or the actions they need to take to achieve the required outcome/behaviour. Whilst knowledge has been found to be important in behaviour change, it is not a sufficient factor. For example, understanding the health risks associated with obesity might not by itself determine whether someone chooses to lose weight. A key line of enquiry for the interviews was to understand parental awareness of child overweight. Whilst all interviewees correctly identified their child as being a healthy weight at the age of 10/11 years (see table 17), parents seemed unaware that their child was overweight at 4/5 years age. None of the interviewees used terminology such as 'obese' or 'overweight' to describe their children and therefore it was unclear whether parents made any conscious changes to their child's activity and diet behaviours as a result. However, two parents used terms such as 'chunk' and 'buddha' that were suggestive that their child was not of a healthy weight at 4/5 years of age.

"..funnily enough, of my three kids, I don't think there's ever been a point where #nameofchild was a bit, has been on my mind…um me considering him to be chunky or fat even. The reason I asked about whether you were looking at his weight from birth is because he was my big baby and was a very chunky baby." (Parent 3)

Another parent spoke about how they gave their child a nickname based on their weight:

"..and that was his nickname, the chunk, #nameofchild chunk…and he was like a Buddha…." (Parent 4)

One parent recalled how their child approached them with concerns about their weight and how they found it difficult to respond to this. This could be suggestive that the parents were unaware of their child's weight status or that the child themselves may have been misclassifying their own weight

"I just said to her, #nameofchild, you know, you're not fat darling. You know, you're, you know, that's all I used to say to her and you're, you're quite healthy, you're not overweight, and I tried to not make much of an issue out of it because I don't want it to be an issue. But I didn't know, I didn't really know what else I could say to her." (Parent 5)

Another parent spoke of their child having 'their genes' and therefore predisposing them to putting on weight. This is a common misconception made by the public, often ignoring the complex and multifactorial causes of obesity. Few parents made any specific references to national guidelines focusing on body weight (e.g. 5-a-day, CMO physical activity guidelines), although one parent was aware of the guidelines around BMI.

COM-B	Theoretical domain	Theme	Quotes
Psychological capability	Knowledge	Knowledge of child weight status	*"It's better for them if they're a healthy weight, isn't it? I wouldn't say it was majorly important." (Parent 5)*
Physical capability	Skills	Home cooked foods and preparation of food	*I'm hoping that you know, them learning to cook. That was one thing I did try to do…actually was get them to cook the food themselves and prepare it." (Parent 4)*
Reflective motivation	Beliefs about capabilities (self-efficacy)	Involving children in shopping	*''So like, if we go shopping, I didn't, you know, I get to help choose what food we have that obviously encourage her like, you know, instead of buying bags and bags of sweets, well we also need to eat fruit and stuff as well." (Parent 5)*
		Giving children autonomy over food choices	*"I've always asked them is there anything you need in our shopping and market shopping, and I will buy sweets and chocolate even now I'll buy strawberry laces or Haribo's um and they're freely available in the cupboard and biscuits. And um I have a bottom drawer which we've got like the lunchbox chocolate bars in like Timeout Twixes so they got free access to the bottom drawer and the biscuit cupboard." (Parent 3)*
		Encouraging children to try different foods	*"But I also tried explaining, you know, simple things that #nameofchild loves chocolate. So how did you know that you liked it? You know, at some point, you put that in your mouth for the first time, you've got to try things to know that you, you like them, you know. Um, but when it comes to, you know, as I've taken them into, you know, the supermarket tried to get into the shopping themselves as well." (Parent 2)*
	Beliefs about consequences	Awareness of consequences of weight on health	*"I think #nameofchild's unlucky because I think he's got my genes. And I think he will have a tendency to put on weight. And he's very much built like me, and my son and my sons, my eldest son is chunking up a little bit, you know." (Parent 4)*
		Importance of child mental wellbeing	*"For me mental health is the most important. I think so long as they're happy, I think the rest sort of follows, you know, um sort of the good eating habits, things like that and the exercise, you know, if they're generally happy in themselves." (Parent 4)*
		Family history of overweight and illness	*"I am aware of the consequences of weight. My mom was extremely overweight and ended up dying because of it." (Parent 4)*
Automatic motivation	Reinforcement	Sleep routine	*"From a very early age, I've insisted that they go to bed at a certain time, and they have a bed routine in terms of cleaning the teeth, reading a book, and then go to sleep." (Parent 2)*
		Rewards	*"I didn't use sweets because I don't like using that as like a reward because it's not good for them." (Parent 5)*

Physical opportunity	Environmental context and resources	School Environment	*"I honestly think it was because he just started doing more exercise, just the sport, the bigger school, the facilities, being able to, you know, scoot to school, massive playing fields being able to run around more at breaktime. Because it's a big field." (Parent 4)* *"We were very lucky that our primary school had already implemented a healthy eating programme, um, for, for all of the children in the school." (Parent 1)*
		Access to community sport	*"…we're very fortunate to have various children's football clubs around us." (Parent 1)*
Social opportunity	Social influences	Parental modelling and accessibility	*"Yeah, he's become more active. The last two years. Um I've got a new partner. He's a PE teacher. And so he's actively taking #nameofchild out to golf. And, you know, trying to get him he is getting more sport, talk, you know, football matches, talk about sports, things like that and exercise." (Parent 4)*
		Spending time to together	*"so the kind of exercise is a bit of a secondary outcome, but actually spending time together is more important." (Parent 3)*
		Peer modelling and influence of siblings	*"He's fortunate enough to have a brother. And I think that helps in terms of being very sporty." (Parent 1)*
			"If I think and look back at it, you know, when he saw #nameofsibling being, you know, sort of saying I don't want to eat that and me desperately trying to get him to eat something. Um, whether he picked up on that a bit, I don't know." (Parent 4)
Non TDF Theme	Restriction	Restricting screen time	*"We've enforced parameters around screen time. We've got parental locks on most things, the boys know that, that they can have screen time, but it's in moderate amounts. And it's once they've done everything else." (Parent 1)*

Table 29. Summary of themes from participants mapped against theoretical domains framework

4.3.4 Beliefs about capabilities (self-efficacy)

In short, the capabilities domain is the skills and ability of individuals to carry out specific behaviours. This is often referred to as self-efficacy and in the context of this study is the ability of parents to influence and shape their children's behaviour (Bandura 1997). Beliefs about capabilities are relevant because the level of confidence an individual possesses about their ability to perform a particular behaviour is likely to affect whether or not they implement it (Lipworth et al. 2013).

A common theme from interviewees was the importance of home-cooked food and its role in providing a nutritious and balanced diet for their children. One parent commented that 'it doesn't take much to make a vegetable stew', likely underplaying their ability and knowledge to carry out the task. Whilst the children in this study observed a positive shift in weight status between the two time points, most of the interviewees spoke about the challenges in providing their children with a healthy diet. All interviewees saw cooking homemade food as important and the benefits this brings to their children's health, but this was not perceived to be without its challenges. One parent talked about how they were distressed and annoyed that their child refused to eat home prepared food and that this was made even more frustrating due the parent having previously been a chef and competent at cooking:

"I'm a good cook. I used to be second chef, I've run my own pub, but my um kids won't eat what I cook. And it frustrates the hell out of me because I used to love my grandmother's cooking for me, stews and casseroles and, you know, and, and things like that. And I love them from a young age, I can't understand why my kids won't eat that food when it's so lovely. I can't get them to eat it. And they just won't. And it's frustrating. And it's been frustrating since they were young." (Parent 4)

Some of the parents reflected on their own life experiences of growing-up and drawing comparisons with the upbringing of their own children. Most interviewees noted that parental influences during development were highly influential in not only forming their own personal habits but also in inspiring them to focus on instilling positive habits in their children. This often led to a range of emotions such as sadness for not being able to share similar memorable experiences. One parent referred to how they often cooked different meals for members of their family to ensure that they would enjoy and eat their food. One parent talked about how this frustrated them and that they missed their family not being able to enjoy the traditional Christmas meal and this forming a central part of family of life:

''I just love the Christmas dinner. I would love for them all to sit down and have Christmas dinner covered in gravy. And I know they won't, I'll be cooking four or five different bloody meals. Because everybody doesn't like, you know, elements of it and it's a shame."
(Parent 4)

Parents spoke of giving in to the demands of their children, indicative of a permissive parenting style whereby they were unwilling to exert control and appease their children. Another parent talked about the time they were attending slimming world and that this resulted in them cooking several different meals to please all the family members. One parent acknowledged that despite all their best efforts they simply ran out of ideas on how to encourage their child to eat the food that was made for them:

"…but other than force feeding them to make them eat it, I don't know how to get them round to trying these things. You know, they just don't like them." (Parent 4)

Whilst some parents found it difficult for their children to eat healthily, many demonstrated adaptive and creative ways to encourage their children to eat healthy foods. This may indicate that these parents had the skills and knowledge to come up with alternative solutions that other parents might not have been able to. For example, feeding their children raw vegetables instead of cooked vegetables, and using dips. Several parents spoke about how they involved children with cooking to teach them how to prepare food and encourage them to consume what they made. This level of engagement, modelling and devolved decision making was also apparent across other food related areas. For example, parents reported being engaged with their children in decisions around what food they wanted to try through adopting more authoritative styles of parenting. One interviewee alluded to how food was freely available within the house with the intention of children having an informed choice and understanding that some types of food should be eaten infrequently:

"I've always asked them is there anything you need in our shopping and market shopping, and I will buy sweets and chocolate…. I'll buy strawberry laces or Haribo's um and they're freely available in the cupboard and biscuits. And um I have a bottom drawer which we've got like the lunchbox chocolate bars like Timeout, Twixes so they got free access to the bottom drawer and the biscuit cupboard." (Parent 3)

This parent also talked about not looking to 'police' what their children did but did ask that their children eat their sandwiches and fruits in their lunchbox before having "anything else." They

also reminded their children that they could not continue eating like they did into adulthood, which questions whether the approach they adopted meant that their children were eating healthily. Another parent also talked about empowering their child and giving them the skills, knowledge, and capability to determine their own behaviours, indicative of a non-authoritative parenting style:

"Um, I think we want him to make his own kind of healthy, healthy choice, um, and for him to really grow up with a love of being healthy. So a love of the outdoors and a love of fresh food, and understanding of how food is grown and where it comes from an understanding of the way that food affects the body……we would like #nameofchild to be able to recognise those kinds of things in his own body and his own day to day routine, and be able to moderate, um, his lifestyle accordingly without feeling like he's being told what to do constantly by me and his dad." (Parent 1)

However, one parent recalled their child having unrestricted access to food within the house during the COVID-19 pandemic and that this was a challenge, particularly whilst they were working from home and were not able to effectively monitor what their child was eating. These references may have suggested that whilst children had access to unhealthy snacks and perceived by parents to be 'unrestricted', an element of monitoring was in place.

Two parents referenced how they involved their children with the shopping, enabling them to help select and choose what foods they might like to try at home:

"So like, if we go shopping, I get them to help choose what food we have that obviously encourage her like, you know, instead of buying bags and bags of sweets, well we also need to eat fruit and stuff as well." (Parent 5)

Whilst one parent recognised the skills they had learnt were passed down from their parents, they felt that they could have done more to impart these skills onto their children:

"….I regret not spending more time teaching them more about food….I had three really key women in my life, who taught me to cook, you know, and, and cook well and make the most of what I had in the fridge and things….but I didn't do very much when they were younger." (Parent 4)

4.3.5 Beliefs about consequences

Beliefs about consequences refers to a person's acceptance of the outcome of a given situation and may relate to factors including their beliefs and expectancies from performing a desired behaviour. The beliefs a person holds about the outcomes of particular behaviour will affect whether or not they decide to comply (Lipworth et al. 2013). In parents, recognising the detrimental impact that obesity has on health, may have influenced parental motivation to ensure a healthy home environment for their children, Interviewees demonstrated an understanding of the link between being overweight and ill-health. One participant made the link between health in early life and how this can influence physical health in later life:

"I suppose there are guidelines for weight, then that's an indication potentially, of their health later in life, that maybe an inclination towards being overweight in, in their youth is potentially an indicator of being overweight later in life. And therefore, anyone, um, dealing with, um, issues of weight in later life are always going to be subject to certain other health issues. Um, pressure on the heart or the circulatory system or on the other vital organs." (Parent 1)

Participants spoke about the importance of their child's wellbeing and that good mental wellbeing could be a precursor for a healthy body weight and good health more generally. One parent talked about how they encouraged physical activity as means of promoting well-being:

"I think, from my perspective that, that they are happy that, um, that particularly in their mental health, and that they're happy, happy with their, their body, um, physiological, you know, how they look……. He's always been into the physical activity, which I've tried to push as an outlet for him for his not just about keeping fit, but his mental health and wellbeing." (Parent 2)

Parents were also familiar with the consequences of too much screen time and sedentary behaviour and the importance of children's health to overall society and population health as one parent so eloquently described:

"I mean, really, the future of society is based on children's health. You know, if we don't have a healthy, healthy community of children, we haven't got a healthy future society." (Parent 3)

Interviewees often remarked of illness within their family making an impression on them with references to struggles with their weight, disease, or illness of close family members One parent spoke about the history of obesity in their family and that their mother died from the

'disease' and that this motivated for both them and their children to not experience the same fate:

"…I've struggled with my weight, all of my adult life…I am aware of the consequences of weight. My mom was extremely overweight and ended up dying because of it, um you know, they couldn't examine her properly, because she was so big." (Parent 4)

4.3.6 Reinforcement techniques

In the TDF, reinforcement is behavioural technique defined as "Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus" (Lipworth et al. 2013, p. 8). It is held that reinforcement can influence behaviour through perceived rewards or punishments and affect whether someone decides to implement it.

In the context of parenting and childhood obesity, reinforcement has often been associated with rewarding behaviour through unhealthy snacks or restricting unhealthy behaviours through controlling parenting practices. When participants were asked about rewards or restrictions to promote healthy behaviours, there was a mixed response. All parents commented that they used rewards to encourage healthy behaviours but did not use sweets. This corroborated with parents' answers from the FNPA questionnaire whereby an average score of 3.6 across the 'rewards' subdomain by interviewees, was higher than the total sample mean of 3.36, suggestive that parents interviewed were more likely to reward children with unhealthy foods, although care should be taken in relation to interpretation given the small sample size. One parent commented:

"I've never used food as a reward. So if you eat that, that particular fruit, you can get a bag of sweets. I've never done that. Um and it's always you know, you need the fruit and veg to be healthy." (Parent 4)

One parent stated that they use rewards such as outings, in response to positive school reports. They also reported that they would often only allow their child to have a pudding if they have eaten their main dinner/course which may have reflected an authoritarian parenting style. One parent resorted to "bribing" their children with money to try different food.

Monitoring screen time as a method of reinforcing desired behaviour was a common theme in conversations and how families used electronic devices. Whilst interviewees recognised this

as being an important 'tool' to limit exposure to high levels of screen time for their children, the score for monitoring screentime across the sub-domain in the FNPA was slightly lower that the matched sample (2.91 vs 3.04). Participants talked about using a wide variety of technology at home with discussions primarily focusing on their children using video games. In general, parents reported greater use of video games amongst their children towards the latter part of the child's primary school years which followed through into secondary school.

One parent reflected on the importance of reasoning within the context of screen time and explaining to their child why sedentary behaviour might limit their exposure to other lifelong opportunities and that children should be given informed choices and understand the consequences of their choices:

"And this is what I've tried to explain to them. Whilst they're sitting just doing that. They're not exploring their other talents. They're not out there becoming exceptional football players, or they're not out there becoming better at rugby, or seeing their friends or going outside and exploring a forest or because they love doing things like that as well. So I always try and present them with options and help them see that actually, it's one or the other. Because life is always about making decisions. And you're always gonna feel like you're missing out, but if you sit for four or five, six hours at a time in front of a screen, it means you've missed out on all those other wonderful opportunities. And I think if, as young children, they, they learn that. And they learned that at the end of the day, it's up to them to make a healthy choice, whether it's to do with what they're eating, who they're seeing, where they're going, what they're doing with their body. I think that they then become empowered. And they then don't feel that they've been restricted by an adult." (Parent 1)

Likewise, most interviewees shared a similar viewpoint by talking about screentime being given to children once they had done other chores or more important activities such as homework, had their lunch/dinner, played with the dog or done music practice.

A further theme involved child sleep with parents emphasising the importance of a good sleep routine. A nightly bed routine has been identified as a key factor in healthy sleep, but also of broad development and wellbeing in early childhood (Mindell and Williamson 2018). In particular, evidence has consistently found a negative association between sleep duration and overweight and obesity among primary school-aged children (Morrissey et al. 2020).

4.3.7 Environmental context and resources

The environmental context and resources TDF domain featured frequently in all the interviewee's responses. This domain refers to "circumstances of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour" (Lipworth et al. 2013, p. 7). This proposes that the nature of the environment where a person is required to perform a specific behaviour is likely to affect whether a person is able or willing to perform it. Environmental context and resources emerged as a key factor with many of the interviewees stating how the environment influenced both the dietary and physical activity behaviours of their children. Access and opportunities to physical activity was mentioned by all interviewees as important drivers for behaviour change. This ranged from opportunities to be active at school to the availability of local sport clubs and activities in the community.

The size of school and sport opportunities was highlighted as a particular area that encouraged or inhibited children's physical activity behaviour. One parent spoke passionately about their child changing school mid-primary school years and this having a significant positive impact on their child's activity levels which may have contributed toward a positive child in weight status:

"….at the beginning was a little tiny village school. They couldn't even have enough boys for a football team, you know, let alone anything else. And then he moved to a school where there were either 60 or 90 in the year group. And all of a sudden, there's after school, sports activities and things. I think that's what has happened to him as he has enjoyed sports school and suddenly had the opportunity to do it….. I think he really could have done with that at the beginning." (Parent 4)

The built environment and access to green space, proximity of schools and plethora of sport clubs was identified as important in the context of physical activity opportunities for children. Three of five interviewees referred to the amount of swimming their children participated in and that this increased substantially throughout the primary school years with one parent recalling how their child was doing *"half an hour swimming per week at reception age"* to between four and six hours" by the year 6 (Parent 2). Living close to the school and other community facilities was seen as advantageous by parents, as it enabled their children increase active travel opportunities to school and walk to the local shops. This reflected key aspects of encourage health enhancing behaviours through structural factors and increasing

accessibility due to where the children lived. This was further emphasised by the parent whom child moved house which resulted in them living closer to the child's school:

"But then when they moved to #nameofschool, in #nameofltown, I live around the corner. So then they started scooting, they started walking, or we'd be on a scooter. So then that exercise picked up, you know, we walk the dogs over the park." (Parent 4)

There were further references to the built environment by the same parent and how the food environment also shaped the dietary behaviours of their children. In particular, how moving house to an area with poorer access to fast food reduced the number of convenience meals they consumed as a family:

….. And when we lived in #nameofarea, it was seven miles to the nearest shop, let alone a takeaway. No one delivered. So, so, all of that really has stopped……they don't have as much junk food." (Parent 4)

There is growing evidence on the negative role on the proximity of fast food outlets to where people live with research previously having found an association between access to fast food outlets and weight gain in mid-childhood (Pearce et al. 2017).

Another common theme that arose regarding the school environment was food, and in particular the introduction of the Universal Infant Free School Meals initiative for key stages 1 (ages 4-7yrs) (Sellen 2018). Parents referenced this as important in providing their children with "at least one nutritious meal per day' and that this was something that had not been available for their older children as it was implemented in 2014. This reflects the value which parents place on national policy, whereby legislation is acknowledged as being a key instrument in influencing behaviour change. In particular, research has found wide support from parents for universal free school meals and the positive impacts in the short term on educational, social and health outcomes, with evidence also indicating an positive impact on obesity rates (Angus 2020). Parents also talked about the effort that schools went to, to create healthy school environments as part of the PSHE programme and how it was important that these reflected the same values and ethos around healthy behaviours that were practiced at home:

"…children, um, were discouraged from taking chocolate bars, um, packets of crisps, fizzy drinks, sweets, or anything similar to that to school, either for their pack lunch or, or for their playtime break, they were encouraged to take fruit, um, yoghurt, um, sandwiches, um,

simpler foods, essentially. And that was, that was really quite rigorously upheld, um, by numerous members of staff throughout #nameofchild's time at primary school." (Parent 1)

Despite parents actively trying to encourage healthy living, three parents talked about the challenges of daily life and how being busy was sometimes a barrier to providing for their children as they wanted to, as one interviewee commented:

"...I think life was just so busy……that you just kind of just want anything just down the neck and a bit of an easy life*." (Parent 4)*

However, other parents talked about how they always tried to cook from scratch despite how busy their family life were. Another parent talked about how the provision of school meals meant that they did not *"have to cook a meal for them in the evening"* and therefore fitted in with their hectic work schedules.

There were mixed responses to the financial resources that were available to parents and how this influenced the opportunities to shape their child's behaviours. Most parents acknowledged that they were fortunate to be able to pay for activities and outings, that would not necessarily be affordable for everyone:

"….we've always taken them to places like, Sudeley Castle, which you may know, has got big outdoor climbing, wooden climbing frames of Castle climbing frames, trees to climb forests to explore lots of land and external kind of acts activities to benefit from. And I do realise those kinds of outdoor pursuits involve um, money and extra resources that I appreciate we're very lucky to have as a family and I know that other families won't have those things. So I think the access to additional funds, um the fact that I've always had some um some financial ability to do those extra activities with them." (Parent 1)

Parents also referenced how having good financial resources enabled them to ensure a diet of homemade food. However, another parent talked about how a change in their financial circumstances contributed toward them adopting more healthy parenting practices:

"When the kids are at junior school, and I was quite a wealthy woman, I'm now on benefits, and go to Lidl rather than Waitrose. And do you know what, I probably buy more vegetables now than I did when I had, you know, the money, because I bought more takeaway, if I'm honest. And so I don't think money is always a good thing. And I think if you want to eat healthily, when you look at the money of how much vegetables cost you in Lidl, and you

know, if you go to a greengrocer, or just you know, or farm, they are reasonably cheap actually, and I don't quite understand how people say, I can't feed my kids healthily…actually, I'm probably healthier now. I'm poorer than when I had the money." (Parent 4)

The parents' ability to cook from scratch in this instance, may have provided a level of 'buffering' to the consequences of low income and its association with poor diet, although there is a complex relationship between income and a healthy diet (Serasinghe et al. 2023)

4.3.8 Social relationship influences

The social influences domain of the TDF aims to understand the extent to which social influences facilitate or hinder behaviour. Social influences refer to "those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours". Factors such as pressure, encouragement, or support from others can often influence the performance of a desired behaviour (Lipworth et al. 2013). Throughout the interviews, there were frequent references from all interviewees regarding the social influences on their children's behaviour (physical activity and diet) and how social norms were established through interacting with friends and family.

Family structure plays an important role in childhood obesity but the association between having siblings and childhood obesity is not well understood (Park and Cormier 2018). Siblings were identified by all parents as both positively and negatively influencing their child's behaviour. This involved many direct and indirect forms. For example, there were several references to how older siblings potentially acted as role models and acting as gate keepers by exposing their younger brothers and sisters to videogames as one parent described:

"Minecraft was probably about Year four maybe something like that, but that was only because her brother had it." (Parent 5)

Parents tended to perceive this as having a negative impact and encouraging sedentary behaviour from an early age. On the other hand, one parent talked about how taking their child to watch their siblings do sporting activities exposed their child to greater physical activity opportunities as well as encouraging them to take part. They commented:

"…he will have come out with me when the other kids have gone, when I take them to swimming lessons and dancing lessons. I remember being with him at ballet classes. …he

joined the ballet class in the end, because we were just sat there, and he will join in for about a year…rather than sitting outside with me being bored." (Parent 3)

One parent held the view that the number of siblings and the gender of children impacted on a family's ability to be active:

"I've noticed that um it's harder for those parents to entertain their only sons. And so um we realised that #nameofchild is actually quite fortunate to have a brother. And we, we recognise that being a very active family is something that we've had to engage with, since the boys were very, very young. Whereas I know that in some other families where they've either got only one son, or they've got one son, and maybe a daughter or two daughters, they have found it harder to incorporate, to incorporate kind of the boys desire for high level sporty activity, into a lifestyle where they've got girls, I don't, don't want to, I really don't want to, um to pigeonhole it is male and female. But it's just what we've experienced in our in our own life." (Parent 1)

This is supported by research that has found that having fewer siblings is significantly related to child unhealthy lifestyle behaviours (e.g., skipping breakfast, eating fast food/snacks, and being sedentary) (Mushtaq et al. 2011; Olds et al. 2011). Evidence has also found that children without siblings (only children) are more likely to be overweight compared to those with one or more siblings (Mosli et al. 2016; Santiago et al. 2012).

