THE ROLE OF THE PRIMARY SCHOOL IN PREVENTING CHILDHOOD OBESITY

by

JOANNE LOUISE CLARKE

A thesis submitted to
the University of Birmingham
for the degree of
DOCTOR OF PHILOSOPHY

Institute of Applied Health Research
College of Medical and Dental Sciences
University of Birmingham

November 2015

ABSTRACT

Childhood obesity is a global public health concern. In England, the prevalence of overweight/obesity increases from one fifth at the start of the primary school years to one third by the age of 10-11 years. This thesis examines the role of primary schools in preventing obesity. Stakeholder views are considered through a systematic review, and two qualitative studies investigating the perceptions of headteachers, parents and children. Data from a childhood obesity prevention trial (the WAVES study) are also used to examine the relationships between school policy/practice and pupil weight status/physical activity levels. Findings show that stakeholders support the school role in preventing obesity, and in helping families to lead healthier lifestyles, though limited expertise and resources are barriers. Although most schools actively promote health, there is much variation. For example, time allocated for physical education and breaks varies by school and has a significant impact on children's physical activity levels, particularly for boys. In conclusion, school policies and practices can impact on children's health, and schools are ideally placed to support families to prevent obesity. However, schools require support to perceive this role as a feasible and integral part of their function, rather than as an increasing burden of responsibility.

Dedicated to my husband and children

Pete, Daniel and Matthew

ACKNOWLEDGEMENTS

I would like to say a huge thank you to everyone who has helped and supported me over the last four years. First of all, to my supervisors Peymane Adab, Emma Lancashire and Miranda Pallan, for giving me the opportunity to undertake this study, and for their ongoing support, advice and belief in me. Thank you to Ben Fletcher, for his invaluable contribution to, and support with Chapter 2; to Jayne Parry for qualitative advice for Chapter 4; and to Karla Hemming for statistical advice for Chapter 5.

I would also like to thank Tania Griffin, for involving me in the WAVES study process evaluation, for her support and perseverance with Chapter 4, and for the lunchtime walks. Thank you to Gemma Knowles for doing much of the preparatory work on the physical activity data used within Chapter 5. To all members of the WAVES study team, past and present – Behnoush, Emma P, Kiya, Laura, Nicola, Phillippa, Sheila, Suzie, Vanessa and the many WAVES data collectors – thank you for your hard work, camaraderie and fun times.

Thank you to all the schools, teachers, parents and children that participated in the WAVES study, and to all the headteachers that gave up their time to be interviewed for Chapter 3.

To my parents, Linda and Steve (‘thinking all the time’), for their ongoing encouragement, and to my brother Phil for leading the way. Finally, a huge thank you to my wonderful husband Pete, for his love and support, and to my children, Daniel and Matthew, for showing me what is important and making me laugh every day.

CONTENTS

LIST OF TABLES AND FIGURES

Figures

ABBREVIATIONS

ANGELO	ANalysis Grid for Environments Linked to Obesity
BMI	Body Mass Index
CASP	Critical Appraisal Skills Programme
CEBM	Center for Evidence Based Management
CI	Confidence Interval
DEXA	Dual-Energy X-ray Absorptiometry
DfES	Department for Education and Skills
DH	Department of Health
FMI	Fat Mass Index
HE	Healthy Eating
HPS	Health Promoting Schools
HSE	Health Survey for England
HTA	Health Technology Assessment
ICC	Intra-class Correlation Coefficient
IMD	Index of Multiple Deprivation
Kg	kilogram
kJ	Kilojoules
LSOA	Lower Super Output Area
m	metre
mins	minutes
ml	millilitre
MPA	Moderate Physical Activity
MRC	Medical Research Council
MRI	Magnetic Resonance Imaging
MVPA	Moderate-Vigorous Physical Activity
NCMP	National Child Measurement Programme
NHS	National Health Service
NHSP	National Healthy Schools Programme
NHSS	National Healthy School Standard
NIHR	National Institute for Health Research
OfSTED	Office for Standards in Education
PA	Physical Activity
PE	Physical Education
PSHE	Personal, Social and Health Education
SD	Standard Deviation
SES	Socio-economic Status
SOPs	Standard Operating Procedures
TV	Television
UK	United Kingdom
USA	United States of America
VPA	Vigorous Physical Activity
WAVES	West Midlands ActiVe lifestyle and healthy Eating in School children
WHO	World Health Organisation

CHAPTER 1

1.0 INTRODUCTION

Childhood obesity is regarded as one of the most serious global public health challenges for the 21st century (1). The focus of this thesis is to examine the role of the primary school in preventing childhood obesity. This introductory chapter sets the scene for the thesis by outlining the issue of childhood obesity, including its definition, prevalence, consequences and causes. Approaches to preventing childhood obesity are discussed, including a focus on the contributory role of the primary school. Next, the particular situation within English primary schools is discussed, and an outline of the West Midlands ActiVe lifestyle and health Education in School children (WAVES) study is given, as parts of this thesis were undertaken within the context of this study. Finally, an overview of included chapters, and the specific aims of the thesis are presented.

1.1 Defining obesity

Obesity is defined as abnormal or excessive body fat accumulation that may impair health (2). A range of techniques exist to assess body composition, and thus body fat (including, for example, underwater weighing, magnetic resonance imaging (MRI), dual-energy x-ray absorptiometry (DEXA) (3). However, such direct techniques of assessing body fat vary in their suitability and accuracy, and tend to be expensive and time-consuming (3). Within epidemiological studies, indirect or proxy measures are used to estimate body fat, with body mass index (BMI) being the most widely used. BMI, a method for adjusting an individual's weight relative to their height

(4), is calculated as weight in kilograms (kg) divided by height in metres squared (m^2). Cut-off points of 25kg/m^2 and 30kg/m^2 are internationally identified as thresholds for defining adult overweight and obesity respectively (5).

The advantage of using BMI as a proxy measure for body fat, and therefore in determining obesity, is that height and weight measurements are relatively simple, and therefore inexpensive to undertake at a population level when compared with other measures of body fat (6). Despite the advantages of BMI, and its widespread use, it should be noted that BMI is based on a measurement of body weight, rather than body fat, resulting in limitations to its use. Firstly, the relationship between BMI and body fat varies by ethnicity, and the applicability of definitions of obesity for different ethnic groups is a subject of debate (7). South Asians, for example, tend to have a higher proportion of body fat for a given BMI than Whites (8), resulting in an equivalent risk of diabetes, other health conditions or mortality at a lower BMI (9). Secondly, BMI fails to differentiate between excess fat mass and excess lean mass (10), leading to a potential over-diagnosis of obesity in more muscular body types.

Other methods of estimating body fat that are used to measure obesity within epidemiological studies include waist circumference, skinfold thickness and bioelectrical impedance (3).

1.2 Defining childhood obesity

Measuring obesity in children requires special attention due to their continuous growth and gender differences in growth patterns. BMI is the most commonly used method within epidemiological studies for determining obesity in children aged two years and above.

However, BMI in childhood changes substantially with age (11), and differs between the sexes (12). Therefore, age-related, sex-specific reference charts are used to define childhood overweight and obesity. In the United Kingdom (UK), reference charts were created from height and weight measurements of 30,000 children and young people aged from 0 to 23 years in 1990 (4). Percentile cut-offs are used to define overweight and obesity (85^{th} and 95^{th} percentiles respectively are recommended in epidemiological studies (13)). However, the use of different reference charts in different countries (3) makes international comparisons difficult. To counter this, Cole et al (14) established international sex-specific BMI cut-off points for overweight and obesity for children aged between 2 and 18 years. This was achieved by extrapolation from the adult cut-offs of 25kg/m^2 and 30kg/m^2 for overweight and obesity using data from six different reference populations (Great Britain, Brazil, Netherlands, Hong Kong, Singapore and USA). Additionally, in 2007, World Health Organisation (WHO) growth reference data were developed for school-aged children and adolescents (15).

As with adults, waist circumference is an alternative method of determining obesity in children (3). Skinfold thickness and bioelectrical impedance analysis are also used within epidemiological studies in children as alternative methods of estimating body fat (3).

1.3 Prevalence of childhood obesity

1.3.1 Globally

In most developed and many developing countries, childhood obesity prevalence has increased over the last few decades, and prevalence is now high (12). Globally, ten per cent of school-aged children are estimated to be overweight, and a quarter of

these (2.5% of all children) are obese (3). Overweight and obesity are markedly higher in developed countries, but are increasing considerably in most parts of the world (3). In 2013, 42 million infants and young children under the age of five were overweight or obese (16), predicted to rise to 70 million by 2025 if current trends continue. The rate of increase is 30% higher in low- and middle-income countries, than in developed countries (16).

1.3.2 England

In England, the height and weight of around one million schoolchildren are measured annually through the National Child Measurement Programme (NCMP) (17) (see section 1.7.8.5 for further details). Data for 2013/14, where 94% of the eligible population were measured, show that 19.1% of children in Year 6 (aged 10-11 years) were obese and a further 14.4% were overweight. For children in the reception year (aged 4-5 years), 9.5% were obese and a further 13.0% were overweight. In summary, almost a third of 10-11 year olds and over a fifth of 4-5 year olds were either overweight or obese, with a doubling of obesity prevalence over the primary school years (17).

Data from the Health Survey for England (HSE) 2013, which included a smaller sample of children than the NCMP but covers a wider age range, show that 29.5% of children aged 2 to 15 years were classed as either overweight or obese (18).

1.3.3 ‘Plateauing’ of prevalence

Since 2000, there has been an observed plateauing of childhood obesity prevalence in developed countries (19), leading to suggestions that public health programmes to prevent obesity may be having an effect. However, despite the apparent levelling off, prevalence rates are still high (20), and studies in the USA have shown that severe

obesity (defined as BMI ≥99th percentile for age and gender) is still increasing (21, 22). In England, analysis of data between 2006/7 and 2013/14 demonstrates that although a significant downward trend has been observed in overweight and obesity prevalence among 4-5 year old boys, significant upward trends have been observed among 10-11 year old girls and boys (23).

1.3.4 Socio-economic and ethnic differences

In the developed world, although children within all socio-economic groups have been affected by the obesity epidemic, childhood obesity is inversely associated with socio-economic status (SES), with the most disadvantaged groups being at highest risk (12). This is in contrast to developing countries, where those at greatest risk of obesity are the most affluent groups (12).

In England, NCMP data show a strong positive relationship between deprivation and obesity prevalence for children in both age groups (4-5 and 10-11 years): obesity prevalence among children attending schools in areas in the least deprived decile was 6.6% and 13.1% for 4-5 and 10-11 year old children respectively, compared to 12.0% and 24.7% among those attending schools in the most deprived decile (17). Analysis of data between 2006/7 and 2013/4 reveals widening inequality in overweight and obesity prevalence by socio-economic group (23).

Additionally, a cross-sectional study of over 20,000 children aged 5-14 years in Plymouth, UK, found a linear association between increasing deprivation (measured using the Townsend multiple deprivation score (24)) and obesity (measured objectively), with children living in the most deprived areas having rates of obesity 2.5 times higher than the national average (25).

NCMP data show that some ethnic groups are at greater risk of being obese. Childhood obesity prevalence is significantly higher than the national average in the ethnic groups ‘Black or Black British’, ‘Asian or Asian British’, ‘Any Other Ethnic Group’ and ‘Mixed’ (17). Given that this prevalence is measured by BMI, and that body fat is higher at a given BMI for some ethnicities (8), those groups (particularly Asian groups) are at particular risk of the health consequences of obesity. It should be noted, however, that there exists a debate around whether Black groups are over-diagnosed as obese due to being generally taller (10).

1.4 Health consequences of childhood obesity

It is well-recognised that childhood obesity has effects on physical health, both in the short- and long-term. As reviewed by Lobstein et al (3), physical health consequences include sleep-disordered breathing and asthma; orthopaedic problems; fatty liver disease; menstrual problems and early menarche; type 2 diabetes and cardiovascular risk factors including hypertension. The emergence of type 2 diabetes in children is of particular concern as it was once a disease of adulthood and virtually unrecognised in children (26). There is a significant tendency for obesity, with the associated cardiovascular risk profiles, to persist from childhood and adolescence into adulthood (27).

Psychological and social consequences of childhood obesity are also recognised, including stigmatisation, discrimination and body dissatisfaction (3). Such consequences are often perceived as more immediate than those of physical health.

1.5 Causes of childhood obesity

At a rudimentary level, obesity is caused by an imbalance in the energy equation, where energy intake (from the consumption of food and drink) is higher than energy

output (through the body's metabolic processes and physical activity (PA)) over a sustained period of time, leading to the accumulation of excess body fat (28).

The simplicity of this explanation, however, masks the numerous and complex behavioural and societal factors that contribute to the development of obesity. The Foresight report 'Tackling obesities: future choices' (6) presented a 'complex web of societal and biological factors' contributing towards obesity. The report's 'obesity system map' illustrates more than 100 variables which directly or indirectly affect energy balance, showing the complex interaction between biology and human behaviour. In short, the energy imbalance is determined by individual behaviour, but is influenced by biology and the environment. In the following sections, biological, behavioural and environmental determinants of childhood obesity are discussed.

1.5.1 Biological determinants

Within the body, various physiological processes maintain the balance between energy intake and output, thus regulating weight (29). Any factor that increases energy intake or decreases energy output, even by a small amount, will result in obesity in the long-term (26).

Genetic susceptibility helps to explain some of the differences in weight gain between individuals (30), and specific genes related to obesity have been recognised. Maes et al (31) reviewed the literature on familial resemblance of adiposity. Using evidence from twin studies, they reported that 50 to 90 per cent of the variance in BMI can be explained by genetic factors (31).

A review of genetic and environmental influences on obesity describes how the majority of the population possess a genetic disposition that has evolved to survive scarcity of food, does not cope well in an environment where food is plentiful, and in

which low levels of PA are the norm (32). In a fast-changing external environment, preserving an energy balance becomes increasingly difficult.

1.5.2 Behavioural determinants

In basic terms, individuals control their energy intake and output, through decisions made around food intake and PA, although it is evident that children have less autonomy concerning these decisions than adults. Health behaviours are affected by individual factors, such as attitudes, beliefs and knowledge set within a context of wider, environmental influences. Behavioural determinants of childhood obesity will now be discussed with respect to behaviours relating to energy intake and energy output.

1.5.2.1 Energy intake

It would appear logical that the rise in childhood obesity prevalence would be accompanied by an increase in energy intake. Yet self-reported data from national dietary surveys of UK children show a lower reported energy intake in 1997 than in 1983 (33, 34), with comparable decreases reported in the USA (35, 36). Reasons for this decline are unknown, although it has been postulated that it reflects a trend towards greater under-reporting of dietary intake among young people (30).

A number of studies have investigated dietary factors and their relationship with obesity; many of these have conflicting results. A recent evidence review investigated the strength of evidence for associations between individually modifiable behaviours and weight-related outcomes in children, and reported that the only strong evidence of a positive association was for intake of sugar-sweetened beverages (37). No evidence was found of an association between intake of fruit and vegetables and weight-related outcomes in children (37). Another review found no

relationship between snacking, fast food or portion sizes (38) and childhood obesity. Skipping breakfast, and eating whilst watching TV, have however both been correlated with child overweight through cross-sectional studies (38).

Food and drink behaviours are variable and complex, and it is therefore difficult to pinpoint individual risk factors that contribute towards childhood obesity. It is likely that a number of behaviours operating in combination are leading to energy imbalance with intake exceeding output. Dietary patterns that are characterised by a high intake of energy-dense, high-fat and low-fibre foods have been shown to predispose children to overweight and obesity (38).

1.5.2.2 Energy output

PA is the modifiable element of energy output (thermogenesis and resting energy expenditure being the other unmodifiable elements). The WHO and the Chief Medical Officers (UK) recommend that children aged 5-18 years should achieve at least 60 minutes of moderate-vigorous PA (MVPA) daily (39, 40).

Self-reported PA data from the HSE (2012) show only 21% of boys and 16% of girls aged 5-15 years achieved the recommended 60 minutes per day MVPA (41). However, PA is a multifaceted behaviour and its quantification can be problematic, particularly in young children whose PA often consists of spontaneous, unstructured activities (30). More recently, studies are increasingly using objective measures of PA, for example through accelerometry (42). An analysis of accelerometer data from 6,497 British 7-8 year old children participating in the Millennium Cohort Study found 63% of boys and 38% of girls to be meeting the PA recommendation (43). Studies consistently demonstrate that boys are more physically active than girls (44), and that levels of PA decline as children get older (45).

As childhood obesity levels have increased, it would seem intuitive for PA levels to show a corresponding decline. However, lack of good data makes this difficult to prove. The decrease in the proportion of children walking and cycling has been used as an indicator to show declining activity levels over time (46). A systematic review of observational studies which used objective measures of PA in children, showed low levels of PA to be associated with a higher risk of childhood obesity (47). In addition, results from a recent cross-sectional and prospective analysis have shown MVPA to be associated with lower adiposity independent of covariates or sedentary time (48).

Sedentary behaviour in children has been implicated as a risk factor for obesity (46, 49), with systematic review evidence showing that lowering sedentary time in children leads to reductions in BMI (50). Studies have found a strong association between high amounts of TV viewing and risk of obesity in children (51-53), although time spent playing digital games has been shown to have no association with overweight (54). The relationship between TV viewing and obesity could be plausibly explained not only by the low energy output caused through being sedentary, but by the higher consumption of energy associated with TV viewing (55), or the influence of TV food advertisements (56).

1.5.3 Environmental determinants

Notwithstanding the evidence showing that genetics have a role in the development of childhood obesity, the recent rise in prevalence among genetically stable populations cannot be explained by biological factors (26). Although health behaviours are a result of individual decisions and actions, there are external factors that impact on the individual when making such decisions. Increasingly ‘obesogenic’ environments, which encourage energy intake to be higher than energy output, are widely accepted as the predominant driving forces behind the escalating obesity

epidemic (57). As Bray (2004) analogised: “genetic background loads the gun, but the environment pulls the trigger” (58).

The ‘obesogenic environment’ is defined as ‘the sum of influences that the surroundings, opportunities or conditions of life have on promoting obesity in individuals or populations’ (59). It has been argued that humans easily adapt to environments promoting sedentary behaviours and poor quality food choices (6). Examples of influences that the obesogenic environment may have on the energy balance include easier access to unhealthier foods for home consumption, proliferation of restaurants and takeaways, and a built environment that decreases and disincentivises the need to walk (6).

However, the obesogenic environment is difficult to delineate, and most individuals exist across multiple settings (for example school, home and community) all of which may influence individual decisions on food intake and participation in PA (6). The environment has been described in terms of ‘microenvironments’ (such as the school or home) which are influenced by wider ‘macroenvironments’ (such as education and health systems, government policy, and societal attitudes and beliefs) (59).

1.5.3.1 Family factors

Children of overweight and obese parents are at higher risk of overweight and obesity (60, 61). This is partly due to genetic factors, and in some way due to family lifestyles (‘obesogenic families’) (3). Parents are role models and have a level of responsibility for decisions surrounding children’s food intake and PA, particularly in young children. Both the home environment and parent-child interactions can influence dietary and activity behaviours (26). For example, eating together as a family has been show to both decrease TV viewing (62) and improve dietary quality (63). Other family factors that have been associated with children’s dietary

behaviours include the availability and accessibility of healthy food in the home environment (64), parental eating habits (65), parenting styles (66) and parental feeding practices (for example encouragement, role modelling and rules) (67). Family factors shown to positively impact on children's PA include parental support for children's PA (68, 69), parental encouragement of PA (70), parental PA levels (69, 71) and parental engagement in PA with children (69).

1.6 Preventing childhood obesity

Treatment of obesity and its associated comorbidities is expensive: in the UK, the National Health Service (NHS) has been estimated to spend £5.1 billion each year treating conditions resulting from overweight and obesity (72), a figure projected to double by 2050 (6). Although childhood obesity is largely preventable, once established it is very difficult to treat, and often tracks into adulthood (73). In addition, obesity prevention is likely to be more cost-effective than treatment (1). Therefore, preventing childhood obesity, by focusing on the adaptable, behavioural elements of the energy balance equation (74), is a priority. A number of individual- and population-level approaches to obesity prevention have been described.

Individual behaviour change theories such as Social Cognitive Theory (SCT) (75), the theory of planned behaviour (76), and the transtheoretical model of behavioural change (77) form the basis of approaches to obesity prevention at the individual level. SCT, for example, holds that individuals acquire knowledge through the observation of others, and that self-efficacy is a strong determinant of individual behaviour (78).

Egger and Swinburn (79) suggested that such individual-level approaches to obesity prevention can be ineffective because individual behaviour is partly determined by

interactions with the physical and socio-cultural environment. Obesity, therefore, is a normal reaction to living within an obesogenic environment. To counter this, they described an 'ecological' approach to obesity prevention, which takes into account how individuals interact with the environments in which they spend their time, thus looking at the wider influences on obesity. The corresponding conceptual model outlines three main influences on the energy balance equation: biology (considered unalterable), behaviour and environment. The authors suggested that a population-level approach to changing the obesogenic environment into one which supports healthier behaviours, is vital in order to prevent obesity. Such environmental changes, however, require a strong policy lead from government.

The ANGELO (ANalysis Grid for Environments Linked to Obesity) framework (59) was subsequently presented as a tool to identify and prioritise environments (physical, economic, political and socio-cultural) for intervention at the micro-level (such as schools and homes) and macro-level (such as health services and government). As such, the ANGELO framework provides a conceptual model for scrutinising the obesogenic environment and prioritising areas for intervention, with the understanding that environmental interventions should run alongside individual approaches to obesity prevention, rather than replacing them.

Also building on the ecological approach, the Obesity Policy Action framework was proposed (80), to provide guidance for governments on policies to prevent obesity. The framework recognises three distinct levels for tackling obesity: *upstream* (tackling the underlying determinants of health and social equity in society, for example education); *midstream* (targeted at the settings level, for example school and households) and *downstream* (individual-level interventions, often in clinical settings).

The ‘settings approach’ to health promotion originated from the Ottawa Charter for Health Promotion (81). The approach reflects an ecological model, taking into account the influence of context on the individual (82), and has resulted in initiatives in a range of settings, including schools.

Furthermore, in 2012, the WHO produced guidance on ‘Population-based approaches to childhood obesity prevention’ (83). The guidance recognises three main components to population-based approaches: (1) Government structures, e.g. taxation, dedicated funding for health promotion; (2) Population-wide policies and initiatives, e.g. nutrition labelling; and (3) Community-based interventions e.g. within schools.

It is recognised that whilst individual-level interventions can provide significant benefit to the individual, there is very little impact on the total population. In contrast, with population-level interventions, there is very little impact on the individual, yet population-wide benefits are apparent (84, 85). This has been termed the ‘prevention paradox’: “a measure that brings large benefits to the community offers little to each participating individual” (86). The advantage of a population-level environmental approach is that even small, clinically unimportant, impacts on individuals can have positive effects on a population if large numbers of people are exposed to the environment (85, 87). As an illustration of how small changes in individual factors can result in significant population-level benefits, Butte and Ellis (88) calculated that an individual energy reduction of around 1046kJ per day (the equivalent of less than a 600ml bottle of soft drink) is needed to prevent further weight gain in 90% of overweight children. Similarly, Rose and Day (89) showed that a 1kg reduction in mean weight in an adult population with an average BMI of 25 was equivalent to a 2% decrease in overweight prevalence.

1.7 Schools and childhood obesity prevention

1.7.1 Schools as a key setting

Schools are seen as a key setting for obesity prevention as they reach the majority of children and have long-term, in-depth contact with them (90). Schools offer many opportunities to prevent obesity by creating environments in which children eat healthily and engage regularly in PA (91, 92). Their physical environment, policies, curricula and personnel have great potential to positively influence child health (93), and schools can play an vital role in instilling healthy behaviours that carry forward into adulthood (94). The school environment can reinforce or hinder messages delivered through the curriculum and can thereby either promote, or create barriers for, healthy behaviours (95). As childhood obesity rates have increased, consensus has emerged that schools have an important contribution to make in reversing this trend (96-98).

1.7.2 The symbiosis of health and education

There is increasing awareness of the impact of good health on education. As Story *et al* (91) outline, “health and education success are intertwined”: schools cannot achieve their primary goal of education if children are not healthy and fit. Several studies have demonstrated a close association between health and academic attainment, with attainment influencing, and being influenced by health status (99-101). PA at school is associated with improved motivation and reduced anxiety and depression (102), whilst there is strong evidence that more time spent on PA and correspondingly less time in academic lessons, does not impair academic attainment (103). Nutrition, especially in the short-term, is understood to impact on concentration, with the potential to influence academic performance at school (104).

Skipping breakfast, in particular, has been shown to have negative effects on energy-levels and cognition in children (105). A systematic review of literature on childhood obesity and educational attainment reported that the negative relationship may be mediated through a variety of pathways including poor mental health, disordered sleep, stigmatisation and discrimination, a reduction in time spent in PA and socialising, and absenteeism (106).

1.7.3 Health Promoting Schools

The symbiotic relationship between health and education underpins the Health Promoting Schools (HPS) framework (107). Through a 'whole school approach', HPS deliver activities within the curriculum which are reinforced through a supportive school ethos and environment. In this way, HPS promote policy implementation with the goal of improving the school environment alongside the curriculum (108). HPS contribute towards obesity prevention through the promotion of healthy eating (HE) behaviours and increased PA.

The HPS framework was first developed in the 1980s, and has been endorsed by the WHO, calling for an increase in the number of schools adopting the approach worldwide (109). The HPS framework is promoted in numerous countries through national and local schemes, many of which are awards-based.

A Cochrane review of the HPS framework found that the approach improved children's PA and fitness, and increased fruit and vegetable intake (110). Although intervention effects were small, it was believed that population-wide public health benefits could be accrued. Following the review, a synthesis of process evaluation data was conducted to help explain heterogeneity in reported impacts of the HPS approach (111). Facilitators for success included tailoring programmes to the needs

of individual schools, and ensuring that interventions support schools' core aims. Barriers to implementation included a lack of institutional support, and schools' emphasis on academic subjects.

1.7.4 School-based obesity prevention interventions

For reasons already discussed, the school is a popular setting for obesity prevention interventions. Indeed, the majority of childhood obesity prevention programmes have been carried out in schools (20). Studies have shown that school-based obesity prevention interventions are more likely to be effective if they are comprehensive and multi-faceted (112, 113).

A 2011 Cochrane Review of 55 intervention studies to prevent obesity in children (114) (the majority of which targeted children aged 6 to 12 years) found strong evidence to support positive effects of interventions on BMI. The following promising policies and strategies were highlighted:

- School curriculum that includes HE, PA and body image
- Increased sessions for PA and the development of fundamental movement skills throughout the school week
- Improvements in nutritional quality of school food
- Environments and cultural practices that support children eating healthier foods and being active throughout each day
- Support for teachers and other staff to implement health promotion strategies and activities
- Parent support and home activities that encourage children to be more active, eat more nutritious foods and spend less time in screen-based activities

Evidence from studies on the relationship between school policies and practice and weight status and health behaviours will be further detailed in Chapter 5.

1.7.5 School-based physical activity interventions

A 2013 Cochrane Review summarised the evidence relating to the effectiveness of school-based interventions to promote PA and fitness among children aged 6-18 years (115). Although the authors urge caution in interpreting the results (due to the risk of bias, and the small effect size), school-based interventions to promote PA and fitness were found to have a positive impact on duration of MVPA, reduction in TV viewing time, and VO_2 max (maximal oxygen consumption, a measure of individual aerobic capacity). The review also found, however, that school-based PA interventions had little effect on children's overall PA levels or BMI.

1.7.6 School-based nutrition interventions

A systematic review of school-based interventions in Europe to promote healthy nutrition in children (116) found strong evidence of effect for multi-component interventions to promote fruit and vegetable intake. Limited evidence of effect was found for educational interventions to promote healthy behaviours or for environmental interventions promoting fruit and vegetable intake. However, anthropometric measures were rarely taken, and therefore evidence of effect of school-based nutrition interventions on BMI is lacking.

1.7.7 Limitations of the role of the school

Despite the attraction of the school as a setting for childhood obesity prevention interventions, its limitations should be considered. A key barrier is the pressure schools face in raising educational standards in the core subjects of literacy and numeracy (117), and the resultant resistance amongst school personnel to the use of

education time for health promotion (118). The ‘crowded curriculum’ alongside a lack of teacher competence and training in PA and nutrition also limit the school role (119). In addition, Whitby (120) discusses the burden to schools with regards to planning, budgeting, time for staff training and time for delivery of health promotion programmes.

A further limitation in the role of the school in obesity prevention is the focus on school-aged children. Over a fifth of children in England are overweight by the time they start school (17), suggesting that the school role in preventing childhood obesity needs to be considered alongside preventative approaches targeting younger children (121).

Schools should not be viewed in isolation, but as one of several contexts for change (121). The family and home environment is another key area for intervention, alongside community and healthcare settings.

1.7.8 English primary schools and childhood obesity prevention

Chapters 3, 4 and 5 of this thesis are set within the context of English primary schools. It is therefore relevant to present a summary of the major national initiatives taking place in English primary schools that contribute to the promotion of healthy lifestyle behaviours important in preventing childhood obesity.

1.7.8.1 National School Fruit and Vegetable Scheme

The government-funded National School Fruit and Vegetable Scheme has been in operation in England since 2000, and entitles every child aged 4 to 6 years within state-funded primary schools to receive a free portion of fruit or vegetable every school day. Evaluation of the scheme has shown that whilst the scheme is effective in increasing fruit and vegetable consumption among children aged 4 to 6 years

(compared to children in schools who were not part of the scheme), there is no long-term effect on fruit and vegetable consumption among children aged 7-8 years who had previously been part of the scheme (122, 123).

1.7.8.2 School Food Standards

Nutritional standards for school meals were first instituted in the 1940s, and later abolished in 1980. In 2001, statutory nutritional standards were re-established, with the intention of ensuring daily availability of healthy options (124). However, concerns over children making unhealthy choices, and rising levels of obesity, led to the publication in 2004 of the Department for Education and Skills (DfES) guidance 'Healthy Living Blueprint for Schools' (125), and the Government's white paper 'Choosing Health: Making Healthy Choices Easier' (126). Furthermore, a high profile campaign in 2005 by TV chef Jamie Oliver was a driving force behind the introduction of new school nutritional standards in 2006 (127), followed by standards for foods other than school lunches in 2007 (128). These standards necessitated a healthy balance of food and drink to be provided throughout the school day, and banned certain items from sale, such as confectionary and crisps. Research has shown that the introduction of standards since 2006 has resulted in better food provision, and improved food and nutrient intakes among children consuming school meals, alongside a positive impact on their overall diet (129). In 2013, the government-supported School Food Plan (130) was published, providing a range of measures for schools to increase school meal take-up, further improve the quality of school meals, and teach pupils about cooking. Following on from the School Food Plan, a new set of food standards were introduced for all schools in January 2015 (including academies and free schools which had been previously excluded) (131).

1.7.8.2.1 Free school meals for infants

From September 2014, every child in Reception, Year 1 and Year 2 (aged 4-7 years) in England has been entitled to a free school meal, following a key recommendation in the School Food Plan.

1.7.8.3 Healthy Schools programmes

England's implementation of the Health Promoting Schools model, the National Healthy Schools Programme (NHSP), led jointly by the DfES and the Department of Health (DH), was launched in 2001 (132). The aim of the programme was to develop schools which enabled children to reach their full potential through providing physical and social environments conducive to learning (132). The programme had four core 'themes' which schools could develop to achieve the National Healthy School Standard (NHSS): Personal, Social and Health Education (PSHE); Healthy Eating; Physical Activity; and Emotional Health and Wellbeing. The programme was successful in setting up healthy schools schemes in each of the 150 Local Education Authorities in England. Schools worked towards the NHSS as part of their local authority's programme.

The NHSP was cut in 2011 following a change in UK government. The move away from 'dictating what should be done in schools and how they should do it' was further emphasised in the UK obesity strategy 'Healthy Lives Healthy People' in 2011 (133). However, a number of local authorities still run locally-funded healthy schools programmes based on the national model.

1.7.8.4 Physical Education (PE) and sport premium for primary schools

Introduced in 2013, the PE and sport premium for state-funded primary schools is designed to help schools improve the quality of PE, sport and PA experiences offered to pupils (134). The funding can be used by headteachers however they see

fit, and has been used to train teachers, employ sports coaches, buy new equipment and provide more extra-curricular activities.

1.7.8.5 National Child Measurement Programme (NCMP)

The NCMP was established in 2005 to monitor the weight status of children (17). Children from state-maintained English primary schools are measured in reception class (aged 4-5 years) and in Year 6 (aged 10-11 years), unless their parents opt them out of the programme. Trained healthcare professionals collect height and weight data annually, and now over 90% of eligible children are measured (17). BMI centiles are calculated from the data, and resultant overweight and obesity prevalence data are used to support national and local planning and delivery of services. Local authorities within England are now responsible for local delivery of the NCMP.

1.8 The WAVES study

Chapters 4 and 5 of this thesis use data collected as part of the WAVES study, a cluster-randomised controlled trial to assess the clinical- and cost-effectiveness of an intervention programme targeted at 6-7 year old children and aiming to help them maintain a healthy weight and thereby prevent childhood obesity.

The WAVES study (ISRCTN: 97000586) received ethical approval from the National Research Ethics Service Committee, West Midlands, The Black Country (10/H1202/69, 25/11/2010), and is funded through a grant from the National Institute for Health Research (NIHR) Health Technology Assessment (HTA) programme. Full details of the WAVES study are available in the published protocol (135).

The study took place in 54 primary schools in the West Midlands (UK), a region with an ethnically and socio-economically diverse population. For logistical reasons,

measurements for the WAVES study have been undertaken in two phases. For Group One schools, baseline measurements were undertaken in the summer term 2011 (children aged 5-6 years), the intervention took place over 12 months but mainly during the 2012/13 school year (children aged 6-7 years), and children were followed up in the autumn term 2012 (aged 7-8 years), spring term 2014 (aged 8-9 years) and autumn term 2014 (aged 9-10 years). For Group Two schools, baseline measurements were undertaken in the summer term 2012 (children aged 5-6 years), the intervention took place mainly during the 2013/14 school year (children aged 6-7 years), and children were followed up in the autumn term 2013 (aged 7-8 years) and the spring term 2015 (aged 8-9 years). The primary outcome of the study is the difference in BMI z-scores between intervention and control arms at 3- and 18-months follow-up after completion of the intervention.

1.8.1 Sampling and recruitment of schools

All local authority primary schools within a 35-mile radius of the University of Birmingham were eligible for inclusion in the study (n=980). To ensure there were sufficient numbers of pupils in the sample to enable sub-group analysis by ethnic minority groups, school populations were stratified by ethnic mix. School populations were dichotomised as being in the top quintile for South Asian and/or Black pupil representation, or not. A weighted random sample was then used within the sampling strategy so that schools in the top quintile for South Asian or Black pupils had an increased chance of being sampled by a ratio of 3:1. The sampling strategy was also balanced to ensure a range of characteristics were represented, including the proportion of pupils entitled to free school meals, school size and urban/rural location of the school.

Using this method, 200 schools were selected, ordered using a random number generator, and invited in turn to participate in the study. The study team approached 148 schools (by letter, a follow-up phone call, and a visit to interested schools) until the necessary sample size of 54 schools was attained. Of the 148 schools approached, 90 declined to take part, four made no response and seven were excluded due to ineligibility (either because they failed to meet the minimum required cluster size of 17 pupils in the relevant year group, or because they were in 'Special Measures' (Office for Standards in Education (OfSTED) status applied to schools not providing an adequate standard of education). Response bias checks were carried out (during the invitation process) to test for any differences between schools that agreed to take part and those that declined in terms of school size, ethnic mix of pupils, and free school meal entitlement; no significant differences were found.

1.8.2 Recruitment of study participants

All children in Year 1 (aged 5-6 years; n=2462) of participating schools were eligible to participate in the study. Parents/carers were sent a letter of invitation, information sheet and consent form, distributed via the schools. Written parental consent was received for 1,467 participants (60% of those eligible).

1.8.3 Measurements undertaken

A variety of measurements was undertaken on consented children at baseline, and repeated at follow ups. Verbal assent from individual children was received before each measurement. Measurements took place within the children's school, were carried out by trained researchers following standardised operating procedures (SOPs), and included anthropometric, PA, dietary and psychological assessments. Children took home a Parent Questionnaire after each measurement occasion which included questions on family characteristics and habits. Further details of the

measurements undertaken that are relevant to this thesis are given in Chapter 5 (section 5.3.1).

1.8.4 Method of random allocation

Randomisation occurred at the school-level following baseline measurements. A blocked balancing algorithm (136, 137) was used to randomise schools to either the intervention or the control arm of the trial. This method was used to minimise imbalance between the means of covariates (proportion of children within the school: eligible for free school meals; of South Asian, Black or White ethnicity, and number of pupils within the school).

1.8.5 The WAVES study intervention programme

The school-based intervention comprised four components focused on promoting HE and PA.

1.8.5.1 Component 1: Additional structured opportunities for PA within the school day

The aim was to increase structured opportunities for PA within the school day, with a target for children to achieve an additional 30 minutes of MVPA each day compared to their current level. Teachers were able to select two of four commercially available PA programmes to achieve this: Activate (138); Positive Play (139); Take 10 (140), and Wake Up Shake Up (141).

1.8.5.2 Component 2: Cooking workshops for children and parents

Teachers were trained to deliver three cooking workshops to children and their parents, with the aim of improving nutritional knowledge and food preparation skills of both children and parents. The workshops, intended to be delivered once each term throughout the school year, focused on ‘breakfast’, ‘lunch and snacks’ and ‘evening meals’. Key messages (reinforced in each workshop) included increasing fruit, vegetable and fibre intake, and decreasing fat and sugar intake. Workshops

consisted of an interactive education session followed by a practical food preparation and tasting session. Before each workshop, teachers were asked to deliver three 10-minute lessons to prepare children for the topics covered.

1.8.5.3 Component 3: Villa Vitality

Teachers were asked to supervise class attendance at Villa Vitality, a healthy lifestyle programme run at Aston Villa, an English Premier League football club. The programme focused on promoting HE and PA through interactive sessions, using the key messages consistent with other intervention components. The six-week programme involved two day trips for children to Aston Villa, and one visit to school by an Aston Villa Football Academy coach. Activities included nutrition education sessions, PA games and ball skills, preparing a healthy meal in the Aston Villa kitchens (which children eat at lunchtime), and a session in the radio recording studio where children recorded a song they had practised at school on the theme of healthy lifestyles. During the six-week period between visits to Aston Villa, children were set a series of weekly challenges to complete at home, facilitated by the teacher (60 minutes of PA every day; swap a snack; drink more water; eat a healthy breakfast every day; eat five portions of fruit and vegetables every day, and design and cook a healthy meal).

1.8.5.4 Component 4: Signposting

Teachers were asked to distribute two information sheets to parents to encourage out-of-school PA. The first sheet, distributed after baseline measures, highlighted the importance of children achieving 60 minutes of MVPA a day, and provided information and ideas for keeping active over the summer holidays. The second sheet was school-specific, directing families to local PA opportunities, such as clubs,

leisure centres and parks. A termly newsletter was also distributed to parents by teachers to reiterate the importance of healthy lifestyles.

1.9 Overview of the thesis

This thesis presents an in-depth exploration of the role of the primary school in preventing childhood obesity, with a particular focus on the West Midlands region of England. Prior to commencing this thesis, I worked as Healthy Schools Coordinator for a local authority within the West Midlands (2001-2011). My responsibility was to encourage schools to work towards, achieve and maintain the National Healthy School Standard. Through this experience, I observed many differences between schools with respect to their health policies and practices, as well as contrasting attitudes of school staff and the wider school community towards the school role in promoting health. When I began my current research post, I was interested in exploring these perceived differences in more detail, and finding out whether differences between schools regarding their policies and practices had any relationship with the health outcomes of the children attending the schools.

The thesis uses a mixed methods approach to explore the role of the primary school in preventing obesity. Use of qualitative methods enables investigation of school stakeholder perceptions on the topic and offers potential explanations for contrasting practices across schools. Using statistical techniques, I have been able to explore differences between schools in terms of pupils' health and health behaviours, and examine relationships with potential school-level explanatory factors.

1.9.1 Overview of chapters

Chapter 2 presents a systematic review of studies investigating the views of stakeholders on the role of the primary school in preventing childhood obesity, the first systematic review to have been conducted on this topic.

Chapter 3 reports a qualitative study of the views of 22 primary school headteachers within the West Midlands on their views of the role of the primary school in preventing childhood obesity. Views from this particular stakeholder group were identified as a research gap in the systematic review presented in Chapter 2.

Chapter 4 explores the experiences of parents and children participating in the WAVES study intervention programme. This study was undertaken as part of the WAVES study process evaluation and presents data from focus groups. The scarcity of published studies of participant views in the evaluation phase of interventions is a research gap that this study attempts to address.

Chapter 5 describes the differences between schools participating in the WAVES study with regards to policy and practice by presenting the results of a school questionnaire concerning HE and PA practices. The chapter also presents findings from a multilevel analysis investigating the 'school effect' and the differences between schools in terms of pupil weight status and PA levels, exploring some of the explanatory variables that may be implicated in any differences. This study makes an important contribution towards understanding how schools' policies and practices create differences between schools regarding individual pupil outcomes and behaviours.

Chapter 6 draws together findings from all previous chapters into a discussion, and presents overall conclusions of the thesis.

1.9.2 Aims of the thesis

The focus of this thesis is to examine the role of the primary school in preventing childhood obesity. Specific aims are:

1. To review the evidence concerning stakeholder views on the role of the primary school in preventing childhood obesity.
2. To investigate the perspectives of headteachers on the primary school role in childhood obesity prevention.
3. To consider the experiences of parents and children participating in the WAVES study school-based obesity prevention intervention programme.
4. To examine the differences between WAVES study schools with regard to policies and practices relating to HE and PA.
5. To investigate the school effect on weight status and PA and sedentary behaviours of 5-6 year old children.

CHAPTER 2

2.0 VIEWS OF STAKEHOLDERS ON THE ROLE OF THE PRIMARY SCHOOL IN PREVENTING CHILDHOOD OBESITY: A SYSTEMATIC REVIEW

This chapter presents a systematic review of the views of stakeholders on the role of the primary school in preventing childhood obesity, and is presented in three sections: 2A, 2B and 2C.

Chapter 2A reports a meta-synthesis of 18 qualitative studies. This meta-synthesis has been published in a peer-reviewed journal and is presented as the published paper:

Clarke J, Fletcher B, Lancashire E, Pallan M, Adab P. The views of stakeholders on the role of the primary school in preventing childhood obesity: A qualitative systematic review. Obes Rev 2013;14:975–988.

Chapter 2B reviews 17 cross-sectional studies identified through the literature searches for the above paper.

Chapter 2C reports a review of eight relevant papers published since the systematic review searches were conducted.

Overall conclusions to the chapter are then presented.

Author contributions: The idea for the systematic review was developed by JC, PA and EL. JC designed the search strategy with input from BF, PA and EL. JC conducted the literature searches and screened all titles and abstracts for inclusion. BF independently screened the first 1,000 results. Full texts of screened papers were assessed for eligibility by JC and BF. All authors were involved in data extraction and

quality assessment of the selected papers. JC wrote the chapter with advice and guidance from all co-authors.

CHAPTER 2A

2A.0 VIEWS OF STAKEHOLDERS ON THE ROLE OF THE PRIMARY SCHOOL IN PREVENTING CHILDHOOD OBESITY: QUALITATIVE METASYNTHESIS

2A.1 Introduction

Childhood obesity is regarded as one of the most serious global public health challenges for the 21st century (1). In England, data from the National Child Measurement Programme (2011-12) showed that among 4-5 year olds, 22.6% were overweight or obese, rising to 33.9% of children aged 10-11 years (142) and that there is a trend for increasing prevalence over the last five years in the older age group (143). The long-term health and social consequences of childhood obesity are well-established. Since overweight and obesity are largely preventable (1), and evidence on long-term effectiveness of treatment interventions is lacking (144), prevention of childhood obesity is a priority. Given the increasing trend in obesity prevalence during primary school years, this is an important period for intervention.

Schools are viewed as a key setting for obesity prevention for several reasons. First, the majority of children attend school, where they spend a large proportion of their waking time. Schools also offer practical opportunities for children to eat and undertake PA, as well as formal (e.g. within the curriculum) and informal (e.g. through peers or role models) opportunities to learn about health behaviours. Schools can develop strategies to prevent obesity by creating supportive environments for HE and regular PA (91), as well as policies, curricula and personnel to positively influence child health (93). The school environment can reinforce or hinder messages delivered through the curriculum and can promote or

prevent healthy behaviours (95). Consequently, health researchers and guidelines all highlight the critical role of schools in obesity prevention (96-98).

There is increasing onus on schools to deliver more than academic education, often without additional resources. To consider the role of the primary school in preventing childhood obesity, and how this goal fits within their many competing priorities, it is important to gauge the opinions of stakeholders that work in, work with, or attend schools.

2A.1.2 Aims and objectives

The aim of this review was to identify and synthesise the research literature concerning the views of stakeholders on the role of the primary school in preventing childhood obesity. In addition the review aims to identify gaps in knowledge which could indicate further research requirements. This paper provides a synthesis of the qualitative studies.

2A.2 Methods

2A.2.1 Selection criteria

We undertook a systematic search for studies that explored stakeholder views on the role of the primary school in preventing childhood obesity, including the role of the school in promoting healthy eating (HE) and/or physical activity (PA). Stakeholders were defined as parents, school staff, school governors, school nurses or students. Studies were included if they focused on primary schools (elementary schools - USA) and primary school-aged children (aged 4 to 11 years inclusive). Studies focusing on children outside of this age group or settings other than primary schools were excluded. Studies relating to treatment of childhood obesity were also excluded. We used the SPICE framework (145) to define criteria for selecting studies

(Table 2.1). Following initial searching, the reviewers made a pragmatic decision to exclude unpublished studies.

Table 2.1: SPICE framework (145) used to define study selection

Focus	Criteria
Setting	Studies focusing on primary schools and primary school-aged children (aged 4-11 years inclusive).
Perspective	"Stakeholders" i.e. parents, school staff, school governors, school nurses or students.
Interest	The role of the primary school in preventing childhood obesity.
Comparison	None.
Evaluation	Views/beliefs.

2A.2.2 Search strategy

During May and June 2012, a comprehensive literature search was carried out, using a range of electronic databases (Table 2.2). The search terms used are outlined in Table 2.3. There were no search restrictions for country of origin or language.

Table 2.2: Databases searched for systematic review

Database	Date searched
Applied Social Sciences Index and Abstracts (ASSIA)	Earliest to May 2012
Australian Education Index	1977 to May 2012
British Education Index	1975 to May 2012
British Nursing Index	1994 to May 2012
Cumulative Index to Nursing and Applied Health Literature (CINAHL)	1937 to May 2012
Education Resource Information Centre	1966 to May 2012
EMBASE	1974 to May 2012
Index to Theses	Earliest to June 2012
Medline	1946 to May 2012
Open Sigle	Earliest to June 2012
Physical Education Index	Earliest to May 2012
PsycINFO	1967 to May 2012
Web of Science	1898 to May 2012

Table 2.3: Search terms used

Search terms				
OR	AND OR	AND OR	AND OR	AND OR
stakeholder	perception*	weight*	prevent *	school*
parent*	attitude*	overweight*		educ*
carer*	aware*	obes*		
caregiver*	feeling*			
mother*	understand*			
maternal	concept*			
father*	knowledge			
paternal	opinion*			
guardian*	observ*			
staff	recogni*			
teacher*	belief*			
director*	view*			
headteacher*	perspective*			
headmaster*				
headmistress*				
principal*				
student*				
pupil*				
child*				
school nurse*				
governor*				
school board				

**Truncation symbol used to search databases for word ending variants*

2A.2.3 The reviewed studies

Duplicate records were deleted. The first reviewer (JC) screened all titles and abstracts, assessed against the "setting" and "interest" inclusion criteria (primary schools and preventing obesity). The second reviewer (BF) independently screened the first 1000 results. Post-screening, the full-texts of potentially relevant studies were independently assessed for eligibility against the full inclusion criteria by two reviewers (JC and BF). The process for selecting studies is shown in Figure 2.1.

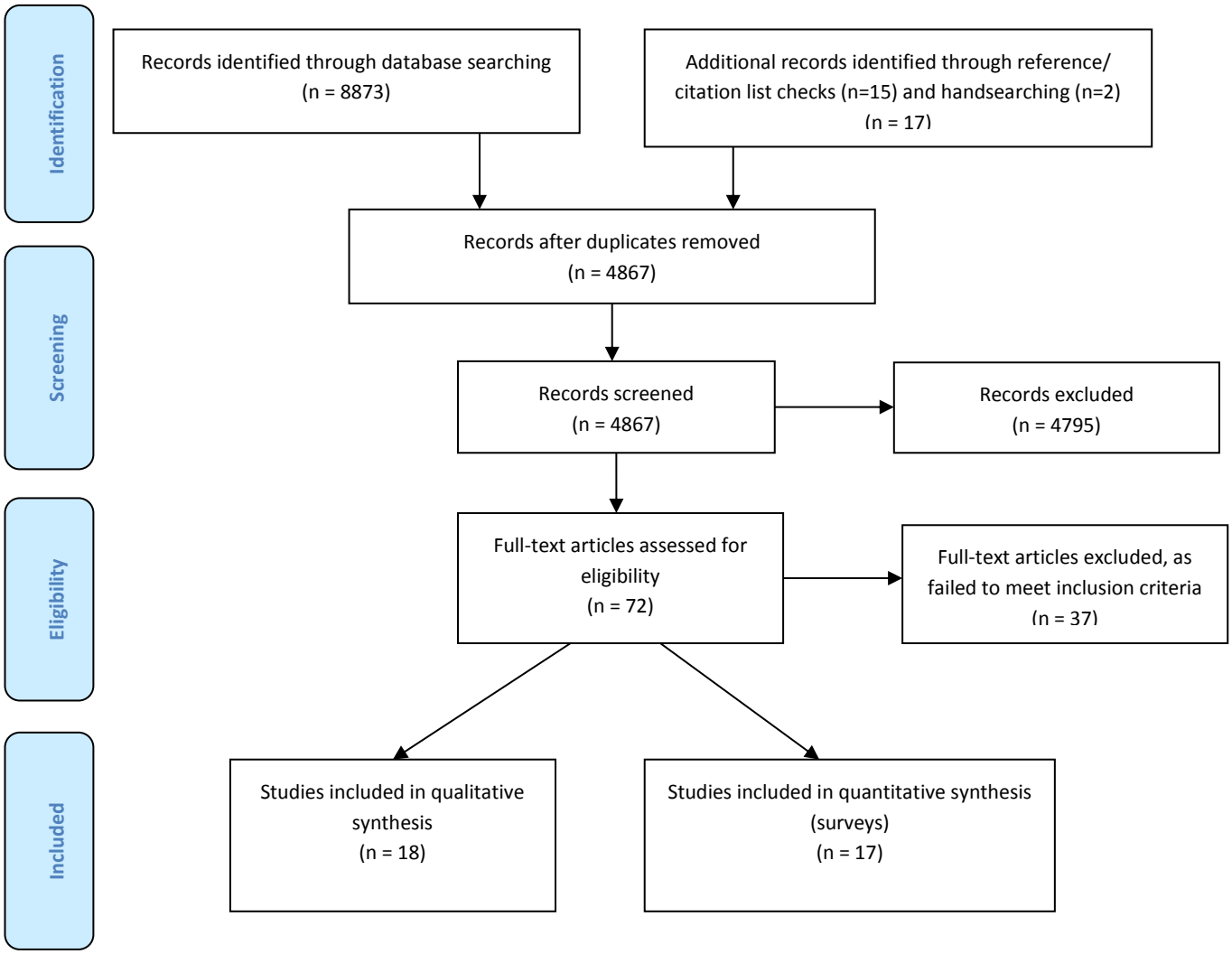


Figure 2.1 PRISMA (146) flow diagram of study selection

2A.2.4 Quality assessment method

Quality assessment of qualitative studies is a contentious issue, and there are many different tools available. We evaluated the quality of included studies using the CASP (Critical Appraisal Skills Programme) qualitative research appraisal tool (147). The checklist (Appendix 1) includes ten questions that cover rigour, key research methods used, credibility and relevance. An assessment of quality of the studies is included in the review, but studies were not excluded for poor quality. Quality assessment was carried out separately by two reviewers, and consensus for any discrepancies was reached by discussion.

2A.2.5 Data extraction and synthesis

A data extraction form based on the Quality Assessment and Review Instrument (QARI) data extraction tool (148) was used. The form (Appendix 2) was piloted, discussed and refined by reviewers, and was designed to capture information relating to methodology, data analysis procedures, setting and context, participants, phenomena of interest, key findings from the abstract and author conclusions. Extraction of data into the data extraction form, and an iterative process of reading and re-reading the studies allowed broad categories to be identified from included studies. Following this, all relevant text was extracted from sections labelled as "results" or "findings" in the included papers, according to the method suggested by Thomas and Harden (149). Other sections of the papers were then checked for any additional data. Data were extracted independently from the first seven studies by two reviewers and extracted data were compared for consistency. For the remaining studies, data were extracted by the first reviewer and checked by a second reviewer. Differences were resolved through discussion. Extracted data were entered into Microsoft Excel for qualitative thematic analysis. Line-by-line coding of data was carried out, and codes were organised into related areas to construct descriptive themes. Abstracted analytical themes were then created by combining similar descriptive themes. Emerging themes were discussed and agreed by reviewers. The number of reports in which the finer-level themes were present was noted.

2A.3 Results

2A.3.1 Study selection

The initial searches produced 8890 records which were imported into Reference Manager (a bibliographic database). Duplicates were manually deleted, leaving 4867 records as the starting point for screening. 4795 studies were excluded when study title and abstract were assessed against the setting and interest inclusion criteria (i.e.

primary schools and preventing obesity). The full-text of 72 studies was assessed by two reviewers for eligibility against the full inclusion criteria. Thirty-five studies were ultimately selected for inclusion. Eighteen of the 35 studies were qualitative studies, and the synthesis of these 18 studies is the focus of this paper. The remaining 17 studies were cross-sectional and did not form part of the qualitative synthesis. No mixed methods papers were identified. Table 2.4 shows a summary of the included qualitative studies. Of the 18 included studies, one paper (150) was related to two of the other studies (151, 152) as it reported on their findings. Study authors were contacted in an attempt to obtain any missing information.

Table 2.4: Summary of included qualitative studies

Study	Aim(s)	Method	Setting	Participants
Bathgate & Begley (2011) (153) Australia	To describe factors affecting school food selection by parents and their opinions on school food resources	Focus Groups (*n*=9)	**Schools** Low socio-economic primary schools, Perth	**Parents** of children aged 5-7 yrs (*n*=58; 55 F; 3 M)
Booth *et al.* (2009)* (151) Australia	To investigate perceptions of parents of school-aged children regarding child and adolescent overweight and obesity	Focus Groups (*n*=6)*	**Schools** Primary and high schools in socio-economically diverse areas across Sydney and rural New South Wales	**Parents** of primary and high school pupils (*n*=55; 54 F; 1 M)*
Borra *et al.* (2003) (154) USA	To understand children's, parents' and teachers' attitudes, perceptions, and behaviours about preventing overweight in childhood and to explore potential avenues for communicating overweight prevention messages	Focus Groups (Phase 1) (*n*=16)	**Community** Chicago and Baltimore	**Children** aged 8 to 12 yrs (*n*=not stated) **Parents** of children aged 8 to 10 yrs and 12 to 14 yrs (*n*=not stated) **Teachers** of children aged 9 to 12 yrs (*n*=not stated) Total participants: *n*=112
Bucher della Torre *et al.* (2010) (90) Switzerland	To explore the feasibility and acceptability of obesity prevention strategies that could be implemented in Swiss schools	Focus Groups (*n*=8)	**Schools** Switzerland	**Head Teachers** (*n*=6; 1 F, 5 M); **PE teachers** (*n*=5; 1 F, 4 M); **Catering staff** (*n*=5; 3 F, 2 M); **School nurses and health educators** (*n*=5; 4 F, 1 M); **Parents** of children aged 10-13 yrs (*n*=9; 8 F, 1 M); **Children** aged 10-11 yrs (*n*=10; 5 F, 5 M)
Cox *et al.* (2010) (155) New Zealand	To examine the meaning of personal, parental, and third party responsibility for children's PA	Focus Groups (*n*=8)	**Schools** 2 schools in Auckland (1 low, 1 high socio-economic school)	**Teachers** (*n*=15; 10 F, 5 M) **Parents** (*n*=13; all F) **Children** (*n*=32; groups separated by gender; 13 F, 19 M)
Gosling *et al.* (2008) (156) UK	To explore perceptions of PA and HE among children	Focus Groups (*n*=4)	**Schools** 2 primary schools in a deprived ward of Warrington, NW England	**Children** aged 9-10 yrs (*n*=32; 16 F, 16 M)
Hesketh *et al.* (2005) (157) Australia	To investigate child and parent views regarding social and environmental barriers to HE, PA and child obesity prevention programmes, acceptable foci, and appropriate modes of delivery	Focus Groups (parents: *n*=2; children: *n*=not stated)	**Schools** 3 demographically diverse primary schools in Victoria. 2 government schools; 1 independent school	**Parents** of primary school aged children (*n*=17; 15 F, 2 M) **Children** aged 7-8 yrs and 10-11 yrs (*n*=119)
Huberty *et al.* (2012) (158) USA	To describe the knowledge of elementary school staff related to PA and their importance of the school environment being conducive to PA prior to the implementation of a recess intervention	Focus Groups (*n*=12)	**Schools** 12 elementary schools, Midwestern USA, with at least 50% of children registered for free and reduced lunch	**School staff** (*n*=64): PE teachers (*n*=8), classroom teachers (*n*=39), nurses (*n*=2) and paraprofessionals (teaching assistants) (*n*=15). 52 F; 12 M
Korwanich *et al.* (2007) (159) Thailand	To investigate opinions of parents, school board members, and teachers regarding HE habits	Focus Groups (*n*=14)	**Schools** 8 schools in rural communities	**Teachers** (*n*=21) **Parents** of 5-6 year old children (*n*=123; 96 F, 27 M) **School board members** (*n*=11)
Kubik *et al.* (2007) (160) USA	To gather information on parents' opinions and beliefs about height, weight, and BMI screening at school and how to develop notification programs in a sensitive manner and convey supportive messages to parents and children about weight and healthy weight control	Focus Groups (*n*=10)	**Schools** 2 elementary schools in Minnesota	**Parents** of elementary school children aged 5 to 12 yrs (*n*=71; 64 F, 7 M)

MacLellan *et al.* (2010) (161) Canada	To explore parent and student perceptions of barriers and facilitating factors influencing the implementation of school nutrition policies, specifically focusing on the changes made to the school food environment and the acceptance of those changes	Focus Groups with children (*n*=8); Interviews with parents (*n*=12)	**Schools** 4 Prince Edward Island elementary schools (grades 1 to 6) and consolidated schools (grades 1 to 8), Canada	**Children** aged 10 to 13 yrs (*n*=41; 22 F, 19 M) **Parents** of children aged 6-14 yrs (*n*=12; all F)
Massey-Stokes & Meaney (2006) (162) USA	To understand a service-learning community through exploring parent, teacher, and student perceptions about healthy lifestyles, barriers to achieving healthy lifestyles, and what families and schools can do to help prevent childhood obesity	Focus Groups (*n*=6)	**School** One elementary school in a minority, low-income neighbourhood, West Texas	**Teachers** (*n*=22) **Parents** (*n*=12; all F) **Children** (*n*=20)
Morrison-Sandberg *et al.* (2011) (163) USA	To gain insight into current obesity-related school nursing practice in elementary schools, opinions regarding school nurse-led obesity prevention programs, and school nurses' interest in implementing obesity prevention programs	Semi-structured interviews (*n*=21)	21 school districts, Minnesota	**School nurses** (*n*=21; all F)
Pagnini *et al.* (2009)[*ı] (150) Australia	To investigate similarities and differences in the perceptions of parents, adolescents, GPs and education professionals regarding childhood overweight and obesity	Focus Groups with parents (*n*=6)* and interviews with teachers (*n*=6)	**Schools**, early childhood centres and GP divisions 4 locations including rural, low, medium and high socio-economic areas in one state (New South Wales)	**Parents** of primary and high school children (*n*=55; 54 F; 1 M)* **Teachers** (*n*=6) *(Also **High School Students**, **Early Childhood Staff, GPs, Parents** of preschool children. Data not included in synthesis)*
Patiño-Fernández *et al.* (2013) (164) USA	To investigate parent and school staff perspectives of childhood health and weight in order to guide the development of a school-based obesity prevention program for minority youth	Focus Groups (*n*=4)	**School** One local elementary school, location not stated, in a predominantly Hispanic, low-moderate income neighbourhood	**Parents** of children aged 6-7 yrs (*n*=9; 8 F, 1 M) **School staff** (*n*=7): first grade teachers (*n*=2); school counsellor; Exceptional Student Education and Media Center specialist; PE teacher; food service manager; community school program manager
Schetzina *et al.* (2009) (165) USA	To understand perceptions of teachers, parents and 4th grade students related to nutrition, PA, and the role of the school in obesity prevention	Focus Groups (*n*=7)	**School** One elementary school, rural Tennessee	**Teachers** (*n*=23; 22 F, 1 M) **Parents** (*n*=12; 11 F, 1 M) **Pupils** aged 9-10 yrs (*n*=19; 11 F, 8 M)
Van Lippevelde *et al.* (2011) (166) Belgium, Hungary, Norway, Spain	To investigate parents view on parental participation in school-based interventions on energy balance-related behaviours	Focus Groups (*n*=17)	**Schools** Belgium, Hungary, Norway and Spain	**Parents** of 10-12yr old children (*n*=92; 80 F, 12 M)
Wilkenfeld *et al.* (2007)[ı] (152) Australia	To gain information about how schools engage in promoting HE and PA, as well as the individuals' perceptions about overweight and obesity	Interviews (*n*=6)	**Schools** Primary and secondary schools in Sydney and one rural New South Wales area	**School Staff** (*n*=6): Principal, Assistants (*n*=2), Deputy Principal, Year Coordinator/PE teachers, primary classroom teacher. Included male and female staff members

* [ı] These studies used the same study population; M=Male; F=Female; HE=Healthy Eating; PA=Physical Activity

2A.3.2 Quality assessment

Quality of studies, as assessed by CASP was very good overall. The main area of weakness, found in 14 of the 18 studies was lack of adequate consideration of the relationship between researcher and participants. It may be that this is not commonly considered or reported in the type of studies included in this review, and may therefore reflect a weakness of the CASP for quality assessment of this type of study. Ethical approval was not reported in two studies. Table 2.5 shows a summary of results of the quality assessment.

Table 2.5: Quality assessment summary of the included studies

Study	Clear aims	Method appropriate	Research design appropriate	Recruitment strategy appropriate	Data collection appropriate	Relationship adequately considered	Ethical issues considered	Data analysis rigorous	Clear findings	Research valuable
Bathgate & Begley (2011) (153)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Booth *et al* (2009) (151)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Borra *et al* (2003) (154)	Y	Y	Y	Y	Y	U	N	Y	Y	Y
Bucher della Torre *et al* (2010) (90)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Cox *et al* (2010) (155)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Gosling *et al* (2008) (156)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Hesketh *et al* (2005) (157)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Huberty *et al* (2012) (158)	Y	Y	Y	Y	Y	U	N	Y	Y	Y
Korwanich *et al* (2007) (159)	U	Y	Y	Y	Y	U	Y	Y	Y	Y
Kubik *et al* (2007) (160)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
MacLellan *et al* (2010) (161)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Massey-Stokes & Meaney (2006) (162)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Morrison-Sandberg *et al* (2011) (163)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Pagnini *et al* (2009) (150)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Patiño-Fernández *et al* (2013) (164)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Schetzina *et al* (2009) (165)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Van Lippevelde *et al* (2011) (166)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Wilkenfeld *et al* (2007) (152)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y, yes; N, no; U, unclear

2A.3.3 Key findings

The total number of stakeholders across all 18 studies was 1,079. The largest group was parents, followed by students, school staff, school nurses/health educators and school board/governors. Only 10 of the 172 school staff identified (6%) were school managers (Head/Deputy Head/Assistant Head Teachers). The majority of stakeholders were female, particularly amongst the parent group. Table 2.6 shows participant details.

Table 2.6: Participant details (qualitative studies)

Stakeholder type	Number (% of total)	Female	Male	Unspecified
		(% of stakeholder type)		
Parents	483 (44.7%)	428 (88.6%)	55 (11.4%)	0 (0%)
Children	273 (25.3%)	67 (24.5%)	67 (24.5%)	139 (50.9%)
School Staff (all)	172 (15.9%)	87 (50.1%)	29 (16.7%)	56 (32.6%)
Teachers	138 (12.8%)	68 (49.3%)	22 (15.9%)	48 (34.8%)
Paraprofessionals (Teaching Assistants)	15 (1.4%)	15 (100%)	0 (0%)	0 (0%)
Head and Deputy/Assistant Head Teachers	10 (0.9%)	1 (10%)	5 (50%)	4 (40%)
Catering Staff	6 (0.6%)	3 (50%)	2 (33.3%)	1 (16.7%)
Other School Staff	3 (0.3%)	0 (0%)	0 (0%)	3 (100%)
School Nurses/Health Educators	28 (2.6%)	27 (96.4%)	1 (3.6%)	0 (0%)
School Board/Governors	11 (1.0%)	0 (0%)	0 (0%)	11 (100%)
Unknown	112 (10.4%)	0 (0%)	0 (0%)	112 (100%)
ALL	1,079	609 (56.4%)	152 (14.1%)	318 (29.5%)

Seven studies were from the USA, five from Australia, one from New Zealand, one from Canada, one from Thailand, one from Switzerland, one from the UK and one was a European multi-site study. Five of the studies specifically targeted low-income settings, and two studies targeted rural communities.

From the data synthesis, six broad categories and 37 finer level themes were identified (Table 2.7). The broad categories were ‘School as a key setting’, ‘What schools should be doing to promote Healthy Eating (HE)’, ‘What schools should be doing to promote Physical Activity (PA)’, ‘General barriers’, ‘Barriers to promoting Healthy Eating at school’ and ‘Barriers to promoting Physical Activity at school’.

Additionally, there were two main cross-cutting themes. Firstly, the need for consistency between the school environment, school policies, and the messages promoted within the curriculum. Ideally, these messages should also be consistent with what parents promote outside of school. Secondly, schools were seen as a bridge between children and their parents and the wider community enabling practical involvement of parents with their children in activities relating to HE and PA.

Table 2.7: Themes identified in qualitative metasynthesis

School as a key setting	What schools should be doing to promote Healthy Eating (HE)	What schools should be doing to promote Physical Activity (PA)	General barriers	Barriers to promoting HE at school	Barriers to promoting PA at school
Sub-themes with frequency shown of theme across all 18 studies					
Schools play a significant, influential role *"We used to be reading, writing, arithmetic, but now schools are responsible for academic education and social education and emotional education and physical well-being and all this kind of thing - so it's a really holistic approach to children and what they do and their families."* (152) N=6 (90, 151, 152, 159, 162, 166)	Working with parents *"The majority of our parents are doing the best they can with what they've got. If we can give them more tools and offer them more encouragement… maybe put a little funding into the right resources, then we have to believe that they will do the right thing."* (162) N=10 (90, 151, 152, 159-164, 166)	Provide and promote opportunities for PA *"Just get them out of their seats now and then to do jumping jacks. Do something. And I think teachers are getting aware from having kids in their desks all day long. They are having them just moving around."* (158) N=12 (90, 150-152, 155, 157, 158, 160, 162, 164-166)	Parents are mainly responsible for children's diet and exercise 'Staff members noted that parents have the primary responsibility of ensuring that their children get adequate nutrition and plenty of PA: *"... if there are overweight children in your class you can't really be suggesting to them what they should or shouldn't be eating because in reality that's the parents' responsibility."'* (164) N=12 (90, 150, 152, 154, 155, 157-159, 161, 163, 164, 166)	Unhealthy/poor quality food choices provided by school *"We will have pizza, French fries, and corn and starch, starch, starch." (165)* N=6 (90, 157, 161, 162, 164, 165) Lack of parent support for HE at school *"I think it's parents and I think we can only back up what's happening at home, the food comes from home, so we can only try and assist parents in getting kids to eat nutritionally."* (152) N=6 (151, 152, 161, 163, 165, 166)	School focus on academics/not enough time for PA *"You have to meet these standards and in order to meet these standards you have to teach and if you are out at recess you're not teaching and you can't meet the standards."* (158) *"There is no time to teach PA."* (165) N=7 (90, 152, 158, 163-166)
Desire to improve children's health *"I believe [school nurses] are committed. They are. They realize the health ramifications that will eventually come from [childhood obesity]."* (163) N=4 (152, 159, 163, 165)	Provide and promote healthy foods *"It's not enough to tell me they are overweight if they [the school] don't give them healthy foods."* (164) N=9 (90, 150, 151, 153, 159, 160, 162, 164, 165)	Working with parents 'They [teachers] saw parents as partners, and described schools as trying to work with parents, and to encourage them in terms of providing healthy food and getting their children to play sport.' (152) N=8 (90, 151, 152, 160, 162-164, 166)	Lack of government coordination, regulation and guidance *"It's a shame, there are a lot of small things done here and there, finally, a lot of energy is lost . . .. It would be good to coordinate all that".* (90) 'Many participants felt there was a role for increased government regulation of issues related to HE and PA.' (150) N=6 (90, 150, 152, 158, 160, 163)	Time pressures *"They are not giving them enough time to eat their food. They just want them to gulp it down, and that's not healthy."* (162) 'Teachers felt that they have a full curriculum to get through already and any new initiatives have to fit within this framework.' (152) N=5 (90, 152, 153, 162, 163)	Lack of resources *"Funding is always a little bit of a problem, because sport equipment if it is used, really has quite a short use-by date - so you are constantly buying new equipment all of the time and you are always scraping for funds to be able to do that."* (152) N=4 (152, 158, 163, 164)
Healthy children perform better academically *"I think what helps kids is when you have exercise. It gets the blood flowing to the brain and also releases stress and tension." (165)* N=3 (153, 163, 165)	Nutrition education *""I see it as educating children as to what a good balance of food is…trying to encourage good habits, because good habits they get at a young age will carry through for the rest of their lives."* (152) N=6 (90, 151, 152, 156, 164, 166)	Space, facilities and equipment 'Teachers recommended opening the gym after school.' (165) N=7 (90, 150, 151, 155, 157, 164, 165)	Lack of adequate funding and resources 'All teachers would like more	School uses unhealthy foods as rewards and fundraisers *"So it's difficult to get out of that habit of saying 'you have done really really well, here have something to eat.'"* (152) N=5 (152, 159, 160, 164, 165)	Lack of priority *"As a culture we have what we value. The things we have right now are a result of what we value. If we truly value physical education, if we truly value education, you'll see that stuff everywhere."* (158) N=3 (158, 163, 166)
Ability to support parents *"I think [parents] would love it*	To restrict or not? *"It's good, because you have a partner [the school] at home. When the kids whinge, you*	Role Modelling *"I jumped rope with the kids the other day and they all lined up where I was so they could jump with me and teach me the little dances and they were really excited because that was their*		Student food preferences	

School as a key setting	What schools should be doing to promote Healthy Eating (HE)	What schools should be doing to promote Physical Activity (PA)	General barriers	Barriers to promoting HE at school	Barriers to promoting PA at school
[obesity prevention program]. . . I think that . . . At the elementary level, a lot of them . . . are looking for help . . . and will take whatever we offer them." (163) N=3 (157, 163, 166)	*can pack an apple into their lunchbox, . . . And just say 'sorry. It's the rule, this is what we do."* (151) *"I don't think they have the right to step in and say, 'You're not allowed to bring these products to school,' just because they think it's not healthy. I don't think that's their right. That's up to the parent. They're our children, and their outcome in life, whether it's good or bad, is left to us."* (161) N=5 (90, 151, 159, 161, 165) Role Modelling 'They [parents] recognized the important role of parents and teachers to model healthy lifestyles rather than merely to encourage children to consume healthier diets and increase physical activity.' (157) N=4 (152, 157, 162, 166) HE policy 'The focus groups reiterated that establishing a school policy on snacks would be a good strategy to encourage children to take nutritious foods and snacks'. (159) N=3 (150, 157, 159)	*teacher."* (158) N=5 (152, 155, 157, 158, 162) Inclusivity *"I think too it would be good to have sport that is just recreational rather than competitive, some kids aren't competitive. . ."* (151) N=4 (90, 151, 152, 166) Backstop to lack of PA at home *"I think we need to provide them an opportunity for it because sometimes they're not going to get it [at] home, it's the only opportunity they're going to have."* (158) N=3 (150, 155, 158) Use PA as a reward, don't withhold as punishment *"You know, it's important for kids to get out. Especially when they have worked all day and you want to reward them and say 'Hey you guys have done everything that I have given you to do and let's spend 15 minutes outside' . . . which they appreciate."* (158) *"I also see a lot of staff use recess as a form of discipline . . .when the kids are misbehaving the first thing that goes is recess."* (158) N=3 (90, 158, 165)	support for existing structures (e.g. school canteens, PDHPE [Personal Development, Health and Physical Education]) and strategies, in terms of funding, staffing and training.' (152) N=4 (90, 152, 155, 160) Need to start before school age 'There was consensus amongst parents that obesity prevention strategies needed to begin early in a child's life, long before they reached the school setting.' (157) N=1 (157) Poor role models *"We're all overweight."* (165) N=1 (165)	*"If they want one vegetable or they don't want to have one, they don't have to have one. If they don't want a fruit, they don't have to take it."* (165) N=4 (161, 162, 164, 165) Expense of/access to healthy foods *"For lunch, students prefer to buy a pizza instead of going to the school cafeteria, so they spare 1 Swiss franc from what their parents give them."* (90) N=4 (90, 163-165) Limited school resources *"…But it's not fun that we don't have a cafeteria so we can't try different things every day."* (26) N=3 (153, 161, 163) Stigma *"My kid loves carrots, but the problem is that he's been called ''the rabbit''. . . so. . .. ".* (90) N=2 (90, 166) Contradictory messages Many foods that children are taught to recognize as unhealthy are available at the school canteen resulting in some children believing that *'they're not really bad for you*.' (157) N=1 (157)	Parents don't want to get involved in school PA promotion 'A majority of the parents (Belgium, Hungary, and Norway) mentioned being not motivated to participate in activities to promote PA and decrease sedentary behaviour.' (166) N=2 (163, 166) Safety and liability 'A majority of the participants, including parents, felt that some parents were overprotective of their children, discouraging them from walking or biking to school or to participate in school physical activities or to play outdoors.' (90) N=2 (90, 166) Students' entrenched behaviours and poor physical condition *"The problems are already there way before kids get to school."* (157) N=2 (90, 157)

2A.3.4 Thematic findings

2A.3.4.1 School as a key setting

Stakeholders thought that schools have a significant, influential role to play in preventing childhood obesity. They believed schools have a considerable level of responsibility for preventing childhood obesity, in part due to the large period of time children spend in the school environment from an early age. Some parents thought that teachers have an influential authority over their children, and that they could guide children in a way that proved difficult in the home environment. Stakeholders recognised a low knowledge-base for many parents and children regarding HE and PA, and thus saw schools as providing a valuable educational service. Some school staff cited a 'holistic' approach to children, with a school focus on child health and well-being as well as academic education.