Parents also talked about how they had acquired knowledge and awareness of local sporting clubs gained through taking older siblings to such activities and that this introduced their child to new activities, as one parent highlighted:

"*I actually think #nameofchild might have been offered a greater opportunity for physical activity, because I've gotten to know, yeah, we can do football and definitely um definitely swimming." (Parent 3)*

Whilst the parents interviewed talked about encouraging their children to take part in physical activity, the interview sample only scored marginally higher for encouraging physical activity within the FNPA questionnaire compared to the matched sample (3.41 vs 3.38). Interviewees also talked about how their children's friends and peers positively influenced their physical activity and eating behaviours. One parent commented:

"If he sees his friends eating a banana, or eating an apple or whatever it might be, yeah, almost like peer pressure. Well, if they can do it, then…" (Parent 3)

One parent talked about the importance of school friends and other children living with the vicinity of their home which enabled their child to meet up and play in the street and be active together. Two of the interviewees talked about how they treated their children differently to their older siblings, and that they did not have the same opportunity to establish bigger peer groups and networks. One parent referenced how they had *"kind of done everything"* with their older siblings and tried to build relationships with other parents, but this was not reciprocated with their youngest child (child under investigation). Interviewees expanded on this and suggested that supporting their older children, meant that they had limited time and energy to support their younger children.

"He probably didn't have a very big peer group cohort pre-school because I was always so busy with my other two kids. I didn't need that as a mum and he just mix got into the mix with the other two kids, so I don't remember him having any particular friends actually." (Parent 3)

Whilst parents acknowledged bringing up their younger children differently, evidence around birth order and unhealthy behaviours is inconsistent, although birth order has been found predictive of obesity, with youngest siblings at higher risk of compared to their older siblings. This might be due to parents being indulgent in their feeding styles with their youngest children because they have relaxed their nutrition standards and/or are less vigilant as a function of childcare burden which might corroborate the parent view in this instance (Park and Cormier 2018). Interviewees spoke about how they regretted not exposing their child more to other children and their families, as they recognised this to be a part of socialising their child and learning how others behaved, particularly within other family home environments.

Social influences were not confined to child peers and their siblings, with parents frequently referring to other parents when comparing child health behaviours and parenting practices. This ranged from references to other parents' financial circumstances to how they may or may not put in place screen time limits. One parent talked how they felt embarrassed and shameful about taking their child to McDonalds, how over time this was becoming more normalised with other parents saying they did the same:

"I'm not very proud about it, is that #nameofchild had McDonald's within the first week of weaning with solid food, I think. Not quite that. But very early on he has McDonald's because

we do like a McDonald's. But even a McDonald's would have been once a short term. So once in every six or eight weeks….if you confess in public that you like McDonald's, that feels a little bit embarrassing, but actually, these days, I'm feeling great about it. And they would say, Yeah, I'd really like a McDonalds. And so often, somebody else will say, Yes, we do as well. I don't think we had an excess of McDonald's. My first baby would not have had the McDonald's nearly as soon as my third." (Parent 4)

This might be suggestive of parents wanting to conform to societal expectations of healthy eating and being perceived as a 'bad parent'.

4.3.9 Motivation and goals

Motivation and goals refer to the reasons why parents may have carried our certain parental practices and how much they felt they needed to do it. Whilst there were not any specific references made to goals, parents frequently referred to instances or intentions to encourage healthy behaviours for their children. The link between obesity and family history was also made by one parent recognising the risks this posed to their child and indicative of their motivation to try and protect their child from following this pattern:

"I don't think it was necessarily a conscious influence, but it's always been in the back of my mind that my nan was a big lady, her daughter is reasonably big, my auntie. And, you know, I know I gain weight very easily, and I'm not very active. So I think I'm trying to just not, I just don't want my kids to have those fights when they're older." (Parent 4)

This statement suggests that the parent is resigned to an inevitability of her off-spring becoming overweight and low self-efficacy in ability to prevent this from happening. A key theme throughout the interviews was the importance of families taking part in activities together as a goal in itself, rather than for other health benefits. Four of the five parents spoke about the importance of eating together as a family and something they valued. One parent recalled how important eating together was whilst they were growing up and that this formed part of treasured memories and spending quality time with their parents. One parent spoke about how spending time together to eat formed an important of the family bonding:

"I attached a lot of emotional security to the idea of having a family meal together as a very regular thing. And having it as a, a bonding experience and a nurturing experience, as well as something which is the source of healthy lifestyle." (Parent 1)

However, it was also acknowledged by interviewees that different parental working patterns often meant that eating together was not practically possible. One parent talked about how they mitigated this by staying with the child if they were eating by themselves;

".. what I've tried to do is even if I had to feed #nameofchild and his brother separately from me and his father, I have always tried to remain there as a presence while they've been eating. So when they're at the table, I don't leave, I don't leave the room or the kitchen so that they're eating but I'm still there having a conversation with them, even if I'm doing the washing up or doing the ironing or something while they're eating." (Parent 1)

Where parents spoke about eating as a family, this was reflected in the corresponding FNPA score for the construct of eating one meal a day with at least one other family member.

Spending time to be active as a family was also perceived to be important to parents recognising that the all the family would benefit as one parent highlighted "the kind of exercise is a bit of a secondary outcome, but actually spending time together is more important." Whilst spending active time together was seen as being important by those interviewed, there were no observed differences between the interview sample and matched sample for the FNPA question on family exercising (FNPA Score (Q16) 3.83 vs 3.83).

4.3.10 Themes identified outside of the TDF

Restriction

Most of the parents reported using some degree of restriction and parameters for their child's gaming devices and use of other screens e.g. televisions, recognising that too much screen time and/or sedentary behaviour was detrimental to their child's health This focused-on parental controls and limiting the amount of time children spent on screens. The technical knowledge and ability of parents being able to restrict electronic devices were seen as important, as many perceived this to be challenging. One parent reported their husband as being 'tech savvy' that enabled them to put restrictions in place from an early age therefore straddling into the knowledge and skills domain of the TDF. Other parents talked about their child receiving a mobile phone for the first time and the parameters they put in place to limit the time they spent on it

"He got his mobile phone for the first time. So he didn't he didn't have it before then. Um so we have got a lock on there. So he could only have certain amount of time on his phone, and it only give him access to certain days that we'd kind of we're happy with." (Parent 2)

Parents recognised the addictive qualities of some gaming devices, whereby without restrictions, their children would “sit there all day if you gave them the chance”. There were also examples of authoritative parenting tendencies, with parents saying that they often explained to their children the reason why limitations on screens were enforced to help them understand, as one parent so eloquently put:

> “I’ve went when we’ve taken away screen time for instance, I’ve repeated over and over again to #nameofchild for years now. It’s not a punishment. It’s just to help you understand that you need to factor in things to a daily timetable. There are only enough hours in the day and certain things have to take priority. And the screen time is for when you’re bored. Or when you’ve done all your homework you’ve done all you’re your, um your sports you’ve done all your other things you need to do.” (Parent 4)

4.4 Summary and conclusion

This chapter has summarised the keys findings from the quantitative and qualitative components of the research. The quantitative phase presented data from the total and sub-sample populations, exploring a range of associations between different factors and variables. This found that the FNPA was predictive of being overweight, weight gain over time and that parent recognition of child overweight was poor.

Through the qualitative analysis of the five interview transcripts. Several themes were identified which straddled 7 of the 14 TDF domains, with a further domain identified around restriction. None of the parents stated that they intentionally put in place strategies to reduce their child’s body weight, although they all recognised the importance of their child being healthy and structured the family-home environment through a multitude of different approaches. This was primarily instigated through an awareness of the health consequences of their child practising unhealthy behaviours and a history of family illness.

Of the parenting styles and parenting practices observed from the interviews, key aspects of authoritative parenting featured prominently, alongside specific parenting practices aimed at promoting healthy behaviours such as involving children in cooking and shopping, as well as social influences on behaviour and access to physical activity opportunities. The following chapter critically examines these findings in the context of current literature.

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Chapter 5
Discussion

5.0 Discussion

This mixed methods study aimed to understand firstly, the association between family-home factors and the emergence, persistence and remission of weight gain between 4/5-10/11 years of age, and secondly, to explore and understand the factors influencing some children to resolve their weight status to a healthy weight by the age of 11 years. The study had a particular focus on examining the social and physical environments of families and households to identify factors that may be protective against obesity.

Our review of the literature identified a complex array of factors that influence a child's weight. This ranges from specific parenting styles aimed at providing a positive emotional and relational environment, to parenting practices such as regular sleep routines, eating often with family, eating fruit and vegetables, and encouraging regular physical activity. Few studies have evaluated the overall obesogenic family home environment with those that assessed such dynamics producing mixed results. Furthermore, little evidence was found in the literature on how the family home environment may influence childhood obesity and for children who successfully achieve positive shifts in weight status during mid-childhood outside of formal weight management programmes.

5.1 Quantitative component

The initial phase of the study involved capturing population level data on 10/11-year-old children through a survey of parents across secondary schools in Gloucestershire. The intention of the initial phase was to understand the family home environment across a large cohort and to inform a purposive sample for which further detailed analysis could be undertaken to explore factors that might contribute toward a positive shift in weight status. The large sample (n=719) provided interesting insights into behaviours in families and the identification of parenting practices that influence the home environment. The quantitative phase of the research was significantly impacted by the COVID-19 pandemic, both in terms of researcher capacity and Government induced non-pharmaceutical interventions which led to school closures as well as the early cessation of the NCMP which affected the coverage rates for children measured during the 2019/20 academic year.

The quantitative phase utilised a validated screening tool that captured family-based practices and child behaviours that are known to be predictors of childhood obesity such as meal routines, regular physical activity and sleep (Ihmels et al. 2007). Similar to other research, this study found a clustering of the individual constructs that make up the FNPA questionnaire,

suggesting a co-occurrence of multiple health risk behaviours in young children (Grunseit et al. 2011; Pearson et al. 2018; Schrempft et al. 2015). Several of the FNPA constructs scored more favourably than others, suggesting that some parenting practices were more common in shaping positive home environments. The 'family meal' domain, which involved how regularly children eat breakfast and eat with a family member, were identified as behaviours which was frequently practiced by parents. This was followed by 'good sleep' and 'bedtime routines' which also scored highly within the FNPA, indicating that parents were confident in modelling and practicing these healthy behaviours.

The importance of eating together is well documented, with family meals offering a rich opportunity to expose children to healthy foods in addition to the social aspect of families spending time together (Dallacker et al. 2018). There is also emerging evidence regarding the importance of regular bedtimes as an independent predictor of obesity at age 11 (Anderson et al. 2017). The constructs of drinking milk regularly and the amount of screen time children undertook scored the lowest of all constructs, suggesting that parents did not demonstrate positive parenting practices in these areas. Whilst milk is documented as providing wide ranging benefits for health, the survey suggests that parents may not perceive this as being important (Zhang et al. 2021). Furthermore, parents may assume that schools and the Government support this through providing milk at school (DHSC 2023; Rural Payments Agency 2023).

The low scores attributed to the screen time construct, may reflect the vast development of media-related technologies over the last decade, with a growing number of children spending a considerable amount of time on screens (OFCOM 2020). Evidence suggests that the plethora and diversity of screens within the home (e.g. TV, iPads, Mobile Phones, PC's) has meant that parents often report challenges in keeping their children aways from screens (Chong et al. 2023). Increases in screen time results in children undertaking less physical activity and increased sedentary behaviour, which would lead to lower energy expenditure and therefore may exacerbate the risk of overweight/obesity (Fang et al. 2019). Despite this, currently no national guidelines exist concerning optimal amounts of screen use (CMO 2019).

Evidence has consistently shown that children who have obese parents are at increased risk for obesity (Lee et al. 2022; Mears et al. 2020). This increased risk has been partly explained through genetics and through parental modelling of healthy behaviours and characteristics of the home environment (Timm et al. 2022). Our analysis of the 719 survey records, found that parents living in high-risk family environments (determined by lower FNPA composite scores) were more likely to self-identify as being overweight or obese. Parents who self-identified as

being overweight or obese had 3.15 times the odds (95% CI 2.16–4.48) of having low FNPA scores (less healthy environment) compared to those with high FNPA scores. These findings are similar to research by Williams et al. (2017b) which found that parents who were overweight or obese were more than twice likely to have a low FNPA score (less healthy environment) than high FNPA scores.

The relationship between the home-environment and parental BMI suggests that targeting parent weight management behaviours might be an effective strategy to influence child BMI and the home environment. Given the evidence between parents attending weight management programmes and how this may shape child behaviour and weight outcomes, encouraging parents to lose weight might provide a useful strategy to help address child obesity. This would support research which has previously found that parents who attend weight management programmes indirectly influence the health behaviours of children (Song et al. 2018).

Analysis of the sub-sample (n=179) assessed the relationship between the home environment with that of child weight and weight change. To our knowledge, this is the first study to examine associations between composite indicators of the home environment that captures important modifiable factors which are known to influence obesity related behaviours, as measured by the FNPA, with data from the NCMP. Whilst only low-moderate associations were found between the overall home environment composite and BMI SDS at 4/5 years, 10/11 years and weight change between the two time points, we found that children living in high-risk family environments were more likely to be obese at 10/11 years old.

When adjusting for independent variables (IMD, parental weight status and gender), children living in high-risk obesogenic family environments were 5.5 times more likely to be obese (≥95th percentile for BMI) compared to those living in low-risk obesogenic family environments. The inclusion of covariates that were known to influence child's weight reduced the odds ratio, suggesting that it explains some of the effect on the family environmental and behavioural variables. This implies that interventions should target children who live in areas of deprivation who are likely to be of even greater risk of obesity, irrespective of their home environment. There is some evidence that previous attempts by Government through initiatives such as Sure Start, has had some limited success in improving outcomes amongst children and families from disadvantaged areas and therefore it could be argued that these programmes should be reintroduced (Meadows 2010).

Only a handful of studies have included an assessment of multiple domains of the family home environment and child BMI using composite measures (covering aspects such as sleep, family meals, physical activity, beverages etc), it is therefore difficult to draw comparisons to existing literature (Ihmels et al. 2009a; Martinson et al. 2011; Schrempft et al. 2015). This is also challenging given the heterogeneity across the measurement tools adopted across studies to examine the home environment. However, despite the lack of consistency across published studies in quantifying the family home environment, our study is broadly in agreement with a limited number of studies that have included composite measures of the home environment.

In particular, the results are comparable to a study by Ihmels et al. (2009a), who devised and validated the FNPA in the United States, which found that children who lived in high-risk family environments were nearly twice more likely to be overweight (≥85th percentile for BMI) compared to children who lived in low risk family environments. One comparable study using a composite score consisting of a physical food and physical activity environment, were associated with a three times higher risk of child obesity (Sirikulchayanonta et al. 2011). Other studies utilising composite measures of the home environment have not found an association with BMI (Schrempft et al. 2015). This study also found a weak correlation (r=−0.29) between FNPA and child BMI centile at 10/11 years, which is similar in magnitude to the correlations reported in other papers incorporating the FNPA (Ihmels et al. 2009a; Johnson et al. 2012a).

To understand the independent contribution of individual aspects of the home environment, a further breakdown of the FNPA composite was undertaken by dividing into the three sub-domains of sedentary/media, nutrition and physical activity. Like other studies, analysis of these subdomains has found strong associations with an overall family home composite score, reflecting that all three make an important contribution toward the family-home environment (Schrempft et al. 2015). Associations between the subdomains revealed a moderate association amongst nutrition and the sedentary domains, indicating that positive parenting practices in one area may relate to positive aspects in another. Other studies have found associations between parent practices relating to nutrition and sedentary behaviours (Fletcher et al. 2018; Pearson and Biddle 2011). Low correlations between physical activity and sedentary domains may reflect the growing consensus that sedentary behaviour is an independent risk factor with evidence showing a dose-response association between sitting time and mortality, independent of physical activity (Katzmarzyk et al. 2009). The three sub-domains across the FNPA found weak associations with BMI status as 10/11 years, but not at 4/5 years, perhaps more accurately reflecting the time-period in which the FNPA was completed.

Further analysis within this study looking at the three sub-domains of physical activity, nutrition and sedentary/media behaviour, and the predicted probabilities of being overweight (BMI ≥85%), found that children who were exposed to environments that encouraged high levels of sedentary/media behaviour were four times more likely to carry excess weight compared to those children living in environments with low levels of sedentary behaviours. This finding is similar to that of evidence reviews which have found that the most robust associations between the home environment and child adiposity are within the sedentary/media domains (Kininmonth et al. 2021). Whilst the majority of studies linking sedentary behaviour and child overweight have been cross-sectional, the underlying mechanisms are unclear. Several explanations have proposed that children being exposed to advertisements for energy-dense food whilst watching television, as well as screen time providing a distraction to children whilst they eat, both may lead to overconsumption (Ogden et al. 2013). Equally, the evidence for the impact of screentime on health is inconsistent, with systematic reviews showing mixed findings (Avery et al. 2017). It has been suggested that this may be due to the failure to separate screentime from non-screen sedentary behaviours which are characterised by low physical movement and energy expenditure (Stiglic and Viner 2019). It may also be due to a failure to separate the sedentary elements of screentime from the content watched on screens. An example in this study was where screen time was perceived positively, was where one parent indicated that their child used their Kindle to read as part of “their bedtime routine”, and reinforced healthy behaviours.

Our analysis of the FNPA and BMI within the sub-sample, did not identify any clear patterns or associations, likely reflecting the complex interplay between determinants. Several constructs of the FNPA showed predictive validity by having significant correlations with BMI and weight change. Nine of the ten constructs were weakly or moderately negatively associated with a change in weight between the two time periods. Family meals and screen time demonstrated the strongest, negative, association although correlations were low. The health environment ($r = -0.298$, $p<0.01$) was most strongly correlated with BMI at 10/11 years. Overall, the individual constructs within the FNPA were not found to be associated with changes in BMI status or changes in BMI z-scores over the 7-year period. This might reflect the overall cumulative effective of the individual parenting practices on childhood obesity, recognising the complex interplay between different contributing factors. However, it is noteworthy, that the total FNPA score had a stronger positive correlation with child BMI percentile than any individual construct. Significant correlations were found between weight status at 10/11 years and 7 of the 10 FNPA constructs.

The disparities in outcomes in the evidence have been attributed to a number of factors: the validity and reliability of measures; the complexity of defining the family home environment; and the cross-sectional, observational nature of most research designs (Timperio et al. 2008). Whilst previous studies in this area have largely incorporated cross-sectional designs, few studies have investigated the family home-environment and weight outcomes over time.

The present study was able to link child biometric data over a 7-year period that enabled insight between two time points and assess potential predictive factors for child BMI. After controlling for independent variables (IMD, parental weight status and gender), children with a total score in the lowest tertile of the FNPA were approximately 3 times more likely to have gained weight (BMI z-score change ≥ 0.6) between the ages 4/5 years and 10/11 years. This increased to nearly 9 times more likely, when looking at more significant levels of weight gain (BMI z-score change ≥ 1.0). To our knowledge only one study has examined weight over time using a composite measure for the home environment, although that study only covered a period of 1-year (Ihmels et al. 2009b). This finding therefore provides new insights into weight gain in mid-childhood and its association with the family home-environment and adds to the growing body of literature suggesting that the home environment may play an important role in the development of obesity and conversely, provide a setting to which obesity can be prevented.

It remains critical that further research identifies the key factors that contribute toward this weight gain. The design of the NCMP means that children are measured at 7-year intervals and through measuring children on a more frequent basis, alongside a comprehensive analysis of the home environment, it may provide greater insights to which factors most influence child weight (Hughes et al. 2011). However, concerns raised by parents on the effect which the NCMP has on child self-esteem, might mean that changing policy may be challenging (Statham et al. 2011).

5.2 Qualitative component

The qualitative analysis utilised purposive sampling with five semi-structured interviews conducted to increase understanding of parental behaviours, strategies, and responses from parents to socialize children's obesity-protective behaviours. The aim was to draw on the findings from the quantitative phase and understand potential reasons for weight loss amongst children who were previously overweight at ages 4/5 years. For this study a thematic approach to analysis was undertaken through which 16 themes were identified.

In this study, no children were identified as being obese at ages 4/5 and then measured as healthy weight at 10/11 years. Parents were therefore selected for interview based on observed weight reduction of -0.6 BMI z-score and/or a positive change in weight category from overweight to a healthy weight. Whilst the study involved a small qualitative sample, it provides several insights into intentional and unintentional factors that may help understand why some children were able to resolve their weight status to a healthy weight by age 10/11 years.

This study was informed by a conceptual model based on the socioecological theory and the TDF, to examine the aetiology of childhood obesity, including aspects of the home environment that may influence the risk of childhood obesity or lend itself to understanding the protective factors that may contribute to weight loss. Whilst the research primarily focused on factors that were proximal to children within the socio-ecological model, parents often spoke about macrosystem and community level dimensions that shaped their child's behaviour. Analysis of the manuscripts identified 16 Themes across 7 TDF concepts suggestive of how their child's behaviour may have been influenced within the context of the family home environment and wider community. The theoretical domains included knowledge, skills, beliefs about capabilities, beliefs about consequences, reinforcement and environmental context and resources and social influences. A further theme was identified (reinforcement) that that did fit with any of the TDF domains. Identifying these behaviour change processes are important to inform behaviour change interventions (Cowdell and Dyson 2019). A summary of the key themes is summarised in figure 25.

Drawing on the health belief model, our initial hypothesis for this research was that parents recognition of their children as being overweight and at risk of health problems, would be a precursor for parents to engage in health-related behaviours (Ajzen 1991; Janz and Becker 1984). Therefore, the need for parents to recognise and understand the importance of child weight was a fundamental prerequisite to a parent's motivations to influence their child's behaviour in the management of childhood overweight and obesity. Data from our study mirror findings from other research regarding the misperception of child weight status by parents (Alshahrani et al. 2021; Rodrigues et al. 2020).

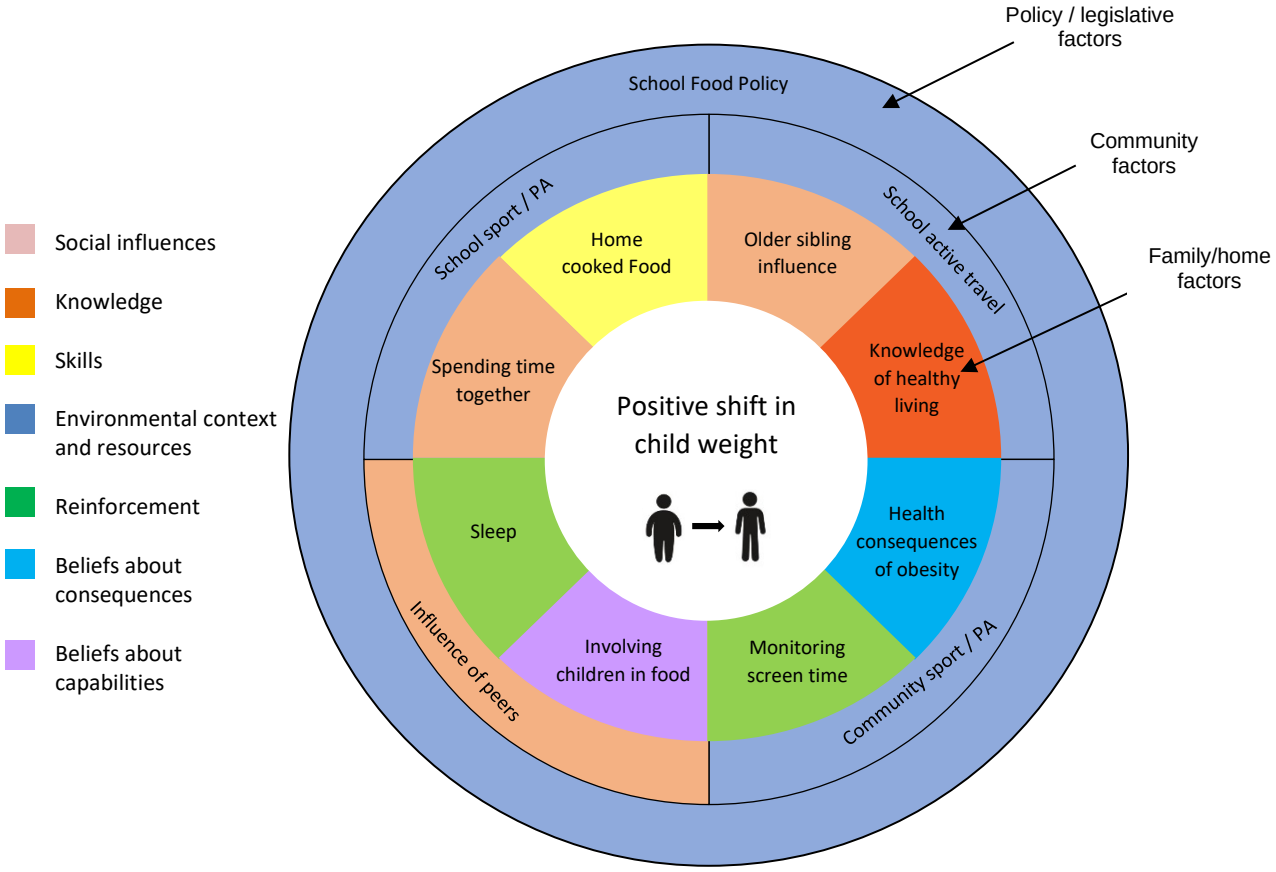

Figure 25. Diagram illustrating some of the TDF themes identified by parents as possible factors to weight loss within the socioecological model

From the matched sub-sample (n=179), the study found a significant number of parents misclassified their child's weight status at 10/11 years. Analysis of the matched dataset found that nearly two thirds of children who were identified as being overweight at 10/11 years, were misclassified by their parents as being a healthy weight. This is comparable to other studies that have analysed NCMP data and have reported similar results, whereby between two thirds and three quarters of parents of overweight children not recognising their child to be overweight (Falconer et al. 2014b).

If we take the proportion of unrecognised overweight and obese children obtained in our study, it can be estimated that there are approximately 5,632 overweight 10/11-year-old children in Gloucestershire who are not recognised by their parents as being overweight. This equates to around 106,740 children across England who are overweight, and not identified as overweight by their parents (NHS Digital 2021). This presents a significant challenge for policy makers and practitioners who rely on parents recognising child overweight in order to put in place mitigating actions to resolve their weight status. All the parents interviewed in this study (n=5) did not perceive, or perhaps knowingly admit, their child to be overweight at ages 4/5 years,

despite biometric data indicating otherwise. However, this could be due to recall bias and the parents' inability to remember their child's weight from several years ago.

The misclassification of child weight by parents may imply that the parents may not have consciously altered any of their behaviours to reduce their child weight. This is important, as weight perception accuracy has been hypothesised to relate to behaviour change (Ajzen 1991; Lydecker and Grilo 2016). Despite this, two parents used euphemistic terminology associated with larger body types when their child was younger, suggesting that their perception, did not necessarily reflect their true feelings. This has been found in other studies whereby excess weight in children were viewed by many as 'puppy fat', which their child would grow out of as they got older. It is equally plausible, that as all the children of parents interviewed were 'overweight' rather than 'obese', distinguishing excess weight may have been more challenging for parents (Smith et al. 2008). It has been suggested that the increasing prevalence of overweight may have 'normalised' obesity, although none of the parents in this study compared their children to their peers in making this assertion (Binkin et al. 2013).

As found in other studies, parents recognised the health risks associated with childhood overweight (Falconer et al. 2014b; Warschburger and Kroller 2009; Warschburger and Kröller 2012). Throughout the interviews, parents did not express concern over their child's weight at any age. This may in part be derived from their inability to correctly identify their child as overweight. However, nearly all parents interviewed perceived health and happiness to be more important to them than their child's weight, which corresponds with other research in this area (Falconer et al. 2014b; Syrad et al. 2015). Parents tended to place more importance on their child's emotional health than their weight, this is consistent with previous studies, whereby parents have conceptualised child health in terms of diet, activity level and wellbeing (Croker et al. 2012). Whilst recognising the importance that parents place on being healthy, happy and active, being overweight can have long term consequences on health and therefore it is important that parents understand these risks to mitigate the likelihood of their children becoming overweight adults.

Evidence has shown parenting styles to be associated with weight outcomes with evidence of a protective role of authoritative parenting style against adverse weight outcomes (Sleddens et al. 2011; Vollmer and Mobley 2013). Whilst the interview sample was small, it was evident that parents often approached parenting using an authoritative style. Whilst this was not always explicit in their responses, parents referred to responding to their child's emotional needs and taking into consideration their child's thoughts, feelings, and opinions. Examples of

this included fostering independence and reasoning with their child to help them understand the decision they took as parents. Parents frequently spoke about how they were aways open with their child, explaining the rationale for their decisions and empowering their children to help make informed decisions and promoting agency. Furthermore, parents recognised the need for their home to have a level of authority and rules where appropriate. For example, parents spoke about limiting screen time, by discussing why screen time limits were important with their child and negotiating how much screen time was allowed. Similar to other research, parents also drew on their own upbringing as strong motivation to either parent similarly, or to parent differently in response to their own childhood experiences (Downey and Gudmunson 2022). Most parents noted they had the necessary competencies and skills such as cooking from scratch and how they wanted to pass on these values onto their children.

The views expressed by parents to help their children understand the value of healthy behaviours may reflect the concept of internalisation. This implies that children "take in" social regulations, make them their own, and eventually self-regulate autonomously (Joussemet et al. 2008). In the context of healthy behaviours, this may relate to the family context facilitating a child's intrinsic motivation to undertake health behaviours autonomously e.g. deciding to attend school activity clubs. Previous research on parental support of autonomy suggests that parents support internalisation best when embracing the perspectives of their children and acknowledging their feelings such that they use reasoning and allow choices (Joussemet et al. 2008).

Research has found that providing structure and guidance, such as setting limits on how much time a child can spend using screen media or the placement of screen media devices in the home (e.g. in common areas such as the living room rather than in a child's bedroom), are associated with lower screen media use (Collier et al. 2016). Parents also gave examples of involving children in decisions around food, whether this was around what food should be purchased or involving children in preparing food. Emerging research has shown that uninvolved practices, characterised by a lack of structure, are associated with the poorest dietary behaviours and weight outcomes, including lower fruit and vegetable intake and greater likelihood of the child being overweight or obese (Patrick et al. 2013). Therefore, the parents in this study exhibited practices that have benefited their child's health behaviours.

Additional evidence of parents in this study exhibiting an authoritative parenting style was reflected in their composite FNPA score, which was found to be slightly higher than the overall sample (63.80 vs 62.37). This is suggestive that these parents at the time of completing the

FNPA demonstrated a more favourable family-home environment than the overall sample population. Research has found that higher FNPA composite scores (healthy home environments) are associated with authoritative parenting styles (Johnson et al. 2012a). It is therefore possible that the styles adopted by the parents in this study may have played a role in their child's future risk for overweight and obesity as a contextual factor that moderated specific parenting practices. Pinpointing potential influences and transition periods during the time-period under investigation for this study is challenging, with research showing that parenting styles and practices may vary across time and context (Gubbins 2021; Pychyl et al. 2002).

It has been recognised that there has been a long-term decline in authoritarian parenting (i.e., high control; low warmth) and movement toward more authoritative (i.e., high control; high warmth) child rearing practices (Larsen et al. 2018). It could be plausible that the parents of children who achieved a positive shift in weight status may have changed their parenting style over the 7-year period, which might explain differences in weight status between the two time points. However, uncertainty exists about whether parenting styles are amenable to change over time and whether the parents in the study changed their parenting style between the two points is unclear (Duncanson et al. 2016). It has been suggested that there may be critical ages where parenting style has a pronounced association with later weight outcomes, but evidence does not currently support this supposition (Sokol et al. 2017). Future longitudinal studies of greater durations and more frequent assessment of parenting styles should be considered to observe any changes in parenting styles and practices over time.

Parents in this study also provided evidence of a bidirectional relationship between parent-child interactions, whereby children influence their parents, as well as the other way around (Gubbins 2021; Ventura and Birch 2008). Parents spoke about how their approach changed when their child demonstrated challenging behaviour, leading to them using a more authoritarian parenting style. This suggests that children who are defiant may lead to parents increasing the 'harshness' of their parenting.

The environmental context and resources TDF domain featured frequently amongst respondents, reflecting the extent to which physical or resource factors hindered or facilitated child health behaviours. Research has found that families live and function in multiple contexts and settings all of which are likely to have some influence on nutrition and physical activity behaviours (Stokols 2000). A change in physical activity levels was a recurrent theme amongst parents as a potential reason for the positive shift in weight status between the two time points.

The underlying reasons given by parents varied, ranging from factors within the immediate vicinity of the family-home environment, such as the influence of siblings and family routines, to community level factors such increased access to active travel, sport clubs and greater opportunities for activity at school and within the community.

Schools were identified by parents as important settings that provided environments that facilitated healthy behaviours amongst their children. Schools have frequently been identified as important settings to influence on children's health, due to children spending approximately 40% of their waking time at school (Fox 2004; Pearson et al. 2015). The recognition of the role of schools and the wider community on child health is not new, with 'health promoting schools' following the publication of the WHO Ottawa Charter, marking a significant shift in public health policy, from a focus on individual behaviour to recognition of the wider social, political, and environmental influences on health (WHO 1986). Empirical evidence suggests that the school environment is ideal for tackling change in obesity-related behaviours as they provide concentrated contact, teach health education, provide meals, promote physical activity and can model health-promoting settings (Nally et al. 2021). However, it has been argued by some, that schools have a limited role to play in tackling childhood obesity (Ofsted 2018).

Changing schools was highlighted as a positive influence on one child's physical activity levels, transitioning from a small school with limited sport and physical activities, to one where there were greater availability and opportunities to be active. It was difficult to quantify the role and extent to which parents had encouraged their children to take part in school based physical activities, but there were frequent references to children just 'taking to it'. However, it is widely acknowledged that supporting and encouraging children to take part in after school activities can positively influence children's activity levels (Hutchens and Lee 2017). Studies have shown that that local school contexts have a significant impact on children's physical activity levels (Gomes et al. 2017). This is likely down to schools providing ample opportunities for children to be physically active because of their social and physical settings, namely school size or playground areas, sports equipment or facilities, lunch breaks, and the promotion of active travel initiatives (Nally et al. 2021).

Evidence suggests that physical activity friendly schools are associated with lower risk of excess weight, with the size of the school, more opportunities for taking part in physical activity and better facilities had a much lower risk of prevalence of obesity than those without (Ip et al. 2017; Sallis et al. 2012). However, longitudinal studies have consistently found that moderate

vigorous physical activity (MVPA) reduces throughout primary school, with a greater reduction in MVPA amongst those who are overweight or obese (Jago et al. 2020).

Parents also referenced schools in the context of the food environment and how this shaped positive behaviours. Parents talked about the impact of the Universal Infant Free School Meals initiative which was introduced for children aged 4-7 years in 2014 (Sellen 2018). Holford and Rabe (2022) found that children who were exposed to universal free school meals had short term benefits on their bodyweight. Importantly, this effect was observed most prominently by children not previously eligible for free meals, suggesting that the diets of pupils from the least deprived, were primarily improved. However, evidence from the US has suggested adverse impacts on bodyweight outcomes from free school meals, although it has been argued that these programmes were subject to less stringent food standards compared to the UK (Whitmore 2009).

Whilst the introduction of these policies are primarily aimed at raising educational attainment, social skills and more broadly child behaviour, they may positively impact child obesity through the introduction of high nutritional quality food, with lunchboxes likely to be lesser quality and of higher calorie content (Evans et al. 2010). Whilst, it would be unwise to associate the introduction of universal free school meals as having an impact on the weight outcomes in this study, children consume a significant proportion of their daily energy intake in schools; therefore, schools may be one mechanism that contributes to a positive shift in weight status. However, the continued rise in the prevalence of child obesity across the England may counter this premise. Further research should investigate the long-term impact of the free school meal policy on a range of health outcomes (including obesity) over a longer period.

Understanding of the public health message about increasing physical activity was evident in our sample. The proximity of children's homes to school and local sport opportunities, was identified as a key factor that led to perceived increases in levels of physical activity amongst children by parents. The ability to partake in active travel through walking and cycling to school, was identified as important in one child's life who had moved house to be close to school, which enabled them to walk, rather than be taken by car to school. There is growing evidence that the built environment has strong potential to promote and sustain behaviour changes over a long time period (Mayne et al. 2015). One UK study involving 8,432 children, found that children who switched to active transport between the ages of 7 and 14 had healthier body weights than those who continued to travel by car (Anthony et al. 2021). This suggests that children can achieve a healthier body weight by switching to more physically

active forms of travel. Swimming was another activity identified by several parents as a possible factor in weight loss amongst their children. Whilst the health benefits of swimming are widely documented, only a handful of studies have explored its impact on childhood obesity. A small number of studies have shown benefits of swimming regularly for several health markers for overweight children. This includes improvements in fitness and overall cardiometabolic risk (Lee and Oh 2014; Machado et al. 2022). There was no clear motivating factor for why swimming was a popular activity, although parents acknowledged that they had the financial resource to support their child, which may not be the case for everyone and is a key enabler for behaviour change.

The findings from this research aligns with that of a systematic review on environmental correlates of weight-related behaviours in children which suggested that, unlike parental influence on eating practices, children's physical activity levels are not highly influenced by modelling, parental support, or home opportunities for physical activity (de Vet et al. 2011). Instead, physical activity is influenced by characteristics of the school and community environment than by features of the interpersonal environment. This may be explained by the fact that many physical activities occur outside the home environment (e.g. active transport, playing outdoors and sport in schools), thereby reducing the influence of the home environment. Despite, this it can be argued that parents have a role in facilitating and influencing the environment to which children are able to be active. For example, parents in this study often referenced their financial circumstances as something that enabled them to provide and engage their children to different experiences and opportunities, that some parents might not have been to do for their children (Downey and Gudmunson 2022). The changes to physical activity levels in children observed by parents in this study, are at odds to research finding that overweight/obese children do less physical activity than children with normal weight (Jago et al. 2020), however we did not measure levels of physical activity between the two points. It has been suggested that being overweight may lead to inactivity due to a range of factors including victimisation by peers, body image and low self-esteem (Stankov et al. 2012).

The role of siblings and peers is reported as significantly influencing children's behaviour. Several studies have examined the role of siblings and how this relates to children's behaviour and their weight (Hunsberger 2014; Mushtaq et al. 2011; Ochiai et al. 2012; Wells et al. 2011). Siblings, as close members of young children's social networks, have potential to influence their social, emotional, and physical development. The relationship between siblings is of particular interest to researchers due to siblings living together in a family that has a similar

genetic background and grow up in the same social environment, therefore presents the opportunity to study the impact of a range of variables. A systematic review by Park and Cormier (2018) found that children without siblings are more likely to be overweight or obese. Research has also suggested that birth order contributes to an increase in childhood obesity, with younger siblings at a higher risk of becoming overweight or obese than their older siblings (Meller et al. 2018). However, recent evidence has found that for single-born siblings, the association between birth order and BMI only persisted only up to 11 years of age (Bohn et al. 2022).

Several explanations have been proposed, such as children with siblings more likely to engage in physical activity or a higher number of siblings resulting in less food availability (Mosli et al. 2016; van Sluijs et al. 2013). In particular, boys without siblings spend more time watching television than those with siblings (Bagley et al. 2006). Others have suggested that parents are more indulgent in their feeding styles with their youngest children because they have relaxed their nutrition standards and/or are less vigilant as a function of childcare burden (Park and Cormier 2018). While others have proposed that younger siblings may copy older siblings unhealthy behaviours such as the consumption of soft drinks, snacking and larger food portions at mealtimes that evolve with age (Kramer and Conger 2009). A study by Timperio et al. (2008) examined the influence of the family physical activity and sedentary environment at the age of 10–12 years old on weight change over three years during the transition from elementary to secondary school. They found that the frequency of physical activity participation among siblings at baseline was associated with relatively greater decreases in BMI change scores over the three years among girls, but not boys. Other social influences reported by parents on child behaviours, was that of witnessing peers and taking part in physical activity. Whilst evidence has found overweight children to be less active, than normal weight peers, research suggests that relationships with peers are an important precursor to physical activity during childhood and adolescence (Barkley et al. 2014).

Whilst a change in food consumption was not identified by parents as a potential contributor to weight loss amongst their children, it was evident that parents recognised the importance of food and its relationship with good health. A further theme identified by parents in promoting healthy behaviours, was the involvement of children in the purchasing and preparation of food, further illustrating authoritative tendencies. Findings from studies generally support positive associations between children helping with meal preparation and healthier overall dietary quality, consumption of specific healthy foods, food preferences, and self-efficacy related to eating healthy foods and cooking/food preparation skills (Perdew et al. 2020; Quelly 2019).

However, evidence of an association with weight outcomes is less clear (Méjean et al. 2018). Parents spoke about this in the context of giving their children choices and allowing them to be part of the decision-making process to help them feel involved and more in control and therefore more likely to consume what was cooked at home.

Parents also spoke about the importance of home cooked food for their children and that they acquired cooking competencies through learning from their parents. This reflected the capability and knowledge domain from the TDF, recognising that parents understood the nutritional benefits of home cooked foods compared to processed food where evidence has shown an association with excess weight and adverse health outcomes (Harb et al. 2023; Pagliai et al. 2021). Whilst parents spoke about strategies to encourage healthy eating, there were frequent references to times when parents 'gave in' to their children's demands and some evidence of guilt when they did. Whilst this may reflect a permissive trait and succumbing to a child's demands, it also suggests that parents did not pressurise their children to eat which has been associated with an authoritarian parenting style (Hubbs-Tait et al. 2008). This parenting style has often manifested itself when parents are busy but could also reflect parents looking after themselves and 'picking their battles'. Several studies have found that parents from low income families often avoid conflict over food to keep the child content and made them adopt a more lenient approach by satisfying child's food requests (Ravikumar et al. 2022).

Research has found that parent BMI change is a significant predictor of child weight change, with a reduction of 1 BMI unit in parents associated with a 0.25 reduction in child BMI (Andriani et al. 2015). This may reflect that if parents are motivated to reduce their weight, this can positively influence the weight of their children. Whilst five of the parents interviewed identified themselves as being overweight, only one parent referenced the challenges they faced with their weight and the strategies they undertook to lose weight. This included an acknowledgement that they had attended a commercial weight management programme resulting in them changing the type and nutritional content of the meals they prepared at home. Of the limited research focusing on reasons for weight loss within mid-childhood, parents attending weight management programmes has been identified as a potential contributing factor to a positive shift in child weight (Gillison et al. 2017).

5.3 Strengths and limitations to study

The are several strengths to this study. This is the first study in the UK to utilise the FNPA to assess a broad range of factors associated with the obesogenic home environment and its

application to the NCMP. The study has a large sample, is longitudinal in design, and utilises BMI change-scores, considered the gold standard for evaluating anthropometric measures (Must and Anderson 2006). The study also incorporated a validated screening tool designed to assess the family home environment. Using a composite variable rather that multiple individual measures provides quantification of a collective view of household obesogenic potential (Grunseit et al. 2011). The individual constructs included a range of practices known to affect health behaviours.

The mixed methods design is also key strength of this study which enabled the use of quantitative and qualitative approaches, in combination, providing a better understanding of research problems than either approach alone (Creswell 2009). The use of TDF as a theoretical lens is a further strength, allowing for the identification of determinants of weight loss (Michie et al. 2011). The TDF was applied flexibly to optimize its use in exploratory qualitative research. This enabled a line of questioning that allowed participants to respond with views and opinions that did not necessarily fit within the specified theoretical domains (McGowan et al. 2020).

This study is not without limitations. The study took place during the COVID-19 pandemic and therefore the response rate to the survey was impacted due to constant changes to national restrictions. The pandemic also led to the NCMP being ceased partway through the year. As a result, recorded participation rate for the population under investigation was lower than expected (73.9% vs 95.0%) (NHS Digital 2021). The survey was undertaken up to 12 months after the child had been weighed and measured and therefore parental responses might not have accurately reflected the family and home environment during the period under investigation and thus subject to recall bias (Coughlin 1990). The delay in interviewing parents may have skewed their perceptions of their child's behaviours as result of the pandemic, despite this period not being under investigation. For example, many parents discussed how their children's behaviours dramatically changed during COVID-19. This is supported by national evidence which has found that extended school closures may have exacerbated childhood obesity prevalence due to food insecurity and reduced opportunities for children participating in physical activity (Nowicka et al. 2022; Razi and Nasiri 2022). Finally, the decision not to pilot the questionnaire, because of the pandemic, limited the ability to test the accessibility, appropriateness, and validity of the questions. As the associations in this study were cross-sectional, causal inferences cannot be made.

Due to the absence of ethnicity coding, an established risk factor for child obesity, within the child health system, this was not controlled for in the analysis (Falconer et al. 2014a). In addition, there is evidence that some ethnic minority groups may live in more obesogenic home environments (Chuang et al. 2013). Despite the evidence of parental BMI (Mears et al. 2020) and deprivation (Little and Nestel 2017) and its influence on obesity, these variables did not contribute significantly in the analysis of the model, although parental BMI was self-reported and therefore subject to report bias and likely to underestimate the true prevalence of obesity amongst this population. However, it should be noted that the sample was also disproportionately skewed with a more affluent population which may have limited the ability to control for deprivation in the analysis. This might be for several reasons including levels of health literacy amongst this population, invitations for the survey not being provided in alternative languages (although the online survey had the functionality to be viewed in 14 different languages) or motivation for completing the questionnaire.

Our research defined weight gain as an increase in BMI z-score of ≥0.6 between the two time points, however this increase in weight may have indicated that some children simply moved toward the upper end of the healthy weight threshold. We therefore also undertook analysis for an increase in BMI z-score of ≥1.0 which showed statistically significant differences between FNPA scores, although confidence intervals were large. It is also important to recognise that a rising BMI trajectory can predict future risk of obesity and therefore any significant increase in weight can be seen as being detrimental to health (Geserick et al. 2018; Pryor et al. 2011; Stuart and Panico 2016). For example, a study by Field et al. (2005), found that children in the upper part of the normal or healthy weight range (50^{th} - 84^{th}) percentiles of BMI for age and gender are at increased risk of becoming overweight or obese in adulthood. Therefore, any deviations away from the 'path to obesity' would likely be advantageous to the health of the child.

While the study design allowed mothers, fathers, and other primary caregivers to participate, fathers were underrepresented with 90% of those surveyed being mothers, and all participants meeting criteria to be interviewed being mothers. Evidence has found that parenting styles differ amongst mothers and fathers. For example, mothers have been found to be more accepting, responsive, and supportive, as well as more behaviourally controlling, demanding, and autonomy-granting than fathers. Conversely, fathers are reported to be more restrictive, coercive, and harsher (as well as more punitive), and to show less parental concern than mothers (Yaffe 2020). This may mean that the research provides a single parenting perspective and might not reflect full parental influences and thus susceptible to social

desirability biases. This might be of particular importance as there is a growing body of research indicating that fathers play a key role in influencing child behaviours (Litchford et al. 2020). Moreover, the research did not attend to the nuances of family structure, such as one-parent households, non-biological caregivers, dual mother parenting, or dual father parenting.

One of the limitations of the FNPA is that it may not reflect the diversity of electronic devices currently available to children. There have been considerable changes in children's use of screens, with a decline in TV viewing and an increase in use of other devices (e.g. tablets, mobile phones, laptops) to access video content as well as new media platforms which are a potential source of disinformation and resulting harm (OFCOM 2020). Surveys have also reported a substantial increase in tablet ownership amongst 5-15 years, rising from 2% in 2011 to around 50% in 2018 covering a significant period of the time period under investigation as part of this research (OFCOM 2020). There has been a call for more detailed measurements of media use that reflect current technology trends and diverse contexts of use are needed to better understand media use and parent regulation of child media exposure (Aftosmes-Tobio et al. 2016). Since this research was initiated, the FNPA has been updated to capture behaviours and environments relevant to contemporary life (Peyer et al. 2021). This includes capturing the different ways children utilise smartphones and tablets.

Explaining why children in this study resolved their weight status to a healthy weight is challenging. Considerable attention has been placed on the importance of genetic factors and their influence on BMI, which may have a stronger (over-riding) than home environmental factors. Some families, for example, may have good dietary and activity habits/environments but be genetically predisposed to overweight/obesity (Johnson et al. 2012b). It is also possible that associations between the home environment and weight may only appear among those who are genetically susceptible to weight gain. The overall contribution of genetics in weight is contested, but there is evidence that has found obesity-related genes to be more strongly associated with BMI in more obesogenic home environments (Schrempft et al. 2018). It can also be argued that the use of BMI-SDS as the primary measure of body fatness is a limitation as it fails to account for factors such as fitness (muscle mass), which can alter the relationship between BMI and body fatness, therefore misclassification of weight status can occur at an individual level, especially during childhood when maturation occurs at different rates. However, using BMI at a population level is seen as relatively robust (Reilly 2007).