School stakeholders expressed a desire to improve children's health through obesity prevention, and recognised overweight and obesity as an important issue for children, and therefore for schools. School nurses in particular were concerned about obesity, and showed an understanding of the future health consequences as well as present-day health and social ramifications. School nurses stated a desire to do more to prevent obesity in schools.

Stakeholders identified a link between health (in terms of eating healthily and participating in PA) and several outcomes that are of more importance for schools, thus providing a sound reason for schools to be involved in preventing childhood obesity. Some stakeholders associated PA with stress reduction amongst children, and viewed HE as having a positive influence on behaviour. Stakeholders cited the positive impact of HE and of PA on academic performance and concentration. They

also reported a connection between health and attendance; healthy children were more likely to be in school.

Schools were also recognised as a key setting for reaching parents. In addition to complementing the role of parents in promoting HE and PA to children, they can offer support and education to parents.

2A.3.4.2 What schools should be doing to promote Healthy Eating (HE)

A common theme emerging from the studies was that schools should work in partnership with parents through supporting and reinforcing parental efforts with regards to healthy nutrition. Communication with parents and parental involvement were also cited as important, particularly in relation to the provision of healthier school lunches. Stakeholders thought it important that schools provide nutrition education for parents. This could involve experiential learning, classes, events or workshops. Child involvement in parents' nutrition education, with parents and children learning together, was seen as motivational.

School lunchtimes were seen as a key opportunity for promoting HE messages. All stakeholder groups agreed that school canteens should provide healthy, good quality foods with healthier choices made more appealing. Stakeholders often expressed concerns about the ability of younger children to make healthy choices, and thought that school staff should help and encourage children in this regard. Some parents stated that they would prefer a one-option healthy lunch to prevent children from making less healthy choices. Other suggestions for promoting HE at school lunchtime included making the canteen and dining environment more attractive and refrigeration facilities for packed lunches. Stakeholders, and in particular parents, thought that schools needed to allow sufficient time for children to eat. Some stakeholders would like schools to provide healthy snacks and drinks such as fruit

and milk, and mentioned the importance of breakfast provision in school. Generally, stakeholders expressed that school food provision should be consistent with HE messages promoted by the school to avoid contradictory messages.

Schools were also considered to have a key role in teaching children about nutrition and encouraging good eating habits. One suggestion was that existing curricular sessions, for example health education or cooking, could be used to promote HE. It was generally seen as important to integrate HE messages across the whole curriculum rather than have nutrition education as a stand-alone subject area. Students mentioned the use of outside expert speakers as a way of promoting HE messages.

It was generally believed that schools should set a good example to children. In particular, there was a perceived need for teachers to lead by example through modelling healthy lifestyles. Some stakeholders thought that schools should promote positive, culturally-appropriate role models from the wider community.

Some stakeholders cited that establishing school HE policies would be a useful way of promoting a consistent approach to HE. In particular, it was thought that these policies should incorporate rules for healthy snacks and canteen provision, as well as keeping down costs of healthier options.

There was one area of conflict amongst parents: whether or not schools should impose restrictive measures on less healthy foods. Some parents welcome food rules, in particular those relating to the content of packed lunches and snacks from home, as this helps reinforce their own views on what their children should be eating. Other parents thought that it was not the school's remit to control or restrict foods brought in from home. Some parents expressed concern when unhealthy foods were

eliminated from school canteens, as they were worried that their children would not eat enough if only healthy choices were available.

2A.3.4.3 What schools should be doing to promote Physical Activity (PA)

A common theme was that schools should provide more opportunities for children to be physically active. A call for more Physical Education (PE) was frequently expressed, with some stakeholders citing this should be daily and/or mandatory. It was also thought that schools should provide a wide range of activity opportunities, including more time outside at breaktimes, lunchtime activities, after-school programmes, skill development, and more movement during classes. Ideas for motivating children included verbal encouragement and provision of incentives.

Stakeholders believed that schools should work in partnership with parents to share responsibility for children's PA and provide consistent messages to children. One suggestion was that schools put on events and activities that involve and educate parents and children. These should be fun (rather than competitive) and culturally appropriate.

The provision of plenty of space, facilities and equipment for PA was seen as an essential part of the school's role. Suggestions included schools opening up facilities for use after school hours, and provision of a wide range of indoor and outdoor facilities and equipment. A number of novel ideas were suggested to improve children's PA, including walking trails in the school grounds and providing children with pedometers. An accessible school playground of sufficient size was seen as critical for children's PA levels. In relation to the provision of space, facilities and equipment for PA, some stakeholders cited the school's requirement to take care of issues of safety and liability.

Stakeholders viewed role modelling as one function of the school in promoting PA. In particular, teachers should model healthy lifestyles and actively participate in PA with children. A few teachers recognised that their own participation made children more enthusiastic about PA. Some stakeholders also thought that schools should promote role models in the wider community, citing sports personalities as a particularly pertinent example.

Ensuring inclusivity of PA opportunities was seen as important. Non-competitive, recreational opportunities focusing on enjoyment from movement and social relationships were favoured. Provision of special classes for children in poor physical condition divided opinion. Whilst some were in favour, others thought that they risked alienating and stigmatising certain children, preferring instead whole-class approaches to PA that did not draw attention to or push too hard the less active children.

The role of the school in promoting PA was sometimes seen as a ‘backstop’ for where parents fail to ensure their children were physically active. A number of parents stated that they rely on their children being active at school as they do not have time at home to ensure sufficient PA. Some teachers cited that they were aware of children’s lack of PA at home, and believed there was a need for schools to fill that gap.

Some stakeholders believed that schools should not withhold PA from children as a punishment for bad behaviour or a failure to complete their classwork. Instead, it was cited that PA could be used as a reward for good behaviour, for example extra breaktime as a prize for meeting goals.

2A.3.4.4 General Barriers

The view that parents have the main responsibility for children's diet and PA was seen as the principal barrier to obesity prevention in the primary school setting. Stakeholders considered schools to have a supporting rather than a leading role in prevention of childhood obesity. Parents should model healthy lifestyles to their children, educate them about healthy choices, and motivate and encourage them to adopt healthy behaviours. The barrier to obesity prevention in the school environment arose when parents were not viewed as adequately fulfilling their responsibilities, making the school role more difficult. Additionally, where parents were not fulfilling their responsibilities in the home setting, their support for school attempts to improve HE and PA was sometimes seen to be lacking. Stakeholders considered the lack of support agencies for parents as a significant barrier.

Furthermore, in studies from several countries there was a perceived lack of government regulation and guidance around obesity prevention in primary schools, and a lot of energy was being lost in informal, uncoordinated efforts. Fundamental to this was the sense of overall lack of priority by governments for obesity prevention in schools. Stakeholders felt there was a need for coordination of efforts and a global programme with clear guidelines supporting development and implementation of programmes in every school. These programmes need to be flexible, adaptable, long-term and integrated into current curricula, with key stakeholders involved in programme development. In addition, it was felt there was a need for increased government regulation of issues related to HE and PA. Some stakeholders called for nutritional standards in schools, reduced food marketing to children, and an increase in time dedicated to PE.

Lack of funding and resources was seen as a barrier to school's obesity prevention efforts. Stakeholders called for increased funding for school canteens and the school PA environment (for example sports fields and specialist sports instructors).

Other perceived barriers to the prevention of obesity at school were poor role models (as school staff were often perceived as overweight) and the view that obesity prevention efforts need to start long before children start school.

2A.3.4.5 Barriers to promoting HE at school

Unhealthy and poor quality school food options were quoted as a major barrier to the promotion of HE. The school canteen was considered an obstacle to healthy lifestyles, with too many unhealthy or fast food options such as pizza, hot dogs and chocolate cake and not enough healthier choices available. Some stakeholders were concerned about the lack of consultation and communication between school and students and their parents about school food options and changes to school menus. School breakfasts were also considered by some stakeholders to be of low nutritional value. School food was seen to reinforce unhealthy eating patterns in children rather than promote HE. Alternative food sources, for example sales of unhealthy foods at breaktime and nearby fast food outlets were also viewed as barriers. Some school staff felt there was little they could do to improve school food.

Another barrier discussed by stakeholders was lack of parental support for the promotion of HE at school. School staff felt they could only back up what was happening at home, and that packed lunches brought from home were often unhealthy. Lack of parental involvement and participation in school efforts at parent education were seen as another barrier. Some parents stated that they had no interest in nutrition; others suggested they were suffering from 'information overload'.

Other hurdles to parental participation were transport, parental time constraints and language and cultural barriers.

Time pressures were seen as a barrier to the promotion of HE at school. Included in this theme was the short amount of time available for children to eat lunch, particularly relevant for younger children who take longer to eat. In schools where children were free to go outside when they had finished lunch, stakeholders expressed concern that children were eating less so they could go out and play. Even in schools where there was a set time period for eating lunch, this was sometimes viewed as not long enough and children were pressured to eat quickly which was not seen as healthy. Pressures on curriculum time were also considered under this theme. School staff felt that the curriculum was already full, with no room for health promotion or new initiatives. School nurses stated that they met with opposition from school senior management for using curriculum time for obesity prevention programmes. School nurses also reported competing priorities on their time, and often had to give priority to individual student and family issues over obesity prevention.

Another barrier to the promotion of HE at school is the use of unhealthy foods as rewards and fundraisers. Some parents thought that schools should not use sales of unhealthy food items for fundraising. Some school staff discussed the success of selling sweets and fast foods at fundraisers and stated that they hadn't received any complaints from parents about this. Some stakeholders, and in particular parents, believed that schools should not be using unhealthy foods, such as sweets, as rewards for good behaviour. Some school staff mentioned that this was a difficult habit to break.

Student food preferences were seen as a barrier. Stakeholders were concerned about the lack of rules and/or supervision for children making choices in the canteen. For example, some stakeholders mentioned that children did not have to choose fruit or vegetables from the canteen if they did not want to, and that there was no portion control. Children's preferences for unhealthy foods were seen as a barrier, as well as their resistance to trying new, healthier food choices in the school canteen.

The expense of healthier foods was cited as a barrier, including the cost of improving school lunches and making healthier options available. Some stakeholders quoted that healthier choices were priced higher than the less healthy options in the school canteen. Family financial restraints were also a barrier, resulting in children bringing in cheap, unhealthy options in their packed lunches. Competitive offers on unhealthier foods both inside and outside of school were seen to impede the promotion of HE.

Limited school resources were considered a hindrance to the promotion of HE at school, including a general lack of funds available to improve school food. Some stakeholders stated the lack of kitchen facilities meant that there were few foods that could be prepared and made it difficult to include healthier choices. Some stakeholders discussed the lack of volunteers to prepare lunchtime foods as an obstacle to HE. Another barrier considered, particularly in warmer climates, was the lack of refrigeration facilities for packed lunches, making it difficult for parents to include healthier foods.

Stigma was also cited as a problem. Some stakeholders discussed children being teased for making healthy choices. Additionally, it was seen that overweight or obese children and parents may feel stigmatised taking part in activities related to HE.

Contradictory messages within schools were seen as another barrier to HE promotion. Children believe foods permitted by and indeed provided by school will be healthy, and that contradictory messages exist between what is taught in the curriculum and what is available in the school canteen.

2A.3.4.6 Barriers to promoting PA at school

The main barrier to promoting PA at school revolved around the lack of time for PA owing to the school's focus on academic standards. Stakeholders agreed that children did not get enough time for PA at school, stating that there were not enough PE classes, and that these were short in duration. Additionally, it was considered that children did not get enough time outside, and that duration of breaktimes has reduced over the years. Staff felt that lack of time for PA was beyond their control due to pressures to meet academic standards. Stakeholders considered the fact that academic standards were assessed, whereas PA was not, leading to an erosion of time for PA to allow more time for academic work. Some stakeholders mentioned children missing breaktime in order to finish their work. School staff considered there was no time for additional PA or new initiatives in the already crowded academic curriculum.

Lack of resources was also cited as a barrier to promoting PA. Some stakeholders discussed the lack of space available for PA, with school fields and playgrounds being used to build extra classrooms. Lack of equipment was another concern, as sports equipment requires frequent replacement and school staff discussed the ongoing need for funding for new equipment. Some stakeholders mentioned the lack of staff to lead sports activities, with no specialist teachers for sport as there were for other subject areas.

Another barrier to the promotion of PA at school is its perceived lack of priority. Some stakeholders were unaware of PA guidelines or recommendations in relation to children. Some parents considered other health issues to be more important than PA, and school nurses reported other competing priorities. Some school staff believed that the value of PA was not recognised within schools.

Lack of parental involvement in school promotion of PA was another barrier, with some parents stating they had no motivation to participate in activities to promote PA. Other difficulties in securing parental support included transport, time, language and cultural barriers.

Safety and liability emerged as a further barrier. This related to concerns about legal issues in case of an accident whilst undertaking PA, as well as 'overprotective' parents who discourage their children from participating in PA in case of injury. Anxieties about traffic, bicycle storage and potential theft discouraged the promotion of active forms of transport to school.

Students' entrenched behaviours and poor physical condition emerged as another barrier. School staff saw that students' differing physical condition made it difficult for teachers to adapt classes to suit all, and that some students were subject to teasing by peers.

2A.4 Discussion

The aim of this systematic review was to identify and synthesise the research literature concerning the views of stakeholders on the role of the primary school in preventing childhood obesity. Eighteen qualitative studies were identified, data from which were synthesised and mapped into six broad categories and 37 finer-level themes.

The review confirms that stakeholders consider the school to be a key setting in which to prevent childhood obesity, and that work on promoting HE and PA has benefits as well as costs for the school. Stakeholders have largely harmonious views on what they think schools should be doing to promote HE and PA, and were equally united in identifying barriers for the school in achieving this.

In terms of what schools should be doing to prevent obesity, the main viewpoints were around providing opportunities for HE and PA, and working with parents. Counter-balancing this, the main barriers identified related to lack of time and resources within schools and lack of parental support, especially for HE. Parents could be seen as part of the solution as well as part of the problem. There appears to be a 'responsibility conflict' in schools, with unclear boundaries about whose responsibility it is to ensure children eat a healthy diet and access sufficient PA. Lack of government coordination also came out as a strong theme.

Some barriers are clearly within the school's control to overcome (e.g. withholding PA as punishment; using unhealthy foods as rewards; role modelling). However, many of the barriers are at least in part outside of school control. A number of the cited barriers to preventing childhood obesity in the school environment are linked to parenting, individual child-level factors, and the home environment (e.g. lack of parent support; student food choices; students' entrenched behaviours and poor physical condition) with unhealthy behaviours already established before children reach school. Consistent with findings from previous reviews (121, 167), this steers us to the conclusion that obesity prevention efforts need to start long before children reach the school environment, and that support for parents in this respect needs to be in place from infancy.

Other barriers (e.g. lack of adequate funding and resources; time pressures in school due to the focus on academic standards; expense of/access to healthy foods) add to the evidence pointing to a need for governments to raise the priority of obesity prevention and offer coordination and guidance to schools, with tougher regulation as appropriate. Swinburn et al (168) state that the obesity epidemic will not be reversed without government leadership, regulation and investment, yet governments have largely abdicated this responsibility.

This review highlights the dilemma that schools face when deciding whether or not to impose restrictions on school food, with stakeholder views divided. Jaime and Lock's (169) systematic review of the impact of school-based food and nutrition policies on diet and obesity concludes that there was very little evidence, and lack of consistent findings for the effectiveness of regulations of food and beverage availability.

This review adds to the evidence on the awareness of the impact of good health on education, and the barriers that schools face in promoting health. Story *et al* (91) outline that "health and education success are intertwined": schools cannot achieve their primary mission of education if children are not healthy and fit. A recent systematic review of literature on childhood obesity and educational attainment reported the following factors resulting from obesity that impact upon attainment: poor mental health; disordered sleep; stigmatisation and discrimination; a reduction in time spent in PA and socialising, and absenteeism (106). Despite this, schools face pressure in raising educational standards in the core subjects of literacy and numeracy (117), and there is some resistance amongst school personnel to the use of education time for health promotion (118). In addition, Whitby (120) discusses the burden to schools in terms of planning, budgeting, time for staff training and time for delivery of health promotion programmes.

The review suggests stakeholders perceive that schools often take time away from PA as they feel they need to instead focus on academic achievement. Schools find themselves in a position of 'trade-off' between giving children enough time to get the PA that they need and the pressure to achieve academic standards. However, recent reviews of the association between school-based PA, including PE, and academic performance (170, 171) suggest that increased PA is either positively related to academic performance or that there is no relationship, and therefore additional PA can be incorporated into the curriculum without risk of hindering academic achievement.

2A.4.1 Limitations

There are methodological limitations to this qualitative systematic review. We had no access to the original, unpublished data of the included studies, but instead had some raw data (participant quotes) and author interpretation of the data from the published papers. As such, this review can be seen as a synthesis of other authors' analyses and interpretations.

Some relevant studies may have been missed in the search. The decision to exclude unpublished studies may also have resulted in certain opinions being missed.

There is a gender bias amongst participants (Table 2.6), with more female than male viewpoints, particularly within parent and school staff groups. This is probably a reflection of society, with females being the principal carers of children, and primary schools having predominantly female employees. Parents made up 45% of participants, whereas other stakeholder groups had particularly small numbers of participants (Head or Deputy/Assistant Head Teachers; Catering Staff; Governors), which may mean their viewpoints have been under-represented in this review.

The included studies were from a range of countries, all of which (with the exception of one study undertaken in Thailand) could be considered Westernised, developed countries. Viewpoints from developing countries are therefore under-represented.

We recognise that the socio-economic background of participants may influence their views. Some studies provided no socio-economic data of participants, and the different presentational formats made it difficult to synthesise information that was provided. For example, a number of studies reported the socio-economic status (SES) of the school's location, but no information on the actual participants. Therefore, no socio-economic data about participants is presented in this review. However, a cautious summary of information provided in included studies shows variation in the SES of the school's location.

Despite these limitations, the large number of participants' views included in this review (from different backgrounds and using different methods) gives confidence in the findings and enables tentative conclusions to be made.

2A.5 Conclusion and recommendations for future research and practice

This synthesis points to a need for schools, parents and government to fulfil their responsibilities and work together to prevent childhood obesity in the school setting.

Some obesity prevention measures are within school control. For example, schools should be able to implement rewards policies that do not reward children with unhealthy food items for good behaviour or withhold PA as a punishment for bad behaviour. Schools could stop using unhealthy foods as fundraisers. School staff could consistently encourage and promote healthy behaviours (for example through supporting children to make healthier choices in school canteens) and provide role

models to children. All schools could have active HE and PA policies to ensure a consistent approach across the whole school.

Stakeholder viewpoints demonstrate a need for parents to take responsibility for childhood obesity prevention through providing their children with a healthy diet and ensuring sufficient PA. Parental role modelling of healthy behaviours to children from infancy is seen as key to achieving this goal. Schools and parents need to work together to ensure consistency of messages in the home and school environments. Parents require support to be able to fulfil their responsibilities.

This review indicates a need for governments to prioritise childhood obesity prevention through a joined-up policy approach to health and education, with an understanding of the impact HE and PA in the school environment can have on academic achievement. The perceived lack of time and resources in schools to focus on HE and PA could only be resolved through wider, government-level intervention. There is an apparent need for governments to offer clear guidance and coordination to schools as well as effective support to parents.

There is a need for more research into the views of under-represented stakeholder groups on the role of the primary school in preventing childhood obesity, in particular headteachers as the principal decision-makers within schools.

CHAPTER 2B

2B.0 VIEWS OF STAKEHOLDERS ON THE ROLE OF THE PRIMARY SCHOOL IN PREVENTING CHILDHOOD OBESITY: REVIEW OF CROSS-SECTIONAL STUDIES

As reported in the published paper presented in Chapter 2A, 17 cross-sectional studies were identified in literature searches on the topic of 'views of stakeholders on the role of the primary school in preventing childhood obesity'. The aim of this section is to synthesise the findings of these cross-sectional studies concerning stakeholder views of stakeholders on the primary school role in childhood obesity prevention.

2B.1 Methods

The study selection criteria, search strategy, data extraction techniques and PRISMA flow diagram of study selection are outlined in the qualitative metasynthesis (Chapter 2A).

2B.1.1 Quality assessment methods

A quality assessment form (Appendix 3), adapted from the Center for Evidence Based Management (CEBM) 'Critical appraisal of a survey form' (172), supplemented with additional questions from the Critical Appraisal Skills Programme (CASP) qualitative research appraisal tool (147), was developed. Items that were not relevant from the CEBM form (for example, questions concerning statistical power or significance) were excluded. Additional items from the CASP tool included questions relating to ethical considerations and clarity of findings; these were used to assess quality in the qualitative metasynthesis, and are equally relevant to the cross-sectional studies in this review. The adapted form consists of ten questions covering methods, bias and relevance. Results of the quality assessment of studies are

included in this review, but studies were not excluded for poor quality. Quality assessment was carried out separately by two reviewers (JC with one of BF, MP or EL). Discrepancies were discussed and consensus reached.

2B.1.2 Data synthesis

All relevant findings from individual studies were extracted and sorted into three stakeholder groups: ‘parents’; ‘education and school personnel’, and ‘school nurses and health workers’. Extracted data were categorised into topics, and presented in separate tables for each stakeholder group. Presenting the data in this way enabled responses to similar questions from different papers to be compared. Meta-analysis of responses was not possible due to the high level of heterogeneity of questions included in the studies. Instead, a narrative synthesis was undertaken.

2B.2 Results

2B.2.1 Study selection

Seventeen cross-sectional studies were identified that met the inclusion criteria. A summary of the included papers is shown in Table 2.8. The studies, published between 1987 and 2012, were all from developed countries (mainly USA). Five of the studies (173-177) were conducted by the same lead researcher.

2B.2.2 Quality assessment findings

Quality of studies (Table 2.9) was found to be good overall. The main area of weakness was related to selection bias (identified in 15 of the 17 studies), and a failure of studies to report information on non-respondents. Also, the representativeness of the study sample was unclear in 13 studies. Only 11 studies reported use of a validated questionnaire. Ethical approval was not reported in seven studies.

Table 2.8: Summary of included cross-sectional studies

Study	Aim(s)	Method	Setting	Participants
Crawford et al (2008) (178) **Australia**	To examine the changes parents would like to see (in settings where children spend time) in policies and practices that impact on children's risk of obesity, and to establish whether parents might be willing to advocate changes in these settings.	Surveys Paper-based, self-administered Response rate: not indicated	**Schools** 5 primary schools and 5 kindergartens in Melbourne.	**Parents** of children in kindergarten or primary school (n=175; 79% mothers, 20% fathers, 1% other) Mean age of kindergarten children = 4.7 years. Mean age of primary school children = 10.1 years.
Frongillo et al (1990) (179) **USA**	To investigate administrator views on food and nutrition teaching, how they view the teaching that occurs in their schools, and how they have supported that teaching.	Surveys Paper-based, self-administered Response rate: 76%	**Schools** Elementary schools in New York state and New Jersey.	**Superintendents** (n=426) **Principals** (n=395)
Jaballas et al (2011) (180) **USA**	To investigate perceptions of parents regarding their children's weight, eating habits, and physical activities.	Surveys Paper-based, self-administered Response rate: 37%	**Schools** 23 urban elementary public schools in Ohio.	**Parents** of children aged 8-9 years (n=348)
Kubik et al (2006) (181) **USA**	To investigate parents' opinions and beliefs regarding school-based BMI screening and parent notification programs.	Surveys Paper-based, self-administered Response rate: 70%	**Schools** 4 suburban elementary schools in St Paul/Minneapolis.	**Parents** of elementary school children (n=790; 90% female)
Kubik et al (2007) (182) **USA**	To determine responsibilities of school nurses in delivering obesity prevention services; assess opinions and beliefs about school-based obesity prevention, and establish factors associated with school nurses supporting and providing obesity prevention services.	Surveys Paper-based, self-administered Response rate: 80%	Members of the School Nurse Organization of Minnesota.	**School nurses** (n=221, mostly female)
Moyers et al (2005) (183) **USA**	To investigate school nurses' perceptions of childhood obesity.	Surveys Paper-based, self-administered Response rate: 63%	**Schools** Elementary and middle public schools in the Missouri 8th Congressional District.	**School nurses** (n=106)
Murnan et al (2006) (184) **USA**	To examine parents' perceptions of the role of elementary schools in preventing childhood overweight.	Surveys Paper-based, self-administered Response rate: 53%	**Households** Random sample of households in Ohio with children aged 5-12 years from Info USA address lists.	**Parents** of elementary school children (n=344; 78% female)
Murphy & Polivka (2007) (185) **USA**	To investigate parents' perceptions of childhood obesity, BMI, and the school's role in prevention and treatment of obesity.	Surveys Paper-based, self-administered Response rate: 23%	**After-school program** An after-school program in suburban Ohio.	**Parents** of children aged of 5-12 years (n=117; 90% female)

Pettigrew et al (2012) (186) **Australia**	To assess the extent to which parents and school-based stakeholders (principals, teachers, canteen managers and Parents & Citizen Committee presidents) are supportive of potential expansions to a new school food policy.	Survey Telephone survey (parents); On-line survey (school stakeholders) Response rate: 68% (parents); 44% (principals); unknown for other school stakeholders	**Households and schools** Parents recruited through random digit dialling. School stakeholders survey completed online, administered via the Department of Education's email notification system to all government schools. Western Australia	**Parents** of children aged 6-18 years (n=1200; 83% female) **Teachers** (n=147) **Principals** (n=310) **Canteen managers** (n=86) **Parents & Citizen Committee presidents** (n=64)
Price et al (1987) (176) **USA**	To examine principals' perceptions regarding childhood obesity and the schools' role in dealing with the problem.	Surveys Paper-based, self-administered Response rate: 76%	**Schools** A randomly selected group of school principals from the National Association of Elementary School Principals.	**Principals** (n=227; 60% male; 40% female)
Price et al (1992) (175) **USA**	To examine parents' perceptions regarding childhood obesity and the schools' role in dealing with the problem.	Surveys Paper-based, self-administered Response rate: 75%	**Schools** and **paediatric clinic** Illinois and Ohio.	**Parents** (n=375; 83% female; 10% male; 7% unknown)
Price et al (1987) (174) **USA**	To investigate school nurses' perceptions regarding childhood obesity.	Surveys Paper-based, self-administered Response rate: 88%	A random sample of nurses from the American School Health Association membership.	**School nurses** (n=220)
Price et al (1990) (173) **USA**	To assess elementary school PE teachers' perceptions of obesity and the schools' role in dealing with the problem.	Surveys Paper-based, self-administered Response rate: 80%	A random sample of PE teachers from the Council of PE for Children.	**PE Teachers** (n=321; 65% female; 27% male; 8% unknown)
Price & Telljohann (1994) (177) **USA**	To assess food service directors' perceptions of childhood obesity and their role in its prevention.	Surveys Paper-based, self-administered Response rate: 70%	**Schools** Ohio.	**Food Service Directors** (n=210; 86% female)
Stalter et al (2011) (187) **USA**	To investigate rural parents' perceptions of child obesity, use of BMI in schools, preferences for receipt of BMI information and the rural school's role in obesity prevention/treatment.	Surveys Paper-based, self-administered Response rate: 36%	**School** A rural Ohio elementary school.	**Parents** of children aged 4-13yrs (n=65)
Sutherland et al (2004) (188) **Australia**	To investigate attitudes of parents, teachers and health professionals on factors contributing to childhood obesity and the role of the school in preventing childhood obesity.	Surveys Paper-based, self-administered Response rate: 85% (parents); 89% (school staff); 80% (health workers)	**School** One large primary school on the Central Coast of New South Wales.	**Parents** of children aged 4-12yrs (n=170) **School staff** (n=31) **Health Workers** (n=40)
Vereecken et al (2009) (189) **Belgium**	To examine parent and teacher opinions on school food policy.	Surveys Paper-based, self-administered Response rate: 62% (parents); 78% (teachers)	**Schools** In East- and West-Flanders.	**Parents** (n=884; 85% female) **Teachers** (n=70; all female)

BMI=Body Mass Index

Table 2.9: Quality assessment summary of included cross-sectional studies

Study	Clear aims	Study design appropriate	Participant characteristics / selection clearly described	Selection bias avoided	Sample representative	Response rate satisfactory	Questionnaire validated	Ethical issues considered	Clear statement of findings	Research valuable
Crawford *et al* (2008) (178)	Y	Y	Y	U	U	U	N	Y	Y	Y
Frongillo *et al* (1990) (179)	Y	Y	U	Y	Y	Y	U	U	Y	Y
Jaballas *et al* (2011) (180)	Y	Y	U	U	U	U	U	Y	Y	Y
Kubik *et al* (2006) (181)	Y	Y	Y	U	U	Y	Y	Y	Y	Y
Kubik *et al* (2007) (182)	Y	Y	Y	U	U	Y	Y	Y	Y	Y
Moyers *et al* (2005) (183)	Y	Y	Y	U	U	Y	Y	Y	Y	Y
Murnan *et al* (2006) (184)	Y	Y	U	U	U	U	Y	Y	Y	Y
Murphy & Polivka (2007) (185)	Y	Y	Y	U	U	U	Y	Y	Y	Y
Pettigrew *et al* (2012) (186)	Y	Y	Y	U	U	U	U	Y	Y	Y
Price *et al* (1987) (176) Principals	Y	Y	Y	U	Y	Y	Y	U	Y	Y
Price *et al* (1987)(174) School nurses	Y	Y	Y	U	U	Y	Y	U	Y	Y
Price *et al* (1990) (173) PE Teachers	Y	Y	Y	U	Y	Y	Y	U	Y	Y
Price *et al* (1992)(175) Parents	Y	Y	Y	U	U	Y	Y	U	Y	Y
Price & Telljohann (1994) (177) Food service directors	Y	Y	Y	Y	Y	Y	Y	U	Y	Y
Stalter *et al* (2011) (187)	Y	Y	Y	U	U	U	Y	Y	Y	Y
Sutherland *et al* (2004) (188)	Y	Y	U	U	U	Y	U	Y	Y	Y
Vereecken *et al* (2009) (189)	Y	Y	Y	U	U	Y	U	U	Y	Y

Y=yes; N=no; U=unclear

2B.2.3 Key findings

The total number of stakeholders across the 17 studies was 7,342. The largest stakeholder group was parents, followed by headteachers, school nurses/health workers, teachers, chief education officers and catering staff. The majority of stakeholders were female, especially among the parent group. Participant details are shown in Table 2.10.

Table 2.10: Participant details (cross-sectional studies)

Stakeholder group	Number (% of total)	Female (% of stakeholder type)	Male (% of stakeholder type)	Unspecified (% of stakeholder type)
Parents (all)	4532 (62%)	3280 (72%)	577 (13%)	675 (15%)
Parents & Citizens Committee Presidents*	64 (1%)	0 (0%)	0 (0%)	64 (100%)
Education / School Personnel (all)	2223 (30%)	551 (25%)	252 (11%)	1420 (64%)
Teachers	538 (7%)	279 (52%)	87 (16%)	172 (32%)
Headteachers	932 (13%)	91 (10%)	136 (15%)	705 (76%)
Chief Education Officers	426 (6%)	0 (0%)	0 (0%)	426 (100%)
Catering Staff	296 (4%)	181 (61%)	29 (10%)	86 (29%)
Other School Staff	31 (0.4%)	0 (0%)	0 (0%)	310(100%)
School Nurses/Health Workers	587 (8%)	0 (0%)	0 (0%)	587 (100%)
ALL	7342	3831 (52%)	829 (11%)	2682 (37%)

*Parents & Citizens Committees provide volunteer support and raise funds for schools in Australia
Percentages may not add up to 100 due to rounding of numbers

Extracted findings for parents, education and school personnel, and school nurses/ health workers are shown respectively in Table 2.11, Table 2.12 and Table 2.13. With the exception of one study that used telephone and on-line questionnaires (186), studies used self-administered, paper-based questionnaires.

2B.2.3.1 Findings from synthesis of cross-sectional studies

2B.2.3.1.1 Parents' views on the role of the primary school in preventing childhood obesity

Parents supported the school role in teaching about HE (184, 185, 187-189), with strong support for trying new foods at school (189), and learning about the importance of eating a healthy breakfast and plenty of fruits and vegetables (184). Parents perceived the school canteen to play an important role in supporting the school's health education curriculum (186, 188), and that school meals should

include healthier items (184, 186) which should be promoted to children (186). In general, parents wanted more involvement with, and more communication from, school canteens (178, 186, 189). Ensuring children had sufficient time to eat lunch (178, 184), and were encouraged to drink enough fluids at school (189) were important to most parents.

There was moderate support from parents in terms of restricting the availability and consumption of unhealthier foods and drinks in school (178, 188), and for lunchbox guidelines (178). There was strong support for schools not selling unhealthy foods and drinks as fundraisers or using them as rewards for children (178, 184).

Parents were very supportive of the school role in encouraging PA in children (188), although only moderately supportive of schools dedicating more time to PE, sport or outdoor play (178). There was strong support for school provision of after-school sports (178, 180) and moderate support for school PA facilities being available out-of-school hours (178, 184). The school role in encouraging active transport was generally well supported by parents (178). There was some parental support for BMI screening in schools (181, 184).