To our knowledge this is the first study in the UK to have employed the FNPA screening tool, as well as demonstrating an association between an assessment of the overall family home

environment and weight in mid-childhood. Our analysis found a high proportion of parents misperceived their child's weight status, and that this was also found amongst the parents of overweight children who were interviewed. Whilst none of the parents intentionally put in place strategies for the purpose of reducing their child's weight, our analysis draws parallels to existing literature, with parents reporting a range of strategies and practices that are known promote healthy behaviours amongst children and thus likely to have a positive impact on BMI.

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Chapter 6
Conclusion

6.0 Conclusion

Childhood obesity remains a public health priority, but despite global efforts to tackle the issue, obesity levels have remained stubbornly high. This presents significant risks to the health of individuals who have excess weight, but also on society as whole through economic and social consequences, including the burden which obesity places on national health and care systems. There are few examples of successful strategies that have been implemented to stem the rise in obesity and evidence suggests the need for a whole system and a social ecological approach. Within this, the family-home environment remains a critical setting to which children's health behaviours are shaped and therefore active engagement with parents and families remains important.

We hypothesised that unfavourable family home environments would be associated with child overweight/obesity and weight gain during mid-childhood. This is particularly important as body weight is known to track from childhood into adulthood, making early intervention particularly critical. Our results found that children who live in less favourable home environments were more likely to be obese at 10/11 years age. We also found that children who lived in less favourable home environments were more likely to increase significant amounts of weight during their primary school years. The study lends support to the theory that the home environment plays an important role in the development of child obesity and provides new insights into weight gain in mid-childhood and its association with the family home environment.

Few studies have developed comprehensive measures of the physical and social environment and those that have, have found mixed results. Our analysis provides support for the notion of a composite measure for the family home environment. The findings raise important questions about the role of the family home environment and its influence on children's behaviours, suggesting that health promotion interventions should target the family environment as a key determinant within a wider strategy to tackle obesity. This could take the form of many interventions through utilising the BCW and targeting specific behaviours that promote positive parenting practices and healthy behaviours.

One of the challenges of investigating the impact of the influence of the family home environment is that individuals tend to function in multiple settings, all of which may influence children's behaviour (Jones et al. 2007). It can therefore be difficult to isolate the key underlying factors and processes that may exert influence on child behaviour (Ball et al. 2006).

Whilst the causes of obesity are multi-factorial, our findings suggest that parents and the family home environment play a key role in determining a child's weight status. We confirm that no single behaviour or family practice was the sole contributor toward an unhealthy or healthy home environment and further, influenced child weight. Given the evidence on the multi-factorial nature of obesity, it is likely that it is the totality of several factors that shape a child's environment and their weight. However, our study did find media/sedentary behaviour as one area that may warrant further investigation as a key contributor toward weight gain in children. The proliferation of media devices is a concern amongst policy makers and their effect on unhealthy behaviours, although the rise in obesity prevalence is unlikely to be explained solely by this phenomenon, given that the increase in obesity levels have increased over a longer period of time prior to the mass introduction of media devices.

Two theoretical perspectives informed the qualitative aspects of our study on how family-home factors are associated childhood obesity and weight change overtime. The first, was the health belief model and parental recognition of child overweight. Our hypothesis was that parents who recognised overweight amongst their children may take steps to promote healthy behaviours. Our study found that a large proportion of parents inaccurately estimated the extent of their child's overweight which may place their children at risk for early onset of overweight. This suggests that policy makers and practitioners (e.g. school nurses) should do more to improve the recognition of childhood overweight and obesity, so that help, and support can be given to reduce future health risks.

The second theoretical perspective was the socio-ecological model, which was based on the premise that health behaviours are determined by factors across multiple levels spanning individual, family, community, organisational and policy. The socio-ecological theoretical framework alongside the TDF guided the study design focusing on the family-home environment recognising this as the proximal level of influence on child behaviours. Several themes were identified in our sample conducive to healthy home environments including healthy feeding practices, physical activity opportunities and sibling and social influences. However, whilst the study did not explicitly inquire about influences outside of the family home environment, it was evident from the qualitative findings and perceptions of parents, that community and macro level factors were important in shaping children's health behaviours.

The breadth of responses from parents reflects the complex interplay and interrelated factors that influence eating, physical activity and sleep behaviours and supports the premise that whilst the immediate family setting is important, it is likely that the other influences outside the

control of parents shape the healthy behaviours of children. This may mean that some families may struggle to promote healthy behaviours in the family-home environment due to external factors, despite parents' intent to provide a healthy home environment.

Our final hypothesis was that parents of overweight / obese children put in place strategies and practices to promote a healthy weight. Research on the factors that influence excess weight loss amongst children outside of weight management interventions continues to remain scarce, and this study provides potential explanations for why some children can shift the balance toward a healthy weight status. To our knowledge, this is the first study of its kind to incorporate a validated behavioural framework to understand home and family factors for weight loss in children and its application to the NCMP. Parents in this study did not indicate any intentional strategies which they put in place to influence their child weight, although there were clear examples of parenting styles and practice that may have positively impacted on their child's health behaviours and weight outcomes. Hearing the voices of parents, provided a new narrative and perspective that lends limited, yet unique insight into the family home environment and potential contributing factors within this complex area. The findings reflect the complex interplay between different factors.

The insights from the interviews support findings from the quantitative component and may explain how some parents manage to create more favourable family-home environments. For example, consistent with our quantitative finding that high FNPA scores were associated with a range of health behaviours, parents expressed a range of family home practices that are known to positively influence child weight. This was further demonstrated by our findings that were able to show an association between the FNPA and child obesity. Furthermore, parents interviewed also demonstrated interactions with the children indicative of authoritative parenting styles which may operate as a moderator between specific practices and children's health. Whilst parents identified many facilitators for health enhancing behaviours, they also identified barriers that limited opportunities for their children to practice healthy habits at home. However, despite these challenges, parents generally expressed strong values and motives for promoting favourable family-home environments. The small sample used in this study makes it difficult to draw any conclusive evidence on why the children under investigation successfully achieved a healthy weight status by the end of primary school.

6.1 Recommendations

There are several recommendations for policy and future research that build on and compliment the findings from this study. Firstly, given the significant increase in levels of child obesity in mid-childhood, early detection of weight gain, poor parenting practices and intervention is critical. Given the predictability of the FNPA on child BMI, low cost of implementation, brevity, and ease of use (that would likely mitigate any exacerbation of health inequalities through health literacy), policy makers should consider the adoption of the FNPA (or a similar home environment tool) in practice, to help raise awareness to parents on the causes of obesity, and the positive actions they can take to influence their child's and family behaviours (Peyer et al. 2021). For example, health professionals could use the FNPA to identify key areas of concern in the homes of parents potentially at risk for childhood obesity to prioritise and tailor intervention efforts.

Research suggests that most weight gain in mid-childhood occurs between 7 and 11 years of age, and therefore it might be prudent to implement the FNPA before this period (Hughes et al. 2011). The NCMP provides a unique opportunity to identify and support parents of children are overweight and the introduction of the FNPA may also complement more traditional approaches to child weight management where uptake has reportedly been low and may offer a more cost effective and sustainable solution (Hastie 2012). One study in the US have demonstrated the utility and acceptability of the FNPA in clinical practice amongst parents of preschool children. This includes using the FNPA to provide patient-centred advice and set behaviour change goals for families that has resulted in positive outcomes across food, diet and screen time within early childhood (Bailey-Davis et al. 2019).

In England, this could involve incorporating the FNPA within the Healthy Child Programme, which involves Health Visitors undertaking five mandated health and wellbeing reviews for all children up to the age of two and half years. Whilst the last of the five mandated visits is between the ages of 2-2.5 years, many local authorities are now commissioning an additional visit between the ages of 3-4 years to prepare children and parents for the transition to primary school. Implementing the FNPA within this period would provide an early opportunity for parents to understand the impact of the home and family environment on child outcomes and respond accordingly. Other opportunities for inclusion of the FNPA within practice could be at the beginning of weight management programmes for children identified through the NCMP at 4/5 years and then measured over time to monitor changes to behaviours.

Since the original validation of the FNPA, efforts have been undertaken to ensure that the FNPA captures behaviours and environments relevant to contemporary life. This has led to some minor modifications to the original questionnaire, specifically on being able to capture screen time through use of smart phone and other screen formats. Changes have also been made to the wording around 'restriction' and reframing this to 'monitoring' to differentiate between proactive (and generally desirable) monitoring behaviours and potentially counterproductive restriction practices. Furthermore, an alternative FNPA has been produced whereby nine of the 20 items were modified to include more objective responses (e.g., days per week per behaviour instead of subjective response scale of (almost always/ often/ sometimes/almost never) (Peyer et al. 2021).

Furthermore, with increasing concern over the amount of time children are spending on screens and the exponential growth in the availability of digital devices, prevention strategies should consider targeting these behaviours in the future. This could include guidelines and advice for parents and families on reducing screen time. In addition, raising awareness of the potential harms of too much media/sedentary time, may enable parents to negotiate screen time limits with their children based upon the needs of children or better utilise the functions that exist on some media platforms to restrict access.

Whilst this study provided new insights into weight loss amongst children, further longitudinal research involving a larger sample that includes children who were obese and managed to achieve a healthy weight status, should be undertaken. Better understanding of the context in which parents either intentionally or unintentionally socialise children's obesity proactive behaviours, whilst living in a non-supportive environment, remains important. In addition, a greater representation from fathers and the role they play in shaping the home environment should be considered, as well as a more diverse sample with a higher proportion of families from areas of deprivation and ethnic minorities. This is particularly important, given the higher prevalence of child obesity amongst this cohort. Further, future studies examining the relationship between the FNPA factors and risk of child overweight to identify which FNPA components are most central to the relationship with weight gain.

Our finding of physical activity, as well as other themes identified within this research, as being a potential mediator / moderator that is conducive to weight loss may warrant further investigation. A plethora of guidance already exists that outlines how the home environment and specifically parents, can influence physical activity levels of children through modelling, increasing access to opportunities, active travel and participating with friends/peers (NICE

2009; Wyszyńska et al. 2020). Work should therefore be undertaken to raise awareness of this advice and guidance to parents.

Third, whilst the parents interviewed in the present study did not think that their child looked overweight, a significant proportion of parents from the overall sample failed to recognise excess weight. Because recognising overweight is likely to be necessary for behaviour change, research should focus on developing methods to improve parental recognition of childhood overweight and obesity and the associated health risks so that parents can take the required action to mitigate these risks.

6.2 Final conclusions

With childhood obesity approximately doubling between the ages of 4/5 and 10/11 years, it remains critical that we increase our understanding to why so many children are gaining weight and endangering their health and wellbeing. This urgency is amplified given that evidence has consistently shown that the likelihood of attaining a healthy weight, once overweight in adulthood is challenging (Fildes et al. 2015). Prevention and management of childhood obesity remains highly challenging with intervention effects that are often modest at best and poorly sustained over time (Ling and Gebremariam 2023).

It is widely acknowledged that the causes of obesity are not fully understood and shaping the environment to support more favourable conditions to be healthy, is important if we are to be successful in tackling the obesity epidemic. The family home environment remains a critical setting for the growth and development of children, while being bounded by the social determinants of health (e.g., economic stability, built environment, social context, food accessibility) (Ling and Gebremariam 2023). Parents continue to serve as critical gatekeepers in shaping children's healthy behaviours, and this study strengthens the evidence on the role of the family home environment on obesity. To develop effective interventions, it is important that we further our understanding on how children and their families interact with their neighbourhood and environment.

Undertaking this study has been a rewarding and enriching endeavour that has developed my knowledge, skills, capability and understanding of research and academia more broadly. Through adopting a mixed methods approach it has enabled to grasp a greater understanding of the two primary research methodologies and the inherent strengths and weakness for each approach. I believe that the thesis builds on existing theories and presents new knowledge

and insights around childhood obesity, that I hope will make a positive contribution to future practice and research.

7.0 References

Wardle J, Guthrie C, Sanderson S, Birch L, Plomin R. Food and activity preferences in children of lean and obese parents. Int J Obes. 2001.

A. Hamid, M. S. and Sazlina, S. G. 2019. Interventions for obesity among schoolchildren: A systematic review and meta-analyses. *PLOS ONE* 14(1), p. e0209746.

Abbasi, A., Juszczyk, D., van Jaarsveld, C., Gulliford, M 2017. Body Mass Index and Incident Type 1 and Type 2 Diabetes in Children and Young Adults: A Retrospective Cohort Study. *J. Endocr. Soc.*

Abdul Rehman, A. and Alharthi, K. 2016. An introduction to research paradigms. 3.

Adab, P. et al. 2018. Effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6 and 7 year olds: cluster randomised controlled trial (WAVES study). *BMJ* 360.

Aftosmes-Tobio, A. et al. 2016. A systematic review of media parenting in the context of childhood obesity research. *BMC Public Health* 16(1), p. 320.

Ajzen, I. 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50(2), pp. 179-211.

Almoosawi, S. et al. 2016. Parental Perception of Weight Status: Influence on Children's Diet in the Gateshead Millennium Study. *Plos One* 11(2), pp. e0144931-e0144931.

Alshahrani, A. et al. 2021. Underestimation of overweight weight status in children and adolescents aged 0-19 years: A systematic review and meta-analysis. *Obesity Science & Practice* 7(6), pp. 760-796.

Althubaiti, A. 2016. Information bias in health research: definition, pitfalls, and adjustment methods. *Journal of multidisciplinary healthcare* 9, pp. 211-217.

Altman, D. G. and Bland, J. M. 1994. Statistics Notes: Quartiles, quintiles, centiles, and other quantiles. *BMJ* 309(6960), pp. 996-996.

Ames, H. et al. 2020. Communication of children's weight status: what is effective and what are the children's and parents' experiences and preferences? A mixed methods systematic review. *BMC Public Health* 20(1), p. 574.

Aminian, A. et al. 2021. Association of obesity with postacute sequelae of COVID-19. *Diabetes, Obesity and Metabolism* 23(9), pp. 2183-2188.

Anderson, S. E. et al. 2017. Self-regulation and household routines at age three and obesity at age eleven: Longitudinal analysis of the UK Millennium cohort study. *Int J Obes*.

Andrew, S. a. H., E. 2009. *Mixed methods research for nursing and the health sciences*. England: Blackwell Publishing Ltd.

Andriani, H. et al. 2015. Parental weight changes as key predictors of child weight changes. *BMC Public Health* 15, p. 645.

Angus, H. B., Rabe 2020. *Going universal - The impact of free school lunches on child body weight outcomes1*. Institute for Social and Economic Research.

Anthony, A. L. et al. 2021. Associations of active travel with adiposity among children and socioeconomic differentials: a longitudinal study. *BMJ Open* 11(1), p. e036041.

Ash, T. et al. 2017. Family-based childhood obesity prevention interventions: a systematic review and quantitative content analysis. *International Journal of Behavioral Nutrition and Physical Activity* 14(1), p. 113.

Atkins, L. et al. 2017. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Science : IS* 12.

Avery, A. et al. 2017. Associations between children's diet quality and watching television during meal or snack consumption: A systematic review. *Matern Child Nutr* 13(4).

Bagley, S. et al. 2006. Family structure and children's television viewing and physical activity. *Medicine and science in sports and exercise* 38(5), pp. 910-918.

Bagnall, A. M. et al. 2019. Whole systems approaches to obesity and other complex public health challenges: a systematic review. *BMC Public Health* 19(1), p. 8.

Bailey-Davis, L. et al. 2019. Feasibility of enhancing well-child visits with family nutrition and physical activity risk assessment on body mass index. *Obesity science & practice* 5(3), pp. 220-230.

Baker, C. 2023. Obesity Statistics. In: Commons, H.o. ed.

Ball, K. et al. 2006. Understanding environmental influences on nutrition and physical activity behaviors: where should we look and what should we count? *International Journal of Behavioral Nutrition and Physical Activity* 3(1), p. 33.

Bandura, A. 1986. *Social foundations of thought and action: a social cognitive theory*. New Jersey: Prentice-Hall International Inc.

Bandura, A. 1997. *Self-Efficacy: the Exercise of Control*. New York: W.H. Freeman and Co.

Bandura, A. 2004. Health promotion by social cognitive means. *Health Educ Behav* 31(2), pp. 143-164.

Baraniuk, C. 2020. Fears grow of nutritional crisis in lockdown UK. *BMJ* 370, p. m3193.

Barkley, J. E. et al. 2014. Peer influence and physical activity behavior in young children: an experimental study. *J Phys Act Health* 11(2), pp. 404-409.

Bartlett, R. et al. 2017. Schools as Sites for Recruiting Participants and Implementing Research. *Journal of community health nursing* 34(2), pp. 80-88.

Bates, C. R. et al. 2018. Links between the organization of the family home environment and child obesity: a systematic review. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity* 19(5), pp. 716-727.

Baumrind, D. 1966. Effects of Authoritative Parental Control on Child Behavior. *Child Development* 37(4), pp. 887-907.

Bennetts, S. K. et al. 2019. Using Paid and Free Facebook Methods to Recruit Australian Parents to an Online Survey: An Evaluation. *Journal of medical Internet research* 21(3), pp. e11206-e11206.

Berenson, G. S. 2002. Childhood risk factors predict adult risk associated with subclinical cardiovascular disease. The Bogalusa Heart Study. *Am J Cardiol* 90(10c), pp. 3l-7l.

Berge, J. M. et al. 2017. Examining unanswered questions about the home environment and childhood obesity disparities using an incremental, mixed-methods, longitudinal study design: The Family Matters study. *Contemporary Clinical Trials* 62, pp. 61-76.

Berwick, D. M. 2008. The Science of Improvement. *JAMA* 299(10), pp. 1182-1184.

Bhaskar, R. 1978. *A Realist Theory of Science*. Harvester Press.

Bindra, S. et al. 2020. Sex and gender differences in childhood obesity: contributing to the research agenda. *BMJ Nutrition, Prevention & Health* 3(2), p. 387.

Binkin, N. et al. 2013. What is common becomes normal: The effect of obesity prevalence on maternal perception. *Nutrition, Metabolism and Cardiovascular Diseases* 23(5), pp. 410-416.

Birch, L. et al. 2019. What change in body mass index is associated with improvement in percentage body fat in childhood obesity? A meta-regression. *BMJ Open* 9(8), p. e028231.

Bjelland, M. et al. 2014. Development of family and dietary habits questionnaires: the assessment of family processes, dietary habits and adolescents' impulsiveness in Norwegian adolescents and their parents. *International Journal of Behavioral Nutrition and Physical Activity* 11(1), p. 130.

Black, J. A. et al. 2015. Child obesity cut-offs as derived from parental perceptions: cross-sectional questionnaire. *British Journal of General Practice* 65(633), p. e234.

Blaine, R. E. et al. 2017. Food parenting and child snacking: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity* 14(1), p. 146.

Bloomberg, L. D. and Volpe, M. 2012. *Completing Your Qualitative Dissertation: A Road Map From Beginning to End: A Road Map From Beginning to End*. SAGE Publications.

Bohn, C. et al. 2022. Having siblings promotes a more healthy weight status—Whereas only children are at greater risk for higher BMI in later childhood. *PLOS ONE* 17(7), p. e0271676.

Boswell, N. et al. 2019. Family food environment factors associated with obesity outcomes in early childhood. *BMC Obes* 6, p. 17.

Boutelle, K. N. et al. 2012. Parent predictors of child weight change in family based behavioral obesity treatment. *Obesity (Silver Spring, Md)* 20.

Braun, V. and Clarke, V. 2022. *Thematic analysis : a practical guide*. London: SAGE Publications Ltd.

Brisbois, T. D. et al. 2012. Early markers of adult obesity: a review. *Obes Rev* 13(4), pp. 347-367.

Bronfenbrenner, U. 1979. *The Ecology of Human Development*. Harvard University Press.

Brown, C. L. et al. 2015. Addressing Childhood Obesity. Opportunities for Prevention. *The Pediatric clinics of North America* 62(5), pp. 1241-1261.

Brown, C. L. et al. 2019. Weight Control Practices in Children of Parents Participating in Weight Management Programs. *Childhood Obesity* 15(7), pp. 451-458.

Brown, C. L. et al. 2016. Behaviors and motivations for weight loss in children and adolescents. *Obesity* 24(2), pp. 446-452.

Brueton, V. C. et al. 2014. Strategies to improve retention in randomised trials: a Cochrane systematic review and meta-analysis. *BMJ Open* 4(2), p. e003821.

Bryant, M. J. et al. 2008. Reliability and validity of the Healthy Home Survey: A tool to measure factors within homes hypothesized to relate to overweight in children. *Int J Behav Nutr Phys Act* 5.

Bunniss, S. and Kelly, D. R. 2010. Research paradigms in medical education research. *Medical Education* 44(4), pp. 358-366.

Burchett, H. E. D. et al. 2018. Lifestyle weight management programmes for children: A systematic review using Qualitative Comparative Analysis to identify critical pathways to effectiveness. *Prev Med* 106, pp. 1-12.

Campbell, D. T. and Fiske, D. W. 1959. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin* 56(2), pp. 81-105.

Campbell, K. J. et al. 2006. Family food environment and dietary behaviors likely to promote fatness in 5-6 year-old children. *Int J Obes* 30(8), pp. 1272-1280.

Cane, J. et al. 2012. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science* 7(1), p. 37.

Charles, J. V., Jr. et al. 2014. Building Sustainable Research Engagements: Lessons Learned From Research With Schools. *Journal of research practice* 10(1).

Chong, S. C. et al. 2023. Exploring the perception of parents on children's screentime: a systematic review and meta-synthesis of qualitative studies. *Pediatric Research* 94(3), pp. 915-925.

Chuang, R.-J. et al. 2013. Ethnic Differences in the Home Environment and Physical Activity Behaviors among Low-Income, Minority Preschoolers in Texas. *American Journal of Health Promotion* 27(4), pp. 270-278.

Clark, H. R. et al. 2007. How do parents' child-feeding behaviours influence child weight? Implications for childhood obesity policy. *J Public Health (Oxf)* 29(2), pp. 132-141.

Classen, T. J. and Thompson, O. 2016. Genes and the intergenerational transmission of BMI and obesity. *Econ Hum Biol* 23, pp. 121-133.

CMO 2019. United Kingdom Chief Medical Officers' commentary on 'Screen-based activities and children and young people's mental health and psychosocial wellbeing: a systematic map of reviews'. In: Officers, U.C.M. ed.

Cohen, J. 1988. *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Cole, T. J. 1990. The LMS method for constructing normalized growth standards. *Eur J Clin Nutr* 44.

Cole, T. J. 2000. Establishing a standard definition for child overweight and obesity worldwide: international survey. *Brit Med J* 320.

Collier, K. M. et al. 2016. Does parental mediation of media influence child outcomes? A meta-analysis on media time, aggression, substance use, and sexual behavior. *Dev Psychol* 52(5), pp. 798-812.

Coughlin, S. S. 1990. Recall bias in epidemiologic studies. *J Clin Epidemiol* 43(1), pp. 87-91.

Cowdell, F. and Dyson, J. 2019. How is the theoretical domains framework applied to developing health behaviour interventions? A systematic search and narrative synthesis. *BMC Public Health* 19(1), p. 1180.

Creswell, J. a. C., V.P. 2007. *Designing and Conducting Mixed Methods Research*. London: Sage.

Creswell, J. W. 2009. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications.

Creswell, J. W. and Clark, V. L. P. 2007. *Designing and conducting mixed methods research*. Thousand Oaks, CA, US: Sage Publications, Inc, pp. xviii, 275-xviii, 275.

Creswell, J. W. and Clark, V. L. P. 2011. *Designing and Conducting Mixed Methods Research*. SAGE Publications.

Croker, H. et al. 2012. Cluster-randomised trial to evaluate the 'Change for Life' mass media/ social marketing campaign in the UK. *BMC Public Health* 12(1), p. 404.

Cuevas, A. G. et al. 2020. Assessing the Role of Health Behaviors, Socioeconomic Status, and Cumulative Stress for Racial/Ethnic Disparities in Obesity. *Obesity (Silver Spring)* 28(1), pp. 161-170.

Cullinan, J. and Cawley, J. 2017. Parental misclassification of child overweight/obese status: The role of parental education and parental weight status. *Economics & Human Biology* 24, pp. 92-103.

Dallacker, M. et al. 2018. The frequency of family meals and nutritional health in children: a meta-analysis. *Obesity Reviews* 19(5), pp. 638-653.

Daly, J. et al. 1997. *The Public Health Researcher: A Methodological Guide*. Oxford University Press.

Darling, N. and Steinberg, L. 1993. Parenting style as context: An integrative model. *Psychol Bull* 113.

Davey Smith, G. et al. 2007. Is there an intrauterine influence on obesity? Evidence from parent child associations in the Avon Longitudinal Study of Parents and Children (ALSPAC). *Archives of disease in childhood* 92(10), pp. 876-880.

Davison, K. K. and Birch, L. L. 2001. Childhood overweight: a contextual model and recommendations for future research. *Obes Rev* 2.

Davison, K. K. and Campbell, K. 2005. Obesity prevention and public health. Oxford University Press.

De Amicis, R. et al. 2022. Ultra-processed foods and obesity and adiposity parameters among children and adolescents: a systematic review. *Eur J Nutr* 61(5), pp. 2297-2311.

de Vet, E. et al. 2011. Environmental correlates of physical activity and dietary behaviours among young people: a systematic review of reviews. *Obes Rev* 12(5), pp. e130-142.

DeCarlo, M. 2018. Scientific Inquiry in Social Work.

Defeyter, G. and Mann, E. 2020. The Free School Meal Voucher Scheme: What are children actually eating and drinking?

Department of Health 2019. Health Survey of England 2017.

DHSC. 2023. *The Nusery Milk Scheme* [Online]. Department of Health and Social Care. Available at: https://www.nurserymilk.co.uk/ [Accessed: 17/09/23].

Digital, N. 2021. *Health Survey for England* [Online]. Available at: https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2021/health-survey-for-england-2021-data-tables [Accessed:

DoE. 2022. *PE and sport premium for primary schools* [Online]. Department Of Education. Available at: https://www.gov.uk/guidance/pe-and-sport-premium-for-primary-schools [Accessed:

Dos Santos, C. S. et al. 2020. Early Individual and Family Predictors of Weight Trajectories From Early Childhood to Adolescence: Results From the Millennium Cohort Study. *Front Pediatr* 8, p. 417.

Dowler, E. 2008. Symposium on 'Intervention policies for deprived households' Policy initiatives to address low-income households' nutritional needs in the UK. *Proc Nutr Soc* 67(3), pp. 289-300.

Downey, J. C. and Gudmunson, C. G. 2022. Mothers' Strategies for Promoting Children's Healthy Eating, Physical Activity, and Screen-Related Behaviors. *OBM Integrative and Complementary Medicine* 07(01), p. 006.

Driessen, C. E. et al. 2014. Effect of changes to the school food environment on eating behaviours and/or body weight in children: a systematic review. *Obesity Reviews* 15(12), pp. 968-982.

Duncanson, K. et al. 2016. Child Feeding and Parenting Style Outcomes and Composite Score Measurement in the 'Feeding Healthy Food to Kids Randomised Controlled Trial'. *Children* 3(4), p. 28.

East, P. et al. 2019. Home and Family Environment Related to Development of Obesity: A 21-Year Longitudinal Study. *Childhood Obesity (Print)* 15(3), pp. 156-166.

Economic and Social Research Council. 2021. *Framework for research ethics* [Online]. Available at: https://www.ukri.org/councils/esrc/guidance-for-applicants/research-ethics-guidance/framework-for-research-ethics/our-core-principles/#contents-list [Accessed: 22/1/2021].

Egger, G. and Swinburn, B. 1997. An "ecological" approach to the obesity pandemic. *Bmj* 315(7106), pp. 477-480.

El-Sayed, A. M. et al. 2011. Ethnic inequalities in obesity among children and adults in the UK: a systematic review of the literature. *Obesity Reviews* 12(5), pp. e516-e534.

Elgar, F. J. and Stewart, J. M. 2008. Validity of self-report screening for overweight and obesity. Evidence from the Canadian Community Health Survey. *Can J Public Health* 99(5), pp. 423-427.

Eli, K. et al. 2014. “A little on the heavy side”: a qualitative analysis of parents' and grandparents' perceptions of preschoolers' body weights. *BMJ Open* 4(12).

Epstein, L. H. et al. 1980. Comparison of Family-Based Behavior Modification and Nutrition Education for Childhood Obesity1. *Journal of Pediatric Psychology* 5(1), pp. 25-36.

Evans, C. E. L. et al. 2010. SMART lunch box intervention to improve the food and nutrient content of children's packed lunches: UK wide cluster randomised controlled trial. *Journal of Epidemiology and Community Health* 64(11), p. 970.

Evans, J. and Mathur, A. 2018. The Value of Online Surveys: A Look Back and a Look Ahead. *Internet Research* 28.

Ewald, H. et al. 2014. Parent-only interventions in the treatment of childhood obesity: a systematic review of randomized controlled trials. *Journal of Public Health* 36(3), pp. 476-489.

Eysenbach, G. 2004. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *Journal of medical Internet research* 6(3), pp. e34-e34.

Faith, M. S. 2004. Parent-child feeding strategies and their relationships to child eating and weight status. *Obes Res* 12.

Falconer, C. et al. 2012. Does BMI FEEDBACK change parental perceptions about The health risk associated with their child's BMI? *Obesity Facts* 5(SUPPL. 1), p. 240.

Falconer, C. L. et al. 2014a. Can the relationship between ethnicity and obesity-related behaviours among school-aged children be explained by deprivation? A cross-sectional study. *BMJ Open* 4(1), p. e003949.

Falconer, C. L. et al. 2014b. The benefits and harms of providing parents with weight feedback as part of the national child measurement programme: a prospective cohort study. *BMC public health* 14, p. 549.

Fan, W. and Yan, Z. 2010. Factors affecting response rates of the web survey: A systematic review. *Computers in Human Behavior* 26, pp. 132-139.

Fang, K. et al. 2019. Screen time and childhood overweight/obesity: A systematic review and meta-analysis. *Child: Care, Health and Development* 45(5), pp. 744-753.

Fernanda, R. et al. 2019. Ultra-processed foods and excessive free sugar intake in the UK: a nationally representative cross-sectional study. *BMJ Open* 9(10), p. e027546.

Field, A. E. et al. 2005. Weight Status in Childhood as a Predictor of Becoming Overweight or Hypertensive in Early Adulthood**. *Obesity Research* 13(1), pp. 163-169.

Fiese, B. H. et al. 2002. A Review of 50 Years of Research on Naturally Occurring Family Routines and Rituals: Cause for Celebration? *Journal of family psychology* 16(4), pp. 381-390.

Fildes, A. et al. 2015. Probability of an Obese Person Attaining Normal Body Weight: Cohort Study Using Electronic Health Records. *American Journal of Public Health* 105(9), pp. e54-e59.

Fletcher, E. A. et al. 2018. Associations between sedentary behaviours and dietary intakes among adolescents. *Public Health Nutrition* 21(6), pp. 1115-1122.

Ford, A. L. et al. 2010. What reduction in BMI SDS is required in obese adolescents to improve body composition and cardiometabolic health? *Arch Dis Child* 95.

Fox, K. R. 2004. Childhood obesity and the role of physical activity. *J R Soc Promot Health* 124(1), pp. 34-39.

Freeman, E. et al. 2012. Preventing and treating childhood obesity: time to target fathers. *Int J Obes (Lond)* 36(1), pp. 12-15.

Friedemann, C. et al. 2012. Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ : British Medical Journal* 345.

Gainsbury, A. and Dowling, S. 2018. 'A little bit offended and slightly patronised': parents' experiences of National Child Measurement Programme feedback. *Public health nutrition* 21(15), pp. 2884-2892.

Galesic, M. and Bosnjak, M. 2009. Effects of Questionnaire Length on Participation and Indicators of Response Quality in a Web Survey. *Public Opinion Quarterly* 73(2), pp. 349-360.

Galloway, A. T. et al. 2010. Retrospective Reports of Child Feeding Practices, Current Eating Behaviors, and BMI in College Students. *Obesity* 18(7), pp. 1330-1335.

García-Blanco, L. et al. 2022. Parental perception of child's weight, their attitudes towards child's dietary habits and the risk of obesity. *World J Pediatr* 18(7), pp. 482-489.

Gates, A. et al. 2020. Effectiveness and safety of interventions to manage childhood overweight and obesity: An Overview of Cochrane systematic reviews. *Paediatrics & Child Health* 26(5), pp. 310-316.

Gattshall, M. L. et al. 2008. Validation of a survey instrument to assess home environments for physical activity and healthy eating in overweight children. *Int J Behav Nutr Phys Act* 5.

Gerards, S. M. and Kremers, S. P. 2015. The Role of Food Parenting Skills and the Home Food Environment in Children's Weight Gain and Obesity. *Curr Obes Rep* 4(1), pp. 30-36.

Gerards, S. M. P. L. et al. 2011. Interventions addressing general parenting to prevent or treat childhood obesity. *Int J Pediatr Obes* 6.

Geserick, M. et al. 2018. Acceleration of BMI in Early Childhood and Risk of Sustained Obesity. *New England Journal of Medicine* 379(14), pp. 1303-1312.

Gillison, F. et al. 2014. Exploring the basis for parents' negative reactions to being informed that their child is overweight. *Public Health Nutr* 17(5), pp. 987-997.

Gillison, F. et al. 2017. Parents' perceptions of reasons for excess weight loss in obese children: a peer researcher approach. *Research Involvement And Engagement* 3, pp. 22-22.

Golan, M. 2006. Parents as agents of change in childhood obesity--from research to practice. *Int J Pediatr Obes* 1(2), pp. 66-76.

Golan, M. and Crow, S. 2004. Parents Are Key Players in the Prevention and Treatment of Weight-Related Problems. *Nutrition Reviews* 62.

Golan, M. and Weizman, A. 1998. Reliability and Validity of the Family Eating and Activity Habits Questionnaire. *European Journal of Clinical Nutrition* 52.

Gomes, T. N. et al. 2017. Correlates of compliance with recommended levels of physical activity in children. *Sci Rep* 7(1), p. 16507.

Granich, J. 2011. Individual, social, and physical environment factors associated with electronic media use among children: sedentary behavior at home. *J Phys Act Health* 8.

Grimmett, C. et al. 2008. Telling parents their child's weight status: psychological impact of a weight-screening program. *Pediatrics* 122(3), pp. e682-e688.

Gruber, K., Haldeman, L 2009. Using the Family to Combat Childhood and Adult Obesity. *Preventing Chronic Disease* 6(3).

Grunseit, A. C. et al. 2011. Composite Measures Quantify Households' Obesogenic Potential and Adolescents' Risk Behaviors. *Pediatrics* 128(2), pp. e308-e316.

Guba, E. G. and Lincoln, Y. S. 1994. Competing paradigms in qualitative research.*Handbook of qualitative research.* Thousand Oaks, CA, US: Sage Publications, Inc, pp. 105-117.

Guba, E. G. and Lincoln, Y. S. 2005. Paradigmatic Controversies, Contradictions, and Emerging Confluences.*The Sage handbook of qualitative research, 3rd ed.* Thousand Oaks, CA: Sage Publications Ltd, pp. 191-215.

Gubbins, V. 2021. Parenting across cultures from childhood to adolescence: by Jennifer E. Lansford, W. Andrew Rothenberg and Marc H. Bornstein, New York, Routledge, 2021, 272 pp., £30.48 (paperback), ISBN 9780367462321; ISBN 9781003027652 (ebook); ISBN 9780367462314 (hardback). *Educational Review*, pp. 1-2.

Gustafson, S. L. and Rhodes, R. E. 2006. Parental correlates of physical activity in children and early adolescents. *Sports Med* 36(1), pp. 79-97.

Haigh, F. et al. 2019. Developing a critical realist informed framework to explain how the human rights and social determinants of health relationship works. *BMC Public Health* 19(1), p. 1571.

Halcomb, E. and Hickman, L. 2015. Mixed methods research. *Nursing standard* 29(32), pp. 41-47.

Halcomb, E. J. 2019. Mixed methods research: The issues beyond combining methods. *Journal of Advanced Nursing* 75(3), pp. 499-501.

Hall, K. D. et al. 2012. Energy balance and its components: implications for body weight regulation. *Am J Clin Nutr* 95(4), pp. 989-994.

Halliday, J. A. et al. 2014. The relationship between family functioning and child and adolescent overweight and obesity: a systematic review. *International Journal of Obesity* 38(4), pp. 480-493.

Harb, A. A. et al. 2023. Ultra-processed foods and the development of obesity in adults. *European Journal of Clinical Nutrition* 77(6), pp. 619-627.

Harrison, M. E. et al. 2015. Systematic review of the effects of family meal frequency on psychosocial outcomes in youth. *Can Fam Physician* 61(2), pp. e96-106.

Hastie, K. 2012. *Expert Testimony presented to the NICE Programme Development Group on 'Obese and overweight children and young people: lifestyle weight management services'*. NICE.

Hendrie, G. A. et al. 2012. Combined home and school obesity prevention interventions for children: what behavior change strategies and intervention characteristics are associated with effectiveness? *Health Educ Behav* 39(2), pp. 159-171.

Hennessy, E. et al. 2010. Parent-child interactions and objectively measured child physical activity: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity* 7(1), p. 71.

Holford, A. and Rabe, B. 2022. Going universal. The impact of free school lunches on child body weight outcomes. *Journal of Public Economics Plus* 3, p. 100016.

HSCIC. 2014. *National Child Measurement Programme: England, 2012/13 school year* [Online]. HSCIC. Available at: http://content.digital.nhs.uk/catalogue/PUB13115 [Accessed:

Hubbs-Tait, L. et al. 2008. Parental Feeding Practices Predict Authoritative, Authoritarian, and Permissive Parenting Styles. *Journal of the American Dietetic Association* 108(7), pp. 1154-1161.

Hudda, M. T. et al. 2017. Body mass index adjustments to increase the validity of body fatness assessment in UK Black African and South Asian children. *Int J Obes (Lond)* 41(7), pp. 1048-1055.

Hughes, A. R. et al. 2011. Incidence of obesity during childhood and adolescence in a large contemporary cohort. *Prev Med* 52(5), pp. 300-304.

Hunsberger, M. 2014. Early feeding practices and family structure: associations with overweight in children. *Proceedings of the Nutrition Society* 73(1), pp. 132-136.

Hutchens, A. and Lee, R. E. 2017. Parenting Practices and Children's Physical Activity: An Integrative Review. *The Journal of School Nursing* 34(1), pp. 68-85.

Ihmels, M. A. et al. 2007. *One year changes in BMI among first grade children in a large urban school district [dissertation]*. Ames (IA): Iowa State University.

Ihmels, M. A. et al. 2009a. Development and preliminary validation of a Family Nutrition and Physical Activity (FNPA) screening tool. *International Journal of Behavioral Nutrition and Physical Activity* 6(1), p. 14.

Ihmels, M. A. et al. 2009b. Prediction of BMI Change in Young Children with the Family Nutrition and Physical Activity (FNPA) Screening Tool. *Annals of Behavioral Medicine* 38(1), p. 60.

Ip, P. et al. 2017. Childhood Obesity and Physical Activity-Friendly School Environments. *J Pediatr* 191, pp. 110-116.

Ivankova, N. V. et al. 2006. Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. *Field Methods* 18(1), pp. 3-20.

Jackson, J. A. et al. 2017. The Family Home Environment, Food Insecurity, and Body Mass Index in Rural Children. *Health Educ Behav* 44(4), pp. 648-657.

Jago, R. et al. 2011. Parenting styles, parenting practices, and physical activity in 10- to 11-year olds. *Prev Med* 52(1), pp. 44-47.

Jago, R. et al. 2020. Association of BMI category with change in children's physical activity between ages 6 and 11 years: a longitudinal study. *International Journal of Obesity* 44(1), pp. 104-113.

James, K. S. et al. 2013. Childhood Obesity Risk in Overweight Mothers. *ICAN: Infant, Child, & Adolescent Nutrition* 5(6), pp. 375-382.

James, W. P. T. 2018. Obesity: A Global Public Health Challenge. *Clinical Chemistry* 64(1), pp. 24-29.

Janse, R. J. et al. 2021. Conducting correlation analysis: important limitations and pitfalls. *Clinical Kidney Journal* 14(11), pp. 2332-2337.

Janz, N. K. and Becker, M. H. 1984. The Health Belief Model: a decade later. *Health Educ Q* 11(1), pp. 1-47.

Jia, P. et al. 2023. Environmental determinants of childhood obesity: a meta-analysis. *Lancet Glob Health* 11 Suppl 1, p. S7.

Jiang, J. et al. 2023. Association of fast-food restaurants with overweight and obesity in school-aged children and adolescents: A systematic review and meta-analysis. *Obesity Reviews* 24(3), p. e13536.

Johnson, R. et al. 2012a. Parenting Styles and Home Obesogenic Environments. *International Journal of Environmental Research and Public Health* 9(4), pp. 1411-1426.

Johnson, R. et al. 2012b. Parenting Styles and Home Obesogenic Environments. *International Journal of Environmental Research and Public Health* 9(4), p. 1411.

Johnson, R. B. et al. 2007. Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research* 1(2), pp. 112-133.

Johnstone, G. and Grant, S. L. 2019. Weight stigmatisation in antiobesity campaigns: The role of images. *Health promotion journal of Australia* 30(1), pp. 37-46.

Jones, A. et al. 2007. Tackling Obesities:: Future Choices – Obesogenic Environments – Evidence Review.

Jones, N. R. et al. 2014. The growing price gap between more and less healthy foods: analysis of a novel longitudinal UK dataset. *PLoS One* 9(10), p. e109343.

Joussemet, M. et al. 2008. A self-determination theory perspective on parenting. *Canadian Psychology / Psychologie canadienne* 49(3), pp. 194-200.

Kara, H. 2015. *Creative research methods in the social sciences : a practical guide*. Bristol : Policy Press.

Karnik, S. and Kanekar, A. 2012. Childhood Obesity: A Global Public Health Crisis. *International Journal of Preventive Medicine* 3(1), pp. 1-7.

Katzmarzyk, P. T. et al. 2009. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Medicine and science in sports and exercise* 41(5), pp. 998-1005.

Kim, K. and Rohner, R. P. 2002. Parental Warmth, Control, and Involvement in Schooling:Predicting Academic Achievement among Korean American Adolescents. *Journal of Cross-Cultural Psychology* 33(2), pp. 127-140.

King, N. a. H., C. 2010. *Interviews in Qualitative Research*. London: Sage.

Kininmonth, A. R. et al. 2022. Associations between the home environment and childhood weight change: a cross-lagged panel analysis. *International Journal of Obesity* 46(9), pp. 1678-1685.

Kininmonth, A. R. et al. 2021. The relationship between the home environment and child adiposity: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity* 18(1), p. 4.

Kitzman-Ulrich, H. et al. 2010. The Integration of a Family Systems Approach for Understanding Youth Obesity, Physical Activity, and Dietary Programs. *Clinical Child and Family Psychology Review* 13(3), pp. 231-253.

Klare, G. R. 1976. A Second Look at the Validityl of Readability Formulas. *Journal of Reading Behavior* 8(2), pp. 129-152.

Knowlden, A. P. and Sharma, M. 2012. Systematic review of family and home-based interventions targeting paediatric overweight and obesity. *Obes Rev* 13(6), pp. 499-508.

Kong, K. L. et al. 2022. Systematic Review of General Parenting Intervention Impacts on Child Weight as a Secondary Outcome. *Child Obes*.

Kramer, L. and Conger, K. J. 2009. What we learn from our sisters and brothers: for better or for worse. *New Dir Child Adolesc Dev* 2009(126), pp. 1-12.

Krueger, P. M. and Reither, E. N. 2015. Mind the gap: race/ethnic and socioeconomic disparities in obesity. *Curr Diab Rep* 15(11), p. 95.

Langford, R. et al. 2015. Obesity prevention and the Health promoting Schools framework: essential components and barriers to success. *Int J Behav Nutr Phys Act* 12, p. 15.

Larsen, J. K. et al. 2018. General Parenting Styles and Children's Obesity Risk: Changing Focus. *Front Psychol* 9, p. 2119.

Leary, S. et al. 2010. No evidence of large differences in mother-daughter and father-son body mass index concordance in a large UK birth cohort. *Int J Obes (Lond)* 34(7), pp. 1191-1192.

Lee, B. A. and Oh, D. J. 2014. The effects of aquatic exercise on body composition, physical fitness, and vascular compliance of obese elementary students. *J Exerc Rehabil* 10(3), pp. 184-190.

Lee, B. Y. et al. 2017. A systems approach to obesity. *Nutr Rev* 75(suppl 1), pp. 94-106.

Lee, J. S. et al. 2022. Global relationship between parent and child obesity: a systematic review and meta-analysis. *Clin Exp Pediatr* 65(1), pp. 35-46.

Lindsay, A. C. et al. 2006. The role of parents in preventing childhood obesity. *Future Child* 16(1), pp. 169-186.

Ling, J. and Gebremariam, M. 2023. Embracing parenting role in childhood obesity. *BMC Public Health* 23(1), p. 1118.

Lipworth, W. et al. 2013. Can the theoretical domains framework account for the implementation of clinical quality interventions? *BMC Health Services Research* 13(1), p. 530.

Litchford, A. et al. 2020. Influence of fathers on the feeding practices and behaviors of children: A systematic review. *Appetite* 147, p. 104558.

Little, E. and Nestel, P. 2017. Association of deprivation with overweight and obesity among primary school children in England: an ecological cross-sectional study. *The Lancet* 390, p. S59.

Loveman, E. et al. 2015. Parent-only interventions for childhood overweight or obesity in children aged 5 to 11 years. *The Cochrane Database Of Systematic Reviews* (12), p. CD012008.

Lundahl, A. et al. 2014. Parental Underestimates of Child Weight: A Meta-analysis. *Pediatrics* 133(3), pp. e689-e703.

Lydecker, J. A. and Grilo, C. M. 2016. The apple of their eye: Attitudinal and behavioral correlates of parents' perceptions of child obesity. *Obesity* 24(5), pp. 1124-1131.

Maccoby, E. and Martin, J. A. 1983. Socialization in the context of the family: Parent-child interaction. In: Hetherington, E. ed. *Socialization, Personality, and Social Development. Volume 4*. New York: John Wiley.

Machado, E. et al. 2022. A Recreational Swimming Intervention during the Whole School Year Improves Fitness and Cardiometabolic Risk in Children and Adolescents with Overweight and Obesity. *Int J Environ Res Public Health* 19(24).

Malacarne, D. et al. 2022. The built environment as determinant of childhood obesity: A systematic literature review. *Obesity Reviews* 23(S1), p. e13385.

Marks, R. 2017. Childhood Obesity and Parental Weight Perceptions: An Update. 7, p. 00209.

Marmot, M. A., Jessica; Goldblat, Peter; Boyce, Tammy; McNeish, Di; Grady, Mike; Geddes, iilaria 2010. *'Fair Society, Healthy Lives' The Marmot Review*.

Martens, P. J. 2012. What do Kramer's Baby-Friendly Hospital Initiative PROBIT studies tell us? A review of a decade of research. *J Hum Lact* 28.

Martinson, B. C. et al. 2011. Obesogenic family types identified through latent profile analysis. *Ann Behav Med* 42(2), pp. 210-220.

Mayne, S. L. et al. 2015. Impact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments. *Obes Rev* 16(5), pp. 362-375.

McEvoy, P. and Richards, D. 2006. A critical realist rationale for using a combination of quantitative and qualitative methods. *Journal of research in nursing* 11(1), pp. 66-78.

McGowan, L. J. et al. 2020. How can use of the Theoretical Domains Framework be optimized in qualitative research? A rapid systematic review. *British Journal of Health Psychology* 25(3), pp. 677-694.

McLeroy, K. R. et al. 1988. An ecological perspective on health promotion programs. *Health Educ Q* 15.

McNulty, J. 2013. Challenges and issues in nutrition education. *Food and Agriculture Organization*.

McPherson, K., Marsh, T. and Brown, M. 2007. *Foresight tackling obesities: Future choices modelling future trends in obesity and the impact on health*. London: Department for Innovation, Universities and Skills.

Mead, E. et al. 2016. Predicting future weight status from measurements made in early childhood: a novel longitudinal approach applied to Millennium Cohort Study data. *Nutrition & Diabetes* 6, p. e200.