No differences in parental opinions on the role of the primary school in preventing obesity were found by country of study.

Table 2.11: Views of parents from cross-sectional studies

Topic	Item	Views
Healthy Eating (HE)		
Teaching about HE	Importance of a comprehensive health curriculum with units on nutrition and weight control (187)	52% strongly agree or agree
	Schools should have units on nutrition and weight control (185)	83% strongly agree or agree
	Importance of school offering health classes including topics on food and weight control (175)	71% very important
	At school, there should be an emphasis on teaching about balanced eating (188)	93% strongly agree or agree
	Importance of teaching benefits of HE (184)	70% very important, 29% important
	It is important that children learn about new foods at school (189)	79% agree (mothers), 81% agree (fathers)
	Importance of teaching children to eat a healthy breakfast (184)	66% very important, 31% important
	Importance of teaching to eat plenty of fruit and vegetables (184)	60% very important, 38% important
	Importance of teaching how to select healthy choices from food groups (184)	56% very important, 38% important
	Importance of teaching how to control eating habits (184)	44% very important, 41% important
	Importance of teaching making healthy snacks (184)	43% very important, 47% important
	Importance of teaching how to recognise hunger and fullness (184)	43% very important, 45% important
	Importance of teaching to drink and eat foods low in fat and added sugar (184)	42% very important, 45% important
	Importance of teaching goal setting and decision making skills for HE (184)	34% very important, 51% important
	Importance of teaching how to read food labels (184)	34% very important, 42% important
	Importance of teaching how to balance food intake and PA (184)	34% very important, 52% important
	Importance of teaching the effect of family, media and culture on diet (184)	28% very important, 45% important
	Importance of teaching how to help others to eat healthily (184)	23% very important, 41% important
	The school should pay particular attention to helping children acquire healthy dietary habits (189)	94% agree (mothers), 91% agree (fathers)
Restrictions / availability of food	How important is it that school only allows healthy foods and drinks to be available to children? (178)	44% very important, 19% quite important (kindergarten parents); 57% very important, 26% quite important (school parents)
	Schools should be restricted to selling only healthy food (188)	55% strongly agree or agree
	Schools should have a policy about what should not be eaten in school (188)	42% strongly agree or agree
	How important is it that school provides lunchbox guidelines? (178)	40% very important, 19% quite important (kindergarten parents); 31% very important, 36% quite important (school parents)
	Importance of places other than canteen offering healthy products (184)	36% very important, 36% important
	Schools should restrict what children bring into school as snacks (189)	83% agree (mothers), 78% agree (fathers)
	Sweets should be allowed at school only as a treat (189)	57% agree (mothers), 62% agree (fathers)
	Schools should eliminate junk food machines (185)	75% strongly agree or agree
	Importance of elimination of junk food machines (187)	77% strongly agree or agree
	Importance of elimination of junk food machines (175)	65% very important
	A piece of fruit should be available at school daily (189)	79% agree (mothers), 80% agree (fathers)
	Importance of primary schools offering a breakfast program (184)	41% very important, 36% important

School meals	The school canteen plays an important role in supporting the HE messages taught in the classroom (188)	90% strongly agree or agree
	Foods sold in the canteen to be consistent with the health curriculum taught in schools (186)	63% support (P&C presidents)
	Importance of school meals including a variety of foods (184)	63% very important, 31% important
	Importance of a la carte offerings to include at least one fruit, vegetable and dairy product every day (184)	50% very important, 42% important
	Healthy menu options to be promoted more to children at school (186)	90% support (parents), 58% support (P&C presidents)
	Importance of school food service offering low-fat and skimmed milk every day (184)	53% very important, 29% important
	Importance of school food service reducing fat content of food (184)	44% very important, 37% important
	Canteens to be provided with advertising to promote green menu items (fruit, vegetables, lean meats, low-fat dairy products, wholegrain products) (186)	88% support (parents), 75% support (P&C presidents)
	Canteen to sell foods that do not have preservatives/additives wherever possible (186)	64% support (P&C presidents)
	How important is it that school has rules about how much children can spend in the canteen? (178)	24% very important, 25% quite important (school parents)
	Foods to be priced according to their healthiness, with the healthiest foods being the most affordable (186)	67% support (P&C presidents)
	Support for planning healthier school menus with parent and student input (180)	68% support
	Students to undertake projects to find new healthy food items (186)	93% support (parents), 76% support (P&C presidents)
	Encouraging students to undertake projects to promote healthy menu items (186)	76% support (P&C presidents)
	More cooperation between canteen managers and teachers to educate children on HE (186)	81% support (parents), 62% support (P&C presidents)
	Importance of school food service manager having relevant qualifications (184)	44% very important, 39% important
Time for lunch	Importance of students having enough time to eat school meals (184)	72% very important, 26% important
	How important is it that school ensures children have enough time to eat lunch? (178)	41% very important, 22% quite important (kindergarten parents); 61% very important, 22% quite important (school parents)
Working with parents	Parents should be involved in the school food policy (189)	57% agree (mothers), 54% agree (fathers)
	How important is it that parents have more of a say into what foods are sold in the canteen? (178)	49% very important, 26% quite important (school parents)
	Parents to be involved in suggesting healthy items for canteen menu (186)	87% support (parents), 67% support (P&C presidents)
	It is important that parents are informed about the content of school meals (189)	84% agree (mothers), 77% agree (fathers)
	Schools should inform parents about what their child eats at school (189)	79% agree (mothers), 68% agree (fathers)
	Parents to be able to email lunch orders to the canteen (186)	26% support (P&C presidents)
	Providing parents with more information about how the traffic light system (a way of categorising foods to assist in making healthier choices) applies to the school canteen (186)	69% support (P&C presidents)
	Parents to be given information about how to apply the traffic light system at home (186)	84% support (parents), 73% support (P&C presidents)
	Recipes for the most popular menu items provided to parents (186)	50% support (P&C presidents)
	More information about HE provided in the school newsletter (186)	45% support (P&C presidents)
	Healthy lunchbox workshops for parents (186)	75% support (parents), 60% support (P&C presidents)

	Importance of children working with family on health education homework (184)	45% very important, 43% important
Fundraising, rewards, sponsorship, advertising	How important is it that school ensures fundraising excludes unhealthy foods? (178)	44% very important, 19% quite important (kindergarten parents); 44% very important, 29% quite important (school parents)
	Importance of school fundraising to not sell unhealthy food and drink (184)	64% very important, 27% important
	How important is it that teachers do not use food as a reward? (178)	25% very important, 11% quite important (kindergarten parents); 46% very important, 20% quite important (school parents)
	Importance of schools not using food as reward or punishment (184)	73% very important, 20% important
	How important is it that school bans unhealthy food advertisements?(178)	38% very important, 22% quite important (kindergarten parents); 43% very important, 33% quite important (school parents)
	How important is it that school bans sponsorship from unhealthy food companies? (178)	34% very important, 25% quite important (school parents)
Food preparation	How important is it that teachers allow children to help prepare food more often? (178)	14% very important, 43% quite important (kindergarten parents)
	Children to be involved in food preparation in canteen as part of health curriculum (186)	69% support (parents), 42% support (P&C presidents)
Other	How important is it that school provides a vegetable garden?(178)	14% very important, 45% quite important (kindergarten parents); 41% very important, 23% quite important (school parents)
	How important is it that school avoids excursions to places with unhealthy foods and activities? (178)	26% very important, 32% quite important (school parents)
	Teachers should make sure children drink enough fluids at school (189)	94% agree (mothers), 91% agree (fathers)
	How important is it that schools provides a fridge to store lunches? (178)	26% very important, 26% quite important (kindergarten parents); 42% very important, 27% quite important (school parents)
Physical Activity (PA)		
General	Schools have a major role in encouraging children to be more active (188)	86% strongly agree or agree
	How important is it that teachers are educated about the importance of active time? (178)	16% very important, 22% quite important (kindergarten parents); 42% very important, 35% quite important (school parents)
Physical Education (PE)	Schools should have PE classes (185)	99% strongly agree or agree
	How important is it that school allocates more time to PE and sport? (178)	34% very important, 34% quite important (school parents)
	Support for providing gym class every day (180)	58% support
	Importance of schools providing PE classes which teach life-long fitness (175)	85% very important
	Importance of PE teachers avoiding practices resulting in inactivity (184)	33% very important, 38% important
	How important is it that school provides more trained PE and sport teachers? (178)	46% very important, 25% quite important (school parents)
	Importance of PE program supporting children to be active in the community (184)	39% very important, 43% important
Teaching about PA	Importance of teaching benefits of PA (184)	58% very important, 39% important
	Importance of teaching the role of PA in keeping a healthy weight (184)	55% very important, 40% important
	Importance of teaching ways to be more physically active (184)	54% very important, 40% important
	Importance of teaching goal setting and decision-making skills for PA (184)	41% very important, 46% important
	Importance of teaching examples of PA and physical inactivity (184)	37% very important, 55% important
	How important is it for teachers to encourage children in sport? (178)	59% very important, 27% quite important (school parents)
	How important is it that school teaches ball skills? (178)	19% very important, 46% quite important (kindergarten parents); 37% very important, 33% quite important (school parents)

School PA opportunities	At school there should be an emphasis on providing opportunities for PA (188)	95% strongly agree or agree
	Importance of opportunities for PA at school and in the community (184)	45% very important, 48% important
	How important is it that school increases time spent playing outside? (178)	1% very important, 16% quite important (kindergarten parents); 22% very important, 25% quite important (school parents)
	How important is it for playground supervisors to encourage/teach active games? (178)	43% very important, 32% quite important (school parents)
Active transport	How important is it for school to encourage children to walk or cycle to school? (178)	22% very important, 39% quite important (kindergarten parents); 40% very important, 40% quite important (school parents)
	How important is it for school to provide safe bike storage?(178)	29% very important, 39% quite important (school parents)
	How important is it for schools to run walking buses? (178)	41% very important, 34% quite important (school parents)
	How important is it for schools to provide more road safety education? (178)	32% very important, 26% quite important (kindergarten parents); 62% very important, 25% quite important (school parents)
Equipment and resources	How important is it that school increases the amount of covered outdoor play? (178)	14% very important, 32% quite important (kindergarten parents); 54% very important, 28% quite important (school parents)
	How important is it that school provides better quality outdoor equipment? (178)	14% very important, 27% quite important (kindergarten parents); 46% very important, 31% quite important (school parents)
Out of school hours PA	Support for sports programs after school (180)	71% support
	How important is it for schools to provide after-school sports? (178)	51% very important, 30% quite important (school parents)
	How important is it that school allows access to grounds outside of school time? (178)	24% very important, 31% quite important (school parents)
	Importance of children being allowed to use school gym out of school hours (184)	35% very important, 38% important
Rewards, punishment and restrictions	How important is it for teachers to provide outside activity as a reward? (178)	15% very important, 22% quite important (kindergarten parents); 42% very important, 28% quite important (school parents)
	Importance of school prohibiting PA as punishment (184)	26% very important, 26% important
	How important is it for schools to restrict children bringing computer games to school? (178)	47% very important, 17% quite important (school parents)
Other		
BMI screening	Importance of schools including height/weight as part of annual health screening (181)	39% very important, 39% somewhat important
	Importance of school measuring children's height and weight (184)	16% very important, 28% important
	Support for receipt of information on their child's BMI very year (181)	78% support
	Importance of school informing parents of child's height and weight (184)	20% very important, 26% important
Body image	Importance of teaching acceptance of different body sizes (184)	60% very important, 31% important
Role modelling	How important is it that teachers are encouraged to eat healthy food and be active? (178)	47% very important, 29% quite important (school parents)

2B.2.3.1.2 Education and School Personnel views on the role of the primary school in preventing childhood obesity

Although education and school personnel strongly believed that schools play a major role in promoting children's health (188), compared to views of parents there was much weaker support for schools being an ideal place to prevent weight problems (176, 188). There was wide support for the school role in teaching about HE (173, 176, 177, 179), including trying new foods at school (189), and a strong belief that there should be consistency between the school HE curriculum, and the content of school meals (186, 188). There was moderate support for children being involved in food preparation in the canteen as part of the curriculum (186). In terms of working with parents, education and school personnel were supportive of information being provided, and suggestions being received, about school meals and HE (186). One study from Belgium, however, described low teacher support for parental involvement in school food policies (189).

Only one study included education and school personnel views on the school role in promoting PA; strong support was reported (188).

Table 2.12: Views of Education and School Personnel from cross-sectional studies

Topic	Item	Views
Healthy Eating (HE)		
Teaching about HE	Primary schools should have a role in teaching foods and nutrition to children (179)	98% agree (headteachers and superintendents)
	Teaching of foods and nutrition should be an essential part of the curriculum (179)	82% agree (headteachers and superintendents)
	Importance of comprehensive health curriculum with units on nutrition (176)	77% very important (headteachers)
	Importance of comprehensive health curriculum with units on nutrition (177)	74% very important (catering staff)
	Importance of comprehensive health curriculum with units on nutrition and weight control (173)	91% support (PE teachers)
	At school, there should be an emphasis on teaching about balanced eating (188)	77% strongly agree or agree (teachers)
	The school should pay particular attention to helping children acquire healthy dietary habits (189)	97% agree (teachers)
	It is important that children learn about new foods at school (189)	83% agree (teachers)
Food restrictions/availability	Schools should be restricted to selling only healthy food (188)	68% strongly agree or agree (teachers)
	Schools should have a policy about what should not be eaten in school (188)	32% strongly agree or agree (teachers)
	A piece of fruit should be available at school daily (189)	59% agree (teachers)
	Schools should restrict what children bring into school as snacks (189)	97% agree (teachers)
	Sweets should be allowed at school only as a treat (189)	33% agree (teachers)
	Elimination of junk food machines from schools should be required (176)	71% very important (headteachers)
	Elimination of junk food machines from schools should be required (177)	46% very important (catering staff)
	Elimination of junk food machines from schools should be required (173)	70% support (PE teachers)
School meals	The school canteen plays an important role in supporting the HE messages taught in the classroom (188)	90% strongly agree or agree (teachers)
	Foods sold in the canteen to be consistent with the health curriculum taught in schools (186)	77% support (headteachers), 79% support (teachers), 74% support (catering staff)
	Students to undertake projects to find new healthy menu items (186)	60% support (headteachers), 66% support (teachers), 65% support (catering staff)
	Healthy menu options to be promoted more to children at school (186)	61% support (headteachers), 80% support (teachers), 66% support (catering staff)
	Canteens to be provided with advertising to promote green menu items (fruit, vegetables, lean meats, low-fat dairy products, wholegrain products) (186)	75% support (headteachers), 85% support (teachers), 78% support (catering staff)
	Importance of schools providing lunchroom education programs on how to select nutritious foods (177)	66% very important (catering staff)
	Canteen to sell foods that do not have preservatives/additives wherever possible (186)	75% support (headteachers), 84% support (teachers), 73% support (catering staff)
	Encouraging students to undertake projects to promote healthy menu items (186)	60% support (headteachers), 66% support (teachers), 64% support (catering staff)
	Foods to be priced according to their healthiness, with the healthiest foods being the most affordable (186)	67% support (headteachers), 72% support (teachers), 47% support (catering staff)
	Food-service personnel are obligated to prepare nutritionally balanced lunches for school children (177)	88% strongly agree (catering staff)

	More cooperation between canteen managers and teachers to educate children on HE (186)	60% support (headteachers), 69% support (teachers), 60% support (catering staff)
	School food-service personnel should be role models and maintain normal weight (177)	44% strongly agree (catering staff)
Working with parents	Parents should be involved in the school food policy (189)	34% agree (teachers)
	Parents to be involved in suggesting healthy items for canteen menu (186)	63% support (headteachers), 79% support (teachers), 61% support (catering staff)
	Parents to be given information about how to apply the traffic light system (a way of categorising foods to assist in making healthier choices) at home (186)	77% support (headteachers), 84% support (teachers), 55% support (catering staff)
	Providing parents with more information about how the traffic light system applies to the school canteen (186)	72% support (headteachers), 82% support (teachers), 71% support (catering staff)
	Recipes for the most popular menu items provided to parents (186)	62% support (headteachers), 61% support (teachers), 29% support (catering staff)
	More information about HE provided in the school newsletter (186)	50% support (headteachers), 62% support (teachers), 47% support (catering staff)
	Parents to be able to email lunch orders to the canteen (186)	29% support (headteachers), 24% support (teachers), 8% support (catering staff)
	Parents should receive information about what their children learnt at school about PA and HE (189)	93% agree (teachers)
	It is important that parents are informed about the content of school meals (189)	81% agree (teachers)
	Schools should inform parents about what their child eats at school (189)	71% agree (teachers)
	Healthy lunchbox workshops for parents (186)	71% support (headteachers), 76% support (teachers), 42% support (catering staff)
Food preparation	Children to be involved in food preparation in canteen as part of health curriculum (186)	36% support (headteachers), 43% support (teachers), 45% support (catering staff)
Other	Teachers should make sure children drink enough fluids at school (189)	91% agree (teachers)
Physical Activity (PA)		
General	Schools have a major role in encouraging children to be more active (188)	84% strongly agree or agree (teachers)
Physical Education (PE)	PE teachers should be role models and maintain normal weight (173)	88% strongly agree (PE teachers)
	PE classes with a focus on teaching life-long fitness should be provided to primary school children (173)	91% support (PE teachers)
School PA opportunities	At school there should be an emphasis on providing opportunities for PA (188)	90% strongly agree or agree (teachers)
Other		
General	Importance of schools playing a major role in promoting the health of children (188)	84% strongly agree or agree (teachers)
	Schools are an ideal place to prevent weight problems in children (176)	28% strongly agree (headteachers)
	Schools are an ideal place to prevent weight problems in children (188)	33% strongly agree or agree (teachers)
	Schools are not doing enough to prevent childhood obesity (188)	13% strongly agree or agree (teachers)

2B.2.3.1.3 School nurse / health worker views on the role of the primary school in preventing childhood obesity

There was strong support among school nurses and health workers for the school role in promoting health and preventing obesity (182, 188). This included support for restrictions on unhealthy foods (188), nutrition education within the school curriculum (174, 183), and the provision of opportunities for PA at school (188). School nurses strongly believed that they themselves should be role models in terms of maintaining a normal weight (174, 183). There was only limited support, however, for school nurses conducting annual assessments of children's BMI (182).

Table 2.13: Views of School Nurses and Health Workers from cross-sectional studies

Topic	Item	Views
Healthy Eating (HE)		
Teaching about HE	A comprehensive health curriculum with units on nutrition and weight control should be available in every school (183)	93% agree or strongly agree (school nurses)
	A comprehensive health curriculum with units on nutrition and weight control should be available in every school (174)	90% agree (school nurses)
	At school there should be an emphasis on teaching about balanced eating (188)	92% agree or strongly agree (health workers)
Restrictions / availability of food	Schools should be restricted to selling only healthy food (188)	94% agree or strongly agree (health workers)
	Schools should have a policy about what should not be eaten at school (188)	72% agree or strongly agree (health workers)
	Schools should eliminate junk food machines (183)	98% agree or strongly agree (school nurses)
	Schools should eliminate junk food machines (174)	83% very important (school nurses)
School meals	The school canteen plays an important role in supporting the HE messages taught in the classroom (188)	100% agree or strongly agree (health workers)
Physical Activity (PA)		
General	Schools have a major role in encouraging children to be more active (188)	98% agree or strongly agree (health workers)
School PA opportunities	At school there should be an emphasis on providing opportunities to be physically active (188)	98% agree or strongly agree (health workers)
Other		
General	School health services should be used for obesity prevention (182)	76% agreed (school nurses)
	It is important for schools to play a major role in promoting the health of children (188)	100% agree or strongly agree (health workers)
	Schools would be an ideal place to prevent weight problems in children (188)	76% agree or strongly agree (health workers)
	Schools are not doing enough to prevent childhood obesity (188)	38% agree or strongly agree (health workers)
BMI screening	Schools should conduct annual assessments of students' height, weight and BMI (182)	Nearly 40% agreed (school nurses)
Role models	School nurses should be role models by setting an example as people who maintain their normal weight (183)	87% agree or strongly agree (school nurses)
	School nurses should be role models by setting an example as people who maintain their normal weight (174)	77% strongly agree (school nurses)

BMI: body mass index

2B.3 Discussion

The aim of this review was to synthesise the findings of 17 cross-sectional studies identified through a systematic review of the views of stakeholders on the role of the primary school in preventing childhood obesity.

This review confirms the qualitative metasynthesis finding that stakeholders believe schools have an important role to play in supporting children's health through the promotion of HE and PA, and prevention of childhood obesity. In particular, stakeholders valued the role of the school in teaching about HE, and saw lunchtimes as a useful opportunity to promote HE consistent with the school curriculum.

This review adds to the qualitative metasynthesis by enabling quantification of viewpoints on some of the issues. Consistent with the qualitative metasynthesis, stakeholder opinion was divided as to whether schools should impose food restrictions, although support for restrictions was shown to be higher among school nurses/health workers. Also, whilst a call for more PE was frequently expressed within the qualitative studies, increased PE and time playing outside was only moderately supported by parents within the cross-sectional studies.

The cross-sectional studies reveal strong support for schools not using unhealthy foods as rewards or fundraisers. These unhealthy food practices, also raised as concerns by stakeholders within the qualitative metasynthesis, have been associated with increased pupil BMI (190). In recent years, there has been a reported decline in the sale of unhealthy foods as fundraisers in some areas (a US survey (191) found that 62% of elementary schools now report prohibiting fundraising through the sale of unhealthy food and drink items), although in other areas the practice is still widespread. A New Zealand study (95) found that almost three quarters of primary schools use unhealthy food products as fundraisers. This practice, and the

inconsistent messages it presents to children and families, needs to be addressed in a way that is sensitive to the needs of schools, and the difficulties they face in finding fundraising alternatives (192).

2B.3.1 Strengths and limitations

The major strength of this review of cross-sectional studies is the inclusion of views from a large number of stakeholders from a variety of settings. However, in interpreting the findings of this review, a number of limitations must be considered.

Firstly, the majority of the studies are from the USA, with no studies from low-middle income countries, limiting the generalisability of the results to other settings. Additionally, six of the studies were undertaken before 1993. The changing context over the last 20 years in terms of government policies, lifestyle changes, and increasing rates of obesity, may mean that the findings no longer reflect the views of stakeholders today. In addition, there are limited studies investigating the views of education/school personnel or school nurses/health workers on the role of the school in promoting PA.

Methodologically, the quality of the included studies varied. In particular, response rates ranged between 23 and 88%. Those studies with lower response rates could contain bias in that they may not be representative of all stakeholder viewpoints. As with the qualitative metasynthesis, representation from male participants (particularly parents) is low, meaning that there may be some gender bias in the results.

2B.4 Conclusions

The findings from this synthesis of cross-sectional studies are consistent with those of the qualitative metasynthesis, enhancing its validity. In particular, with reference to the role of the primary school in promoting HE, there is a need for consistent messages to be promoted to children through robust school food policies that

promote health within the school canteen, the curriculum and through the use of healthy fundraisers and rewards systems.

CHAPTER 2C

2C.0 VIEWS OF STAKEHOLDERS ON THE ROLE OF THE PRIMARY SCHOOL IN PREVENTING CHILDHOOD OBESITY: REVIEW OF RECENT STUDIES

The literature searches for the systematic review reported in Chapters 2A and 2B were conducted in May and June 2012. Since this time, several research studies have been published meeting the inclusion criteria specified in the systematic review. The aim of this section is to present a summary of these recently published studies.

2C.1 Methods

Relevant studies were identified through searches of electronic databases, conducted in June 2015, using key terms used within the qualitative metasynthesis (Table 2.3). Additionally, citation lists of studies included in the systematic review were checked. Inclusion criteria used in the systematic review (Table 2.1) were applied to the identified papers.

2C.2 Results

Eight recent studies were found that met the inclusion criteria. Of these, four were conducted in the UK (193-196), two in Iran (197, 198), one in the USA (199) and one in India (200). The two Iranian studies reported data from focus groups and interviews with the same participants. Three of the studies reported the perspectives of various school staff (194, 195, 199), two studies described the views of children (193, 200), one study reported opinions of parents and children (196), and the two Iranian studies described views of parents and school staff (197, 198). Findings from the studies that are relevant to the research question are outlined in Table 2.14. In brief, stakeholders believed that schools have a role to play as a setting for

promoting HE and PA, and thus preventing obesity (193-195, 198, 200). A key role of the school was seen to be the provision of healthy role models by teachers (193-195) and external partners (195). A number of barriers to schools doing more to prevent obesity were discussed. These included: schools' focus on academic achievement (195, 197); inconsistent messages between home and school (195, 199); and children's dislike of school meals and PA (196, 199).

Table 2.14: Summary of relevant studies published post-systematic review searches

Study	Aim(s)	Method	Setting	Participants	Relevant Results
Eyre *et al.* (2013) (193) UK	To understand PA environments, barriers and facilitators of PA in deprived environments for children from South Asian backgrounds	Focus Groups (*n*=5)	**Schools** 2 schools in deprived wards of Coventry, England	**Children** aged 7-9 yrs (*n*=33; 17 F; 16 M)	School, and particularly the PE teacher, played a major role in educating about the benefits of keeping healthy, organising and introducing children to a range of activities. Children's role models were their class teachers and most commonly the PE teacher.
Griffin *et al.* (2014) (194) UK	To elicit teachers' experiences of delivering a childhood obesity prevention programme for children aged 6-7 yrs	Interviews (*n*=12)	**Schools** 12 primary schools in West Midlands, England	**Teachers** (*n*=14; 12 F; 2 M)	All considered that schools have a level of responsibility in relation to obesity prevention. Teachers felt that the school role was about 'the whole education of the child', developing good attitudes and encouraging children to make the right choices. A few teachers recognised their responsibility as role models to the children.
Howard-Drake and Halliday (2015) (195) UK	To explore primary school headteachers' perspectives on childhood obesity and the perceived barriers and facilitators of prevention	Interviews (*n*=14)	**Schools** 14 primary schools in the Yorkshire and Humber region, England	**Headteachers** (*n*=14; 12 F; 2 M)	The majority of headteachers believed schools play a crucial role in obesity prevention. A minority of headteachers refuted the need for an increased focus on children's health, as this was perceived as detracting capacity and resources from what a school is assessed to do. Preventing obesity in schools was deemed complex and extremely challenging due to its multi-causal and sensitive nature. Promoting healthy behaviour in general (e.g. active play, cooking clubs and in the curriculum) was seen as more appropriate than addressing obesity. Improving children's nutrition and PA was widely recognised as supporting and contributing to academic progress. Most headteachers felt that the government's target-driven focus on academia and often fragmented approach to addressing obesity in schools, affected their ability to improve child health. Headteachers' individual values, commitment and leadership could facilitate preventative 'whole school action and activity'. All headteachers referred to the disparities within schools between school staff who are either a positive or negative role model in terms of addressing obesity. Parents were seen as frequently undermining the impact of a school's efforts to influence children's weight status. A whole school approach using parental engagement in the implementation of health initiatives was advocated by most as an effective method to foster improved 'buy-in' from parents. School activities that provided opportunities for the entire family to learn and experience healthy behaviours together were broadly recommended. A minority of headteachers expressed reluctance to influence or dictate people's approaches to parenting. External partners such as school nurses add internal capacity, resources and skills in schools, and can act as role models. However, there is a paucity of certain external partners, e.g. school nurses, and a lack of knowledge about what support is available. External partners were often perceived to have a lack of understanding about a school's individual needs. There was also concern about over-reliance on external partners resulting in obesity prevention never truly being embedded into the ethos of the school. All school personnel would benefit from public health awareness training.

Study	Aim(s)	Method	Setting	Participants	Relevant Results
Mohammadpour-Ahranjani *et al.* (2014) (198) Iran	To identify and prioritise perceived potential interventions to help inform the development of an obesity prevention intervention	Focus Groups (parents: *n*=7; school staff: *n*=3; mixed: *n*=1) Interviews (PE teachers: *n*=2; school nurse: *n*=1)	**Schools** 6 primary schools in socio-economically diverse districts of Tehran	**Parents** of children aged 6-8 yrs (*n*=63; 60 F; 3 M) **School staff** (*n*=22; 17 F; 5 M): **Headteachers** (*n*=3); **Deputy headteachers** (*n*=6); Teachers (n=11); Administrative **staff** (*n*=1); **School nurses** (*n*=2); **PE teachers** (*n*=2)	School was considered the most important setting for undertaking sports and PA. Liaison between family and school needed as parents need to encourage PA. Schools should provide basic sports equipment and develop unused areas in schools to increase space for PA. Schools should provide compulsory morning exercise and non-competitive activities. Teachers have a powerful effect on children's behaviour. School is an appropriate setting for providing parents with health and nutrition knowledge and skills. In school shops there should be a balance of healthy and less healthy options (i.e. not banning less healthy food).
Mohammadpour-Ahranjani *et al.* (2013) (197) Iran	To explore contextual influences on childhood obesity to inform future development of an obesity prevention intervention	Focus Groups (parents: *n*=7; school staff: *n*=3; mixed: *n*=1) Interviews (PE teachers: *n*=2; school nurse: *n*=1)	**Schools** 6 primary schools in socio-economically diverse districts of Tehran	**Parents** of children aged 6-8 yrs (*n*=63; 60 F; 3 M) **School staff** (*n*=22; 17 F; 5 M): **Headteachers** (*n*=3); **Deputy headteachers** (*n*=6); Teachers (n=11); Administrative **staff** (*n*=1); **School nurses** (*n*=2); **PE teachers** (*n*=2)	Parents' working hours result in poor liaison between families and schools. A saturated curriculum and prioritisation of other subjects over PE were barriers to schools supporting children's healthy lifestyles. Stakeholders believed that PE was poorly delivered and schools lack facilities and resources, particularly for younger children.
Odum *et al.* (2013) (199) USA	To examine school personnel's perceptions of obesity as a problem among school-aged children and their views on factors contributing towards obesity	Interviews (*n*=31)	**Schools** 5 elementary schools in a rural south-western school district	**School staff** (n=31; 27 F; 4 M): **Teachers** of 4th grade children (aged 9-10 yrs) (*n*=15); **PE teachers** (*n*=4); **School counselors** (*n*=4); **Cafeteria managers** (*n*=3); **Principals** (*n*=2); **School nurses** (*n*=2); **Assistant principal** (*n*=1).	Personnel believed that the home environment contributed to the poor nutritional diets of children. Only two participants felt that school cafeteria foods were contributing to their students' unhealthy diets; the majority felt that their schools were doing a good job at improving the nutritional quality of food served on campus. Participants felt that children had the power to decide what foods are purchased and what they consumed, and identified both school and home environments as place where children exert control over food selection. Personnel perceived that child inactivity was partially due to children not wanting to engage in PA, particularly outdoor activities, with children preferring to spend breaktime indoors.

Study	Aim(s)	Method	Setting	Participants	Relevant Results
Rawlins *et al.* (2013) (196) UK	To explore the barriers to (and facilitators of) HE and PA habits in ethnic minority children	Focus Groups (parents: *n*=8; children: *n*=13); Interviews with parents (*n*=5)	**Schools and places of worship** 3 primary and 2 secondary schools, 2 churches, 1 mosque, 1 Hindu temple, 1 Tamil temple, 1 Sikh Gurdwara, London	**Parents** of children aged 8-13 yrs (*n*=43; 34 F; 9 M) **Children** aged 8-13 yrs (*n*=70; 39 F; 31 M)	Dislike of school meals and negativity towards PE and school hindered healthy living.
Riggs *et al.* (2013) (200) India	To identify community perceptions of the risk and protective factors contributing to the obesity problem in India and whether students perceive schools as having a role in the prevention of obesity	Focus Groups	**Schools** 5 private schools, New Delhi	**Children** aged 9-11 yrs (*n*=183; 91 F; 92 M)	Schools can play an important role in the prevention of obesity. Schools should replace junk food from the canteen with fruit and vegetables, provide more time for active play and dance, and require PA during current PA periods. Suggestions for school-based approaches to health promotion included teacher advocacy, teacher monitoring of student health behaviours, presentations of movies, poems, poster boards, cartoons, debates, quiz competitions and summer camps.

HE: healthy eating; PA: physical activity; PE: physical education

2C.3 Discussion

Eight studies (all qualitative) were identified that had been published after completion of the systematic review literature searches. Findings of these studies are consistent with those from the systematic review, and add to the body of evidence on the views of stakeholders on the role of the primary school in preventing childhood obesity.

The systematic review identified a lack of studies from low- and middle-income countries. The identification of recent studies from Iran and India contributes towards filling this research gap. Interestingly, the findings from these studies concur entirely with views synthesised in the systematic review, in particular stakeholder perspectives on the importance of the school role in promoting HE and PA, and preventing obesity.

Equally, the systematic review highlighted a lack of studies of headteacher perceptions. Howard-Drake and Halliday (195) report results from interviews with 14 UK headteachers from one local authority area in northern England, and further highlight the issues of capacity within schools to support obesity prevention, and the need for a flexible approach to obesity prevention in schools depending upon the circumstances of individual schools.

2C.4 Conclusion

Stakeholder views from recently published research are in agreement with views from studies that formed part of the systematic review. Studies published since the systematic review searches were conducted include views from some previously under-represented groups. These findings add further credibility to the conclusions of the review.

2.1 Overall conclusions of the chapter

Findings from studies reviewed in the three sections of this chapter are consistent. Overall, the review suggests a clear need for parents, schools and government to work together to fulfil their responsibilities towards obesity prevention, and ensure that children are given consistent messages concerning the importance of healthy lifestyles. Government priority, intervention, guidance and co-ordination are essential elements in supporting the role of the primary school in preventing childhood obesity.

Future studies should contribute to further exploration of perspectives from under-represented groups, and should aim to seek viewpoints on practical ways forward to overcome some of the established barriers that schools face in preventing obesity. Such views would be valuable in the development of school-based obesity prevention programmes, as well as in the evolution of guidance and support for schools.

CHAPTER 3

3.0 OBESITY PREVENTION IN ENGLISH PRIMARY SCHOOLS: HEADTEACHER PERSPECTIVES

This chapter presents a qualitative study investigating headteacher views on the role of the primary school in preventing childhood obesity. The chapter is based on the peer-reviewed manuscript (accepted for publication):

Clarke JL, Pallan MJ, Lancashire ER, Adab P. Obesity Prevention in English Primary Schools: Headteacher Perspectives. Health Promot Int 2015 (in press).

Author Contributions:

JC developed the idea for the study with PA, MP and EL. JC conducted all interviews. Recorded interviews were transcribed by a professional transcription service. JC checked and cleaned the data. JC coded all transcripts, and MP also coded the first five transcripts. JC worked with MP to draft a coding framework which was agreed by all authors. JC wrote the manuscript, guided by PA, MP and EL.

Acknowledgements:

With sincerest thanks to the headteachers who gave their time to be interviewed.

3.1 Abstract

Schools are seen as important contributors to obesity prevention, yet face barriers in fulfilling this function. This qualitative study investigates headteacher views on the primary school role in preventing obesity. Semi-structured interviews were held with 22 headteachers from ethnically and socio-economically diverse schools in the West Midlands, UK. Data analysis was conducted using the framework approach. Two over-arching categories were identified: 'School roles and responsibilities' and 'Influencing factors'. Participants agreed that although schools contribute towards obesity prevention in many ways, a moral responsibility to support children's holistic development was the principal motivator, rather than preventing obesity per se. The perceived impact on learning was a key driver for promoting health. Parents were believed to have the main responsibility for preventing obesity, but barriers were identified. Whilst headteachers recognised the advantageous position of schools in offering support to parents, opinion varied on the degree to which schools could and should take on this role. Headteachers serving more deprived areas reported adopting certain responsibilities that elsewhere were fulfilled by parents, and were more likely to view working with families on healthy lifestyles as an important school function. Several factors were perceived as barriers to schools doing more to prevent obesity, including academic pressure, access to expert support and space. In conclusion, school leaders need more support, through resources and government policy, to enable them to maximise their role in obesity prevention. Additionally, school-based obesity prevention should be an integral part of the education agenda rather than bolt-on initiatives.

3.2 Introduction

Childhood obesity is regarded as a global public health problem (1). In England, 22.2% of 4-5 year olds and 33.3% of 10-11 year olds are overweight or obese based on population-monitoring thresholds derived from the UK 1990 growth reference population, with the highest rates in deprived areas (201). Long-term health and social consequences of childhood obesity are well-understood (26).