Mead, E. et al. 2017a. Diet, physical activity and behavioural interventions for the treatment of overweight or obese children from the age of 6 to 11 years. *Cochrane Database Syst Rev* 6(6), p. Cd012651.

Mead, E. et al. 2017b. Diet, physical activity and behavioural interventions for the treatment of overweight or obese children from the age of 6 to 11 years. *Cochrane Database of Systematic Reviews* (6).

Meadows, P. 2010. National evaluation of Sure Start local programmes: An economic perspective. In: Education, D.f. ed.

Mears, R. and Jago, R. 2016. Effectiveness of after-school interventions at increasing moderate-to-vigorous physical activity levels in 5- to 18-year olds: a systematic review and meta-analysis. *British Journal of Sports Medicine* 50(21), pp. 1315-1324.

Mears, R. et al. 2020. A longitudinal study investigating change in BMI z-score in primary school-aged children and the association of child BMI z-score with parent BMI. *BMC Public Health* 20(1), p. 1902.

Méjean, C. et al. 2018. Influence of food preparation behaviors on 5-year weight change and obesity risk in a French prospective cohort. *International Journal of Behavioral Nutrition and Physical Activity* 15(1), p. 120.

Meller, F. O. et al. 2018. Birth order and number of siblings and their association with overweight and obesity: a systematic review and meta-analysis. *Nutr Rev* 76(2), pp. 117-124.

MHCLG. 2019. *https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019* [Online]. Available at: [Accessed: 20012024].

Micali, N. et al. 2014. Frequency and patterns of eating disorder symptoms in early adolescence. *J Adolesc Health* 54(5), pp. 574-581.

Michie, S. et al. 2005. Making psychological theory useful for implementing evidence based practice: a consensus approach. *Qual Saf Health Care* 14(1), pp. 26-33.

Michie, S. et al. 2011. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science : IS* 6, pp. 42-42.

Mindell, J. A. and Williamson, A. A. 2018. Benefits of a bedtime routine in young children: Sleep, development, and beyond. *Sleep Med Rev* 40, pp. 93-108.

Morgan, D. L. 2007. Paradigms Lost and Pragmatism Regained:Methodological Implications of Combining Qualitative and Quantitative Methods. *Journal of Mixed Methods Research* 1(1), pp. 48-76.

Morrissey, B. et al. 2020. Sleep and obesity among children: A systematic review of multiple sleep dimensions. *Pediatr Obes* 15(4), p. e12619.

Mosli, R. H. et al. 2016. Birth order and sibship composition as predictors of overweight or obesity among low-income 4- to 8-year-old children. *Pediatric Obesity* 11(1), pp. 40-46.

Mushtaq, M. U. et al. 2011. Dietary behaviors, physical activity and sedentary lifestyle associated with overweight and obesity, and their socio-demographic correlates, among Pakistani primary school children. *International Journal of Behavioral Nutrition and Physical Activity* 8(1), p. 130.

Must, A. and Anderson, S. E. 2006. Body mass index in children and adolescents: considerations for population-based applications. *Int J Obes (Lond)* 30(4), pp. 590-594.

Nally, S. et al. 2021. The Effectiveness of School-Based Interventions on Obesity-Related Behaviours in Primary School Children: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Children (Basel)* 8(6).

Neumark-Sztainer, D. et al. 2009. Ready. Set. Action! a theater-based obesity prevention program for children: a feasibility study. *Health Educ Res* 24.

Nga, V. T. et al. 2019. School education and childhood obesity: A systemic review. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews* 13(4), pp. 2495-2501.

NHS Digital. 2021. *National Child Measurement Programme, England 2020/21 School Year* [Online]. Available at: https://digital.nhs.uk/data-and-information/publications/statistical/national-child-measurement-programme/2020-21-school-year [Accessed: 30/3/2022].

NHS Digital. 2022. *Health and Care of People with Learning Disabilities* [Online]. Available at: https://digital.nhs.uk/data-and-information/publications/statistical/health-and-care-of-people-with-learning-disabilities [Accessed: 12/12/2023].

NHS Digital 2023. National Child Measurement Programme, England, 2022/23 School Year. In: England, N. ed.

NICE 2009. Physical activity for children and young people. In: Excellence, N.I.f.H.a.C. ed.

NICE 2023. Overweight and obesity management (Draft Guidance [GID-NG10182])

Nnyanzi, L. A. et al. 2016. Parental response to a letter reporting child overweight measured as part of a routine national programme in England: results from interviews with parents. *BMC Public Health* 16, pp. 846-846.

Nowicka, P. et al. 2022. Explaining the complex impact of the Covid-19 pandemic on children with overweight and obesity: a comparative ecological analysis of parents' perceptions in three countries. *BMC Public Health* 22(1), p. 1000.

O'Dea, J. A. 2005. Prevention of child obesity: 'First, do no harm'. *Health Education Research* 20(2), pp. 259-265.

Ochiai, H. et al. 2012. Number of siblings, birth order, and childhood overweight: a population-based cross-sectional study in Japan. *BMC Public Health* 12, p. 766.

OFCOM 2020. *Children and parents: media use and attitudes report 2019*.

Ofsted 2018. Obesity, healthy eating and physical activity in primary schools.

Ogden, C. L. et al. 2006. Prevalence of Overweight and Obesity in the United States, 1999–2004. *Journal of the American Medical Association* 295.

Ogden, J. et al. 2013. Distraction, the desire to eat and food intake. Towards an expanded model of mindless eating. *Appetite* 62, pp. 119-126.

OHID 2022 National Child Measurement Programme: operational guidance 2022. In: Care, D.o.H.a.S. ed.

OHID. 2023. *Ethnicity Facts and Figures - Overweight adults* [Online]. Available at: https://www.ethnicity-facts-figures.service.gov.uk/health/diet-and-exercise/overweight-adults/latest/#data-sources [Accessed: 18/12/2023].

Olds, T. S. et al. 2011. Sleep duration or bedtime? Exploring the relationship between sleep habits and weight status and activity patterns. *Sleep* 34(10), pp. 1299-1307.

Omer, T. 2020. The causes of obesity: an in-depth review. *Adv Obes Weight Manag Control* 10(4), pp. 90-94.

Orhan KiliÇ, B. et al. 2023. Relationship Between Obesogenic Family Environment, Children's Smartphone Usage, and Depressive Symptoms. *Türkiye Çocuk Hastalıkları Dergisi* 17(4), pp. 279-284.

Öztürk, G. and Kolcu, M. 2023. Are child and parent health behaviors associated with childhood obesity? A descriptive and methodological study. *J Pediatr Nurs* 72, pp. 99-105.

Pagliai, G. et al. 2021. Consumption of ultra-processed foods and health status: a systematic review and meta-analysis. *Br J Nutr* 125(3), pp. 308-318.

Park, M. H. et al. 2014. Predictors of health-related behaviour change in parents of overweight children in England. *Prev Med* 62, pp. 20-24.

Park, S. H. and Cormier, E. 2018. Influence of Siblings on Child Health Behaviors and Obesity: A Systematic Review. *Journal of Child and Family Studies* 27(7), pp. 2069-2081.

Parkinson, K. N. et al. 2017. Mothers' perceptions of child weight status and the subsequent weight gain of their children: a population-based longitudinal study. *International Journal Of Obesity* 41, p. 801.

Parnham, J. C. et al. 2022. The Impact of the Universal Infant Free School Meal Policy on Dietary Quality in English and Scottish Primary School Children: Evaluation of a Natural Experiment. *Nutrients* 14(8).

Parry, L. L. et al. 2008. A systematic review of parental perception of overweight status in children. *J Ambul Care Manage* 31(3), pp. 253-268.

Patrick, H. et al. 2013. Parenting Styles and Practices in Children's Obesogenic Behaviors: Scientific Gaps and Future Research Directions. *Childhood Obesity* 9(s1), pp. S-73-S-86.

Pearce, M. et al. 2017. Weight gain in mid-childhood and its relationship with the fast food environment. *Journal of Public Health* 40(2), pp. 237-244.

Pearce, M. et al. 2016. Changes in objectively measured BMI in children aged 4-11 years: data from the National Child Measurement Programme. *J Public Health (Oxf)* 38(3), pp. 459-466.

Pearson, M. et al. 2015. Implementing health promotion programmes in schools: a realist systematic review of research and experience in the United Kingdom. *Implementation Science* 10(1), p. 149.

Pearson, N. and Biddle, S. J. 2011. Sedentary behavior and dietary intake in children, adolescents, and adults. A systematic review. *Am J Prev Med* 41(2), pp. 178-188.

Pearson, N. et al. 2018. Clustering and correlates of screen-time and eating behaviours among young children. *BMC Public Health* 18(1), p. 753.

Perdew, M. et al. 2020. Family-based nutrition interventions for obesity prevention among school-aged children: a systematic review. *Translational Behavioral Medicine* 11(3), pp. 709-723.

Perez-Pastor, E. M. et al. 2009. Assortative weight gain in mother-daughter and father-son pairs: an emerging source of childhood obesity. Longitudinal study of trios (EarlyBird 43). *Int J Obes* 33(7), pp. 727-735.

Perkins, C. and DeSousa, E. 2018. Trends in childhood height and weight, and socioeconomic inequalities. *The Lancet Public Health* 3(4), pp. e160-e161.

Peyer, K. L. et al. 2021. Development, Applications, and Refinement of the Family Nutrition and Physical Activity (FNPA) Child Obesity Prevention Screening. *Health Promotion Practice* 22(4), pp. 456-461.

Pham, S. B. et al. 2023. Examining the effect of parent participation in an adult weight management program on changes in children's weight. *Clinical Obesity* 13(2), p. e12583.

PHE. 2019. *Differences in child obesity by ethnic group* [Online]. Public Health England. Available at: https://www.gov.uk/government/publications/differences-in-child-obesity-by-ethnic-group/differences-in-child-obesity-by-ethnic-group [Accessed: 09/06/23].

Philips, N. et al. 2014. The influence of parenting style on health related behavior of children: findings from the ChiBS study. *International Journal of Behavioral Nutrition and Physical Activity* 11(1), p. 95.

Pinard, C. A. et al. 2012. Measures of the home environment related to childhood obesity: a systematic review. *Public Health Nutr* 15(1), pp. 97-109.

Pinard, C. A. et al. 2014. The Validity and reliability of the Comprehensive Home Environment Survey (CHES). *Health Promot Pract* 15(1), pp. 109-117.

Pluye, P. and Hong, Q. N. 2014. Combining the power of stories and the power of numbers: mixed methods research and mixed studies reviews. *Annu Rev Public Health* 35, pp. 29-45.

Polit, D. F. et al. 2001. *Essentials of Nursing Research: Methods, Appraisal, and Utilization*. Lippincott.

Pryor, L. E. et al. 2011. Developmental Trajectories of Body Mass Index in Early Childhood and Their Risk Factors: An 8-Year Longitudinal Study. *Archives of Pediatrics & Adolescent Medicine* 165(10), pp. 906-912.

Public Health England 2018. Promoting healthy weight in children, young people and families: A resource to support local authorities. In: England, P.H. ed.

Public Health England 2020. National Child Measurement Programme Operational guidance 2020. In: England, P.H. ed. Public Health England.

Puhl, R. M. and Heuer, C. A. 2009. The Stigma of Obesity: A Review and Update. *Obesity* 17(5), pp. 941-964.

Pychyl, T. A. et al. 2002. Parenting and procrastination: gender differences in the relations between procrastination, parenting style and self-worth in early adolescence. *Personality and Individual Differences* 33(2), pp. 271-285.

Pyper, E. et al. 2016. The impact of different types of parental support behaviours on child physical activity, healthy eating, and screen time: a cross-sectional study. *BMC Public Health* 16(1), p. 568.

Quelly, S. B. 2019. Helping With Meal Preparation and Children's Dietary Intake: A Literature Review. *J Sch Nurs* 35(1), pp. 51-60.

Ravikumar, D. et al. 2022. Parental perceptions of the food environment and their influence on food decisions among low-income families: a rapid review of qualitative evidence. *BMC Public Health* 22(1), p. 9.

Razi, M. and Nasiri, A. 2022. Concerns of parents about children's overweight and obesity during the COVID-19 pandemic: A qualitative study. *Journal of Pediatric Nursing* 63, pp. 111-116.

Rees, R. et al. 2011. The views of young children in the UK about obesity, body size, shape and weight: a systematic review. *BMC Public Health* 11(1), p. 188.

Reilly, J. J. 2007. Childhood Obesity: An Overview. *Children & Society* 21(5), pp. 390-396.

Reilly, J. J. et al. 2005. Early Life Risk Factors for Obesity in Childhood: Cohort Study. *BMJ* 330.

Rendina, D. et al. 2019. Methodological approach to the assessment of the obesogenic environment in children and adolescents: A review of the literature. *Nutrition, Metabolism and Cardiovascular Diseases* 29(6), pp. 561-571.

Reynolds, J. et al. 2011. Quality assurance of qualitative research: a review of the discourse. *Health Research Policy and Systems* 9(1), p. 43.

Richardson, A. et al. 2011. Neighborhood fast food restaurants and fast food consumption: a national study. *BMC Publ Health* 11.

Rietmeijer-Mentink, M. et al. 2013. Difference between parental perception and actual weight status of children: a systematic review. *Matern Child Nutr* 9(1), pp. 3-22.

Ritchie, L. D. et al. 2005. Family Environment and Pediatric Overweight: What Is a Parent to Do? *Journal of the American Dietetic Association* 105(5, Supplement), pp. 70-79.

Robertson, W. et al. 2016. Evidence base for the prevention and management of child obesity. *Paediatrics and Child Health* 26(5), pp. 212-218.

Robinson, E. 2017. Overweight but unseen: a review of the underestimation of weight status and a visual normalization theory. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity* 18(10), pp. 1200-1209.

Robinson, E. and Sutin, A. R. 2016. Parental Perception of Weight Status and Weight Gain Across Childhood. *Pediatrics* 137(5).

Rodgers, R. F. et al. 2013. Maternal feeding practices predict weight gain and obesogenic eating behaviors in young children: a prospective study. *Int J Behav Nutr Phys Act* 10, p. 24.

Rodrigues, D. et al. 2020. Parental misperception of their child's weight status and how weight underestimation is associated with childhood obesity. *American Journal of Human Biology* 32(5), p. e23393.

Rolstad, S. et al. 2011. Response Burden and Questionnaire Length: Is Shorter Better? A Review and Meta-analysis. *Value in Health* 14(8), pp. 1101-1108.

Rosenkranz, R. R. and Dzewaltowski, D. A. 2008. Model of the home food environment pertaining to childhood obesity. *Nutr Rev* 66.

Rossman, G. B. and Wilson, B. L. 1985. Numbers and Words:Combining Quantitative and Qualitative Methods in a Single Large-Scale Evaluation Study. *Evaluation Review* 9(5), pp. 627-643.

Rural Payments Agency. 2023. *School milk subsidy scheme* [Online]. Rural Payments Agency. Available at: https://www.gov.uk/guidance/school-milk-subsidy-scheme [Accessed: 17/09/23].

Rutter, H. D. et al. 2017. The need for a complex systems model of evidence for public health. *The Lancet (British edition)* 390(10112), pp. 2602-2604.

Sahoo, K. et al. 2015. Childhood obesity: causes and consequences. *Journal of Family Medicine and Primary Care* 4(2), pp. 187-192.

Sallis, A. et al. 2019. Improving child weight management uptake through enhanced National Child Measurement Programme parental feedback letters: A randomised controlled trial. *Preventive Medicine* 121, pp. 128-135.

Sallis, J. F. et al. 2012. Physical education's role in public health: steps forward and backward over 20 years and HOPE for the future. *Res Q Exerc Sport* 83(2), pp. 125-135.

Santiago, S. et al. 2012. Perinatal and parental determinants of childhood overweight in 6-12 years old children. *Nutr Hosp* 27(2), pp. 599-605.

Scauso, M. S. 2020. Interpretivism: Definitions, Trends, and Emerging Paths. Oxford University Press.

Schiller, C. J. 2016. Critical realism in nursing: an emerging approach. *Nursing philosophy* 17(2), pp. 88-102.

Schoonenboom, J. and Johnson, R. B. 2017. How to Construct a Mixed Methods Research Design. *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 69(2), pp. 107-131.

Schrempft, S. et al. 2015. The Obesogenic Quality of the Home Environment: Associations with Diet, Physical Activity, TV Viewing, and BMI in Preschool Children. *PloS one* 10(8), pp. e0134490-e0134490.

Schrempft, S. et al. 2018. Variation in the Heritability of Child Body Mass Index by Obesogenic Home Environment. *JAMA Pediatrics* 172(12), pp. 1153-1160.

Scotland, J. 2012. Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. *English Language Teaching* 5.

Sellen, P. 2018. Evaluation of Universal Infant Free School Meals. *Education Policy Institute*.

Serasinghe, N. et al. 2023. Associations between socioeconomic status, home food availability, parental role-modeling, and children's fruit and vegetable consumption: a mediation analysis. *BMC Public Health* 23(1), p. 1037.

Shloim, N. et al. 2015. Parenting Styles, Feeding Styles, Feeding Practices, and Weight Status in 4-12 Year-Old Children: A Systematic Review of the Literature. *Frontiers In Psychology* 6, pp. 1849-1849.

Sirikulchayanonta, C. et al. 2011. Self discipline and obesity in Bangkok school children. *BMC Public Health* 11, p. 158.

Sischka, P. E. et al. 2022. The Impact of Forced Answering and Reactance on Answering Behavior in Online Surveys. *Social Science Computer Review* 40(2), pp. 405-425.

Sleddens, E. F. et al. 2014. Development of the Comprehensive General Parenting Questionnaire for caregivers of 5-13 year olds. *International Journal of Behavioral Nutrition and Physical Activity* 11(1), p. 15.

Sleddens, E. F. C. et al. 2011. General parenting, childhood overweight and obesity-inducing behaviors: A review. *Int J Pediatr Obes* 6.

Smith, S. M. et al. 2008. Can we recognise obesity clinically? *Archives of Disease in Childhood* 93(12), p. 1065.

Sokol, R. L. et al. 2017. Parenting styles and body mass index: a systematic review of prospective studies among children. *Obesity Reviews* 18(3), pp. 281-292.

Song, M. et al. 2018. Assessing the feasibility of parent participation in a commercial weight loss program to improve child body mass index and weight-related health behaviors. *SAGE Open Med* 6, p. 2050312118801220.

Sport England 2021. *Active Lives Children and Young People Survey - Academic year 2019/20*.

Sport England. 2023. *Sport England - Active Lives Survey* [Online]. Sport England. Available at: https://activelives.sportengland.org/ [Accessed: 19/11/2023].

Stankov, I. et al. 2012. Overweight and obese adolescents: what turns them off physical activity? *Int J Behav Nutr Phys Act* 9, p. 53.

Statham, J. et al. eds. 2011. *Taking Stock: a rapid review of the National Child Measurement Programme*.

Statista. 2023. *Distribution of Facebook users in the United Kingdom as of April 2023, by age group* [Online]. Available at: https://www.statista.com/statistics/1030055/facebook-users-united-kingdom/ [Accessed: 19/12/2023].

Stavridou, A. et al. 2021. Obesity in Children and Adolescents during COVID-19 Pandemic. *Children (Basel, Switzerland)* 8(2), p. 135.

Stiglic, N. and Viner, R. M. 2019. Effects of screentime on the health and well-being of children and adolescents: a systematic review of reviews. *BMJ Open* 9(1), p. e023191.

Stokols, D. 2000. Social Ecology and Behavioral Medicine: Implications for Training, Practice, and Policy. *Behavioral medicine (Washington, D.C.)* 26(3), pp. 129-138.

Stuart, B. and Panico, L. 2016. Early-childhood BMI trajectories: evidence from a prospective, nationally representative British cohort study. *Nutrition & Diabetes* 6(3), pp. e198-e198.

Swinburn, B. A. et al. 2011. The global obesity pandemic: shaped by global drivers and local environments. *The Lancet* 378(9793), pp. 804-814.

Swyden, K. et al. 2015. Relationship between parental perception and concern for child weight and influence on obesogenic parenting practices. *Adv Pediatr Res* 2, p. 12.

Sylvetsky-Meni, A. C. et al. 2015. The impact of parents' categorization of their own weight and their child's weight on healthy lifestyle promoting beliefs and practices. *Journal of obesity* 2015, pp. 307381-307381.

Syrad, H. et al. 2015. Health and happiness is more important than weight': a qualitative investigation of the views of parents receiving written feedback on their child's weight as part of the National Child Measurement Programme. *Journal Of Human Nutrition And Dietetics: The Official Journal Of The British Dietetic Association* 28(1), pp. 47-55.

Szyjka, S. 2012. Understanding Research Paradigms: Trends In Science Education Research. *Problems of Education in the 21st Century* 43, p. 110.

Tarcin, G. 2023. Familial Nutrition and Physical Activity Habits in Children and Adolescents with Type 1 Diabetes Mellitus. *Journal of Clinical Practice and Research*.

Tashakkori, A. and Creswell, J. W. 2007. Editorial: The New Era of Mixed Methods. *Journal of Mixed Methods Research* 1(1), pp. 3-7.

Tashakkori, A. and Teddlie, C. 2010. *SAGE Handbook of Mixed Methods in Social & Behavioral Research*. SAGE Publications.

Thornton, L. et al. 2016. Recruiting for health, medical or psychosocial research using Facebook: Systematic review. *Internet Interventions* 4, pp. 72-81.

Timm, A. et al. 2022. Strategies to promote health behaviors in parents with small children-A systematic review and realist synthesis of behavioral interventions. *Obes Rev* 23(1), p. e13359.

Timperio, A. et al. 2008. Family physical activity and sedentary environments and weight change in children. *International Journal of Pediatric Obesity* 3(3), pp. 160-167.

Tomiyama, A. J. et al. 2018. How and why weight stigma drives the obesity 'epidemic' and harms health. *BMC Med* 16(1), p. 123.

Trost, S. G. et al. 2013. Measurement of general and specific approaches to physical activity parenting: a systematic review. *Child Obes* 9 Suppl, pp. S40-50.

Trott, M. et al. 2022. Changes and correlates of screen time in adults and children during the COVID-19 pandemic: A systematic review and meta-analysis. *eClinicalMedicine* 48.

Tucker, J. M. et al. 2016. Association between the Family Nutrition and Physical Activity Screening Tool and obesity severity in youth referred to weight management. *Obesity Research & Clinical Practice*.

Tuval-Mashiach, R. 2017. Raising the Curtain: The Importance of Transparency in Qualitative Research. *Qualitative psychology (Washington, D.C.)* 4(2), pp. 126-138.

Tzou, I. L. and Chu, N.-F. 2012. Parental influence on childhood obesity: A review. *Health* Vol.04No.12, p. 7.

van Sluijs, E. M. et al. 2013. Correlates of light and moderate-to-vigorous objectively measured physical activity in four-year-old children. *PLoS One* 8(9), p. e74934.

Vaughn, A. E. et al. 2017. Development of a Comprehensive Assessment of Food Parenting Practices: The Home Self-Administered Tool for Environmental Assessment of Activity and Diet Family Food Practices Survey. *J Acad Nutr Diet* 117(2), pp. 214-227.

Vaughn, A. E. et al. 2016. Fundamental constructs in food parenting practices: a content map to guide future research. *Nutrition Reviews* 74(2), pp. 98-117.

Ventura, A. K. and Birch, L. L. 2008. Does parenting affect children's eating and weight status? *International Journal of Behavioral Nutrition and Physical Activity* 5(1), p. 15.

Volger, S. et al. 2012. Patients' preferred terms for describing their excess weight: discussing obesity in clinical practice. *Obesity (Silver Spring, Md.)* 20(1), pp. 147-150.

Vollmer, R. L. and Mobley, A. R. 2013. Parenting styles, feeding styles, and their influence on child obesogenic behaviors and body weight. A review. *Appetite* 71, pp. 232-241.

Warschburger, P. and Kroller, K. 2009. Maternal Perception of Weight Status and Health Risks Associated With Obesity in Children. *Pediatrics (Evanston)* 124(1), pp. e60-e68.

Warschburger, P. and Kröller, K. 2012. "Childhood overweight and obesity: maternal perceptions of the time for engaging in child weight management". *BMC public health* 12(1), pp. 295-295.

Webber, L. et al. 2010a. Child adiposity and maternal feeding practices: a longitudinal analysis. *The American Journal Of Clinical Nutrition* 92(6), pp. 1423-1428.