Schools are seen as a key setting for obesity prevention as the majority of children have long-term and in-depth contact with them. Indeed, the majority of obesity prevention interventions are school-based (20). Within schools, opportunities exist to undertake and observe key obesity prevention behaviours (healthy eating and physical activity) and to develop strategies to modify unhealthy behaviour (91). The school environment, policies, curriculum, extra-curricular activities and personnel have potential to positively influence children's lifestyle behaviours (93), and play an important role in instilling these behaviours into adulthood (94). Furthermore, these different elements could work together to reinforce, or provide conflicting messages which could hinder, healthy behaviour (95). As childhood obesity rates remain high, and primary school years are a key period for weight gain, there is emerging consensus that schools have a critical role to play in obesity prevention (96-98).

A recent metasynthesis of stakeholder views on the primary school role in preventing obesity pointed to a need for schools, parents and government to work together (202). In particular, the importance of home-school collaboration was emphasised to ensure consistency of messages. Moreover, this review highlighted a scarcity of studies eliciting headteacher opinions, with only nine headteacher viewpoints represented from over a thousand school stakeholders. As principal decision-makers

within school, headteacher views are a vital consideration. Although schools are required to follow certain statutory requirements (e.g. in England, the National Curriculum and school food standards), headteachers have significant power to shape policy and practice, thus affecting how their school contributes to obesity prevention.

A recent study reported on the perspectives of 14 headteachers (2 male) on the barriers and facilitators of preventing childhood obesity (195). The study found schools to lack the capability, capacity and confidence to support obesity prevention, and called for effective partnerships with specialist organisations. However, the study was conducted in only one local authority area in northern England, with a relatively homogeneous population.

This study aims to explore the views of headteachers, from a wide range of schools, on the role of primary schools in preventing obesity. To the best of our knowledge, this is the first study to include headteachers across an ethnically and socio-economically diverse region, and to explore differences in headteacher perception based upon the communities they serve. Understanding differences in the motivations of, and challenges faced by, headteachers serving schools in diverse communities may help shape future approaches to children's health in schools, and thus reduce health inequalities.

3.3 Methods

The study was undertaken within nine local authority areas in the West Midlands region of England. To maximise transferability, schools were purposively sampled to include diversity in location, ethnic mix, size and deprivation. Headteachers from selected schools were invited to participate, although in some schools the deputy

headteacher was interviewed due to availability. In total, 200 headteachers were invited to take part in the study via a letter of invitation and follow-up email. Of these, 25 agreed to be interviewed (although three subsequently declined to participate due to competing demands); 23 declined to participate (all stating lack of time) and the remainder did not respond. In total, 15 headteachers (5 male) and 7 deputy headteachers (2 male) from 21 schools were interviewed (Table 3.1). Subsequently, the term 'headteacher' will be used for all participants.

Table 3.1: Participant and school characteristics – headteacher perspectives on the role of primary schools in preventing childhood obesity

Participant number	Participant characteristics	School ethnicity (% White)	School Free School Meal Entitlement (%)	School Urban/ Rural[a]	School size (number of pupils on roll)
1	Headteacher^{F}	40-49	20-29	Urban	350-399
2	Headteacher^{M}	10-19	50-59	Urban	250-299
3	Headteacher^{M}	90-100	10-19	Urban	450-499
4	Deputy headteacher^{M}	40-49	0-9	Urban	200-249
5	Deputy headteacher^{F}	60-69	30-39	Urban	350-399
6	Headteacher^{M}	10-19	30-39	Urban	150-199
7	Headteacher^{F}	10-19	10-19	Urban	250-299
8	Headteacher^{M}	30-39	50-59	Urban	200-249
9	Headteacher^{F}	90-99	0-9	Rural	100-149
10	Headteacher^{F}	90-99	0-9	Rural	150-199
11	Headteacher^{F}	90-99	0-9	Urban	100-149
12	Deputy headteacher^{F}	50-59	60-69	Urban	300-349
13	Deputy headteacher^{F}	0-9	40-49	Urban	300-349
14	Deputy headteacher^{F}	60-69	10-19	Urban	450-499
15	Headteacher^{F}	10-19	40-49	Urban	250-299
16	Headteacher^{F}	10-19	30-39	Urban	350-399
17 & 18	Headteacher^{F} and deputy headteacher^{F}	80-89	50-59	Urban	200-249
19	Headteacher^{M}	60-69	30-39	Urban	300-349
20	Headteacher^{F}	70-79	20-29	Urban	350-349
21	Deputy headteacher^{M}	80-89	20-29	Urban	250-299
22	Headteacher^{F}	80-89	10-19	Urban	150-199

[a]Defined by school postcode (203); F: Female; M:Male

Semi-structured interviews were used to enable key questions to be asked, whilst allowing free expression and flexibility to probe deeper into responses. A schedule was developed to guide discussion comprised of three key questions plus prompts

(Table 3.2). Ethical approval was obtained from the National Research Ethics Service Committee West Midlands, The Black Country (10/H1202/69). Interviews took place within participants' schools between May 2013 and May 2014. Interviewees were assured of anonymity and confidentiality, and signed a consent form prior to interview. Discussions (which lasted on average 36 minutes) were: one-to-one (except in one school where a combined headteacher and deputy headteacher interview was undertaken), conducted by JC and voice-recorded.

Table 3.2: Schedule for interviews – headteacher perspectives on the role of primary schools in preventing childhood obesity.

1) Do you think that obesity is an issue for primary school age children in the West Midlands?
   - Would you say that childhood obesity is an issue for your school? In what way?
   - How important do you think the prevention of childhood obesity is to your school?
   - Whose responsibility do you think it is to prevent childhood obesity?
2) To what extent do you feel that schools should play an active role in the prevention of childhood obesity?
   - Does your school play any role in helping children maintain a healthy weight or prevent obesity?
   - Do you think, as Head/Deputy Head Teacher, that you have a particular role in the prevention of childhood obesity?
   - Does your school do anything to promote healthy eating? And if so, what?
   - Does your school do anything to promote physical activity? And if so, what?
   - Can you think of any key achievements at your school in promoting healthy eating and physical activity/preventing childhood obesity? Is there anything you are particularly proud of?
   - Is there anything else that could be/needs to be done? Is there anything you would like to be able to do?
   - Do you think there are any benefits to your school in promoting healthy eating and physical activity/preventing childhood obesity?
   - Do you think there are any barriers for your school in promoting healthy eating and physical activity/preventing childhood obesity?
   - Do you get any support to promote healthy lifestyles? Do you work with any partner agencies?
   - Apart from the school, who else has a role in preventing childhood obesity? How important is this role compared to the role of the school?
   - Does your school work with parents to promote healthy lifestyles? And if so, how?
   - Can you think of any barriers to working with parents? And if so, how do you think these could be overcome?
3) Can you think of anything that would help your school take a more active role in preventing childhood obesity?
   - What kinds of resources, support or training would make it easier for your school to take a more active role in obesity prevention?
   - What other things, outside of the school setting, do you think would help?

Recordings were transcribed verbatim and anonymised. QSR NVivo 10 was used to support data analysis. Data collection and analysis were undertaken concurrently to enable discussion of emerging themes at later interviews.

A number of methods of qualitative data analysis are available, each with a slightly different emphasis. Grounded theory is based on inductive data analysis, aiming to generate a plausible theory of the phenomena under study that is grounded in the data (204). As an exploratory method, grounded theory is particularly suited for investigating phenomena with little prior research attention (204). Discourse analysis focuses on the use and meaning of language, going beyond the content of social interaction (205). Narrative analysis seeks to put together the 'big picture' about experiences or events as the participants understand them, focusing on 'the story itself' (206). Thematic, or qualitative content analysis, is a method for 'identifying, analysing and reporting themes' (207), and is used to recognise patterns across qualitative data (207). Commonalities and differences, and relationships between these, are identified from the data, in an attempt to draw descriptive or explanatory conclusions clustered around themes (208)

It was decided that thematic data analysis was the most appropriate method to analyse the dataset within this study, as a priori topics for discussion had been set, with the purpose of the study being to explore commonalities and differences in participant viewpoints rather than theory development. In addition, Braun and Clarke (207) outline a number of advantages of this approach, two of which are particularly pertinent to this study. Firstly, thematic analysis offers a flexible approach, fully accessible to researchers with limited experience of qualitative research. Secondly,

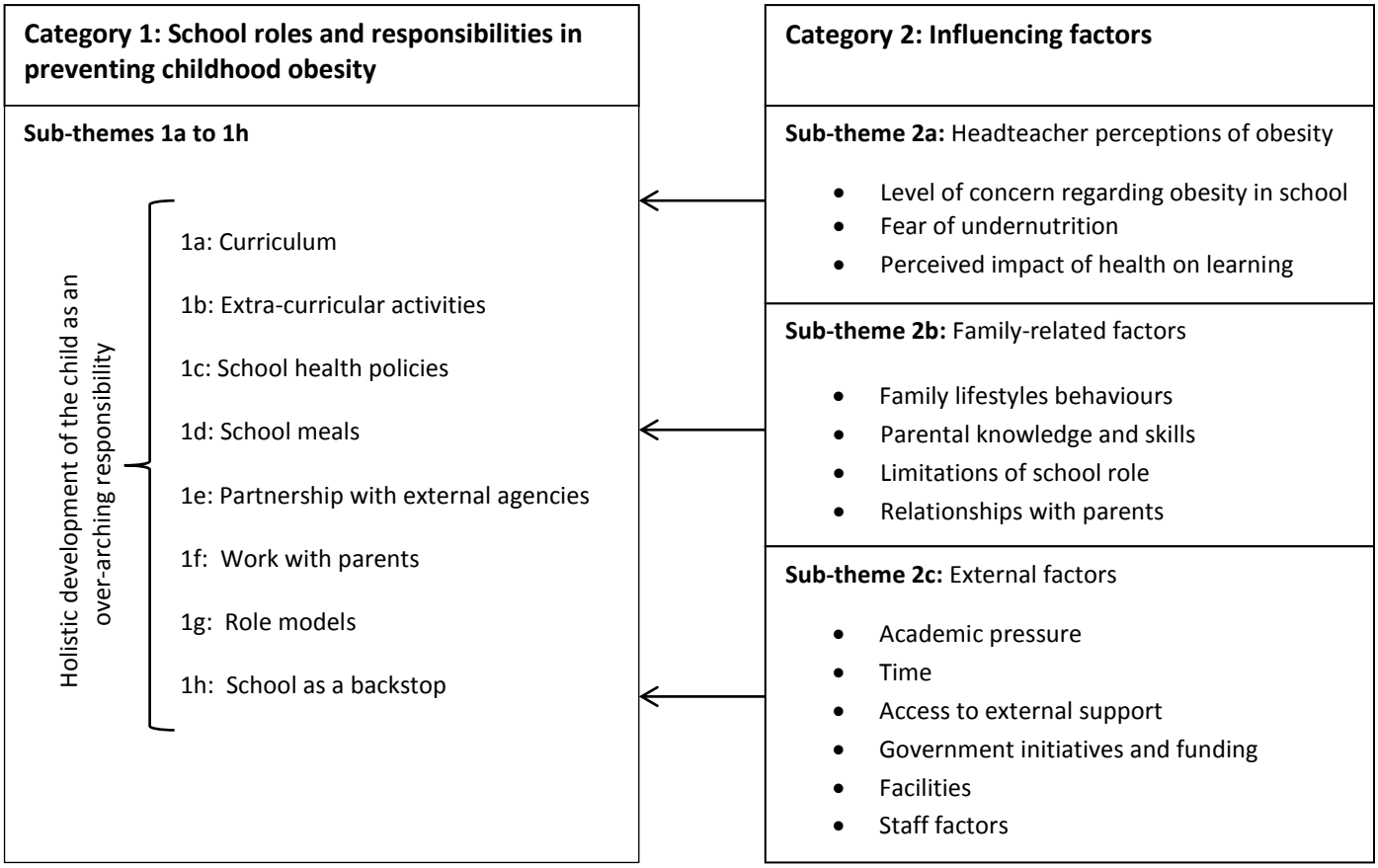
the method allows for social interpretations of the data, and is useful in producing results suitable for informing policy development.

The thematic data analysis was conducted using the framework approach (a flexible tool with the aim of generating themes) (209), following the systematic method outlined by Gale et al. (208). To enhance confirmability, two researchers (JC and MP) independently coded the first five transcripts through data familiarisation and identification of codes. A coding (analytical) framework, agreed through discussion, was applied to all transcripts, and refined over several iterations. A framework matrix was developed as a structure for analysing data both by code and by participant, enabling comparison of themes by participant, whilst maintaining the individual perspective as a whole. The matrix also enabled consistencies in perceptions to be examined between headteachers serving areas of higher and lower socio-economic status (SES). Data were charted into the matrix before all authors met to discuss and interpret the emerging themes. 'Member checking' (where feedback on the interpreted results is obtained from participants) was not conducted to reduce participant burden.

3.4 Findings

Two over-arching categories emerged from the analysis: 'School roles and responsibilities in preventing childhood obesity', under which eight sub-themes were identified, and 'Influencing factors', under which three sub-themes and 13 finer-level themes were identified (Figure 3.1). The over-arching category 'Influencing factors' refers to factors believed by participants to exert an influence over how well the school is able to fulfil the perceived roles and responsibilities.

Figure 3.1: Schematic diagram of school roles and responsibilities in preventing obesity and the factors found to exert an influence.



3.4.1 School roles and responsibilities in preventing childhood obesity

All participants identified that schools play a role in promoting health and discussed a variety of ways in which their school contributed towards preventing obesity. Such activities were seen mainly within the context of the school's moral responsibility to support children's holistic development, and the term 'obesity prevention' was only used in a minority of schools.

"It's about educating the whole child, and I want my children not to just be academic, I want them to be healthy" (P20)

All headteachers felt that promotion of healthy lifestyles through the **curriculum** was an important school responsibility. Additionally, **extra-curricular activities** (such as physical activity, cooking or gardening opportunities) were seen by many participants as enhancing the school's role in healthy lifestyle promotion.

"We do cookery clubs and we try and teach them how to cook… because yes there is a role in the future for that person to understand that when they're an adult that they can cook and they can eat healthily" (P8)

School health policies were discussed as a way of promoting consistent messages throughout school alongside maintaining a high profile for promoting health. Furthermore, the provision of healthy **school meals** was perceived by all as an important school function. Participants believed that external support was required in schools to tackle the complex issue of obesity prevention, and that working in **partnership with external agencies** (such as school meals services, local Healthy Schools teams and school nurses) was an important part of their responsibility.

Within school, the need to **work with parents**, and the importance of staff acting as **role models** were also discussed.

"I think the responsibility comes from not just the education side of it but the examples that you set" (P14)

Some participants alluded to their school taking on a more active role in promoting health and acting as a **'backstop'** when parents seemed to have failed. Examples included breakfast or PE kit provision and additional extra-curricular physical activities.

"We target the families where we know the children are unlikely to get breakfast, to come to breakfast club, so they're targeted, so they've got that meal" (P7)

The extent to which headteachers directed the school to undertake the roles and responsibilities reported above was affected by various factors, described in the next section.

3.4.2 Influencing factors

3.4.2.1 Headteacher perceptions of obesity

Perceptions of obesity as a concern varied and influenced the extent to which healthy lifestyle activities were prioritised by schools. Difficulties with obese children accessing parts of the curriculum (particularly physical education), and the resultant negative impact on learning, were discussed alongside health concerns. Issues regarding weight-related teasing and the emotional wellbeing of obese children were also raised.

“In year six [aged 10-11 years]… I've got girls that weigh more than I do and they have all sorts of health complications and are always at the hospital for one thing and another, so it is very, very worrying” (P17)

“It's an issue for children in terms of their self-esteem, their perception of themselves” (P14)

Some headteachers, although aware of obesity within their school, did not identify it as a big issue. A few were more concerned about undernutrition.

"I don't think it is an absolute priority for us but I’d say in every year group/in every class there's probably one or two children who are significantly overweight" (P2)

“We have a lot of I’d say malnourished children… in many respects we’re the other end of the scale” (P8)

A prominent motivator in promoting healthy behaviours was the belief that health positively impacts learning. Many participants talked about physical activity and healthy eating improving alertness, concentration and school attendance. Some headteachers specifically highlighted the positive impact of physical activity on confidence, self-esteem and team-working skills of children.

“I think healthier children are more switched on to their learning and they seem more enthusiastic and more willing to work hard and be independent and engage with the learning" (P4)

“The children individually obviously get great esteem [from physical activity opportunities], that esteem obviously lasts into their academic work, they feel

boosted, they're given avenues to shine where perhaps they wouldn't be able to shine, again, massive boost" (P21)

Some headteachers discussed the importance of their own role in the promotion of healthy lifestyles, and saw their personal beliefs and attitudes as key to its success.

"It works in our school because I'm passionate about it [health promotion], so if I didn't drive it, it would be difficult to keep it going, you do need that kind of ethos really, a whole school ethos, otherwise it's just unsustainable" (P22)

"I think the high profile of PE [physical education] comes principally from myself" (P3)

3.4.2.2 Family-related factors

Universally, headteachers perceived that whilst schools have a contribution to make in preventing obesity, parents held the principal responsibility.

"We will play a role, we will support... we will educate, but I firmly believe that it's got to be parents who take the ultimate responsibility" (P3)

Despite this, many participants recognised barriers to families leading healthier lifestyles, including lack of time due to working hours, cultural practices, costs of healthy food and activities, and lack of knowledge and skills, particularly in preparing healthy meals. In some schools serving deprived communities, headteacher perceptions of family lifestyle behaviour inadequacies influenced the school to the extent that it assumed roles that under other circumstances would be viewed as parental responsibilities.

"Some of it is linked to choices that families make and maybe understanding of what is a healthy diet… more so probably is the link to how much income families have….

and we do have also issues around poor housing, that have links to health as well. So all of these things impact on the kinds of decisions our parents make and I think are a factor in our children being obese" (P16)

"We have a big gap in parenting knowledge and so we almost step into the shoes and have to do an awful lot of that that would ordinarily be done by parents elsewhere" (P13)

Many participants saw poor quality packed lunches as a problem. Although a minority reported having strict healthy lunchbox policies, most thought this was outside the school's remit and were fearful of 'overstepping the boundary' and harming relationships with parents.

"We don't search lunchboxes, we don't police what parents send their children in with, because I don't think it's our role" (P8)

As evident from headteachers' responses, the extent to which schools worked with parents varied greatly. Although all participants said they would contact individual parents with specific concerns, some felt that parent education was not their responsibility and were keen to express limitations of the school role. Headteachers from schools in more affluent areas felt no need for parent education, as parents tended to support healthy lifestyles. Other interviewees in schools serving more deprived areas, many with high ethnic minority group representation among their pupils, thought that working with parents was crucial to promote consistent messages between home and school.

"We're fortunate in that we're a fairly affluent area and parents are very aware of their children's needs and the whole issue of childhood obesity" (P10)

"What we don't want is for them to go home and it's almost like two steps forward and six steps back; so you educate the parents then to educate the children and then you've got the triangle, everybody working together" (P12)

A few participants discussed successful parent education programmes within school. Facilitators to success included good relationships with parents; having dedicated staff as 'parent workers'; use of 'experts' from external agencies, and the availability of appropriate facilities. Some headteachers felt that inviting parents into school to work alongside their child was more effective than parent-only workshops.

"The only way we can get parents into school is when they do something with their child. They don't want to come to be lectured at" (P1)

However, it was recognised that some parents were hard or impossible to engage with due to work commitments, lack of interest, or fear of school. Some headteachers reported that differences in the perception of obesity among different ethnic groups sometimes made parental engagement problematic. Frustration was evident amongst some interviewees regarding a perceived lack of early years parental support.

"A lot of our parents are very worried about the professional institution; sometimes it's very difficult to get them into the school" (P12)

“We’ll maybe perceive it as they are obese or certainly overweight but their culture says that they're not” (P5).

“Often by the time they've come to us and they're four and five years old, those habits have been set and it’s about unbreaking the habits, you know, we do need to start much, much earlier” (P16)

3.4.2.3 External factors

A range of external factors influencing the school’s role in preventing obesity was identified. The main perceived barriers that prevented schools from doing more to promote health were government pressure to focus on academic achievement and the ‘prescriptive curriculum’.

“The education system at the moment is so pressurised… heads, deputies, staff are all pressurised… it’s got to be results, results, results all the time” (P21)

Despite recognition from interviewees that promoting health had a positive impact on learning, headteachers discussed how the focus on achievement in the core subjects of literacy and numeracy made them reluctant to take time away from academic learning.

“If this was my school and I was able to run it in any way I wanted to… a bigger part of their education would be healthy eating and active lifestyles. I can only do it minimally because of the government agenda… which has to be the ultimate priority otherwise I get into trouble” (P7)

Another common barrier identified was difficulty in accessing school nurse support. Whilst two participants reported good school nursing provision, others found that accessing support was increasingly difficult or impossible. Many interviewees

expressed dissatisfaction with the National Childhood Measurement Programme (NCMP) (a weight surveillance programme measuring children in English state schools in Reception (4-5 years) and Year 6 (10-11 years)) (201) as they felt schools were provided with statistics on pupil weight status, but no further support was offered. In some situations parents were angered by receiving letters telling them their child was obese and vented their frustrations on the school.

"We can't get a nurse for love nor money sometimes when we want a nurse, but you know, we can spend loads of money on weighing the poor kids… "to make a survey and to find out how obese the children are"... it just seems to me a waste of resources… The measuring and the targeting and the numbers and the figures, that won't be cut, that will carry on, there will be people to do that, but actually people to do the real stuff has sort of disappeared" (P8)

Some participants discussed good relationships with external support agencies, for instance health or voluntary groups. Such input was appreciated for adding capacity to deliver plus expertise that may not exist amongst school staff.

"I think they [parents and children] believed it more from him as a… dietary sort of expert, than they would if we'd just been saying the same old things over and over again" (P15)

Other headteachers noticed that some previously valued support had recently been withdrawn, for example local Healthy Schools teams, School Sports Partnerships and Children's Centres, leaving schools to 'do things for themselves'. Some participants, whilst recognising the positive impact of such initiatives, reported not having the capacity to maintain the work once the support was removed.

“The funding has stopped so schools have to pay for it themselves, at one time you would’ve had somebody come in and audit your school and you get a Healthy School award... schools have to manage all that stuff themselves, and when they’re really busy these things are going to go” (P22)

Some participants felt the need for external support was so great that it warranted dedicated support staff to focus on health promotion amongst children and families.

“In an ideal world, if you had a nurse, a school nurse or a school person that was able to be in school two or three days a week that was working with families, that was able to go into houses, that was able to help them at a dinner time, was able to train and teach the families, then, you know, I would welcome that” (P8)

“I've got an IT specialist, I've got a top notch caretaker, I've got a first class bursar, I'm going to have a sports coach, I've got an attendance officer and if we got a healthy person, school nurse, you know, it’d be brilliant wouldn’t it?” (P3)

Various influencing factors were discussed in relation to extra-curricular provision. Some headteachers reported very few extra-curricular activities, whilst others described a vast array of opportunities for physical activity, cooking or gardening. Some participants cited lack of equipment or space as a barrier, and funding was perceived as a major influence. Some schools serving deprived communities were able to fund activities for all children using ‘pupil premium funding’ (additional funding given to English schools to raise attainment of disadvantaged pupils), whereas others charged parents to cover costs. Participants describing the widest range of opportunities were more likely to be from schools serving deprived communities, although headteacher perceptions of the benefits of extra-curricular activities appeared to be an influencing factor regardless of deprivation level. Related to this,

an interesting difference between schools was the use of school staff. Some headteachers believed that teachers lacked the time, skills or confidence to run out-of-school-hours clubs. Other participants reported teachers running clubs on a voluntary basis. In a minority of schools, where participants saw extra-curricular activities as highly beneficial to children, it was compulsory for all staff to run a club.

"They just can't [run extra-curricular clubs] because they're too busy, they have to plan lessons. I mean, most teachers… do a ten hour day anyway and then you just want to go home and flop, haven't got any energy to do anything else" (P22)

"All my teaching staff are expected to do an after-school or lunchtime activity, so that's part of their contracted hours" (P19)

Headteacher expectations of staff also influenced the extent to which schools provided good role models for children. Most viewed this as an important part of the school function which included staff eating with children at lunchtimes, policies prohibiting staff from eating unhealthy foods in front of children, and physical involvement in out-of-school-hours activities.

"We get involved and I think that's part of the secret here, the children don't see us just standing there and watching… we're in a canoe, we're up a wall, we're in the mud, and it's fun" (P20)

Although one participant discussed how they didn't see themselves as a healthy role model; *"I don't model it clearly [laugh] I'm not a good role model, but you know, generally I encourage it throughout the school"* (P7), some felt it vital that they modelled healthy behaviours to children and staff. A few interviewees discussed

problems with staff who they thought were not good role models in terms of their lifestyle choices, and the difficulties this raised in working with parents and children.

“I have some staff who are obese, you know, there's a bit of a thing there isn't there, a difficulty, 'so well you can't really tell me about my child and what they should and shouldn’t be eating, you've got staff who are not very healthy themselves'… tricky” (P22)

3.5 Discussion

Participants in this study recognised the importance of promoting healthy lifestyles within schools and identified a range of factors influencing school roles and responsibilities in preventing obesity. Headteachers perceived positive effects of health on education, and the impact on learning was discussed as a major driver in school efforts to promote health. This finding is consistent with several studies showing the association between health and academic attainment (99, 100, 106, 210), and a substantial body of evidence showing that poor health can inhibit learning (99, 210, 211). Despite this, the current study found an unwillingness or fear amongst headteachers in dedicating more time to health promoting activities due to the ‘prescriptive curriculum’ and academic targets. This resonates with a recent qualitative study of primary school teachers in which taking time away from core curricular subjects (e.g. to participate in physical activity), was perceived as a risk (194). Additionally, within the current study, barriers were perceived that prevented schools from doing more to promote health both within and outside of the curriculum, including lack of space, facilities, time, funding and support. Until school leaders feel better supported to dedicate more time and resources to health promotion, this perception of risk and the associated barriers will continue to pervade.

An important finding of this study is that, within discussions, the term ‘obesity prevention’ was not widely used by headteachers, and health promoting activities were instead considered within the context of providing a rounded education and the development of the ‘child as a whole’. This, combined with headteachers’ positive perceptions of the impact of health promotion on learning, has implications for future branding of obesity prevention programmes within schools. There appears to be a clear need for greater integration between health and education with obesity prevention efforts firmly anchored within the existing school curriculum (212), and fitting with the school emphasis on improving educational attainment (111). Promotion of the wider benefits of obesity prevention programmes to schools should be presented within the context of the core function of primary schools. As such, obesity prevention should be an integral part of the education agenda and curriculum rather than bolt-on initiatives. The Health Promoting Schools approach (213) recognises the symbiotic relationship between health and education, and provides schools with a framework for improving both health and education through a ‘whole school approach’. The approach has been shown to be effective in improving physical activity and nutrition in schools (111). However, many schools need support to implement the Health Promoting Schools approach, particularly in working with families.

Headteacher perceptions of access to and quality of the school nursing service were shown to vary, as also reported in previous school-based studies (195, 214). Many participants described difficulties in accessing services with frustrations seemingly compounded by an apparent lack of support received following the NCMP measurements. The recent withdrawal of other sources of support (for example Healthy Schools teams) due to funding cuts led many participants to believe that

schools were inadequately supported; despite having insufficient time and expertise to tackle the complex and sensitive issue of obesity, schools were left to ‘get on with it’. This was particularly the case in schools serving deprived communities, where need for supporting parents was perceived as high. As suggested by some participants, dedicated support workers in schools would be a possible solution to this problem.

3.5.1 Strengths and Limitations

Views represented in this study are specific to the 22 participants. Those agreeing to participate may have been more interested in obesity prevention than those who declined, meaning alternative views could have been missed. In addition, the decision not to carry out ‘member checking’ may have introduced bias in that interpretation of responses was conducted solely by the authors without the confirmation of participants. However, the consistency of many of the findings with those from other sources lends some validity. Furthermore, the wide range of schools represented, and the in-depth insight into headteachers’ views enables tentative conclusions to be drawn which may help direct future guidance and resources for preventing obesity in schools.

3.6 Conclusions

Headteachers considered children’s holistic development as a key school responsibility. Health promotion was seen in this context, with its perceived impact on learning an additional advantage. Although much of this effort contributes towards obesity prevention, in most schools, this was not the main driver for such activities, an important factor to take into account in the future design and promotion of school-based obesity prevention initiatives.

Headteachers believed that the responsibility for preventing obesity lies mainly with parents, whilst recognising that many families face barriers to adopting healthy lifestyles and require support. Although many agreed that schools are ideally placed to provide such support, some felt they lacked the necessary expertise and capacity. Partnership working with expert input could be a solution.

School leaders need support, through resources and government policy, to enable them to do more on healthy lifestyle promotion both within and outside of the curriculum. Targeting resources to those schools serving deprived communities would help to reduce health inequalities.

CHAPTER 4

4.0 PARENT AND CHILD PERCEPTIONS OF SCHOOL-BASED OBESITY PREVENTION IN ENGLAND: A QUALITATIVE STUDY

This chapter presents a qualitative study exploring parent and child experiences of their involvement in the WAVES study intervention programme. The chapter is presented as a submitted manuscript:

Clarke JL, Griffin TL, Lancashire ER, Adab P, Parry JM, Pallan MJ, and on behalf of the WAVES study trial investigators. Parent and Child Perceptions of School-Based Obesity Prevention in England: A Qualitative Study (under review).

Author Contributions:

The study was designed by all authors. Data collection was performed by JC and TG. Data analysis was performed by JC and TG, with MP adding guidance on methodology. JC, TG, EL, MP and PA contributed to the final identification of themes. PA, MP and EL provided supervision throughout. The first draft of the paper was written by JC and TG. All authors provided critical input and revisions for all further drafts.

Acknowledgements:

With sincerest thanks to the parents and children who gave their time to participate in the focus groups, and to the school staff who helped to organise the sessions. This project was funded by the National Institute for Health Research Health Technology Assessment Programme (project number 06/85/11).

4.1 Abstract

Background: Schools are key settings for childhood obesity prevention, and the location for many intervention studies. This qualitative study aims to explore parent and child experiences of the WAVES study obesity prevention intervention, in order to gain understanding of the mechanisms by which the intervention results in behaviour change, and provide context to support interpretation of the main trial results.

Methods: Focus groups were held with 30 parents and 62 children (aged 6-7 years) from primary schools in the West Midlands, UK. Data analysis (conducted using NVivo 10) was guided by the Framework Approach.

Results: Three over-arching themes were identified: 'Impact', 'Sustainability' and 'Responsibilities', under which sub-themes were determined. Participants were supportive of the school-based intervention. Parental involvement and the influential role of the teacher were seen as key ingredients for success in promoting consistent messages and empowering some parents to make positive behavioural changes at home. Parents recognised that whilst they held the primary responsibility for obesity prevention in their children, they faced a number of barriers to healthier lifestyles, and agreed that schools have an important role to play.

Conclusions: This study enabled us to better understand aspects of the WAVES study intervention programme that have the potential to initiate positive behaviour changes in families, and showed that a combination of pathways influenced such changes. Pathways included: increasing capability through improving knowledge and skills of children and parents; increasing motivation through parental empowerment and role modelling; and the direct provision of opportunities to lead healthier

lifestyles. Strategies to sustain behaviour changes, and the school role in supporting these, are important considerations.

4.2 Background

Childhood obesity is a global public health challenge (1), and its health consequences are well-documented (3). Schools offer an environment in which eating and activity occur, providing opportunities to learn about and implement healthy behaviours. In addition, they have the potential to engage parents to support activities in the home setting (114, 202), and promote consistent messages between home and school. Schools are therefore often seen as an important setting for childhood obesity prevention interventions (107).

Systematic review evidence indicates that school-based obesity prevention programmes targeting both physical activity and eating behaviours can be effective (114). The complexity and heterogeneity of such interventions, however, make it difficult to disentangle the relative effectiveness of individual components and their potential interactions (215). Qualitative techniques can be useful in generating data which provide insight into the attitudes, perceptions, motivations, concerns and opinions of participants (216). This in turn helps us to understand and contextualise the active ingredients, and their mechanism of action, within interventions (217).

The West Midlands ActiVe lifestyle and healthy Eating in School children (WAVES) study is an ongoing cluster randomised controlled trial evaluating the effectiveness of an obesity prevention intervention for children aged 6-7 years. From 54 randomly selected primary schools in the West Midlands, UK, 26 were allocated at random to the intervention arm of the trial. For logistical reasons, half of the schools were scheduled to receive the 12-month intervention in 2011-12, the remainder in 2012-13. Full details of the WAVES study are described elsewhere (135), but in summary,

the intervention focused on promoting healthy eating and physical activity. Teachers were asked to: (i) Incorporate an extra 30 minutes of physical activity into each school day; (ii) Deliver three cooking workshops with children and parents focusing on nutrition education and food preparation skills; (iii) Supervise class attendance at Villa Vitality, a healthy lifestyle programme run at an English Premier League football club; (iv) Distribute two signposting sheets with ideas on how to be more active and specifically directing families to local physical activity opportunities, and a termly newsletter to reiterate the importance of healthy lifestyles.

This qualitative study aims to explore parent and child experiences of the WAVES study, in order to gain understanding of the mechanisms by which the intervention results in behaviour change, and provide context to support interpretation of the main trial results. Although a number of studies have investigated parent and child views in the development phase of obesity prevention interventions (90, 157, 164, 196, 218), there is a paucity of published research on their views in the evaluation phase of such interventions. In addition, recent guidance emphasises the importance of considering and presenting qualitative findings ahead of the main trial outcome to minimise interpretation bias (219). This qualitative study was conducted as part of the WAVES study process evaluation (220); related findings from interviews with teachers have previously been reported (194).

4.3 Methods

This study uses a descriptive-interpretive qualitative methodology (221). A sub-sample of schools participating in the WAVES study intervention programme was purposively selected to ensure contributions from a range of schools (diverse in location, ethnic mix of pupils, school size and deprivation (indicated by free school meal entitlement)). Data collection took place towards the end of the intervention

period (May-July 2012 or May-July 2013). Ethical approval was obtained from the National Research Ethics Service Committee West Midlands, The Black Country (10/H1202/69). Parents provided written consent for themselves and/or their child prior to the focus groups. A £5 shopping voucher was given to parents attending the focus groups.

Ten schools (out of 15 invited) agreed to participate in this qualitative study. Three schools declined due to time pressures and the remaining two failed to respond. In the 10 participating schools, teachers were given letters of invitation to distribute to the parents of all children in their class (380 letters in total) inviting them to take part and/or permit their child to take part in a WAVES study focus group. Two of the schools held child focus groups but advised against the running of parent focus groups in their schools due to an anticipated poor response from parents. One school held a parent focus group but was unable to hold a child focus group due to time constraints in the curriculum. In total, 30 parents and 62 children participated in the study. Seven parent focus groups (mean group size, n=4; range 2-12) (plus one interview (n=1) because only one parent attended a planned focus group), and 13 child focus groups (mean group size, n=5; range 2-7) were conducted. Characteristics of the schools, and participant numbers, are shown in Table 4.1. Focus groups were run by two female researchers with training in qualitative research methods (J Clarke, MSc, Research Associate, and T Griffin, PhD, Research Fellow). One researcher led the focus group, whilst the other made field notes (contextual details and non-verbal expressions to aid data analysis and interpretation). The researchers were previously known by some participants through school visits as part of the WAVES study. Child and parent focus groups were conducted separately, within the participants' school, without the presence of school

staff (except in one child focus group where a teaching assistant helped a child with additional needs, but made no contribution to the discussion). A 45-minute time slot was made available for each focus group. Average duration of discussion was 24 minutes for children and 28 minutes for parents. Topic guides (Table 4.2) were used to help direct discussions and participants were encouraged to talk openly about their experiences. Within parent and child focus groups, participants were asked to recount their experience of the WAVES study overall, and of the separate intervention components (additional physical activity, cooking workshops, Villa Vitality, signposting). Parents were also asked to consider any beneficial effects of the intervention (including any behaviour change) as well as the wider role of the school in preventing obesity.