Webber, L. et al. 2010b. Associations between child weight and maternal feeding styles are mediated by maternal perceptions and concerns. *European Journal Of Clinical Nutrition* 64(3), pp. 259-265.

Welfare, A. I. o. H. a. 2021. Childhood overweight and obesity—the impact of the home environment.Canberra.

Wells, J. C. K. et al. 2011. Associations of Birth Order With Early Growth and Adolescent Height, Body Composition, and Blood Pressure: Prospective Birth Cohort From Brazil. *American Journal of Epidemiology* 174(9), pp. 1028-1035.

Whitmore, S. 2009. Do School Lunches Contribute to Childhood Obesity? *Journal of Human Resources* 44(3), p. 684.

WHO 1986. Ottawa charter for health promotion.

WHO 2004. Global Strategy on Diet, Physical Activity and Health: Childhood overweight and obesity.

WHO. 2023. *Obesity* [Online]. Available at: https://www.who.int/health-topics/obesity/#tab=tab_1 [Accessed: 16/12/2023].

Williams, A. J. et al. 2013. Systematic review and meta-analysis of the association between childhood overweight and obesity and primary school diet and physical activity policies. *Int J Behav Nutr Phys Act* 10, p. 101.

Williams, B. D. et al. 2021. Associations between health-related family environment and objective child sleep quality. *Journal of Paediatrics and Child Health* n/a(n/a).

Williams, J. E. et al. 2017a. Associations Between Parental BMI and the Family Nutrition and Physical Activity Environment in a Community Sample. *J Community Health* 42(6), pp. 1233-1239.

Williams, J. E. et al. 2017b. Associations Between Parental BMI and the Family Nutrition and Physical Activity Environment in a Community Sample. *Journal Of Community Health* 42(6), pp. 1233-1239.

Wolfenden, L. et al. 2009. Obtaining active parental consent for school-based research: a guide for researchers. *Australian and New Zealand Journal of Public Health* 33(3), pp. 270-275.

Woods, T. 2018. Conceptual Application of the Adapted Health Belief Model to Parental Understanding of Child Weight. pp. 1-6.

World Medical Association 2013. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *Jama* 310(20), pp. 2191-2194.

Wrotniak, B. H. et al. 2004. Parent weight change as a predictor of child weight change in family-based behavioral obesity treatment. *Archives of pediatrics & adolescent medicine* 158.

Wyszyńska, J. et al. 2020. Physical Activity in the Prevention of Childhood Obesity: The Position of the European Childhood Obesity Group and the European Academy of Pediatrics. *Frontiers in Pediatrics* 8.

Xu, H. et al. 2015. Associations of parental influences with physical activity and screen time among young children: a systematic review. *J Obes* 2015, p. 546925.

Yaffe, Y. 2020. Systematic review of the differences between mothers and fathers in parenting styles and practices. *Current Psychology*.

Yee, K. E. et al. 2011. Association between The Family Nutrition and Physical Activity Screening Tool and cardiovascular disease risk factors in 10-year old children. *International Journal of Pediatric Obesity* 6(3-4), pp. 314-320.

Zhang, X. et al. 2021. Milk consumption and multiple health outcomes: umbrella review of systematic reviews and meta-analyses in humans. *Nutrition & Metabolism* 18(1), p. 7.

Zutlevics, T. 2016. Could providing financial incentives to research participants be ultimately self-defeating? *Research Ethics* 12(3), pp. 137-148.

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Appendices

Appendices

Appendix 1 - Literature search strategy

Given the complexity surrounding children obesity, the search strategy involved three lines of enquiry:

1) The family-home environment and association with weight
2) Change in weight status amongst children
3) Parental perception of child obesity to instigate behaviour change

The hierarchy of evidence was used to guide the literature review, although evidence selected by its usefulness and relevance to the research question. The search strategy consisted of search strings composed of terms using a phased approach across four concepts (1) obesity (e.g. overweight, body mass index), (2) Home environment (3) family (e.g. family, mother, father), (4) children (e.g. child, infant, youth). Three databases (Embase, Medine and PsycINFO) were searched using individually tailored search strategies most appropriate for each database. The initial literature searches were undertaken in January 2020 and updated in May 2023 to identify any new research.

Search 1: The family-home environment and association with weight

The following terms were used adopting synonyms, truncation and adjacency:

- Child* or “school age” or childhood or infant* or mid-childhood or “primary school” or elementary (S1)
- Obes* or overweight or adiposity or weight or "excess weight" (S2)
- Home or “home environment” or “family environment” or “family home environment” (S3)
- “Parenting styles” or “parenting practices" (S4)
- “weight loss” or “weight reduc*” or "positive shift" or *weight change” (S5)

DATABASE	SEARCH RESULTS
EMBASE (via EBSCO)	
Search 1 (S1)	3,791,689
Search 2 (S2)	1,779,038
Search 3 (S3)	366,748
(S1) + (S2) + (S3)	8,430
Search 4 (S4)	4,972
(S1) + (S2) + (S3) + (S4)	147
(S1) + (S2) + (S3) + (S5)	520
MEDLINE (via OVID)	
Search 1 (S1)	3,365,545
Search 2 (S2)	3,329,955
Search 3 (S3)	307,814
(S1) + (S2) + (S3)	6,771
Search 4 (S4)	3,484
(S1) + (S2) + (S3) + (S4)	103
(S1) + (S2) + (S3) + (S5)	321
APA PsycINFO	
Search 1 (S1)	1,002,408
Search 2 (S2)	126,430
Search 3 (S3)	145,920
(S1) + (S2) + (S3)	2,215
Search 4 (S4)	7,546
(S1) + (S2) + (S3) + (S4)	81
(S1) + (S2) + (S3) + (S5)	108

Search 2: Parental perception of child obesity to instigate behaviour change

The following terms were used adopting both synonyms and truncation:

- Child* or “school age” or childhood or infant* or mid-childhood or “primary school” or elementary (S1)
- Obes* or overweight or adiposity or weight or "excess weight" (S2)
- "Parental Awareness" or "parental perception*" (S3)

DATABASE	SEARCH RESULTS
EMBASE (via EBSCO)	
Search 1 (S1)	4007482
Search 2 (S2)	2384572
Search 3 (S3)	3077
(S1) + (S2) + (S3)	498
MEDLINE (via OVID)	
Search 1 (S1)	3,774,191)
Search 2 (S2)	1,619,188
Search 3 (S3)	2,370
(S1) + (S2) + (S3)	31
APA PsycINFO	
Search 1 (S1)	1002408
Search 2 (S2)	126430
Search 3 (S3)	2209
(S1) + (S2) + (S3)	198

Appendix 2 - NHS England suspension of NCMP letter

19 March 2020

To:

CEOs of NHS and Foundation Trusts

CEOs of Clinical Commissioning Groups

Directors of Public Health

CEOs of Community Health Providers

CEOs of private and not-for-profit community providers

CEOs for community interest companies

Cc:

NHS England and NHS Improvement Regional Directors

Chief Executives of Councils

COVID-19 Prioritisation within Community Health Services

Following on from Sir Simon Stevens' and Amanda Pritchard's letter of 17 March 2020, this letter and annex set out how providers of community services can release capacity to support the COVID-19 preparedness and response. These arrangements will apply until 31 July 2020 in the first instance.

The current priorities for providers of community services during this pandemic are:

1. Support home discharge today of patients from acute and community beds, as mandated in the new Hospital Discharge Service Requirements, and ensure patients cared for at home receive urgent care when they need it
2. By default, use digital technology to provide advice and support to patients wherever possible
3. Prioritise support for high-risk individuals who will be advised to self-isolate for 12 weeks. Further advice on this will be published shortly.
4. Apply the principle of mutual aid with health and social care partners, as decided through your local resilience forum.

Thank you for your support and the important work you are undertaking.

[redacted]

[redacted]

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1. Children and Young People Services

#	Services	Commissioner	Location	Plan during pandemic	Details
Stop Full service					
1.	National child measurement programme	NHS England	Home and school	**Stop**	
2.	Audiology	Clinical Commissioning Groups	Clinic based	**Stop**	
3.	Friends and Family Test	NHS England	Provider based	**Stop**	Cease data submission and collection with immediate effect
Partial stop of service					
4.	Vision screening	Clinical Commissioning Groups	Home and clinic based	**Stop except**: • New-born visual checks (within 72 hours of birth) cannot be stopped as neonatal cataracts need to be spotted early • 6 week check can safely be conducted at 8 weeks • Pre-school checks can be delayed until major incident response is over	See also separate guidance to be published
5.	Pre Birth and 0-5 service (Health visiting)	Local Authorities	Home visits and clinic based	**Stop except:** • Stratify visits and support for vulnerable families • Safeguarding work (MASH; statutory child protection meetings and home visits) • All new Birth visits • Follow up of high risk mothers, babies and families • Antenatal visits and support (consider virtual) • Phone and text advice- digital signposting • Blood spot screening	Providers to work with their Designated Professionals for Safeguarding Explore voluntary sector support Prepare staff for redeployment Consider signposting families to online information if appropriate
6.	School nursing	Local Authorities/ CCG for specialist school nurses	Home visits, school and clinic based	**Stop except:** • Phone and text service • Safeguarding • Specialist school nursing	Consider redeployment if schools shut / support vulnerable at home
7.	New born hearing screening	NHS England	Maternity unit, clinics and home	**Stop except:** • maternity unit based screening	See also separate guidance to be published
8.	Community paediatric service	Clinical Commissioning Groups	Home visits, school and clinic based	**Stop except:** • Services/interventions deemed clinical priority • Child protection medicals • Telephone advice to families • Risk stratify Initial Health Assessments (urgent referrals need to continue however some routine referrals may be delayed with appropriate support e.g. initial basic advice to parents/carers	

Appendix 3 – Online survey

My name is Matthew Pearce. I am a PhD student at Cardiff University and I would like to invite you to take part in a research study.

The aim of my research is to investigate the various home and family factors, motivations of parents/carers and its relationship with the health of children. You have received this letter and the enclosed questionnaire, as you have or look after a child in Year 6 who will soon have their height and weight measured as part of the National Child Measurement Programme (NCMP).

My research is being carried out in two phases. The first phase involves inviting parents/caregivers to complete the enclosed questionnaire. The questionnaire includes several questions about you and the home environment. The second phase of the research will involve following up questionnaire responses by interviewing a small number (approx. 10) of parents/caregivers.

By completing the online questionnaire, you will help researchers gain a better understanding on the role of the environment and the health of children. Parents or Carers will have a good knowledge of the home environment and are therefore best placed to give an overview of the likely factors that influence a child's health.

By submitting the questionnaire, you are giving your consent to taking part in the research. All submitted questionnaires will be entered into a prize draw with the opportunity to win a range of prices including a cattle country family vouchers, free swimming passes and gym memberships

At the end of the questionnaire you will find information about how any personal information you provide will be used as part of the research and how it will be stored.

Please ensure you click on the 'F*inish'* icon at the end of the questionnaire to ensure your responses are submitted.

Please answer these questions as fully as possible. You may complete additional copies of the questionnaire if required e.g. for twins

Section 1 - About you (the person completing the questionnaire)

1. Which of the following are you?

   a. Mother ☐
   b. Father ☐
   c. Caregiver ☐

2. Your age?

   a. Under 25 years ☐
   b. 26 to 29 years ☐
   c. 30 to 39 years ☐
   d. 40 to 49 years ☐
   e. 50 or older ☐

3. Marital Status

   a. Single ☐
   b. Married ☐
   c. Divorced ☐
   d. Long term relationship ☐

4. How would you describe your current weight status?

   a. Underweight ☐
   b. Healthy Weight ☐
   c. Overweight ☐
   d. Very overweight ☐

5. Have you actively tried to lose weight over the last 7-years?

   a. Yes ☐
   b. No ☐ (if no, please go to question 7)

6. If yes, have you been successful in losing and maintaining a healthy weight?

   a. Yes ☐
   b. No ☐

7. Is your child looked after by their grandparent/s either before or after school?
   a. Yes ☐
   b. No ☐ (if no go to section 2)

8. If yes, approximately how many days a week is your child looked after by your grandparent/s
   a. 1-2 days ☐
   b. 3-4 days ☐

c. 5 days or more ☐

Section 2 - About your child (who is currently in Year 6)

2.1 Which of these bests describes your child?

- underweight ☐
- normal weight ☐
- overweight ☐
- very overweight ☐

2.2 Have you ever been informed that your child has a weight issue?

- Yes ☐
- No ☐ (if no go to section 3)

2b. If yes, who informed you that your child might have a weight issue?

- Health professional ☐
- Family member ☐
- Friend ☐
- Work colleagues ☐
- Other _____

Section 3 - About your home environment

This section focuses on the home and family home environment. For each question, select the answer category that best fits your child or your family. It is important to indicate the most common or typical pattern for your family, and not what you would like to happen

.

Family Meals	**Never / Almost Never**	**Sometimes**	**Often**	**Very Often / always**
1. How often does your child eat breakfast, either at home or at school?	1	2	3	4
2. How often does your child eat at least one meal a day with at least one other family member?	1	2	3	4
Family Eating Practices	**Never/ Almost Never**	**Sometimes**	**Often**	**Very Often/ Always**
3. How often does your child eat while watching TV? [Includes meals or snacks]	1	2	3	4
4. How often does your family eat “fast food?”	1	2	3	4
Food Choices	**Never/ Almost Never**	**Sometimes**	**Often**	**Very Often/ Always**
5. How often does your family use packaged “ready--to--eat” foods? [Includes purchased frozen or on--the--shelf entrees, often designed to be microwaved]	1	2	3	4
6. How often does your child eat fruits and vegetables at meals or snacks? [Not including juice]	1	2	3	4
Beverage Choices	**Never/ Almost Never**	**Sometimes**	**Often**	**Very Often/ Always**
7. How often does your child drink soda pop or sweetened beverages? [Includes regular or diet fizzy drinks, Sunny-D, Capri Sun, fruit or vegetable juice, caffeinated energy drinks (Monster/Red Bull), Powerade/Gatorade, etc.]	1	2	3	4
8. How often does your child drink low-fat milk for meals or snacks? [Includes 1% or skim dairy, flavoured, soy, almond, etc.]	1	2	3	4
Restriction/Reward	**Never/ Almost Never**	**Sometimes**	**Often**	**Very Often/ Always**
9. How often does your family monitor the amount of sweets, chips, and biscuits your child eats?	1	2	3	4
10. How often does your family use sweets, ice cream or other foods as a reward for good behaviour?	1	2	3	4
Screen Time	Never/ Almost Never	Sometimes	Often	Very Often/ Always
11. How often does your child have less than 2 hours of “screen time” in a day? [Includes TV, computer, game system, or any mobile device with visual screens]	1	2	3	4
12. How often does your family monitor the amount of “screen time” your child has?	1	2	3	4

Healthy Environment	Never/ Almost Never	Sometimes	Often	Very Often/ Always
13. How often does your child engage in screen time in his/her bedroom?	1	2	3	4
14. How often does your family provide opportunities for physical activity?	1	2	3	4
Family Activity	Never/ Almost Never	Sometimes	Often	Very Often/ Always
15. How often does your family encourage your child to be physically active?	1	2	3	4
16. How often does your child do physical activities with at least one other family member?	1	2	3	4
Child Activity	Never/ Almost Never	Sometimes	Often	Very Often/ Always
17. How often does your child do something physically active when he/she has free time?	1	2	3	4
18. How often does your child participate in organized sports or physical activities with a coach or leader?	1	2	3	4
Family Schedule/Sleep Routine	Never/ Almost Never	Sometimes	Often	Very Often/ Always
19. How often does your child follow a regular routine for your child's bedtime?	1	2	3	4
20. How often does your child get enough sleep at night?	1	2	3	4

Consent (please tick where you consent)

1) I give permission for Gloucestershire Health and Care NHS Foundation Trust to grant the researcher (Matthew Pearce) access to my child's health record to obtain information on my child's height and weight measurements taken as part of the national child measurement programme. ☐

2) I would be happy for you (Matthew Pearce) to contact me as part of the follow-up interviews. ☐

Please provide your contact details below:

Parent full name
Parent Address
Postcode
Email
Childs full name
Childs Date of birth

Appendix 4 – Checklist for Internet E-Surveys (CHERRIES)

Item Category	Checklist Item	Explanation
Design	Describe survey design	The target population was parents of children who were aged between 10/11 years age (year) during the 19/20 academic year.
Ethics	Ethics approval	Ethics was approved by NHS HRA, Cardiff University School Research Ethics and research approval was given by Gloucestershire County Council
	Informed consent	Informed consent for the survey was obtained from all those agreeing to complete a survey, with participant information displayed on the welcome page that the survey would take approximately 10 minutes to complete, that all responses were confidential and anonymous, and that data would be stored and analysed on password protected encrypted computers at UWE,A Privacy Notice was also available to download, and contact details were displayed for the research team. *Explicit consent from parents was sought for the researcher to access children's health record stored by Gloucestershire Health and Care NHS Foundation Trust.*
	Data protection	Final page of questionnaire detailed how information would be stored and a link to the Universities data protection policy was provided. As the study involved sensitive data, information was be **Classified as 'C1 Highly Confidential' in line with Cardiff Universities** Information Classification and Handling Policy**.** Surveys were completed online using the 'Online Survey software' which is fully compliant with UK data protection laws and meets UK accessibility requirements. Responses from the online survey were entered onto an encrypted SPSS Data Sheet and stored securely on Cardiff University's H Drive.
Development and Pre-testing	Development and testing	The survey was designed using input from earlier research and inclusion of previously validated questionnaire. Overview of the development of the questionnaire was provided and rationale for not undertaking testing was provided.
Recruitment process	Open survey versus closed survey	This was an "open survey" is a survey open for each visitor of a site, although primarily through invitation by local schools targeting parents of children who were aged 10/11 years during the 19/20 academic year. Social media was also used to increase response rate.
	Contact mode	Vast majority of parents were contacted by local schools to complete the survey. This primarily consisted of inclusion of the link in school newsletters or direct emails to parents using software platforms such as 'Parent Mail'.
	Advertising the survey	The link was distributed by schools to eligible parents although some marketing was undertaken via paid social media and local Facebook groups
Survey Administration	Web/E-mail	'Online Survey' was used to host the questionnaire (www.onlinesurveys.ac.uk)
	Context	Survey was distributed via a direct link to parents.
	Mandatory/voluntary	Not applicable
	Incentives	All respondents who completed the questionnaire and left contact details were entered into a prize draw. Prizes included leisure and swimming passes as well as a cash prize.
	Time/Date	Responses were collected between September 2020 to 20th December 2020.
	Randomization of items or questionnaires	No randomization of questions was offered. Online Survey does not have the functionality to randomise the order of questions, answer

<table>
<tr><td></td><td></td><td>options or pages, or to randomly assign respondents to different versions of a survey.</td></tr>
<tr><td></td><td>Adaptive questioning</td><td>Adaptive questioning (branched) was used. Relevant survey items were displayed based on previous responses (e.g., those parents who had been informed that their child had a weight issue were shown the follow-up question on who had informed them about the weight issue).</td></tr>
<tr><td></td><td>Number of Items</td><td>The survey comprised three sections with no more than 7 questions per page, with the exception of the FNPA questionnaire (20 questions) that was kept to one page for ease of view.</td></tr>
<tr><td></td><td>Number of screens (pages)</td><td>The full survey was distributed over approximately 6 pages. A progress bar was shown at the top of the page, as the respondent was completing the survey.</td></tr>
<tr><td></td><td>Completeness check</td><td>None of the questions were mandatory with respondents able to skip questions if they needed to.</td></tr>
<tr><td></td><td>Review step</td><td>Respondents were able to review and change their answers using a back button although there was no review functionality.</td></tr>
<tr><td rowspan="4">Response rates</td><td>Unique site visitor</td><td>It was not possible to differentiate unique visitors. Online surveys is designed to protect respondent anonymity. Online surveys does not use cookies for survey completion and external tracking software such as Google Analytics is not supported on online surveys. Additionally, the platform does not give access to the research to respondents' IP addresses.</td></tr>
<tr><td>View rate (Ratio of unique survey visitors/unique site visitors)</td><td>Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary.</td></tr>
<tr><td>Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)</td><td>Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.</td></tr>
<tr><td>Completion rate (Ratio of users who finished the survey/users who agreed to participate)</td><td>Of the 1011 people who started the online questionnaire, 407 clicked finish and submitted their responses. A summary of the respondent progress is below:
<table>
<tr><td>Page 1</td><td>Page 2</td><td>Page 3</td><td>Page 4</td><td>Page 5</td><td>Page 6</td><td>Page 7</td></tr>
<tr><td>1011</td><td>85</td><td>19</td><td>47</td><td>109</td><td>20</td><td>407</td></tr>
</table></td></tr>
<tr><td rowspan="4">Preventing multiple entries from same individual</td><td>Cookies used</td><td>Not used</td></tr>
<tr><td>IP check</td><td>Not used to maintain anonymity.</td></tr>
<tr><td>Log file analysis</td><td>Not used</td></tr>
<tr><td>Registration</td><td>This was an open survey - entry to the survey was predominantly via a web link emailed to eligible participants. Duplicate entries were identified where respondents left their contact or child details.</td></tr>
<tr><td rowspan="3">Analysis</td><td>Handling of incomplete questionnaires</td><td>The online survey software does not enable the research to see incomplete questionnaires. Survey responses can only be seen after the respondent has clicked on the 'Finish button'</td></tr>
<tr><td>Questionnaires submitted with an atypical timestamp</td><td>Only completed questionnaires were included in the final dataset.</td></tr>
<tr><td>Statistical correction</td><td>No weighting scheme was used for the analysis of results.</td></tr>
</table>

Appendix 5 - Participation sheet and information form

The family-home environment and its association with the emergence, persistence, and remission of weight gain in mid-childhood

Participant Information Sheet for Parents/Guardians/Carers (Please keep this copy)

Thank you for expressing an interest in being interviewed as part of the above research project. Ethical procedures for academic research undertaken from UK institutions require that interviewees explicitly agree to being interviewed and how the information contained in their interview will be used.

Introduction

My name is Matthew Pearce. I am a PhD student at Cardiff University and a Public Health Consultant, I would like to invite you to take part in a research study. Before you decide whether to take part you need to understand why the research is being done, and what it will

involve. Please read the following information carefully before you decide whether to take part.

What is the purpose of the study?

The aim of the study is to investigate the various home and family factors, motivations of parents/carers and its relationship with the health of children. Parents or Carers have good knowledge of the home environment and are therefore best placed to help us understand the likely factors that influence a child's health.

Why have I been invited?

You have been selected as you have child (or you look after a child) who is currently in Year 6 who will have had their height and weight measured as part of the National Child Measurement Programme (NCMP). You had also previously completed a questionnaire on the family home environment and said you may be interested in an interview with the researcher

What will I be expected to do?

If you agree to take part in the research, you will be invited to take part in an interview with the researcher taking up to an hour. I will arrange it at a time and location convenient for you.

Do I have to take part?

No, taking part in the research is completely voluntary. If you agree to participate and then change your mind you may withdraw from the study at any time by contact me using the details overleaf.

What are the possible advantages of taking part?

Parents/carers often find that taking part in research of this kind is interesting. The interview may help you think and reflect on your current family lifestyle. Participation in the study will help us understand and develop ways to support children to lead a healthy lifestyle.

What are the possible disadvantages of taking part?

There are unlikely to be any disadvantages in taking part in the research. Exploring health and lifestyle issues can sometimes be difficult, the researcher is fully trained and will be respectful and sensitive in these discussions. If you would like information or advice regarding your child's health and wellbeing, please visit Gloucestershire's Families Directory www.glosfamiliesdirectory.org.uk/

Will my taking part be kept confidential?

The researcher will record the interview and a transcript will be produced. You will be sent the transcript and given the opportunity to correct any factual errors**.** Only the interviewer will have access to the audiotape. All information will be coded and anonymised which will involve removing any information where participants could be identified i.e. name, gender. Once the

transcript has been completed and checked by the interviewer for accuracy, the audiotape will be erased.

All information collected about you and your child/child in your care during the course of the research will be kept strictly confidential and stored securely in line with Cardiff University's Information Security Framework. Neither you nor your child/child in your care will be able to be identified in any reports or publications that are produced. The information I have collected as paper copies will be stored under lock and key, while the electronic data can only be accessed with a secure password. Only the researchers will have access to the data.
It will be stored by the researcher using an ID number, and not your name.

How will my data be managed and looked after?