Table 4.1: Characteristics of schools involved in the focus group study, and number of participants

School number	Year of intervention	School size (no. on roll)	Free school meal eligibility (%)	Ethnicity (% white)	Participants	
					Parents	Children
1	2011/12	<200	10-19	20-29	2 mothers	2 girls, 7 boys
2	2011/12	<200	20-39	90-99	-	4 girls, 3 boys
3	2011/12	≥300	40-60	50-56	1 mother	3 girls, 5 boys
4	2011/12	200-299	20-39	60-69	-	4 girls, 2 boys
5	2012/13	200-299	20-39	0-9	4 mothers	2 girls, 3 boys
6	2012/13	≥300	40-60	20-29	2 mothers, 1 father	6 girls, 4 boys
7	2012/13	≥300	20-39	60-69	2 mothers, 1 father	4 girls, 3 boys
8	2012/13	<200	0-9	90-99	2 mothers, 1 father	-
9	2012/13	≥300	10-19	70-79	2 mothers	3 boys
10	2012/13	200-299	10-19	10-19	10 mothers, 2 fathers	3 girls, 4 boys
TOTAL					**25 mothers, 5 fathers**	**28 girls, 34 boys**

Due to the young age of the children in this study (6-7 years), the facilitation of focus groups required special attention. As recommended by Stewart and Shamdasani (222), the moderators (JC and TG) were experienced in working with young children. First names were used to moderate the hierarchical adult-child relationship (223), and a short, fun ice-breaker helped children to feel comfortable and relaxed. Discussion was encouraged through the use of photographs of the intervention activities, and further prompts were used when necessary to clarify children's responses.

Table 4.2: Topic Guides for parent and child focus groups, to explore experiences of school-based obesity prevention

Topic guide: Parent focus groups
1: Can you tell me what you know about the WAVES study and the activities it involved?
2: Can you tell me about you and your child's overall experience of being involved in the WAVES study?
3: As part of the WAVES study programme, schools were asked to fit in an extra 30 minutes of activity into the school day. Did you know this was happening in your child's school? How do you feel about it?
4: What did you think about the signposting sheets?
5: What did you think of the cooking workshops? Do you think the workshops had any impact on your family?
6: Your child's class also attended Aston Villa football club for the Villa Vitality programme. What do you think your child's experience of the Villa Vitality programme was?
7: Do you think there were components of the WAVES study programme which were more beneficial than others?
8: Do you think the WAVES study programme of activities had any effect on your child's behaviours and attitudes towards healthy lifestyle behaviours?
9: What effect (if any) do you think the WAVES study programme has had on your family's lifestyle habits?
10: What role (if any) do you think schools play in obesity prevention?
Topic guide: Child focus groups
1: Can you tell us what you know about the WAVES Study? What did you do as part of the WAVES study?
2: What did you think of the cooking workshops in school? Did you learn anything new?
3: Can you tell me what you think about the WAVES study physical activities? How do they make you feel?
4: What did you think about the Villa Vitality programme? What did you do at Villa Vitality?
5: Did you take part in the Villa Vitality challenges? What did you think of the challenges?

Group discussions were voice recorded, transcribed verbatim, and anonymised. Thematic data analysis, guided by the Framework Approach (209), was undertaken in five stages: data familiarisation, theme identification, indexing, charting, and mapping the data. As recommended by Gale et al., (208), two researchers (JC and TG) independently reviewed all transcripts, identified themes and applied codes to the data. Codes were compared and discussed, and a thematic framework agreed. This framework was applied (independently) to the transcripts which were indexed using NVivo 10 (QSR International Pty Ltd. Version 10, 2012). At first, child and parent data were analysed separately, but due to the identification of common themes, the two datasets were subsequently reviewed together by all authors to identify and map overarching themes. For pragmatic reasons, member checking was not implemented.

4.4 Results

Three overarching themes were identified from the data: ‘Impact (of the WAVES study)’, ‘Sustainability’ and ‘Responsibilities (for obesity prevention)’, under which sub-themes were determined. The ‘Impact’ and ‘Responsibilities’ overarching themes, and the ‘role of schools’ subtheme arose from the Topic Guide, and thus were researcher-led. All other themes emerged from the data analysis. Fewer themes were generated from the focus group discussions with children than with parents, and these were mainly assigned to ‘Impact’. Table 4.3 shows all themes, and indicates whether these arose from both parent and child discussions, or just from the parent discussions.

Table 4.3: Themes identified from focus group discussions exploring experiences of school-based obesity prevention

Overarching theme	Sub-theme	Discussed by parents and/or children
Impact (of the WAVES study)*	Improved knowledge and skills among children and parents	Parents and children
	Children trying new foods	Parents and children
	Implementing changes in the home	Parents
	Parental empowerment	Parents
	Role modelling	Parents and children
	Children as agents of change in the home	Parents
Sustainability	Sustainability of messages	Parents
	Sustainability of school-based programmes	Parents
Responsibilities (for obesity prevention)*	Role of parents	Parents
	Role of schools*	Parents and children
	Schools in partnership with parents	Parents

*themes arising from topic guides; all other themes 'emerged' from the data

4.4.1 Impact (of the WAVES study obesity prevention intervention)

4.4.1.1 Improved knowledge and skills among children and parents

It was evident that children could recall key messages from the WAVES study intervention programme, and were enthusiastic in sharing their knowledge within the focus group discussions; *'fibre gives you an energy boost and it gives you energy for longer not like sugars, the sugars just give you energy for one minute'* (School 5, child). Children also displayed an understanding of the importance of healthy lifestyles; *'if you don't eat a healthy breakfast every morning then when you go to school you won't be able to learn, you'll go to sleep or something'* (School 5, child).

Following the intervention, participants reported that their interest in food preparation had increased. Children were particularly proud of their new skills (for example, in the safe use of knives to chop vegetables). They were equally keen to demonstrate their learning and practise their skills within the home environment, as one child

explained; *'I teached my mum how to cook it when we cooked in Aston Villa. And I chop a bit at home because I learned how to chop at Aston Villa'* (School 10, child).

Alongside reports of improved knowledge of children, a number of parents also reported that their own knowledge had improved as a result of the intervention; *'I think it's educated us as a parent a lot'* (School 10, mother). For others, the intervention served more as a reminder, with some parents intimating that although they already possessed the knowledge required to lead a healthy lifestyle, the intervention helped them think about, and possibly refine, their family health behaviours; *'it's always good to reinforce these things … it reinforces you to stick with what you know is best'* (School 3, mother).

4.4.1.2 Children trying new foods

Many children excitedly reported trying new foods as part of the intervention; *'I never tried Weetabix with strawberries and bananas on it; it tastes really nice, now I eat it'* (School 5, child), although not all reported enjoying them; *'I tried a blueberry but I didn't like it'* (School 2, child). This exposure to healthy foods was an aspect of the programme that parents especially liked, a number of whom recounted children trying foods at the Cooking Workshops that they wouldn't try at home. Equally, some parents reported that, since the intervention, children were more willing to try new foods in the home environment; *'she's willing to try more fruits and vegetables, that's what I'm pleased with probably more, before she was quite picky with what she'd have, but now she is willing to try new things'* (School 7, mother). One parent, whose child was not keen to try any new foods at the Cooking Workshops, was still happy that children had been given these opportunities, and saw it as a positive learning experience; *'unfortunately my son's such a fussy eater, even though we tried, he wouldn't try anything, I ended up having to try all the food [laugh] and he just*

wouldn't even attempt it, but you know, he has learnt what is good and what is bad' (School 6, mother).

4.4.1.3 Implementing change in the home

Following the intervention programme, some parents reported observing changes at home in terms of children's interest in, and awareness of, healthy lifestyles; *'he talks about his food more, about healthy eating and he tries to eat healthier'* (School 6, mother). A number of parents also reported children's behaviour changes as a result of the intervention; *'My son has made the change from more fizzy drinks and juice to water and he actually knows how much he needs to be consuming a day'* (School 5, mother).

Some parents reported making behavioural changes at home as a result of the intervention; *'there's definitely been a significant change …I'm very pleased to say that it* [WAVES] *has made a big difference in our household as a whole'* (School 5, mother). A number of parents made the connection between their children trying new foods within the intervention programme and behaviour change within the home environment; *'she eat yoghurt, banana, fruits in the morning, before she never had that, before she liked toast and jam, all of us like it… now no more, don't even buy them'* (School 9, mother).

Conversely, a small number of parents (from schools in more affluent areas) felt that the intervention programme had had no effect on their family as they were already leading healthy lifestyles; *'it's nothing different to what I would do at home if I'm being brutally honest.… it's not going to have any impact or make any difference to me'* (School 8, mother).

4.4.1.4 Parental empowerment

A key emergent theme was that parents felt healthy lifestyle promotion at school (through the WAVES study activities) helped support and empower them to make changes at home. Parents recognised the powerful position of the teacher in conveying key healthy lifestyle messages to children. This was thought to a) be useful in promoting consistency between school and home, and b) have more of an effect than when the messages came from parents; *'it's good to have it reinforced I think from somebody other than your parents, sometimes if your teacher says it, it's true!'* (School 8, father). As a result of the intervention, some parents felt empowered and supported in promoting healthy behaviours at home; '*It's made it easy at home to say no fizzy drinks without making a fuss explaining'* (School 10, father).

4.4.1.5 Role modelling

Parents and children enthusiastically discussed the importance of healthy role modelling within the WAVES study intervention programme. For example, children were animated when discussing working with the Villa Vitality chef and football coaches, and one mother talked about the positive influence that the visits to the football club had on her son; *'who wouldn't want to be like a footballer?… they're their role model and this is what they're eating and this is the exercise they're doing, what child's not going to want to copy them?'* (School 10, mother). It was clear that children also viewed their teachers as role models, and particularly enjoyed it when teachers participated in the physical activities; *'it's good exercise for you and I like it when* [teacher's name] *does it'* (School 4, child).

4.4.1.6 Children as agents of change in the home

From parental reports, it emerged that some children were helping to affect changes within the home environment, by encouraging parents to change their habits; *'my*

son… he actually does have an issue with what I put in his lunchbox, you know, and it's like 'oh don't give me a croissant all the time or don't give me this all the time mum, you know, it's not good' so he's made me think about it instead of just rushing around trying to get everything in there and get him off to school, it's made me think twice about what I actually do put in his lunchbox' (School 5, mother). Some parents viewed this positively as a role reversal; '*all them years of nag, nag, nag, nag 'that's not good for you, that's not good for you' but as soon as they do it in school 'you can't put sugar on my [cereal]...'* (School 10, mother).

4.4.2 Sustainability

4.4.2.2 Sustainability of messages

Opinion differed on the sustainability of messages received through the intervention; some parents thought that the one-year intervention could have a long-term impact; *'hopefully there's enough embedded in them now that it'll stay with them, you know, when they get older'* (School 3, mother), whilst others questioned the sustainability of effects. For example, in one focus group, parents discussed one of the Villa Vitality challenges ('Eat 5 a day') which involved children recording what fruits and vegetables they ate each day for one week. Whilst noting a positive impact in terms of children's awareness and behaviour whilst undertaking the challenge, a longer-term effect was more questionable once the novelty of the intervention had passed; *'…obviously once they've sort of had a few weeks of it, it just sort of disappears back into what they were sort of doing'* (School 1, mother).

4.4.2.3 Sustainability of school-based programmes

Parents acknowledged that school-based healthy lifestyle programmes should not be 'one-offs', and there was a need to re-visit the key messages. Some parents

discussed how healthy lifestyles should be an important part of the curriculum in every year group; '*I think they should start at nursery and build themselves up as they go to year six'* (School 10, father). In addition, some parents expressed concerns about the transition from primary to secondary school in terms of healthy lifestyle promotion; '*once you get to secondary school it's all about choice'* (School 10, mother).

4.4.3 Responsibilities for obesity prevention

4.4.3.1 Role of parents

Although the focus of the group discussions was the WAVES study intervention, participants also considered the important role of parents in preventing obesity. All parents, whilst supportive of the intervention, felt they held the main responsibility for preventing obesity in their children; *'at the end of the day you're the parent, you've got to instil most of that into your children'* (School 1, mother) and recognised the need to set a good example; *'as parents, you know, we're role models'* (School 10, father). However, a number of barriers were discussed by children and parents that sometimes interfered with parents' ability to deliver their responsibility. These barriers were raised in discussions about the 'signposting sheets', and could be seen as barriers to the effectiveness of the intervention, including the perceived high cost of healthy foods and activities, lack of local activities, limited space at home, siblings' vying needs, the draw of sedentary activities, competing demands (e.g. religious practices) and lack of time; *'it is difficult a lot of the time 'cause I work, so by the time I've gone to work, get home from work it's the timescale really, it's bedtime before you know it'* (School 6, father).

4.4.3.2 Role of schools

Whilst accepting the main responsibility for obesity prevention, parents believed that schools also have an important role; *'everybody has to encourage good eating and the schools have to be involved'* (School 8, mother). Parents felt that health promotion in schools, such as that delivered through the WAVES study, offered vital lessons to children to support their future health; *'you're thinking about the future, if you start healthy at this young age then obviously you don't get overweight and all these diseases, diabetes, heart disease, they all arise from overweight'* (School 10, father).

'I think schools have to do it [health promotion]*, it's important isn't it because as a society we're not doing particularly well at eating healthily, sadly, so yeah it's good if it can be taught and they can take something on board while they're at school'* (School 3, mother).

Parents and children supported the inclusion of extra nutrition education and physical activities within school time, particularly those who struggled to find time for physical activity outside of school; *'we're Muslims, he goes to mosque as well, so he doesn't really get much time in the evening to play about, so it's good while they're in school instead'* (School 6, mother). One child in particular discussed how the extra physical activity at school was important to her as she didn't get many opportunities to be active at home; '*there's not a lot of room in my house so I can't do it* [physical activity]*...and my mum and dad said I'm not allowed to run around'* (School 7, child).

Furthermore, some parents and children perceived the additional physical activity undertaken through the WAVES study intervention to have a positive impact on concentration and learning; '*I think it makes them more active, more alert as well*

especially first thing in the morning, more able to learn and things… it's very beneficial' (School 9, mother).

'Because I've done my exercise I can think harder and try' (School 6, child).

A few parents, whilst supportive, were aware of difficulties that schools faced with fitting in additional activities. There was a perceived hierarchy of activities that schools should deliver, with academic learning being relatively more important. For example, in relation to fitting extra physical activity into the school day, one parent stated: *'it depends on whether it's going to affect the rest of the academic things like their writing and spelling'* (School 6, mother).

Additionally, some parents expressed concerns about whether focusing on healthy lifestyles could promote eating disorders; *'we don't want plenty anorexics about, because even now we've got children in Year 1* [5-6 years old] *telling each other that they're fat or I'm thin or I'm this or I'm that. So we need to be careful about diet, exercise and healthy eating'* (School 10, mother).

4.4.3.3 Schools in partnership with parents

Parents discussed working in partnership with schools to promote healthy lifestyles to children. They appreciated the opportunities presented by the WAVES study to be involved in their children's learning, and saw this as a way of reinforcing messages learnt at school within the home environment; *'you get a foresight into what they're doing… you know what's happening and also what you can do to make it better, or add to it'* (School 1, mother).

4.5 Discussion

In this qualitative study, we found that parents and children value healthy lifestyle interventions delivered through schools, and report changes in knowledge, skills and family lifestyle behaviour as a result. There were concerns that changes in behaviour would not be sustained longer term. Several practical barriers to behaviour change, which could reduce intervention effects, were also discussed.

Parental involvement in health promotion interventions for children has been identified as an important factor in improving intervention effects (114). Findings from this study suggest that such involvement improves parental knowledge and facilitates consistency of messages between school and home. A key theme was that intervention delivery through school, with teachers as role models and authoritative messengers, leads to a sense of empowerment for parents as they feel supported by schools in their attempts to promote healthy lifestyles for their children. Data from teacher interviews undertaken as part of the WAVES study process evaluation indicated that teachers were generally not in a position to assess the impact of the intervention on behaviour change (194), which may result in their underestimation of the positive effect of intervention delivery. Creating a feedback mechanism, to make teachers aware of intervention impact, may help motivate them to more consistently promote healthy lifestyles. In addition to parental empowerment and teacher influence, there was indication that children themselves were instrumental in influencing parents to implement lifestyles changes at home. This promising finding is similar to a recent study showing that empowering primary school children to educate their families was effective in lowering salt intake (224).

Food neophobia (a reluctance to try new foods) is believed to peak at the age of six years (225), and research suggests that novel food needs to be presented in a positive light, including highlighting the fun of preparing or cooking the food (225). Willingness to try new foods has also been shown to increase when more people around the child consume the food (226). We describe how the practical cooking aspects of the intervention, including preparation and trying of new foods by children (aged 6-7 years) alongside their classmates, parents and teachers, facilitated many to try new, healthy foods. This aspect of the intervention may have been successful in behaviour change which was translated to the home environment.

Although behaviour change theory was not explicitly used in the development of the WAVES study intervention, the empirical data from this study resonate with the framework set out in the Behaviour Change Wheel (227). This has at its centre the COM-B model which describes three conditions necessary for behaviour change to occur; Capability, Opportunity and Motivation. This conceptual model can be used to theoretically explain the reported lifestyle changes resulting from the intervention. For example, improved skills in physical activity and nutrition (physical capability) alongside the empowerment of parents to implement changes with their children (psychological capability leading to increased motivation); the normalisation of healthy lifestyle behaviours, both in and out of school, e.g. at the football club (reflective motivation); positive role modelling from teachers and at the football club (automatic motivation), and the intervention programme providing occasions to promote and enact healthy lifestyle behaviours with children and families (physical and social opportunity). If capability, opportunity and motivation of children and parents, as well as schools and their staff, are addressed in future interventions, they may be more likely to result in behaviour change within families.

Parents and children in this study reported various barriers to behaviour change, many of which were also recognised by the teachers (194), and are consistent with findings from previous studies (157, 193). This study also revealed a differential intervention impact on individual families, with some parents and children reporting significant behavioural changes, and others, despite appreciating the intervention as valuable education for children, reporting no impact as they considered themselves to be already leading healthy lifestyles. In considering the differential impact that the intervention might have had in different strata of the population, we posit that disparities observed could possibly be explained by the socio-economic circumstances of families, as our observations were that the parents who reported higher knowledge and existing healthier practices at home tended to be from schools serving areas of higher socio-economic status (SES). We propose that an important factor in this apparent potential of the WAVES study to affect positive lifestyle changes among families with poorer prior healthy lifestyle knowledge (which in this study tended to be amongst the participants from more deprived communities) was that the intervention targeted simple and achievable behaviour change. This variable impact, depending on family circumstances, resonates with some previous health behaviour change intervention research that showed greater effects amongst populations from lower, compared to higher socio-economic backgrounds (228, 229). Although all schools have an important role to play in the promotion of healthy lifestyles, the level of involvement required is likely to vary depending on the circumstances of, and the challenges faced by, the families of the children who attend. Schools, and those developing school-based healthy lifestyle interventions, need to be sensitive to barriers faced by families, and consider the context of the home and local environment when designing programmes. Different families will

have distinct capabilities, opportunities and motivations, depending on their social, cultural and economic circumstances. Tailoring programmes to suit local needs has been reported as an important approach for maximising parental compliance (230). Our study supports this and suggests that future childhood obesity prevention intervention programmes need to incorporate a degree of flexibility to enable adaptation to individual school and family circumstances.

While participants perceived school-time as an important opportunity for children to be physically active, suggestions that physical activity had increased outside of the school setting were scarce. Equally, there were no reports of any positive impact of the physical activity 'signposting sheets'. The fact that the physical activity component of the intervention was delivered only to children within school, with no parental involvement, combined with the barriers reported by participants when discussing the 'signposting sheets' (for example, high cost or lack of local activities, vying needs of siblings, lack of time, competing demands, and the draw of sedentary activities), suggest that the intervention is unlikely to have promoted physical activity outside of school.

Although the emphasis of the WAVES study intervention programme was encouragement of lifestyle behaviours to help children stay healthy, some parents discussed the possibility of a negative impact on children's perception of body image and risk of developing eating disorders. The Cochrane review of interventions for preventing obesity in children (114) considered the potential harm of such interventions, and although few trials have considered this, none have reported any risk of eating disorders or other harms. It has been suggested, however, that programmes could simultaneously prevent eating disorders and obesity based on the idea that they have common risk factors (231). In such a programme, the focus

would be on health and behaviour change, regardless of weight status, alongside the promotion of positive body image and the acceptance of the diversity of body shapes and sizes (232).

The reports of positive behaviour change resulting from the intervention are encouraging, supporting the promotion of healthy lifestyles through schools. However, sustainability of the impact was a concern for parents. Whether children would retain the acquired knowledge, and have a continued motivation to implement it once the intervention ended, echoes concerns reported by teachers (194), suggesting that healthy lifestyle messages needed to be re-visited and embedded within the school curriculum. This issue of sustaining impact over time, and the need to embed effective interventions into standard practice has been raised previously (114). Incorporating successful components of the WAVES study intervention programme into a 'whole school approach', advocated by the Health Promoting School model (107), would help improve its sustainability.

4.5.2 Limitations

Focus groups were held in purposively sampled schools, and this study represents the views of those parents and children from the selected schools who agreed to participate. These participants may have been more interested in the topic of healthy lifestyles and therefore more motivated to attend a focus group. Parents and children who declined participation, as well as those from schools not selected for this study, may have offered different perspectives. With the exception of one school (School 10), the response rate from parents was quite low. Through an analysis of field notes taken during focus group discussion, we were able to consider group dynamics, both between participants, and between participants and researchers. Some of the focus groups had small numbers of participants (e.g. 2-3 participants), leading to (in a

minority of groups) a reduced level of interaction between group members and limited exploration of shared perspectives. However, in most of the groups, good participant interactions were evident as they worked together to describe their experiences.

The fact that the researchers had some knowledge of participating schools and had previously met some of the participants on school visits as part of the WAVES study may have affected participant responses (e.g. social desirability bias). There may also have been a risk of bias in data interpretation (e.g. researcher pre-conceived ideas about schools or participants based on prior knowledge and experience).

Of the 30 parent participants, only five were male, and they were interviewed alongside female participants. Fathers' views are therefore under-represented in this study. This gender bias is similar to other studies, and is likely a reflection of society, with mothers being the primary carers of children (167, 196, 233). However, when the views of participating fathers were compared to those of mothers, the authors found no clear differences in opinion between male and female participants. Despite these limitations, the number of participants from a diverse range of schools enables tentative conclusions to be drawn about parent and child opinions of school-based obesity prevention programmes.

4.6 Conclusions

This qualitative study enabled us to better understand aspects of the WAVES study intervention programme that have the potential to initiate positive behaviour changes in families, and showed that a combination of pathways influenced such changes. Pathways included: increasing capability through improving knowledge and skills of children and parents; increasing motivation through parental empowerment and role

modelling; and the direct provision of opportunities to lead healthier lifestyles. Strategies to sustain behaviour changes, and the school role in supporting these, are important considerations.

CHAPTER 5

5.0 OVERWEIGHT AND OBESITY PREVALENCE AND PHYSICAL ACTIVITY LEVELS IN 5-6 YEAR OLD CHILDREN: A DESCRIPTIVE AND MULTILEVEL ANALYSIS OF INDIVIDUAL AND SCHOOL CHARACTERISTICS

Acknowledgements:

I developed the idea for the study with Peymane Adab, Miranda Pallan and Emma Lancashire. The WAVES study research team (which I belong to) was responsible for collecting, inputting and cleaning the data. Gemma Knowles manipulated the physical activity data to produce the in-school/out-of-school/weekend physical activity variables used within the analysis. I conducted the statistical analyses, with support from MP and advice regarding the multilevel analysis from Karla Hemming. I wrote the chapter, guided by PA, MP and EL.

5.1 Background

Childhood obesity is a global public health problem (1), and schools are often seen as an ideal setting for promoting health and preventing obesity. The majority of children attend school, and schools have long-term, in-depth contact with children and their families (90). The policies that schools set, alongside opportunities within the curriculum, and the school environment, have the potential to affect child health (93). However, the extent to which schools impact on children's health and health-related behaviours, and the underlying mechanisms, are not known. This background section starts with a summary of previous research on primary school children exploring the school effect on weight status and PA behaviours, and/or the relationship between school-level factors and weight status or PA behaviours. It then specifically highlights studies that have considered the relationship between school-time allocation for physical education (PE) and breaks and weight status or PA behaviour. Pertinent to the analysis of the PA data undertaken within this chapter, background information is also outlined on the Activitystat hypothesis; the relationship between PA and sedentary behaviour; and gender differences in PA. Finally, relevant studies conducted within high schools are outlined.

5.1.1 Studies on primary school children exploring the school effect on weight status and PA behaviours, and/or the relationship between school-level factors and weight status or PA behaviours

Findings from cross-sectional studies indicate a small school effect on pupil body mass index (BMI). Procter et al (234) found variation between schools (n=35) in Leeds, UK, in terms of BMI z-scores of 4-5 and 8-9 year olds (n=2,367), which was only partly explained by pupil ethnicity and socio-economic status (SES). Through the development of a model comparing observed and expected BMI (based on ethnic and deprivation data) the authors demonstrated a small, but significant school

effect on obesity. Similarly, Pallan et al (235) found a small, significant school effect in an investigation of the variation between schools (n=296) in BMI z-scores in 4-5 and 10-11 year olds (n=21,269) in Birmingham, UK (4% and 1% of observed variation in BMI z-scores at the school-level for 4-5 and 10-11 year old children respectively). However, in a repeated cross-sectional study using five years of data from the National Child Measurement Programme (NCMP) for 4-5 and 10-11 year old children (n=57,976) from schools (n=300) in Devon, UK, Williams et al (236) found that although a small amount of the variance in BMI z-score was attributable to inter-school variation (less than 3%), there was inconsistency in school rankings between years in terms of overweight and obesity, suggesting that there was no systematic effect of school attended on pupil BMI.

Studies using multilevel models to explore between-school variation in objectively-measured levels of children's PA have demonstrated a much stronger school effect on PA than those investigating the school effect on BMI. In a cross-sectional study of 10-12 year old primary school children (n=1,025) from five European countries, Van Stralen et al (237) reported intra-class correlation coefficients (ICCs) of 0.28 and 0.27 for school-time spent in MVPA and sedentary activity respectively, indicating a substantial school effect on activity levels within school (i.e. 28% and 27% of the variation in school-time spent in MVPA and sedentary activity respectively can be attributed to between-school variation). Kristensen et al (238) showed a school effect on children's PA both within and outside of school hours using data from 9- and 15-year-old children (n=1,766) from 35 Danish schools. For MVPA, ICCs were 0.18 and 0.06 for school-time and out-of-school-time respectively. Similarly, Fairclough et al (239) examined the variation in school-time and out-of-school time moderate PA (MPA) and vigorous PA (VPA) in 10-11 year olds (n=223) in eight UK primary

schools, and reported ICCs of 0.25 and 0.08 for school-time, and 0.04 and 0.02 for out-of-school time MPA and VPA respectively. In an analysis of 10-12 year olds (n=856) from 18 Canadian primary schools, Faulkner et al (240) demonstrated that school-level differences accounted for 6.7% of the variability in time that children spent in light-to-vigorous PA.

Studies examining the relationship between school-level characteristics and pupil weight status or PA behaviours have shown very few associations. In a recent systematic review to evaluate the effects of school diet and PA policies on the weight status or primary school children, stand-alone policies were found to be insufficient to prevent obesity (241), although multifaceted interventions including a policy element were shown to be effective in reducing weight-related outcomes. Another recent systematic review reported no conclusive findings from studies examining the association between the primary school built environment (for example, PA facilities) and child overweight and obesity (242). In an investigation of the relationship between 56 school-level factors and fat mass index (FMI) in 9-10 year old children (n=1,724) from 92 schools in Norfolk, UK, Harrison et al (243) identified very few school factors associated with adiposity: for boys, being able to eat at breaktimes was associated with higher FMI; for girls, attending a school with more children in the year group was associated with a lower FMI. Similarly, a US study of 11-year-old children (n=4,387) from 112 schools found no associations between school-level factors and individual BMI (244). In terms of PA, Faulkner et al (240) examined the relationship between 22 school-level variables and overall PA in 10-12 year old children (n=856). Two significant associations were reported: schools having a written PA policy; and schools supporting active transport to and from school.

Two studies have presented positive relationships between school-level deprivation and pupil BMI. In a US study (245) of 62,880 households, it was found that children attending public schools (i.e. those funded by the state) had higher BMI than those attending private schools, even after adjustment for household SES, with a larger effect in children from low SES households. In a multilevel analysis examining the relationship between BMI in 4-5 and 10-11 year olds and area- and school-level deprivation in 788,515 children from 14,054 schools, Townsend et al (246) reported positive associations, with stronger relationships in the older age group, which the authors suggested could be a result of the impact of deprivation on children throughout their time at school.

5.1.2 Studies investigating the relationship between school-time allocation for PE/breaks, and weight status or physical activity behaviours

Within school-time, PE and breaks present the main opportunities for children to be physically active. Findings from studies investigating the relationship between school PE and/or breaktime provision, and children's weight status or PA behaviours are largely inconsistent.

Two US studies have examined the relationship between PE time and BMI using large samples of primary school children. Cawley et al (247) estimated the effect of PE time on the weight status of children (aged 5-11 years) using data from state policies for school PE (state-mandated required number of minutes of PE per week) and the Early Childhood Longitudinal Study, and found a beneficial effect (in terms of lower BMI z-score) on 10-11 year old boys only. In a longitudinal prospective cohort study of 11,400 children, Miller (248) found that although there was no association between PE time and BMI, higher amounts of school breaktime were associated with decreases in the rate of BMI growth over time.

In a literature review of 15 studies investigating whether PE provision increased pupils' daily PA levels, Pate et al (249) reported that whilst it was evident that pupils could potentially receive a significant dose of PA during PE, the actual dose provided was not well-established. However, there was some evidence to suggest that activity undertaken during PE was additional to usual activity and did not result in reduced activity during other parts of the day. Cawley et al (247) reported that, among 5-11 year olds, increased PE time resulted in greater overall participation in both structured and free-time PA for boys only. Carlson et al (2013) (250) examined the relationship between US elementary school PA practices and objectively measured school-time PA of 172 children aged 8-13 years from 97 schools. The study found that children at schools providing over 100 minutes of PE per week had 6.7 more minutes per day of MVPA during school-time than those providing less than this (although no significant associations were reported between school provision of breaktimes and children's PA behaviours).

Contrasting findings were reported from the CHAMPS study (Denmark) (251), a natural experiment that examined whether children attending 'sports schools' (schools that increased PE from twice to six times per week over a three-year period) were more physically active than children attending four control schools who received two PE lessons per week. No significant difference in children's objectively-measured overall PA levels between 'sports schools' and control schools was reported: children attending 'sports schools' were more active during school-time (particularly so for boys), but less active in out-of-school-time. The authors suggest that this compensation in PA levels may be due to the perceptions of 'sports school' parents that their children had been sufficiently active at school, and they therefore did not need to facilitate out-of-school PA.

A 2012 systematic review of the association between breaktime duration and children's PA behaviours produced inconclusive results (252). For example, in a US cohort study using PA direct observation techniques, McKenzie et al (253) demonstrated how 6-year-old children (n=287) became significantly less active as time elapsed at breaktime, and in a UK quasi-experimental intervention study of 7-8 year old children (n=297) from 26 schools, Ridgers et al (254) showed higher levels of objectively-measured PA during longer breaktimes. In a longitudinal study, Mantjes et al (255) reported that among 9-10 year old British children (n=839) from 89 schools, followed up after one year, those in schools with longer morning breaktimes had increased MVPA levels, and lower reduction in sedentary time, compared with those in schools with shorter breaks. In a German study investigating the effect of a higher number of school breaktimes on PA levels in seven-year-old children (n=294) from 27 schools, Kobel et al (256) reported that in schools with just one break, children spent a higher proportion of time in MVPA than children in schools with two breaks. However, children attending schools with two breaks had significantly higher overall time spent in MVPA compared to children attending schools with just one break.

5.1.3 Activitystat hypothesis

The much-debated Activitystat hypothesis states that when additional PA is undertaken within one domain (e.g. school-time), there will be a compensatory change in another domain (e.g. non-school-time) to maintain a stable total energy expenditure over time (257). These compensatory behaviours have been put forward as a potential explanation for the limited effects of interventions to increase children's PA. In a meta-analysis of the effectiveness of interventions to increase children's PA, Metcalf et al (258) found only a small intervention effect on children's activity levels

(the equivalent to four minutes more walking or running per day), and suggested that this could be due to compensatory behaviours (the Activitystat hypothesis).

However, a recent systematic review of 28 experimental studies investigating the Activitystat hypothesis across various populations using different methodologies (259) found no clear supporting evidence, with only 15 of the studies providing any evidence of compensation.

5.1.4 Physical activity and sedentary behaviour

Both insufficient PA and excessive sedentary behaviour have been associated with childhood obesity, although evidence is inconsistent (260). Studies have shown that, independent of levels of PA, sedentary behaviours are associated with an increased risk of cardio-metabolic disease, mortality and various physiological and psychological problems (261-263).

The 'displacement hypothesis' (264) suggests that engaging in sedentary behaviours (for example watching television) limits participation in PA. However, a recent meta-analysis found only a small negative association between sedentary behaviour and PA in children and adolescents, providing little support for the displacement hypothesis (265). The authors argue that PA and sedentary behaviour should therefore be considered as separate constructs.

5.1.5 Gender differences in children's physical activity

It is well-established that boys undertake more PA than girls; an analysis of pooled data from 14 studies from the International Children's Accelerometry Database, including 20,871 children aged 4-18 years, found that boys were significantly more active than girls, spending on average 55% more of their time during the day in

MVPA (44). In addition, a systematic review found strong evidence of boys being more active than girls during school breaktimes (252).

5.1.6 Studies conducted in high schools

Although the focus of this thesis is primary schools, it is necessary to have a broad understanding of studies investigating the school effect within high schools. Hale et al (266) examined data from three English longitudinal studies of high school students, to explore school-level variation in several health indicators, including obesity and PA. Multilevel models, adjusted for individual factors, showed that between one and four per cent of variation in obesity and PA could be explained by the school attended. The authors suggest that the low variance in PA could be explained by policy regulations surrounding school-based exercise resulting in very similar practices between schools. Similarly, O'Malley et al (267) investigated the variation in obesity among American high school students by school and school characteristics, and found that three per cent of variation in BMI lies between schools. More variation was found in schools with a low SES, even after controlling for individual SES. In another study, O'Malley et al (268) examined the relationship between high school PA environments and student obesity and activity levels. They found that relationships were not uniformly strong, and that existing variations in school PA policies were not sufficient to produce differences between schools in terms of student obesity and activity levels.

5.1.7 Summary

A review of relevant literature reveals inconclusive evidence of a school effect on children's weight status, and stronger evidence of a school effect on children's PA behaviours. However, findings are largely inconsistent and difficult to compare due to

different study populations and methods of analysis. There is a scarcity of studies investigating school effects on sedentary behaviour in young children.

5.2 Aims and objectives

The aims of this chapter are (1) to examine the differences between schools participating in the West Midlands ActiVe Lifestyle and healthy Eating in School Children (WAVES) study with regard to policies and practices relating to healthy eating (HE) and PA, and (2) to investigate the school effect on weight status and PA and sedentary behaviours of 5-6 year old children. Specific objectives are:

1. To describe baseline data from the WAVES study in terms of (1) children's weight status, PA and sedentary activity levels and (2) school-level factors relating to HE and PA
2. To explore the relative influence of individual- and school-level factors on (1) BMI z-score; (2) time in MVPA, and (3) sedentary time in 5-6 year old children
3. To investigate the association between specific school characteristics related to PA and child activity levels, and to consider any gender differences in these associations

This chapter makes an important contribution to the existing body of evidence regarding the school effect on weight status and PA behaviours of primary school children. To my knowledge, no study has investigated such effects on the PA behaviours of children as young as 5-6 years old.

Within this chapter, through a descriptive and multilevel analysis of individual and school characteristics, overweight/obesity prevalence, PA and sedentary activity levels in 5-6 year old children are investigated. The school-level descriptive analysis includes data on school policy and practices for HE (in addition to school policy and

practices for PA), as this is of relevance for the wider interpretation of the school effect on pupil weight status. However, a multilevel analysis of the associations between school-level factors and individual dietary intake is outside the scope of this thesis, and will be undertaken at a later time point.

Within the analysis of PA levels, MVPA is investigated. Previous research on PA and population health has mainly focused on the health benefits of increasing time spent in MVPA (as opposed to overall, light- or vigorous-intensity PA). MVPA has been shown to be particularly important in improving health outcomes (269), and international agreement and guidelines exist for children to achieve 60 minutes or more of daily MVPA (40). Examining MVPA within this study will facilitate comparisons with other studies. In addition, recent evidence has highlighted the health consequences of sedentary behaviour (including as a potential risk factor for childhood obesity (49, 50)), and has emphasised the need to reduce the time individuals spend sitting down (263). Through investigating sedentary time in- and out-of-school, this study is able to contribute towards this emerging area of research.

5.3 Methods

This study uses data from the WAVES Study; a National Institute for Health Research (NIHR), Health Technology Assessment (HTA) programme-funded cluster randomised controlled trial, being undertaken to assess the effectiveness (and cost-effectiveness) of an intervention programme delivered to school children aged 6-7 years, aiming to encourage maintenance of a healthy weight and thereby prevent overweight and obesity. Details of the WAVES study, including the sampling framework used, are provided in the Introduction Chapter of this thesis (section 1.8), and within the study protocol (135). Data collected at baseline for the WAVES study

(children aged 5-6 years) were used for this analysis. Children from half of the schools (Group 1) underwent baseline measurements in the summer term (April-July) 2011, and the other half (Group 2) in the summer term 2012.

5.3.1 Individual-level data

5.3.1.1 Demographic data

Schools provided data on children's date of birth, sex, ethnicity and home postcode. Children's ethnicity was also acquired from the WAVES study Parent Questionnaire (completed at baseline), from 18 options used in the 2001 Census (270). Children's ethnicity provided by the parent was used in preference to that provided by the school where there were discrepancies. For the purposes of the analysis conducted in this chapter, the 18 ethnicities were categorised into four groups – White, South Asian, Black and Other. Index of Multiple Deprivation (IMD) 2010 scores, assigned to each lower super output area (LSOA), were derived from home postcodes and used as an indicator of area-level deprivation (271). IMD quintiles (formulated using cut-offs derived from the national ranking of LSOA IMD scores) were also assigned; the most deprived group being allocated a value of one and the least deprived a value of five.

5.3.1.2 Anthropometric measures

Height and weight were measured by trained personnel using validated instruments and according to standard protocols (appendices 4 and 5). Height was measured to the nearest 0.1cm using a portable stadiometer (Leicester height measure, UK). Weight was measured to the nearest 0.1kg using Tanita bioimpedance scales (Tanita SC-331S, Japan). From the height and weight data, BMI was calculated in kg/m^2, and converted into a BMI z-score (standard deviation score) based on age-

and sex-specific reference data for the UK (4). BMI z-score was then classified into weight categories according to the British 1990 growth reference (UK90) distribution (4) (underweight: ≤2nd centile; healthy weight: >2nd and <85th centile; overweight: ≥85th and <95th centile; obese: ≥95th centile).

5.3.1.3 Physical activity data

To objectively assess PA, children were fitted with a waterproof combination heart rate and movement sensor (Actiheart, Cambridge Neurotechnology Ltd, Papworth, UK), which they were requested to wear continuously for five days (including a weekend). The Actiheart, validated for use with children as young as three years old (272-274), has been found technically reliable and valid (275). The sensor was set to record heart rate and acceleration in 30-second epochs. From the sensor recordings, accelerometry data were processed using a program developed at the Medical Research Council (MRC) Epidemiology Unit at Cambridge University, and the output was converted into metres per second squared (m/s^2). Only days on which there were at least 10 hours of recorded data were used within the analysis; this has been shown to provide a valid measure of habitual activity in young children (276). Participants were included in the analysis if they provided 10 hours of recorded data on at least one day. Waking hours were defined as 6am to 11pm (277, 278), and data recorded during non-waking hours (11pm to 6am) were removed. Non-wear time data (defined as 90 consecutive minutes of zero acceleration and non-physiological heart rate data) (279) were also removed. From the data, calculations were performed to describe the duration of time (in minutes per day (mins/day) during waking hours) spent sedentary (≤0.075m/s^2), in moderate PA (≥1.75m/s^2 and <5.0m/s^2) and in vigorous PA (≥5.0m/s^2). The moderate and vigorous PA variables were combined to create a variable that described the number of mins/day that were

spent in at least moderate PA (i.e. moderate-vigorous PA (MVPA)). For weekdays, school-time and out-of-school-time PA variables were created, with 9am – 3pm classed as school-time.

5.3.2 School-level data

A School Questionnaire (appendix 6) was developed by the WAVES research team specifically for the WAVES study, and consisted of 36 questions designed to explore the facilities, initiatives and general environment relating to HE and PA in schools. All schools participating in the WAVES study (n=54) were requested to complete the questionnaire at baseline (summer term 2011 for Group 1 schools; summer term 2012 for Group 2 schools). Non-responding schools were given three reminders by post, email and telephone. Some questions from the School Questionnaire were not used in this analysis as they were judged to be poorly completed, or not relevant to this study. Table 5.1 shows School Questionnaire items from which data were used within this study.

Table 5.1: School Questionnaire items from which data were extracted for use within the descriptive and multilevel analyses

Item	Response options
Does the school have a policy for healthy eating and / or physical activity?	Yes / No
How effective is the healthy eating / physical activity policy?	Very effective / moderately effective / has no effect
Healthy eating / physical activity is high on our list of priorities in this school	Strongly agree / agree / neutral / disagree / strongly disagree
To what extent is healthy eating / physical activity supported by school governors / senior leadership team / teachers / teaching support staff / lunchtime supervision staff / other school staff / school council / pupils / parents	Strongly supported / supported / weakly supported / not supported
How is healthy eating actively promoted in school? (tick all that apply)	Not actively promoted / curricular sessions / lunchtime/after school activities / school educational visits / outside visitors / tuck shops / health weeks / activities involving parents / school garden / school cookery club / breakfast clubs / posters/media
How is physical activity actively promoted in school? (tick all that apply)	Not actively promoted / curricular sessions / lunchtime activities / after school activities / school educational visits / health weeks / activities involving parents / school garden / walk to school campaigns / posters/media
What breaktime food provision does your school provide?	Tuck shop / vending machine / provision of free fruit and vegetables for children over 7 years
Curriculum time allocated to PE in Year One per week (minutes)	Number of minutes per week
How difficult is it to deliver the allocated amount of PE per week?	Very difficult / difficult / mostly okay / never a problem
Who teaches PE in the school? (tick all that apply)	Specialist PE teacher / teacher who is not a specialist in PE / adult specialist from outside of the school / other
Duration of breaktimes and lunchtime in school in Key Stage 1 (minutes)	Number of minutes for morning break, lunchtime and afternoon break
Does the school offer any structured physical activity sessions at the following times? (tick all that apply)	Before school starts / at morning break / at lunchtime / at afternoon break / at the start of morning lessons / at the start of afternoon lessons / during none of the above
What facilities / equipment are available for physical activity during breaks and lunchtimes? (tick all that apply)	Playground / playing field / hard court area / playground games / permanent playground equipment / portable play equipment / other
What out-of-school-hours physical activity clubs are available for Year 1?	Free text (individual clubs counted to give total number of clubs available for Year 1)
Is your school part of the National Healthy School Programme?	Yes / No
Does the school offer any healthy lifestyle activities to parents and the wider community?	Yes / No
Does the school support staff development with regards to encouraging healthy lifestyles for children?	Yes / No

PE=physical education

5.3.3 Statistical analysis

All statistical analyses were performed using STATA 13. Individual-level weight status data, and school-level data from the School Questionnaire, were analysed descriptively. To describe the individual-level PA data (i.e. time in MVPA, sedentary time), multilevel regression models were utilised, adjusted for clustering at the school-level, using means with 95% confidence intervals (CIs). These multilevel models were also used to investigate any significant differences in the associations between categorical independent variables (i.e. sex, ethnicity, IMD quintile, weight category) and the dependent variables (i.e. time in MVPA, sedentary time). Reference categories were set as boys (for sex), White (for ethnicity), IMD1 (for IMD quintile) and healthy weight (for weight category). Statistical significance was set at $p<0.05$.

Next, multilevel models were used to investigate the influence of the school on individuals (contextual effects). Models were developed using the XTMIXED command, enabling determination of which (if any) school-level variables (independent variables) had an impact upon the individual-level outcomes (dependent variables), and estimation of the magnitude of any impact. Inclusion of the school as a random effect accounts for the clustered nature of the data (i.e. the potential correlation of observations from pupils in the same school). Using BMI z-score, time in MVPA or sedentary time as the outcome (dependent) variable, two-level models were developed with pupils at Level One, nested within schools at Level Two. The proportion of variance in the model attributed to between-school differences (i.e. the clustering of individual outcomes within schools which might be attributable to contextual school factors) was estimated using intra-class correlation coefficients (ICCs) (280), calculated using the XTMRHO command. School-level

variables were explored as predictors of individual outcome variables. Models were adjusted for sex, ethnicity and deprivation (continuous IMD score). Analyses were sex-stratified to explore any differential effects of explanatory variables on the outcome variables between boys and girls. For all multilevel regression coefficients, 95% CIs were calculated.

5.3.4 Sensitivity analysis

Analyses were repeated using only those participants that provided 10 hours or more of PA data on three or more days (including one weekend day).

5.4 Results

From the 54 participating schools, parental consent to participate in the WAVES study was received for 1,467 children (60% of those eligible). Parental consent was more common among White children compared to other ethnic groups, and among the least deprived group compared to the more deprived groups. Valid height and weight data were obtained for 1,392 children (95% of those consented). Those excluded from the analysis (n=75) had either left the school before the measurement day (n=6), were absent on the measurement day(s) (n=65), or refused the measurements (n=4). Valid PA data (10 hours of recorded data on at least one day) were obtained for 1,052 children (72% of those consented). A summary of PA data availability is shown in Table 5.2. Those excluded from the analysis (n=415) had no parental consent obtained for Actiheart fitting (n=95), had left the school (n=6), were absent on the measurement day(s) (n=65), refused the Actiheart on the measurement day(s) (n=76), or did not provide valid Actiheart data (n=173). School-level data were received from 50 of the 54 participating schools (a questionnaire return rate of 93%), providing school-level data for 1,240 children (85% of those

consented). Both valid PA data and matched school-level data were available for 962 children (66% of those consented). Of the participants providing valid height and weight data (n=1,392), those with both valid PA and matched school-level data (n=962) were more likely than excluded participants (n=430) to be White, and less likely to belong to the most deprived IMD quintile, but were similar in terms of sex, weight status and BMI z-score.

Table 5.2: A summary of physical activity data availability at baseline for the WAVES study

Number of weekdays with ≥10 hours data provided	Number of participants (%)	Number of weekend days with ≥10 hours data provided	Number of participants (%)	Total number of days with ≥10 hours data provided	Number of participants (%)
0	6 (0.6%)	0	147 (14.0%)	1	48 (4.6%)
1	118 (11.2%)	1	134 (12.7%)	2	114 (10.8%)
2	401 (38.1%)	2	771 (73.3%)	3	116 (11.0%)
3	527 (50.1%)			4	316 (30.0%)
				5	458 (43.5%)
Total	1052		1052		1052

Percentages may not add up to 100 due to rounding of numbers

For inclusion, participants needed a minimum availability of 10 hours of recorded data on at least one day (either a weekday or weekend day)

5.4.1 Descriptive analysis – individual-level data

5.4.1.1 Weight status

In the study sample, 8.8% of children were overweight and a further 13.0% were obese, giving a combined overweight/obesity prevalence of 21.8%. Weight status by sex, ethnicity and deprivation are shown in Table 5.3. Overweight and obesity prevalence was higher in boys than girls (24.1% of boys overweight or obese, compared to 19.5% of girls). When examined by ethnicity, the prevalence of overweight and obesity was substantially higher in the Black group. When stratified into IMD quintiles, the prevalence of overweight/obesity was highest in the most deprived group (IMD1).

Table 5.3: Weight status of 5-6 year olds participating in the WAVES study

Characteristic (n, %)	Underweight, n (%)	Normal weight, n (%)	Overweight, n (%)	Obese, n (%)	Overweight/ Obese, n (%)	BMI z-score, mean (SD)
Total, n=1392	41 (2.9)	1047 (75.2)	123 (8.8)	181 (13.0)	304 (21.8)	0.19 (1.22)
Sex, n=1392						
Boys (719, 51.7%)	29 (4.0)	517 (71.9)	68 (9.5)	105 (14.6)	173 (24.1)	0.24 (1.31)
Girls (673, 48.3%)	12 (1.8)	530 (78.8)	55 (8.2)	76 (11.3)	131 (19.5)	0.14 (1.12)
Ethnicity, n=1380						
White (624, 44.8%)	7 (1.1)	494 (79.2)	59 (9.5)	64 (10.3)	123 (19.7)	0.22 (1.05)
South Asian (418, 30.0%)	26 (6.2)	309 (73.9)	31 (7.4)	52 (12.4)	83 (19.9)	-0.02 (1.37)
Black (111, 8.0%)	1 (0.9)	71 (64.0)	12 (10.8)	27 (24.3)	39 (35.1)	0.64 (1.22)
Other (227, 16.3%)	7 (3.1)	164 (72.2)	19 (8.4)	37 (16.3)	56 (24.7)	0.26 (1.32)
IMD quintile[a], n=1376						
1 (764, 54.9%)	30 (3.9)	544 (71.2)	69 (9.0)	121 (15.8)	190 (24.9)	0.21 (1.31)
2 (252, 18.1%)	4 (1.6)	200 (79.4)	23 (9.1)	25 (9.9)	48 (19.0)	0.20 (1.22)
3 (155, 11.1%)	4 (2.6)	119 (76.8)	13 (8.4)	19 (12.3)	32 (20.6)	0.24 (1.11)
4 (116, 8.3%)	1 (0.9)	101 (87.1)	6 (5.2)	8 (6.9)	14 (12.1)	0.08 (0.96)
5 (89, 6.4%)	2 (2.2)	70 (78.7)	10 (11.2)	7 (7.9)	17 (19.1)	0.02 (1.01)

Percentages may not add up to 100 due to rounding of numbers
[a]1st quintile is most deprived
BMI=body mass index; IMD=index of multiple deprivation; SD=standard deviation
Ethnicity data missing for 12 participants; IMD data missing for 16 participants

5.4.1.2 Time spent in MVPA

Table 5.4 presents weekday average daily MVPA during waking hours (6am until 11pm); school-time (9am-3pm) average daily MVPA; non-school-time (6-9am and 3-11pm) average weekday daily MVPA and weekend daily MVPA. Data were stratified by sex, ethnicity, deprivation and weight status. MVPA was significantly higher in boys than girls across all time periods (e.g. for weekday average daily MVPA, boys achieved a mean of 90.1 minutes (95% CI: 84.1, 96.2) compared to 76.2 minutes (95% CI: 70.5, 81.9) for girls ($p<0.0001$)). When stratified by ethnicity, children in the 'Other' group achieved the highest weekday daily MVPA, followed by Black, South Asian and White children. For in-school-time, Black children accumulated more time in MVPA than White or South Asian children. Black children also achieved the highest time in MVPA for weekday out-of-school-time, but the lowest levels at the weekend. When stratified by deprivation, the most deprived group achieved the highest time in weekday daily MVPA, as well as in school-time and weekdays non-school-time, yet had the second lowest MVPA levels at the weekend. Examining MVPA by weight category, underweight children achieved the highest levels of weekday daily MVPA, weekday non-school-time daily MVPA, and weekend daily MVPA followed by healthy weight, overweight and obese children. Within school-time, healthy weight children achieved the highest time in MVPA, followed by underweight, overweight and obese children. Obese children accumulated significantly less time in MVPA than healthy weight children overall, in school-time, and in weekday non-school-time (e.g. for weekday average daily MVPA, obese children achieved a mean of 74.1 minutes (95% CI: 65.6, 82.6) compared to 84.8 minutes (95% CI: 79.1, 90.5) for healthy weight children ($p=0.01$)). Overall, 64% of the study sample achieved an average of over 60 minutes of daily MVPA, with

significantly more boys (72.2% (95% CI: 67.9, 76.5)) achieving this than girls (54.7% (95% CI: 48.8, 60.6)) ($p<0.0001$). Within school-time, children achieved on average 40.5 mins/day of MVPA, which is equivalent to 11% of in-school-time.

Table 5.4: Minutes per day spent being at least moderately physically active among children (aged 5-6 years) participating in the WAVES study

Characteristic (n, %)	Weekday average daily MVPA (mins/day), mean (95% CIs) *n=1052*	p	School-time daily MVPA (mins/day), mean (95% CIs) *6 records missing*	p	Weekday non-school-time MVPA (mins/day) mean (95% CIs) *6 records missing*	p	Weekend MVPA (mins/day), mean (95% CIs) *147 records missing*	p	Achieving ≥60 mins MVPA daily, % mean (95% CIs) *n=1052*	p
Total, n=1052	83.2 (78.1, 88.3)		40.5 (37.1, 44.0)		46.8 (43.4, 50.1)		77.1 (71.4, 82.8)		63.7 (59.2, 68.1)	
Sex, n=1052										
Boys (546, 52%)	90.1 (84.1, 96.2)		44.6 (40.7, 48.4)		50.3 (46.4, 54.2)		83.7 (76.7, 90.7)		72.2 (67.9, 76.5)	
Girls (506, 48%)	76.2 (70.5, 81.9)	<0.0001	36.4 (32.6, 40.2)	<0.0001	43.7 (39.8, 47.5)	0.005	70.2 (64.1, 76.4)	0.002	54.7 (48.8, 60.6)	<0.0001
Ethnicity, n=1045										
White (478, 46%)	79.0 (73.7, 84.4)		39.1 (36.3, 42.0)		43.1 (39.5, 46.6)		75.8 (68.3, 83.3)		62.8 (56.6, 68.9)	
S Asian (323, 31%)	83.6 (76.3, 91.0)	0.857	37.8 (33.3, 42.4)	0.079	49.0 (44.1, 53.9)	0.479	79.4 (71.6, 87.3)	0.848	59.7 (53.9, 65.6)	0.081
Black (71, 7%)	88.6 (72.7, 104.5)	0.316	45.3 (36.3, 54.4)	0.226	53.0 (44.1, 61.9)	0.077	70.2 (52.8, 87.6)	0.519	66.2 (55.2, 77.2)	0.863
Other (173, 17%)	91.3 (79.1, 103.5)	0.113	45.1 (38.5, 51.7)	0.403	51.9 (43.9, 59.9)	0.055	79.0 (68.0, 89.9)	0.674	72.8 (64.5, 81.0)	0.121
IMD quintile[a], n=1039										
1 (562, 54%)	86.9 (79.0, 94.9)		41.7 (36.4, 47.1)		51.2 (46.9, 55.6)		76.1 (68.5, 83.7)		64.4 (59.1, 69.6)	
2 (190, 18%)	78.0 (71.4, 86.6)	0.143	38.4 (34.5, 42.4)	0.260	43.3 (38.2, 48.5)	0.016	75.0 (64.1, 85.8)	0.911	63.2 (53.9, 72.7)	0.963
3 (128, 12%)	81.4 (70.0, 92.8)	0.376	39.8 (33.2, 46.5)	0.262	44.0 (37.0, 51.1)	0.105	81.3 (66.9, 95.7)	0.471	64.7 (53.9, 75.4)	0.797
4 (90, 9%)	74.5 (65.4, 83.5)	0.083	33.6 (29.4, 37.8)	0.035	39.2 (34.2, 44.2)	0.018	76.2 (62.8, 89.6)	0.947	58.6 (47.8, 69.3)	0.539
5 (69, 7%)	81.3 (70.9, 91.6)	0.198	37.8 (31.0, 44.6)	0.115	40.3 (32.2, 48.5)	0.032	85.3 (67.7, 102.9)	0.637	65.3 (51.2, 79.5)	0.986
Weight Category, n=1052										
Underweight (34, 3%)	95.9 (73.9, 118.0)	0.337	39.5 (30.8, 48.2)	0.934	50.6 (39.4, 61.9)	0.921	112.4 (73.2, 151.6)	0.011	61.8 (45.4, 78.1)	0.561
Healthy (793, 75%)	84.8 (79.1, 90.5)		41.7 (38.1, 45.3)		47.7 (43.9, 51.5)		78.1 (71.8, 84.4)		64.5 (59.6, 69.3)	
Overweight (90, 9%)	81.3 (71.4, 91.2)	0.412	37.5 (32.8, 42.2)	0.120	46.7 (40.2, 53.3)	0.584	73.6 (60.8, 86.4)	0.428	66.7 (56.9, 76.4)	0.867
Obese (135, 13%)	74.1 (65.6, 82.6)	0.014	36.2 (31.5, 41.0)	0.024	42.2 (37.1, 47.4)	0.030	67.9 (54.8, 80.9)	0.077	58.9 (49.4, 68.5)	0.122

[a]1st quintile is most deprived

CI=confidence interval; IMD=index of multiple deprivation; MVPA=moderate-vigorous physical activity

Means, with 95% CIs, were obtained from multilevel regression models adjusted for clustering at the school level.

Reference categories: boys (for sex); White (for ethnicity); IMD1 (for IMD quintile); healthy (for weight category)

Ethnicity data missing for 7 participants; IMD data missing for 13 participants

School-time: 9am-3pm

5.4.1.3 Sedentary time

Table 5.5 presents average weekday daily sedentary time during waking hours (6am until 11pm); school-time (9am-3pm) average daily sedentary time; non-school-time (6-9am and 3-11pm) average daily sedentary time and weekend daily sedentary time. Data were stratified by sex, ethnicity and weight status. Girls were consistently more sedentary than boys, both overall and within the different time periods. When stratified by ethnicity, White children were most sedentary overall, as well as in weekday non-school-time and at weekends. South Asian children were significantly less sedentary than White children, both for weekday average daily sedentary time, and for weekend daily sedentary time (e.g. for weekday average daily sedentary time, South Asian children recorded a mean of 408.5 minutes (95% CI: 389.9, 427.1) compared to 436.0 minutes (95% CI: 424.0, 447.9) for White children (p=0.007)). Looking at the data by both deprivation and weight status, there were no consistent trends in sedentary time. Within school-time, children spent on average 108.5 mins/day sedentary. This is the equivalent of 30% of their time in school. By school, the average percentage of time spent in sedentary activities ranged between 16 and 46%.

Table 5.5: Sedentary time among children (aged 5-6 years) participating in the WAVES study

Characteristic (n, %)	Weekday average daily sedentary time (mins/day), mean (95% CIs) *n=1052*	p	School-time daily sedentary time (mins/day), mean (95% CIs) *6 records missing*	p	Weekday non-school-daily sedentary time (mins/day), mean (95% CIs) *6 records missing*	p	Weekend daily sedentary time (mins/day), mean (95% CIs) *147 records missing*	p
Total, n=1052	421.1 (410.6, 431.6)		108.5 (103.1, 113.9)		291.6 (283.9, 299.3)		464.3 (453.5, 475.0)	
Sex, n=1052								
Boys (546, 52%)	414.6 (402.9, 426.4)		106.1 (99.8, 112.4)		286.7 (278.2, 295.1)		458.8 (446.0, 471.6)	
Girls (506, 48%)	426.4 (413.9, 438.9)	0.145	110.9 (105.0, 116.8)	0.156	295.3 (285.8, 304.8)	0.159	469.2 (456.1, 482.3)	0.301
Ethnicity, n=1045								
White (478, 46%)	436.0 (424.0, 447.9)		109.6 (103.6, 115.5)		303.9 (295.5, 312.4)		475.4 (460.4, 490.2)	
S Asian (323, 31%)	408.5 (389.9, 427.1)	0.007	112.5 (103.0, 122.0)	0.175	278.3 (265.8, 290.8)	<0.0001	446.0 (431.3, 460.7)	0.019
Black (71, 7%)	431.8 (403.7, 459.8)	0.873	110.6 (95.8, 125.4)	0.748	292.3 (273.6, 311.0)	0.452	449.4 (464.4, 534.4)	0.145
Other (173, 17%)	406.5 (389.6, 423.4)	0.005	104.2 (96.8, 111.7)	0.506	284.8 (270.8, 298.7)	0.008	456.0 (436.3, 475.7)	0.068
IMD quintile[a], n=1039								
1 (562, 54%)	414.0 (400.4, 427.7)		107.4 (100.4, 114.4)		284.1 (274.8, 293.4)		464.8 (450.2, 479.3)	
2 (190, 18%)	425.2 (406.4, 444.0)	0.465	110.0 (101.1, 118.9)	0.723	293.0 (279.8, 306.1)	0.255	468.9 (448.2, 489.6)	1.000
3 (128, 12%)	428.1 (407.9, 448.3)	0.709	110.8 (100.7, 121.0)	0.552	296.6 (281.2, 312.0)	0.660	463.1 (438.9, 487.2)	0.628
4 (90, 9%)	441.3 (419.0, 463.7)	0.191	113.4 (102.5, 124.4)	0.530	307.3 (290.7, 323.9)	0.113	474.8 (444.7, 505.1)	0.595
5 (69, 7%)	416.6 (394.4, 438.9)	0.588	105.2 (95.1, 115.3)	0.647	301.0 (285.0, 317.0)	0.079	438.4 (411.0, 465.7)	0.202
Weight Category, n=1052								
Underweight (34, 3%)	414.5 (372.5, 456.5)	0.616	111.2 (93.5, 129.0)	0.215	287.8 (259.6, 315.9)	0.587	440.8 (381.2, 500.5)	0.653
Healthy (793, 75%)	420.2 (408.9, 431.4)		107.5 (101.9, 113.0)		291.8 (283.9, 299.7)		462.0 (450.0, 473.9)	
Overweight (90, 9%)	419.5 (397.7, 441.3)	0.831	107.1 (96.7, 117.6)	0.745	287.4 (271.2, 303.6)	0.746	463.5 (436.5, 490.5)	0.847
Obese (135, 13%)	420.7 (401.7, 439.8)	0.702	112.8 (105.2, 120.5)	0.129	287.1 (273.3, 300.8)	0.821	475.8 (449.5, 502.0)	0.231

[a]1st quintile is most deprived

CI=confidence interval; IMD=index of multiple deprivation

Means, with 95% CIs, were obtained from multilevel regression models adjusted for clustering at the school level.

Reference categories: boys (for sex); White (for ethnicity); IMD1 (for IMD quintile); healthy (for weight category)

Ethnicity data missing for 7 participants; IMD data missing for 13 participants

School-time: 9am-3pm

5.4.2 Descriptive analysis – school-level data

Questionnaires (n=50) were completed by the headteacher (n=21), deputy headteacher (n=12), PSHE coordinator (n=8), class teacher (n=6), or school administrator (n=2). One respondent did not report their position in school.

5.4.2.1 Policies

Nearly all schools (96%) reported having a PA policy, with just over three quarters (78%) having a food policy. When present, food policies were perceived as very effective by 36% of respondents with the remainder considering their policy moderately effective. A greater proportion of respondents perceived their PA policy to be very effective (50%); all but one of the other respondents reported moderate effect.

Regarding the priority given by schools to HE and PA, 92% either strongly agreed (39%) or agreed that HE was high on the list of priorities for their school. The same proportion (92%) agreed that PA was high on the priority list, but a greater proportion (54%) strongly agreed that this was the case.

On the subject of support from the different school stakeholders for HE and PA (Table 5.6), respondents perceive HE and PA to be largely supported, although 27% of schools reported only weak support from parents for HE.

Table 5.6: Perceived school stakeholder support for healthy eating and physical activity

School stakeholder	*Support for Healthy Eating*					*Support for Physical Activity*				
	Strongly supported (%)	Supported (%)	Weakly supported (%)	Not supported (%)	Missing (n)	Strongly supported (%)	Supported (%)	Weakly supported (%)	Not supported (%)	Missing (n)
School governors	17 (34.7)	29 (59.2)	3 (6.1)	0 (0)	1	21 (43.8)	27 (56.3)	0 (0)	0 (0)	2
Senior Leadership Team	28 (58.3)	20 (41.7)	0 (0)	0 (0)	2	31 (64.6)	17 (35.4)	0 (0)	0 (0)	2
Teachers	24 (52.2)	22 (47.8)	0 (0)	0 (0)	4	29 (60.4)	19 (39.6)	0 (0)	0 (0)	2
Teaching support staff	23 (47.9)	25 (52.1)	0 (0)	0 (0)	2	27 (56.3)	21 (43.8)	0 (0)	0 (0)	2
Lunchtime staff	25 (52.1)	23 (47.9)	0 (0)	0 (0)	2	23 (47.9)	22 (45.8)	3 (6.3)	0 (0)	2
Other school staff	15 (34.1)	28 (63.6)	1 (1.9)	0 (0)	6	22 (46.8)	24 (51.1)	0 (0)	1 (0.2)	3
School Council	21 (43.8)	25 (52.1)	2 (4.2)	0 (0)	2	24 (51.1)	23 (48.9)	0 (0)	0 (0)	3
Pupils	9 (18.8)	34 (70.1)	5 (10.4)	0 (0)	2	27 (56.3)	21 (43.8)	0 (0)	0 (0)	2
Parents	4 (8.3)	31 (64.6)	13 (27.1)	0 (0)	2	12 (25.0)	32 (66.7)	4 (8.3)	0 (0)	2

5.4.2.2 Promotion of healthy eating

Respondents were asked to report ways in which their school actively promotes HE, using pre-defined responses. Lunchtime/after-school activities (84% of schools), and curricular sessions (80%) were the most commonly selected responses, followed by: breakfast clubs (71%), school garden (61%), outside visitors (55%), tuck shops (49%), health weeks (45%), activities involving parents (47%), cookery club (43%), posters/media (40%) and educational visits (35%). The number of response categories selected ranged from two to ten with a mean number of six.

5.4.2.3 Promotion of physical activity

The ways in which WAVES study schools actively promote PA was explored through a question with nine predetermined response options. After-school activities was the most commonly selected response (96% of schools), followed by curricular sessions (88%), lunchtime activities (86%), educational visits (80%), walk to school initiatives (71%), health weeks (59%), school garden (45%), posters/media (41%), and activities involving parents (35%). The number of response options selected ranged from one to nine, with a mean number of six.

5.4.2.4 School food provision

All respondents reported that their school provided hot school meals, with 82% of schools having their school meals cooked on site. All schools provided water to pupils throughout the school day. Fifty-seven per cent of schools provided a tuck shop for pupils at breaktime, and 33% provided free fruit/vegetables for children over the age of seven years. Only seven per cent of schools reported receiving any kind of sponsorship relating to food and drink, and no schools had a vending machine.

5.4.2.5 School PE and breaktime provision

PE and breaktime provision for Year 1 children (aged 5-6 years) in the WAVES study schools is summarised in Table 5.7. The amount of PE that schools provided ranged from 30 to 180 minutes per week, with a mean provision of 115 minutes. The majority of schools (n=35; 70%) provided 120 minutes of PE per week. Only four schools provided more than this. Respondents were asked to rate the difficulty in providing the allocated amount of PE each week. Whilst no respondents reported the delivery as 'very difficult', 21% reported it to be 'difficult', 56% 'mostly okay' and 23% 'never a problem'. When asked who teaches PE, 35% of participants reported a specialist PE teacher, 92% reported a teacher who is not a PE specialist, and 41% reported an adult specialist from outside of school. In some schools it appears that PE provision was undertaken by multiple personnel as some respondents ticked more than one box.

Total breaktime (including lunchtime) in schools ranged from 60 to 120 minutes, with a mean of 87 minutes per day. Thirty-four respondents (69%) reported that their school had an afternoon break.

Table 5.7: PE and breaktime provision for Year 1 children (aged 5-6 years) in schools participating in the WAVES study

School Physical Activity Characteristic	Mean (SD)	Median (IQR)
PE (mins/week)	115.1 (23.3)	120 (120-120)
Total breaktime, including lunchtime (mins/day)	86.9 (12.5)	90 (80-90)
Total PE and breaktimes (hours/week)	9.1 (1.1)	9.08 (8.67-9.92)

PE: physical education; SD: standard deviation; IQR: inter-quartile range

5.4.2.6 Structured physical activity sessions

Schools were asked when they offered any structured PA sessions (additional to PE). Lunchtime was the most commonly reported opportunity for sessions (67% of

schools), followed by before school starts (29% of schools), at the start of morning lessons (16% of schools), at the start of afternoon lessons (10% of schools), morning break (10% of schools), and afternoon break (4% of schools).

5.4.2.7 Physical activity facilities and equipment

All schools reported having a playground available for pupils. In addition, the majority reported having: portable play equipment (92%); permanent playground equipment (90%); playing fields (78%); playground games (78%); a hard court area (69%).

5.4.2.8 Out-of-school-hours physical activity clubs

The number of out-of-school-hours PA clubs reported to be available to children at school ranged from 1 to 15, with a mean of 5. The number of clubs available for Year 1 children ranged from 0 to 6, with a mean of 2. Twenty-four per cent of schools reported no clubs available for Year 1 children.

5.4.2.9 Other healthy lifestyles initiatives

Ninety-six per cent of respondents reported their school to be part of the National Healthy Schools Programme. Forty-nine per cent of respondents reported their school to offer healthy lifestyle initiatives to parents and the wider community. In addition, 83% reported that their school supports staff development with regards to healthy lifestyles.

5.4.3 Multilevel analysis

Results of the multilevel analysis exploring school effects on pupil BMI z-score, time spent in MVPA and sedentary time are summarised in Table 5.8. The null model (adjusted for sex, ethnicity and deprivation) with pupil BMI z-score as the outcome variable showed no significant random effect for school (χ^2=0.01, p=0.46). Models adjusted for sex, ethnicity and deprivation showed significant school effects on pupil

activity levels, in respect of both overall MVPA (χ^2=22.70, p<0.0001) and sedentary time (χ^2=28.71, p<0.0001). When the outcome variables were split into school-time, non-school-time and weekend time, models remained significant for both MVPA and sedentary time across all three time periods. These results indicate a significant school effect on pupil activity levels both within and outside of school, with the strongest effects for in-school-time. Adjusted ICCs indicate that within school time, 12.9% of the variation in pupil MVPA, and 13.5% of the variation in pupil sedentary time, can be ascribed to between-school variation. These findings demonstrate that there is an effect at the school level which influences the amount of MVPA and sedentary activity that children undertake.

Table 5.8: School effects on pupil BMI z-score, time spent in MVPA and sedentary time

Outcome	ICC	ICC adjusted*	Random effect (χ^2) adjusted*	p
BMI z-score	0.003	0.0007	0.01	0.46
Weekday average daily time in MVPA	0.071	0.063	22.70	<0.0001
School-time daily MVPA	0.145	0.129	59.58	<0.0001
Weekday non-school-time daily MVPA	0.069	0.051	15.26	<0.0001
Weekend daily MVPA	0.053	0.051	15.90	<0.0001
Weekday average daily sedentary time	0.093	0.069	28.71	<0.0001
School-time daily sedentary time	0.141	0.135	72.50	<0.0001
Weekday non-school daily sedentary time	0.094	0.063	21.18	<0.0001
Weekend daily sedentary time	0.050	0.037	9.68	<0.0001

*adjusted for sex, ethnicity and deprivation; school as a random effect
BMI: body mass index; MVPA: moderate-vigorous physical activity; ICC: intra-class correlation coefficient
School-time: 9am-3pm; Non-school-time: 6am-9am and 3pm-11pm

School-level explanatory variables were added into the MVPA and sedentary time models as fixed effects. Variables included reported hours per week allocated to Year 1 children for: 1) PE *(PE Time)*; 2) Breaks (total time spent in breaks including morning break, lunchtime break, and afternoon break (if any)) *(breaktime)*, and 3) PE and breaks combined *(PE and breaktime)*. Models were considered both overall and by sex. Both PE and breaktime have previously been associated with levels of PA in children, and the cross-sectional analysis revealed there to be a range of values by school. The PE and breaktime combined variable was created to explore the associations between individual outcomes and the total number of hours of in-school PA opportunity provided per week.

Table 5.9 presents results for the MVPA models. Although not reaching statistical significance, the coefficients (B) for the school-level variables, in the overall model for total weekday average daily MVPA, were all positive, indicating a non-significant positive relationship between school opportunities for PA and children's weekday average daily MVPA.