Cardiff University is the sponsor for this study based in the UK. We will be using information from you and your child/child in your care in order to undertake this study and will act as the Data Controller for this study. This means that we are responsible for looking after your information and using it properly. Cardiff University will keep identifiable information about you for 15 years after the study has finished.

Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. You can find out more about how we use your information at: https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection or by contacting the University's Data Protection Officer at inforequest@cardiff.ac.uk

What will happen if I decide to withdraw from the study?

If you decide to withdraw from the study, you are free to do so at any point and will not be contacted by the researcher again. However, we will need to keep any responses and information you have provided up until the point you withdrew, for inclusion in the study. If you do decide to withdraw, any data you have provided will be treated confidentially.

What will happen to the results of the study?

Once the study is completed the findings will be written up as part of my thesis, which will be publicly available through Cardiff University. The results may also be presented in academic journals and presented at conferences or to the public. This may include using anonymous direct quotations from the interview, but no one will be able to identify you or your child from any publications or presentations

If you would like to receive a summary of the findings or access to information that held, please contact me using the details at the end of this sheet.

Who has reviewed this study?

This research has been approved by the School of Healthcare Sciences Research Ethics Committee, Cardiff University, the NHS Research Ethics Committee and Gloucestershire

County Council Research Assurance Committee.

What if something goes wrong?

In the event that something does go wrong and you are harmed during the research and this is due to someone's negligence then you may have grounds for legal action for compensation against Cardiff University, but you may have to pay your legal costs

If you require any further information or have any questions please contact:
Matthew Pearce (the researcher), Cardiff University
By email: [redacted]

Should you have any concerns or wish to make a complaint about the research, then please contact the Cardiff University PhD supervisors:
[redacted] School of Healthcare Sciences, Cardiff University

Email: [redacted]

[redacted] School of Healthcare Sciences, Cardiff University

Email: [redacted]

CONSENT FORM

Name of Researcher: Matthew Pearce

Please initial box

1. I confirm that I have read the information sheet dated XXXX (version XXX) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason ☐

3. I understand that my interview will be audio-recorded and that my anonymised word-for-word quotes may be included in the final PhD thesis, publications and/or presentations. ☐
4. (If appropriate) I understand that the information collected about me will be used to support other research in the future, and may be shared anonymously with other researchers. ☐

5. I agree to take part in the above study. ☐

Name of Participant	Date	Signature

Name of Person taking consent	Date	Signature

Appendix 6 – Covering email to schools

Dear Year 7 Lead,

I recognise these are busy and challenging times, but I am hoping that you can help.

I am a PhD student at Cardiff University who lives in Gloucestershire (and a Public Health Consultant by profession) undertaking research on childhood obesity in Gloucestershire. The aim of my research is to investigate the various home and family factors, motivations of parents/carers and its relationship with the health of children.

I would be most grateful if you could circulate the link below to parents of Year 7 children**.** The reason for asking these parents to complete the questionnaire is that their child was likely measured as part the 19/20 National Child Measurement Programme (NCMP) during the last 12-months.

The link to the questionnaire that needs to be circulated to Year 7 parents can be found here - https://cardiff.onlinesurveys.ac.uk/healthy-living-survey

My research has received NHS Ethics Approval and research assurance from Cardiff University, Gloucestershire Health and Care NHS Foundation Trust (School Nursing Service) and Gloucestershire County Council. Please do not hesitate to contact me should you have any questions.

Once again, I would be truly grateful for any support you can offer in circulating the link to parents. For convenience, I have included a template email that you might like to use in your correspondence to parents below

Best wishes
Matt Pearce

Dear Year 7 Parent,

Our school is supporting some local research that is investigating the family home environment and the health of children. Please find a link below to a short online survey that we would encourage you to complete.

https://cardiff.onlinesurveys.ac.uk/healthy-living-survey

All submitted questionnaires (where contact details are provided) will be entered into a prize draw with the opportunity to win a range of prices

Thank you

Appendix 7 – Example incentive for completion of survey

You have won a one month free membership!

To claim your membership, please complete and sign the enclosed membership form and hand in to the customer services desk at Leisure at Cheltenham, along with this letter. The customer services team will then set you up on the system.

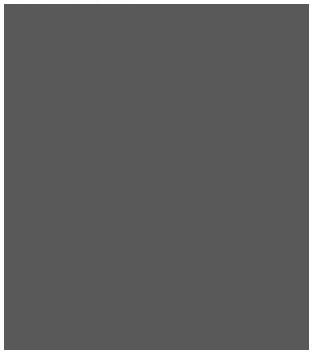
The membership offers you access to all facilities at all times; gym, swim, exercise classes, spa, track and discounted racquet sports. Winner must be 18 or over to redeem the prize.

For further information, please contact our membership sales team by phone 01242 528 764 or by email membership@cheltenhamtrust.org.uk. You can also visit our website www.leisureatcheltenham.com.

Please claim your prize by 31st July 2020.

You can find our most up to date swim and exercise class timetables on our website. We hope you enjoy your membership with Leisure at Cheltenham!

On behalf of the Leisure at membership sales team,



*Terms & Conditions apply

Brought to you by
THE CHELTENHAM TRUST

Appendix 8 - School nursing vision and screening NCMP letter

with you, for you

NHS
Gloucestershire Health and Care
NHS Foundation Trust

Edward Jenner Court
1010 Pioneer Avenue
Brockworth
Gloucester
GL3 4AW

www.ghc.nhs.uk

change 4 life

October 2019

Dear Parent or Carer,

Screening Vision and Measuring height and weight of children

Each year in England, school children in Reception and Year 6 have their height and weight checked at school as part of the National Child Measurement Programme. Height and weight measurements are used to calculate weight status. We collect this information because it is in the public interest to understand how many children are overweight, healthy weight or underweight. Your child's class will take part in this year's programme.

The checks are carried out by trained school nurses or trained health care providers. Children are measured fully clothed, except for their coats and shoes, in a private space away from other pupils. The results will not be visible to your child.

Children will not be made to take part on the day if they do not want to.

Your Head Teacher has agreed that this will happen in your child's school, you can contact your school to find out when we will be visiting.

Vision – Reception aged children only

It is very important for a child's eyesight to be screened when they are young so that any problems can be picked up and treated early on. This will be done during Reception year alongside the NCMP.

On the day, Health and Wellbeing Assistants from your local School Nurse team will screen your child's eyesight at school. We will inform you about the outcome of the screen and if necessary we will refer your child to a specialist. We encourage you to share your child's results with their class teacher.

The information we collect and what it is used for is listed below:

- your child's age, gender, and date of birth are used to calculate your child's weight category
- your child's name, date of birth and NHS Number are used to link your child's measurements from Reception and Year 6. Other data sets may also be linked such as your child's dental survey results or any visits to hospital they may have had. Linking your child's information in this way helps us to understand how and why the weight status of children is changing, and how this affects children's health
- your child's ethnicity and address are used to help understand some of the reasons for the difference and changes in child weight across England
- Your address is required to send you your child's feedback letter. This will include your child's measurements together with information about healthy eating and being active.

All of the data collected is also used for improving health, care and services through research and planning.

All this information is treated confidentially and held securely by us. No individual measurements will be given to school staff or other children.

How the data is used

The information collected from all schools in the area will be gathered together and held securely by Gloucestershire County Council. We will store your child's information as part of their local child health record on the NHS's child health information database.

All the information collected about your child will be sent by us to NHS Digital. NHS Digital is responsible for collecting data and information about health and care so that this can be used to monitor and improve the care provided to people across England.

The information collected about your child will also be shared by NHS Digital with Public Health England but in a de-personalised form only. This means Public Health England will not be able to identify your child. Public Health England is responsible for working to protect and improve the nation's health.

Both NHS Digital and Public Health England will use the information from the National Child Measurement Programme to better understand numbers and trends in child weight and body mass index (BMI). This helps with the planning of services to support healthy lifestyles in your area. No information will ever be published by NHS Digital or Public Health England that identifies your child.

De-personalised information from the National Child Measurement Programme may also be shared by NHS Digital with other organisations, such as universities. This is to help improve health, care and services through research and planning. This information cannot be used to identify your child, and NHS Digital only ever shares information for research with the approval of an independent group of experts.

Withdrawing your child from the National Child Measurement Programme

If you are happy for your child to have their vision screen and to be weighed and measured, you do not need to do anything.

If you do not want your child to take part in one or both of these, please let us know by completing the online form at:

https://ghc.nhs.uk/our-teams-and-services/school-nursing/school-nursing-screening-form/

Alternatively please phone **0300 421 8225** within 2 weeks leaving a message with the details of your child's name, date of birth, address and the school they currently attend.

If your child is already under professional care for their vision, it is important that you notify us using the online form or on the above number to prevent unnecessary referrals.

Children will not be made to take part on the day if they do not want to.

NCMP - Receiving your child's measurement results

We will not automatically inform you of your child's results, only if they fall into the overweight or underweight category. In these instances, you will receive an intervention letter to offer you information and support.

If you would like to be informed of your child's results, please let us know by completing the online form at:

https://ghc.nhs.uk/our-teams-and-services/school-nursing/school-nursing-screening-form/

Alternatively please phone **0300 421 8225.** Please leave a message with details of your child's name, date of birth, address, school they currently attend and your contact telephone number.

NCMP – Local Research Project – Year 6

In order to better understand the health of children in Gloucestershire, we are supporting a local research project led by PhD Student Matthew Pearce. Over the next few months you may be invited to complete a short questionnaire and we would be grateful if you could consider taking part.

Appendix 9 – Presentation to primary school head teachers

The family-home environment and its association with the emergence, persistence, and remission of weight gain in mid-childhood

Matt Pearce MFPH FPH FRSA MPH
PhD Student / Consultant in Public Health
15th September 2019

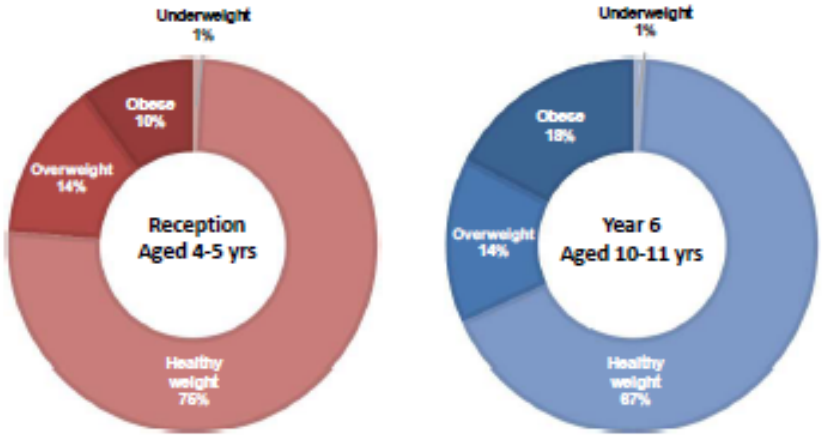
1

Background

- Childhood obesity is a major public health crisis nationally and internationally (Karnik and Kanekar 2012).
- It is well known that people who are overweight or obese are at increased risk of a range of diseases that can have a significant impact on their health (McPherson 2007).
- Evidence shows that growth in early life may be important to later risk of obesity and that many risk factors for developing obesity originate during childhood
- It has also been widely documented that obesity in children can lead to the development of diabetes, asthma, psychosocial morbidity, orthopaedic and cardiovascular problems as well as increased risk of obesity persistence in adulthood

BMI Status by Age

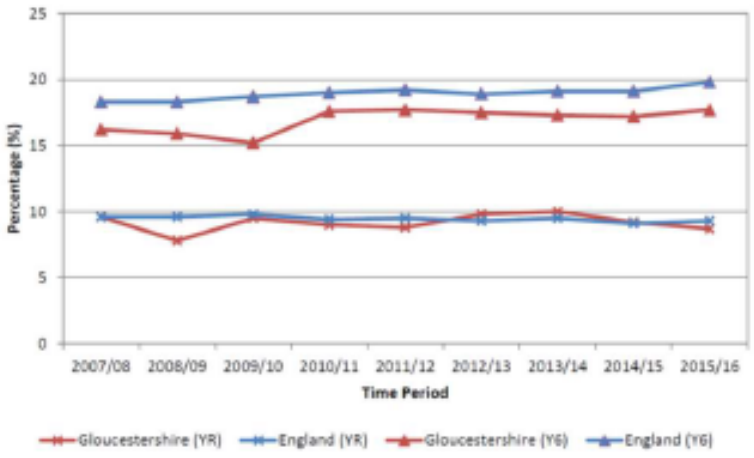
NCMP Gloucestershire 2017/18



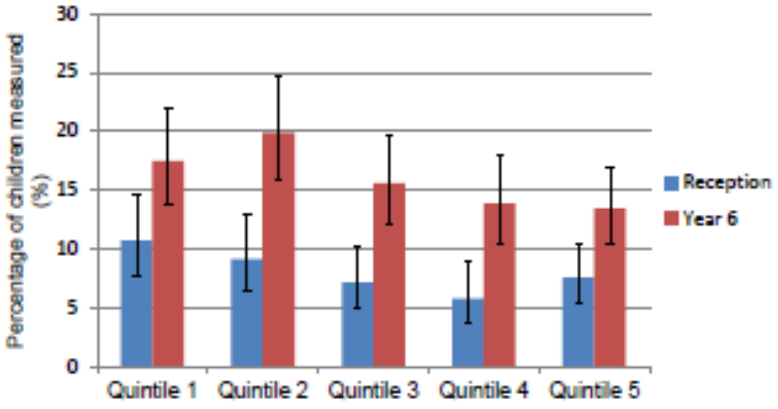
This analysis uses the 2nd, 85th and 95th centiles of the British 1990 growth reference (UK90) for BMI to classify children as underweight, healthy weight, overweight and obese. These thresholds are the most frequently used for population monitoring within England.

3

Obesity Prevalence - Gloucestershire



Analysis by deprivation



Proportion of obese Reception and Year 6 children by deprivation quintile (1-most deprived, 5 least deprived)

5

Tracking weight status

- Once established in childhood, obesity tracks into adulthood (Simmonds et al.,2015) and is extremely difficult to reverse.
- Studies suggest that at least 70% of obese children will become obese adults (Freedman et al., 2007) with increased risk of cardiovascular disease, Type 2 diabetes and other obesity-related diseases (Wijgaet al., 2010).
- It is well recognised that children who are obese are likely to have obese parents. Parental obesity status predicts child overweight status (Reilly et al., 2005).

The causes of obesity are complex encompassing biology and behaviour set within a cultural, environmental, and social framework

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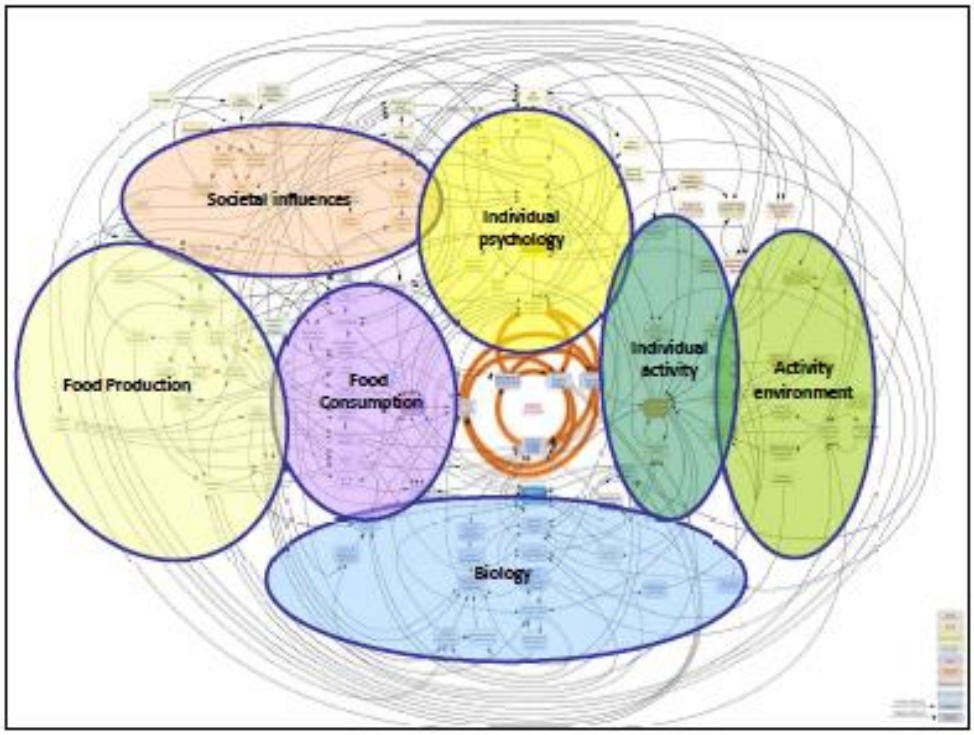

Obesogenic environments

Pearce et al (2018)

9

The family-home environment and its association with the emergence, persistence, and remission of weight gain in mid-childhood

The role of parents

- Children under 12 years of age are under less volitional control than older children, and thus, parents play a major role in promoting or inhibiting opportunities for healthy active living
- Parents may intentionally or unintentionally create the conditions that create a positive shift in weight status
- Parents who are concerned as to whether their child is overweight has been associated with parenting styles and practices that are known to be counterproductive i.e. restrictive feeding (Swyden et al. 2015)

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Emergence and remission

Baseline (Reception)	Follow-up (Year 6)							
	underweight		healthy weight		overweight		Obese	
	n	%	n	%	n	%	n	%
Underweight	3	15	17	85	0	0	0	0
Healthy Weight	16	1.1	1136	78.4	170	11.7	127	8.8
Overweight	0	0	103	42.7	65	27	73	30.3
Obese	0	0	24	15.7	25	16.3	104	68

Change in weight category between Reception and Year 6 using British 1990 (UK90) growth reference charts

Pearce et al (2016)

Questionnaire

Online questionnaire collects data on the following

1. Parent and family characteristics
2. Parent perception of child's weight
3. Awareness of child weight status
4. Assessment of home environment – 20 item validated questionnaire:

Breakfast consumption and family meals	Modelling of healthy nutrition	Consumption of nutrition dense foods	Consumption of high calorie beverages
Use of restriction and reward	Parents modelling physical activity	Child's physical activity behaviour	Screen time
Television use in the bedroom	Sleep schedule		

5. Study overview and participant consent

15

How can you help?

- Circulate the invitation and link to online survey to parents of Year 6 Children (Spring 2020)
- Encourage as parents to complete the questionnaire, particular those 'hard to reach

Appendix 10 – Follow-up email to schools

From: Matthew Pearce
Sent: 13 October 2020 21:17
To:
Subject: RE: Research Help (Please can you pass this email onto the Head of Year 7

Dear Year 7 Lead

Apologies for chasing this up as I know how incredibly busy you are, but I just wanted to check whether you had been able to circulate the link/survey below to Year 7 parents?

I also wanted to provide a few more details that might be helpful:

- Parents of all schools in Gloucestershire were informed last October by the NHS School Nursing Service that they would be invited to take part in the survey as part of the National Child Measurement Programme (NCMP)
- All responses to the questionnaire will be completely confidential and anonymised for research purposes
- I will happily share a summary of my research with schools if helpful

Any help would be really appreciated (even just a quick email to parents) as the more responses we can get, the more insight we will be able to gather to understand how to improve the health and wellbeing of children.

If you do have questions, please don't hesitate to contact me via email or phone (07974 758403)

Best wishes
Matthew Pearce

Appendix 11 – Paid social media overview and data

Social Media Community Groups	Number of members/likes
Cotswolds	
New spotted Gloucester	3,700 members
Open Tewkesbury Noticeboard	3,500 members
Spotted: Cheltenham	7,000 members
Spotted: Cinderford	2,900 members
Spotted: Dursley	1,800 members
Spotted: Forest of Dean	3,900 members
Spotted: Gloucester	10,000 members
Spotted: Stroud and Stonehouse	13,000 members
Stroud chat and information	5,000 members
Tetbury Notice Board	2,800 members
Total	53,600

Appendix 12 – NHS HRA ethics approval letter

Ymchwil Iechyd a Gofal Cymru
Health and Care Research Wales

NHS
Health Research Authority

Mr Matthew Pearce
[redacted]

Email: hra.approval@nhs.net
HCRW.approvals@wales.nhs.uk

17 July 2019

Dear Mr Pearce

HRA and Health and Care Research Wales (HCRW) Approval Letter

Study title:	**Investigating the family-home environment and its association with the emergence, persistence, and remission of weight gain in mid-childhood**
IRAS project ID:	**233725**
Protocol number:	**SPON1719-19**
REC reference:	**19/HRA/4178**
Sponsor	**Cardiff University**

I am pleased to confirm that HRA and Health and Care Research Wales (HCRW) Approval has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

Please now work with participating NHS organisations to confirm capacity and capability, in line with the instructions provided in the "Information to support study set up" section towards the end of this letter.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?
HRA and HCRW Approval does not apply to NHS/HSC organisations within Northern Ireland and Scotland.

If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report (including this letter) have been sent to the coordinating centre of each participating nation. The relevant national coordinating function/s will contact you as appropriate.

Please see IRAS Help for information on working with NHS/HSC organisations in Northern Ireland and Scotland.

How should I work with participating non-NHS organisations?
HRA and HCRW Approval does not apply to non-NHS organisations. You should work with your non-NHS organisations to obtain local agreement in accordance with their procedures.

What are my notification responsibilities during the study?

The document "*After Ethical Review – guidance for sponsors and investigators*", issued with your REC favourable opinion, gives detailed guidance on reporting expectations for studies, including:

- Registration of research
- Notifying amendments
- Notifying the end of the study

The HRA website also provides guidance on these topics, and is updated in the light of changes in reporting expectations or procedures.

Who should I contact for further information?
Please do not hesitate to contact me for assistance with this application. My contact details are below.

Your IRAS project ID is **233725**. Please quote this on all correspondence.

Yours sincerely,

[redacted]

Email: hra.approval@nhs.net

Copy to: [redacted]

Appendix 13 – Cardiff University ethics approval letter

School of Healthcare Sciences
Head of School and Dean Professor David Whittaker

Ysgol Gwyddorau Gofal Iechyd
Pennaeth yr Ysgol a Deon Yr Athrawes David Whittaker

27 September 2018

Cardiff University
Ty Dewi Sant
Heath Park
Cardiff CF14 4XN

Tel Ffôn +44(0)29 20687552
E-mail E-bost harmeri@cf.ac.uk
Prifysgol Caerdydd
Ty Dewi Sant
Mynydd Bychan
Caerdydd CF14 4XN

Matthew Pearce
[redacted]

Dear Matthew

Investigating the family-home environment and its association with the emergence, persistence, and remission of weight gain in mid-childhood

I am writing to inform you that the Chair of the Research Ethics Committee has, following consultation, **approved** your revised research proposal. The Committee will ratify this decision at its meeting on 9 October 2018.

Please note that if there are any major amendments to the project you will be required to submit a revised proposal form. You are advised to contact me if this situation arises. In addition, in line with the University requirements, the project will be monitored on an annual basis by the Committee and an annual monitoring form will be despatched to you in approximately 11 months' time. If the project is completed before this time you should contact me to obtain a form for completion.

Please do not hesitate to contact me if you have any questions.

Yours sincerely

[redacted]

Appendix 14 – Gloucestershire County Council assurance letter

Matthew Pearce
[redacted]

Gloucestershire County Council
Shire Hall
Westgate St
Gloucester
Gloucestershire
GL1 2TG

28th June 2018

Hi Matt

I'm pleased to let you know that, having considered your application, our Research Governance panel has confirmed its approval of your proposal.

Our Information Governance lead has come back with 2 changes which we would like to be incorporated into the information sheet/letter to parents (see below). I don't think either of these is likely to cause you a problem, but do let me know if you need any further information.

In light of GDPR, I'd suggest that the Patient Information Sheet needs to act as a Privacy Notice for those parents who are being asked to complete the survey. Therefore, it also needs to cover:

- how long the information provided/collected will be kept for
- who it might/will be shared with
- Individuals' rights – e.g. how to request access to information held; right to be forgotten, etc.
- The final paragraph of the letter to parents that comes before the questionnaire should be amended to read
  "By completing and returning the questionnaire, ~~it will be assumed that~~ you are giving your consent to taking part in the research. All questionnaires returned will be entered into a prize draw with the opportunity to win XXXXXXXXXX"

The panel likes to be kept informed periodically of progress in those projects it has approved, so I will be in touch every few months for a very short update. A sentence of two will be all that's needed, although, of course, we will be very interested in your final findings once your research is completed.

Best regards

[redacted]

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