Within the school-time MVPA models for all children, the regression coefficients for school-time allocated for breaks (B=3.67 mins/day (0.54, 6.80), p=0.02), and combined school-time allocated for PE/breaks (B=3.28 mins/day (0.70, 5.86), p=0.01) are positive and significant. To illustrate, the coefficient (B) of 3.67 for breaktime indicates that for every additional hour per week of breaktime, children's school-time MVPA increases by 3.67 mins/day. In addition, the coefficient for the PE time variable was positive and approaching statistical significance (B=7.53 mins/day (-0.61, 15.67), p=0.07). These findings suggest that children's levels of school-time MVPA increase as school opportunities for PA increase.

The relationship between school-time provision of opportunities for PA and children's MVPA during weekday non-school-time and at weekends is inconsistent and non-significant, suggesting no substantial evidence of compensation for higher levels of in-school MVPA with lower levels of out-of-school MVPA.

The sex-stratified analyses reveal gender differences. Positive, significant relationships between school-time MVPA and both breaktime (B=5.25 mins/day (1.49, 9.01), p=0.01), and PE/breaks combined (B=4.68 mins/day (1.59, 7.77), p=0.003), remain only for boys. The relationship between PE time and boys' school-time MVPA is also significant (B=10.67 mins/day (1.29, 20.05), p=0.03). The coefficient values (B) in these models indicate that for every additional hour of PE, breaktime, or PE/breaktime combined per week, boys achieve 10.67, 5.25 and 4.68 minutes per day of additional MVPA respectively. For girls, relationships between school opportunities for PA and school-time MVPA are still positive, but coefficient values (B) are lower and non-significant.

In respect of weekday average daily MVPA, the relationship with school opportunities for PA remains positive (although non-significant) for boys, but inconsistent for girls. The associations with school opportunities for PA and non-school-time weekday MVPA remain inconsistent for boys and girls. For weekend MVPA, there is a positive, non-significant relationship with school opportunities in boys, but a negative, non-significant relationship in girls.

Taken overall, these findings indicate stronger, more positive relationships between school opportunities for PA and MVPA in boys than in girls.

Table 5.9: Coefficients for school-level variables when tested in MVPA models adjusted for individual level factors, overall and stratified by sex

	Weekday average daily MVPA B (95% CI)	p	School-time daily MVPA B (95% CI)	p	Weekday non-school-time daily MVPA B (95% CI)	p	Weekend daily MVPA B (95% CI)	p
All								
PE time (hours/week)	7.45 (-5.85, 20.75)	0.27	7.53 (-0.61, 15.67)	0.07	0.69 (-7.60, 8.97)	0.87	3.01 (-13.19, 19.21)	0.72
Breaktime (hours/week)	2.22 (-2.99, 7.42)	0.40	3.67 (0.54, 6.80)	0.02	-0.33 (-3.60, 2.93)	0.84	-0.58 (-6.74, 5.57)	0.85
PE and breaktime (hours/week)	2.24 (-2.20, 6.67)	0.32	3.28 (0.70, 5.86)	0.01	-0.20 (-2.96, 2.55)	0.89	-0.06 (-5.45, 5.32)	0.98
Boys								
PE time (hours/week)	12.68 (-3.23, 28.59)	0.12	10.67 (1.29, 20.05)	0.03	4.42 (-5.84, 14.69)	0.40	3.88 (-16.05, 23.81)	0.70
Breaktime (hours/week)	3.47 (-2.93, 9.88)	0.29	5.25 (1.49, 9.01)	0.01	-0.40 (-4.49, 3.69)	0.85	0.72 (-7.21, 8.66)	0.86
PE and breaktime (hours/week)	3.80 (-1.77, 9.37)	0.18	4.68 (1.59, 7.77)	0.003	0.27 (-3.32, 3.86)	0.88	1.12 (-5.82, 8.05)	0.75
Girls								
PE time (hours/week)	-2.46 (-17.40, 12.48)	0.75	2.84 (-5.72, 11.41)	0.52	-5.99 (-15.36, 3.38)	0.21	-1.49 (-19.92, 16.95)	0.87
Breaktime (hours/week)	1.16 (-4.93, 7.25)	0.71	2.32 (-1.06, 5.69)	0.18	0.78 (-3.89, 4.05)	0.97	-2.87 (-9.87, 4.13)	0.42
PE and breaktime (hours/week)	0.34 (-4.60, 5.27)	0.89	1.82 (-0.92, 4.56)	0.19	-0.72 (-3.86, 2.42)	0.65	-2.26 (-8.20, 3.67)	0.45

School-time: 9am-3pm; Non-school-time: 6am-9am and 3pm-11pm. PE: physical education; MVPA: moderate-vigorous physical activity.
Breaktime: total time spent in breaks including morning break, lunchtime break, and afternoon break (if any).

Table 5.10 shows results for the sedentary time models. For weekday average daily sedentary time for all pupils, there is a non-significant, positive relationship between school opportunities for PA and sedentary time, indicating a possibility that as opportunities for PA increase within school, so does overall sedentary time. When stratified by sex, however, it appears that this positive relationship exists only for girls; for boys, there is a negative, though still non-significant, relationship.

School-time sedentary models reveal non-significant negative relationships between school opportunities for PA, and pupils' in-school sedentary time. When stratified by sex, this non-significant negative relationship remains, with the exception of the relationship between girls' in-school sedentary time and PE time. The negative relationships between boys' school-time sedentary time and school provision of both breaktime (B=-5.34 mins/day (-11.71,1.04) p=0.10) and PE/breaktime combined (B=-4.71 mins/day (-10.29, 0.88), p=0.10) are approaching significance.

The models for weekday non-school sedentary time reveal that for girls, there is a positive significant association between school provision of PE/breaks combined and non-school sedentary time (B=8.89 mins/day (1.00, 16.79), p=0.027). The coefficient (B) of 8.89 indicates that for each additional hour of PE/breaks combined per week, girls accumulate an additional 8.89 minutes of weekday non-school sedentary time per day. In addition, the associations between girls' weekday non-school sedentary time and both PE time (B=24.47 mins/day (0.03, 48.90), p=0.05) and breaktime (8.12 mins/day (-1.14, 17.40), p=0.086) were positive and approaching significance. Similar, though non-significant, positive relationships exist between school opportunities for PA and girls' sedentary time at weekends. For boys, however, relationships between school opportunities for PA and both non-school sedentary time and weekend sedentary time were negative (with the exception of a positive

relationship between breaktime and boys' non-school sedentary time), although none of the relationships for boys were statistically significant.

Taken as a whole, these results suggest that within school-time, there is a general trend of decreasing sedentary behaviour with more school opportunities for PA. However, both overall and outside of school-time, it appears that school opportunities for PA are somewhat associated with less sedentary behaviour in boys, but the opposite in girls.

5.4.4 Sensitivity analysis

Sensitivity analysis, using data on only those who had valid PA data for 3 or more days (n=703 compared with n= 962 in the full analysis), did not change the overall results. The direction and size of effect remained unchanged for all analyses, although some associations were no longer statistically significant due to loss of power.

Table 5.10: Coefficients for school-level variables when tested in sedentary time models adjusted for individual-level factors, overall and stratified by sex

	Weekday average daily sedentary time B (95% CI)	p	School-time daily sedentary time B (95% CI)	p	Weekday non-school daily sedentary time B (95% CI)	p	Weekend daily sedentary time B (95% CI)	p
All								
PE time (hours/week)	2.88 (-23.50, 29.25)	0.83	-0.27 (-14.69, 14.16)	0.97	7.15 (-11.43, 25.72)	0.45	-0.02 (-29.01, 28.96)	0.99
Breaktime (hours/week)	3.19 (-6.71, 13.10)	0.53	-4.04 (-9.31, 1.23)	0.13	5.35 (-1.65, 12.35)	0.13	3.80 (-7.23, 14.83)	0.50
PE and break time (hours/week)	2.67 (-6.03, 11.38)	0.55	-3.13 (-7.74, 1.48)	0.18	4.47 (-1.65, 10.58)	0.15	2.72 (-6.96, 12.39)	0.58
Boys								
PE time (hours/week)	-8.96 (-38.50, 20.59)	0.55	-3.74 (-20.68, 13.20)	0.67	-5.48 (-25.87, 14.90)	0.60	-5.65 (-40.13, 28.82)	0.75
Breaktime (hours/week)	-2.61 (-14.34, 9.12)	0.66	-5.34 (-11.71, 1.04)	0.10	1.68 (-6.56, 9.92)	0.69	-1.05 (-15.05, 12.95)	0.88
PE and break time (hours/week)	-3.57 (-13.75, 6.61)	0.49	-4.71 (-10.29, 0.88)	0.10	-0.17 (-7.26, 6.92)	0.96	-2.18 (-14.29, 9.93)	0.72
Girls								
PE time (hours/week)	22.01 (-10.89, 54.91)	0.19	3.89 (-11.41, 19.18)	0.62	24.47 (0.03, 48.90)	0.05	14.54 (-23.65, 52.72)	0.46
Breaktime (hours/week)	7.48 (-4.98, 19.95)	0.24	-4.11 (-9.85, 1.64)	0.16	8.12 (-1.14, 17.40)	0.086	9.68 (-4.32, 23.68)	0.18
PE and break time (hours/week)	8.57 (-2.08, 19.22)	0.12	-2.18 (-7.04, 2.67)	0.38	8.89 (1.00, 16.79)	0.027	9.13 (-3.01, 21.27)	0.14

School-time: 9am-3pm; Non-school-time: 6am-9am and 3pm-11pm. PE: physical education; MVPA: moderate-vigorous physical activity.
Breaktime: total time spent in breaks including morning break, lunchtime break, and afternoon break (if any).

5.5 Discussion

This study investigated variation in policies and practices relating to HE and PA in a sample of primary schools in the West Midlands, UK, and examined the school effect on weight status, MVPA and sedentary time in 5-6 year old children.

No significant school effect on children's BMI z-score was found. This adds to previous inconsistent findings from UK cross-sectional studies (234-236), and could point to the importance of individual and non-school factors (for example the family environment), rather than school-level factors, in contributing towards variation in weight status. An alternative explanation for the lack of school effect on children's weight status could be the low variation among schools in respect of their policies and practices relating to HE and PA (in this study, exemplified by almost blanket participation in the National Healthy School Programme). It may be that all schools exert a similar influence on pupil weight status, rather than having no or little effect. Results from the school-level cross-sectional analysis within this study clearly demonstrate that schools were essentially committed to promoting health, and were undertaking a wide variety of initiatives to encourage HE and PA. Some variation was, however, shown between schools in terms of their policies and practices. In particular, time allocation for PE and breaktimes was shown to vary substantially between schools (for example, total breaktime ranged from 60 to 120 minutes per day), demonstrating a considerable difference between schools regarding children's opportunities to be physically active.

Our finding of a significant school effect on children's MVPA levels both within and outside of school is consistent with a study of 9- and 15-year-old Danish children (238). Indeed, the ICCs for both within and outside of school are comparable with

both those of Kristensen et al (238), and Faulkner et al (240) who studied the school effect on overall activity in 11-year-old Canadian children. Our findings add to the evidence base by showing a similar school effect in much younger children.

With regards to the school effect on children's MVPA levels outside of school hours, a possible explanation is that children are using school PA facilities or clubs out-of-school hours, or that schools with greater time opportunities for PA also tend to more highly promote PA out-of-school-time. It could reflect school policies regarding, or local environmental influences on, active travel to and from school. It could also suggest the importance of psychosocial factors, for example continued social interactions between school friends outside of school-time. Kristensen et al (238) undertook their study within a small geographical area with common environmental influences. They postulated that this could have under-estimated the importance of the physical environment, and that higher ICCs might be found if the study was replicated over a wider area. Our study was carried out over a wide geographical area encompassing nine local authorities and thus greater variation in the physical environment. The fact that we found very similar ICCs to Kristensen et al (238) could indicate that it is not necessarily the physical environment that is important, rather the psychosocial aspects.

This study reveals a positive significant relationship between school opportunities for PA (breaktimes and PE/breaktimes combined) and children's levels of school-time MVPA (an increase in school-time MVPA of 3.67 minutes per day for every additional hour of breaktime per week), with a weaker relationship for overall daily MVPA (2.22 minutes per day, 95% CIs -2.99, 7.42). Metcalf et al (258), in a systematic review and meta-analysis reported that PA interventions in children result in an increase in overall MVPA of around four minutes per day. This is comparable to

our finding, indicating that the provision of extra breaktime within primary schools may be a relatively cheap and effective way of increasing MVPA in children. Such school-level interventions could be introduced through changes in policy regarding school breaktime provision (248). However, sex stratified analysis of our data showed that the significant relationship between school opportunities for PA and in-school MVPA was only present in boys. Even at the age of 5-6 years, gender differences in school-time MVPA are apparent. Our analysis suggests that an intervention to increase breaktime provision would only have the potential to significantly improve levels of MVPA in boys. Finding ways to improve levels of MVPA in girls at school breaktimes should therefore be seen as a priority.

Results from our analysis of sedentary time are largely consistent with previous studies, with girls more sedentary than boys (237), and children more sedentary at weekends than on weekdays (281, 282). There were no significant differences in sedentary time by weight status; inconsistent relationships between sedentary time and weight status in older primary school children have previously been reported (237). Few studies have considered the school effect on sedentary time. Van Stralen et al (237), in their study of European primary school children aged 10-12 years, reported a school effect on in-school sedentary time with an ICC of 0.26. Our respective adjusted ICC is 0.135, indicating a lesser, but still significant effect within our younger sample (13.5% of variation in pupil sedentary time attributed to between-school variation in our study compared to 26% in the European study).

Within our study, children spent on average 30% of their time in school engaged in sedentary behaviour. This figure is considerably lower than previous studies in older children. Van Stralen et al (237) found that 10-12 year olds spent 65% of their time in school in sedentary activities. Likewise, Van Sluijs et al (283) reported that UK 10-

year-old children were sedentary for 62-70% of their time in school. One possible reason for our contrasting finding could be that the school curriculum for 5-6-year-olds is less academic in focus and permits more movement, active learning and breaks compared to the curriculum for older children. Although it may therefore appear within this younger age group that there is no great need for schools to further reduce sedentary behaviour, there still exists considerable variation between schools, evidenced by the significant school effect (ICC), and the average percentage of time in school spent in sedentary activities ranging between 16 and 46%. This is an under-studied area, and further research is required to investigate (1) the changes in children's in-school sedentary time as they progress throughout primary school, and (2) the relationship between school policies and practices and individual behaviours, in particular the opportunities provided for PA or sedentary breaks.

Within this study, we found no consistent evidence of compensation (as per the Activitystat hypothesis (257)). For example, school PA opportunities were positively and significantly associated with children's school-time MVPA, and although associations with overall MVPA were non-significant, they were positive, with no corresponding negative associations with out-of-school MVPA. Notwithstanding, the positive associations between school PA opportunities and girls' out-of-school sedentary time (significant for PE/breaks combined) is concerning and warrants further investigation.

5.5.1 Strengths and limitations

Major strengths of this study are the large, diverse sample of 5-6 year old children from 54 schools, and the use of an objective and validated method of measuring PA.

Splitting the PA data into different time periods enabled comparison between children's in-school and out-of-school PA.

There are also a number of limitations of the study which must be considered. The cross-sectional design of the study means that causality cannot be inferred in any associations between school characteristics and pupil outcomes. A longitudinal study design would help explore causality.

The possibility of response bias must be taken into account. Parental consent for children to participate in the WAVES study measurements was obtained for 60% of those eligible, and valid PA data were obtained for 72% of those consented. Parental consent was more common among White children compared to other ethnic groups, and among the least deprived group compared to the more deprived groups. For the multilevel analysis, included participants (n=962) were also more likely than excluded participants to be White, and less likely to belong to the most deprived IMD quintile. These factors could have led to a slight overestimation of both sedentary activity outside of school time (as in this sample, White children are more sedentary compared to other ethnic groups), and non-school weekday MVPA (as within this sample less deprived groups do less non-school weekday MVPA compared to more deprived groups). In addition, 55% of the WAVES study sample was made up of children from the most deprived group, meaning that the results may not be generalisable to more affluent areas.

With the PA data, 'waking hours' was set as 6am to 11pm. It must be borne in mind (particularly when examining the out-of-school sedentary time) that many of the children within the study would have been asleep for some of this time. School time was set as 9am-3pm, whereas in reality the precise start and end times vary by

school. Therefore, in some cases school-time activity may have been categorised as out-of-school-time, and vice versa. It should also be noted that from our data it was not possible to ascertain actual levels of PA within breaktimes and PE.

Within the multilevel analysis, we adjusted for sex, ethnicity and deprivation. There may have been other confounders that we did not control for. In addition, although all data collection took place within the summer term, it was not possible to control for weather conditions as this data was not collected. Rainy days have previously been shown to reduce children's PA levels, both overall and at school breaktimes (284).

Use of a non-validated school questionnaire, completed by school personnel, to collect the school-level data has limitations. The non-receipt of a completed questionnaire from four of the 54 schools participating in the WAVES study could have resulted in non-response bias where the results of the non-participating schools may have been different from the results of the participating schools. Within the questionnaire, respondents indicated the length of time allocated to PE and breaktimes within their school timetables. However, within this study, it was not possible to measure the actual amount of time that schools provided in practice during the period of PA data collection, which could have resulted in data inaccuracies. Also, the inclusion of lunchtime (alongside morning and afternoon breaks) in the 'breaktime' variable means that any time spent eating or queuing will have been included in this variable. Individual schools have different routines in place over the lunchtime and breaktime periods (affecting the actual time period available to children to be physically active), and we were unable to control for this in the investigation of between-school variation. Nevertheless, the finding that in general PA levels were higher among children in schools with greater time allocated to PE and breaks suggests that reported times are likely to be valid.

5.6 Conclusions

Although no evidence was found for a school effect on children's BMI, findings indicate that differences exist between schools in terms of time allocation for PA which have associations with children's (and especially boys') levels of PA. We believe this study is the first to provide evidence of a school effect on the time spent in MVPA and sedentary time of 5-6 year old children. These findings suggest that schools should be supported to maximise the opportunities they provide for increasing PA and decreasing sedentary behaviours, particularly among girls.

However, considering that children in this study accumulated the least MVPA and most sedentary time at weekends, strategies to promote activity at weekends should also be prioritised.

CHAPTER 6

6.0 DISCUSSION AND CONCLUSIONS

This chapter aims to bring together findings from the four research studies reported within this thesis and provide overall conclusions. Following a brief summary of the thesis, the contribution to knowledge and implications of the findings are described. Next, overall strengths and limitations of the thesis are outlined before a discussion of ideas for future research. Finally, conclusions of the thesis are presented.

6.1 Thesis summary

The research for this thesis adopted a mixed-methods approach to investigate the role of the primary school in preventing childhood obesity. Specifically, the thesis aims were: (1) to review evidence of stakeholder views on the role of the primary school in preventing childhood obesity, (2) to investigate headteacher perspectives on the primary school role in childhood obesity prevention, (3) to consider experiences of parents and children participating in an obesity prevention intervention programme, (4) to explore variation in school policy and practice relating to food and physical activity (PA) environments, and (5) to examine variation between schools in prevalence of childhood obesity and children's PA behaviours, and explore school factors that contribute to any variation.

6.2 What this thesis contributes

The systematic review presented in Chapter 2 is the first to synthesise views from a wide range of school stakeholders on the role of the primary school in preventing childhood obesity and demonstrates clear support for the key role that schools have to play. In particular, the review suggests that schools have an important role in

promoting consistent messages, both throughout the school day and between school and home. Primary schools are in a position to be able to reach and work with families, seen as paramount in preventing obesity, yet this is an area where appropriate provision of assistance to schools is not available. The review concludes with a call for government priority and support for schools in maximising their role in preventing obesity.

The qualitative investigation of headteacher views (Chapter 3) fills a research gap identified within the systematic review, and furthers our understanding of obesity prevention in schools from this unique perspective. The study reveals that headteachers consider obesity prevention within the context of the holistic development of the child, and can clearly see links between health and education. The recruitment of participants from schools serving ethnically and socio-economically diverse communities enables exploration of differences in headteacher perceptions based on the communities they serve. Headteachers from schools in deprived locations perceived the need to work with and support parents on obesity prevention more strongly, and called for greater external support to help them tackle the complex issues relating to childhood obesity. This suggests a requirement for school-based support to target those school communities in most need.

In Chapter 4 a further qualitative study explores the experiences of parents and children involved in the West Midlands ActiVe lifestyle and healthy Eating in School children (WAVES) study intervention programme. This study addresses an identified research gap through reporting participant views in the evaluation phase of an obesity prevention intervention, which also have wider relevance to future childhood obesity prevention. The study demonstrates the potential of the intervention to initiate behaviour change within families. The ‘power of the teacher’ is seen as

influential in empowering families to make changes. Adding to findings from Chapter 3, socio-economic disparities emerge as a likely source of differential intervention effects, with a seemingly greater impact on more deprived families. Sustainability of behaviour change following a one-year intervention is raised as a concern.

Chapter 5 describes overweight and obesity prevalence and PA levels in 5-6 year old children participating in the WAVES study, as well as school-level characteristics relating to healthy eating (HE) and PA policy and practice. A multilevel analysis examines the relationship between school-level characteristics and pupil outcomes in terms of weight status and levels of PA. An investigation of 'school effects' finds no significant effect on weight status, but significant effects on time spent in moderate-vigorous physical activity (MVPA) and sedentary behaviour. Multilevel analysis of the relationship between school opportunities for PA (i.e. time for physical education (PE) and breaktimes) and children's MVPA reveals a positive relationship, which is significant for in-school MVPA. Gender differences are discovered, with school opportunities for PA showing a much stronger relationship with boys' than girls' MVPA. Findings for the multilevel analysis of the relationship between school opportunities for PA and children's sedentary behaviour suggest that within school-time, there is a general trend of decreasing sedentary behaviour with more school opportunities for PA. However, for average daily weekday sedentary time, and non-school daily sedentary time models, the coefficients (although non-significant) suggest that increased school opportunities for PA could be associated with less sedentary behaviour in boys, but more sedentary behaviour in girls. The impact of school PA opportunity on sedentary behaviour in boys and girls requires further investigation.

6.3 Implications of findings

This thesis adds to findings from previous studies indicating the important potential contribution that primary schools can make to childhood obesity prevention (91-93). Data from both the headteacher interviews and the descriptive school-level analysis show that primary schools in the West Midlands contribute to the promotion of HE and PA (and thereby the prevention of childhood obesity) in many different ways, and there was a general desire amongst headteachers to do more to promote health. The studies also discovered considerable variation in practice between schools, for example in the time allocation for PE or breaktime, the provision of extra-curricular activities, and in approaches to working with parents. This variation could partly be explained by differences in perceived needs, for instance some headteachers felt it was essential to work with parents to promote consistency of healthy lifestyle messages between school and home, whereas others did not perceive such a need. Several barriers were also reported (within the systematic review and the headteacher interviews) that prevented schools from expanding their role in obesity prevention. Some of these could be seen as universal barriers (e.g. time pressures of the curriculum); others were more school-specific (e.g. lack of cooking facilities). To maximise their involvement in obesity prevention, schools require both universal (i.e. government) and more local, targeted support to overcome these hurdles.

Findings from the multilevel analysis conducted within this thesis show that individual-level factors account for much more of the variation in children's weight status and PA levels than school-level factors, indicating that (and consistent with earlier studies (235, 236, 238)) out-of-school environments are of greater importance than the school in the development of obesity and the promotion of PA. In addition, qualitative evidence from Chapters 2, 3 and 4 clearly demonstrates stakeholder

beliefs that parents hold the main responsibility for obesity prevention in their children. Furthermore (and previously reported (281)), analysis of child activity levels in this study shows that children engage in less MVPA and more sedentary behaviour at weekends than on school days. Together, these findings point to a need for obesity prevention efforts to be targeted more 'downstream' towards parents and more 'upstream' towards the wider external obesogenic environment than towards schools. Nevertheless, the unique position of primary schools in their long-term, and often in-depth, contact with parents makes them a potentially ideal location for providing obesity prevention support to families.

Many schools (including almost half of the schools surveyed within this study) involve parents and/or the wider community in healthy lifestyles initiatives, which reviews have shown enhances the effectiveness of school-based interventions (114, 285, 286). Equally, within the headteacher interviews, many participants discussed working with parents as one of the roles of the school in preventing obesity. Findings from the parent focus groups echoed those from the headteacher interviews in reporting the crucial role of the home-school partnership in promoting consistent messages to children. Yet, within schools, working with parents on health promotion activities is often piecemeal: schools struggle to engage with many parents, due to work commitments or lack of interest, and don't have the capacity to support all parents. Evidence from the literature regarding parental involvement and engagement in school-based obesity prevention is inconclusive. In a systematic review, Van Lippevelde et al (287) report conflicting evidence of the effectiveness of parental involvement in school-based nutrition and PA randomised controlled trials (RCTs). Possible explanations put forward by the authors include a lack of studies to test the hypothesis, or non-participation of parents in school-based interventions. In

another systematic review concerning pre-school and school-based obesity prevention interventions aimed at 4-6 year olds, Nixon et al (288) report that successful studies are more likely to include high parental involvement where parents were exposed to the intervention components. Securing involvement of parents therefore seems to be fundamental. Kipping et al (289) report that homework may be an effective mechanism of involving parents of 9-10 year olds in a school-based obesity prevention intervention, whereas within the WAVES study, many teachers reported low engagement among parents of younger children with home-based 'challenges'(194). Although the Health Promoting Schools (HPS) framework (109) provides a model for involving parents and the wider community, schools need help with this, and novel approaches are needed to solve the problem of parent engagement.

Obesity prevention is complex, and schools often lack the expertise to support families, particularly those with children identified as overweight or obese through the National Child Measurement Programme (NCMP). Findings from this thesis indicate that external assistance for schools is currently very limited. Greater investment is needed to support schools in helping children and parents. Such support should be targeted to deprived communities to maximise impact.

6.4 Strengths and limitations

Strengths and limitations of the individual studies presented within this thesis have been outlined within the relevant chapters. This section outlines overall strengths and limitations which should be considered when interpreting findings of the thesis as a whole.

A major strength of this thesis is the use of a mixed-methods approach, thus facilitating a more complete understanding of the research area. Qualitative techniques have supported an in-depth exploration of the subject from the perspective of various stakeholders, with rich data helping to contextualise the broader findings of the quantitative analysis. Correspondingly, quantitative techniques have allowed a wider investigation of the phenomena of interest across a large sample of children and schools. The use of both qualitative and quantitative analysis methods has enabled some triangulation of findings, thereby adding validity.

Within both qualitative studies (Chapters 3 and 4), thematic data analysis was guided by the Framework Approach (209). Although originally developed for the analysis of interview data (208), the approach has also been widely used in focus group analysis (290). Transparency is a particular strength of the approach, providing the ability to relate conclusions back to the original data (291). Equally, the approach offers the potential for input from a wider group of researchers without the need for them to be fully immersed in the reading of transcripts and technical aspects of data processing (208). In addition, the use of a 'framework matrix' permits the analysis of data both by code and by participant/group, thus enabling comparison of themes by participant, whilst maintaining the individual perspective as a whole.

In conducting qualitative research, the influence of my own background, perceptions and interests upon the research process must be considered through a process of reflexivity (292). Furthermore it is important to understand how I am perceived by interviewees. Participants were aware of my job role as a Research Associate on the WAVES study. I was previously employed as Healthy Schools Coordinator within a local authority, a position that was made redundant in 2011 due to budget cuts. In addition, as a parent of two primary school children, I can also be seen as a

stakeholder in the role of the primary school in preventing obesity. Whilst every attempt was made to be objective, and care was taken not to disclose any details of my experiences or personal beliefs before or during the interviews, it is possible that my background could have influenced the qualitative data collection, analysis and interpretation of results.

Chapters 3-5 use data collected from schools within the West Midlands, UK. The findings, therefore, are not necessarily generalisable to other areas or countries. Nonetheless, findings from the qualitative studies in Chapters 3 and 4 are largely consistent with those of the systematic review in Chapter 2, suggesting similar experiences in other areas and countries, and thus lending some validity.

Chapter 5 focused on the PA data without consideration of the dietary data collected for the WAVES study. This may provide an incomplete picture of the role of the school in preventing obesity as any associations there might be between school-level dietary factors and individual outcomes have not been investigated.

6.5 Future research

There appears to be a lack of published studies exploring the potential of the school role in supporting parents to prevent obesity. Further research is required to determine how primary schools can most effectively work with parents in this complex area.

In addition to this, and as identified in previous research, girls' levels of PA remain a particular concern, even at a young age (293). More studies are needed to find effective ways to promote PA and reduce sedentary time in girls, both within and outside of school.

6.6 Conclusion

Findings of this thesis point to the importance of the school role in contributing towards the prevention of childhood obesity. Within all primary schools there is scope for improvement in terms of their practices and policies regarding HE and PA, and schools should be encouraged and supported to maximise their involvement. Yet, exploitation of the long-term, in-depth relationships that primary schools have with children and their families offers the biggest potential in terms of the school role in preventing obesity. Although schools alone cannot eliminate the problem of childhood obesity, working with external partners to provide expert support would make the best use of schools' unique position in being able to target and support parents and families over a sustained period of time. Government support, priority and resources are required to enable schools to perceive this role as a feasible and integral part of the school function, rather than as an increasing burden of responsibility.

7 APPENDICES

Appendix 1: Quality Assessment Form (Qualitative Studies)

Study ID:		
	Yes/No/Unclear	**Comments**
Was there a clear statement of the aims of the research?		
Is a qualitative methodology appropriate?		
Was the research design appropriate to address the aims of the research?		
Was the recruitment strategy appropriate to the aims of the research?		
Was the data collected in a way that addressed the research issue?		
Has the relationship between researcher and participants been adequately considered?		
Have ethical issues been taken into consideration?		
Was the data analysis sufficiently rigorous?		
Is there a clear statement of findings?		
Is the research valuable?		

Appendix 2: Data Extraction Form

Study ID:	
Method ***(what they did):***	
Methodology ***(theoretical basis):***	
Data analysis:	
Setting and context:	
Participants ***(report number/description, include gender and age groups):***	
Interventions/phenomena of interest ***(aim of study)*****:**	
Findings ***(key headings from abstract):***	**Narrative description** ***(your summary of findings under these headings):***
Authors' conclusions	
Comments	

Appendix 3: Quality Assessment Form (Cross-sectional studies)

Study ID:		
	Yes/No/Unclear	**Comments**
Was there a clear statement of aims of the research?*†		
Is the study design appropriate for answering the research question?†		
Are participant subject characteristics and their method of selection clearly described? †		
Did the way the sample was obtained avoid (selection) bias? †		
Was the sample representative with regard to the population to which the findings will be referred? †		
Was the response rate satisfactory in terms of reducing bias? †		
Was the questionnaire validated? †		
Have ethical issues been taken into consideration?*		
Is there a clear statement of findings?*		
Is the research valuable?*†		

*from Critical Appraisal Skills Programme (CASP) qualitative research appraisal tool (147);
†from Center for Evidence Based Management (CEBM) 'Critical appraisal of a survey form' (172)

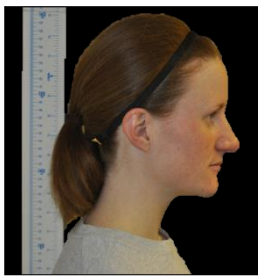
Appendix 4: Standardised Operating Procedures – Height

1. Ask the child to remove their shoes, socks and any hair ornaments, jewellery, buns, or braids from the top of the head.

2. Ask the child to stand upright with their heels touching the back of the platform. Ensure they are positioned facing forwards with their heels and buttocks in contact with the vertical board.

3. Move indicator so that it is touching top of head, but not pressing down.

4. If the child has a hair style which stands well above the top of their head, (or is wearing a joora or turban) record this on the back of the recording sheet to the nearest mm. If the respondent is wearing a joora, or other religious headwear, explain to them what you want to do first and be guided by the child. **Never touch religious headwear without obtaining consent from the child first.**



5. Make sure the child's head is facing forward (not tilted up or down) with eyes looking straight ahead. As a rule of thumb, the eyes should be roughly level with the top of the ears.

6. Explain to the child what you are going to do in Step 7.

7. Cup the child's head in your hands, placing the heels of your palms either side of the chin, with your thumbs just in front of the ears, and your fingers going round towards the back of the neck.

8. Ask child to breathe in.

9. Firmly but gently, lift the child's head upwards towards the head plate, ensuring their heels are kept on the floor and taking care not to alter the level of the head (i.e. Step 5).

10. Release the pressure and allow the child to stand relaxed. If the measurement has been done correctly, the child should be able to step off the measure without ducking their head.

11. Record the reading to the nearest mm.

12. Take a repeat measurement (the child must step off the measure between readings), go from step 5.

13. If the two measurements disagree by more than 4mm, take a third measurement.

Notes:

a) Record on the back of the recording sheet, anything that may affect or interfere with the measurement (for example, refusal to remove shoes, hairstyles and accessories, or posture problems, e.g. bow legs, arthritis)

b) If you were unable to obtain the height for whatever reason, write the reason in the comments section on the back of the recording sheet.

ENSURE THAT YOU USE THE ANTIBACTERIAL HAND GEL PROVIDED IN BETWEEN EACH CHILD MEASURED AND THAT THE PLATFORM OF THE MEASURE IS CLEANED USING ANTIBACTERIAL SPRAY

Appendix 5: Standardised Operating Procedures – Weight

1. The Tanita scales should be set up on a flat surface ensuring that the spirit level indicator is level.

2. Ask the child to remove shoes, socks and any heavy items of clothing e.g. jumper or cardigan. Also, ask them to remove any heavy items of jewellery and check that their pockets are empty. (NB. If the child does not want to remove socks/tights, note this on the back of the recording sheet).

3. Record if the child has been to the toilet prior to coming into the measurement room. (Children should have been asked to go to the toilet before entering the measurement room).

4. **Children are not to step on scales until instructed.** Enter 0.0 for clothes weight. Press enter.

5. Ask child to step on scales. The child's weight should be evenly distributed on both feet. Ask the child to stand upright, hands by their sides and head level with eyes looking straight ahead. Check that the child's heels and feet cover both metal pads. If feet are unable to cover electrodes, change to weight only mode.

6. Press male or female.

7. Press standard.

8. Enter the age in years.

9. Enter height in whole centimetres, rounding up or down, as appropriate. If rounding would result in 2 different whole centimetre values (e.g. if one measurement was 66.4 and the other was 66.5), use the higher of the two values.

10. Ask the child to stand perfectly still - "Be a statue."

11. Once the green light stops flashing, the Tanita will print the results. From this printout, record the weight, to the nearest gram, on the recording sheet.

12. Check the Impedance – if it is less than 350.0 Ω, take the weight again.

13. On the top of the printout, write the child's ID number and date of birth. Staple the printout to the recording sheet.

14. If an error message occurs, check the table overleaf and adjust if required. If error messages occur repeatedly press “weight only” button, to obtain weight.

Note the following in the comments sections of the measurement recording sheet:

- If you successfully obtained the weight but the child had a cast, amputation or medical prostheses.
- If you successfully obtained the weight but the child retained heavy clothing or items on his/her person for cultural reasons.
- If the child refuses to remove their shoes in order to step on the scale.
- If you were unable to obtain the weight for whatever reason state why.

USE AN ANTIBACTERIAL SPRAY TO CLEAN THE SCALES IN BETWEEN EACH CHILD

Appendix 6: School Questionnaire

WAVES

UNIVERSITY OF BIRMINGHAM

SCHOOLS QUESTIONNAIRE

- This questionnaire is designed to explore the facilities, initiatives and general environment relating to food, physical activity and health in the schools participating in the WAVES study. It is really important that this questionnaire is completed by all schools who have agreed to take part in the study, and we would greatly appreciate it if you could take the time to complete this questionnaire for us.

- Most questions require ticking a box ☑, but some ask for further comments or information. We would be grateful if you could answer ***all*** of the questions. You may need to consult with other members of staff in order to answer some of the questions.

- Your answers will remain confidential and you will not be identifiable as an individual in any reports arising from this questionnaire.

- If you have any ***school policies*** relating to diet, physical activity or health in general, we would be most grateful if you could attach a copy of the relevant policies to your completed questionnaire. For each policy you attach, it would be helpful if you could indicate when it was originally written and, if it has been reviewed and updated, when this took place.

- Please ***return*** the completed questionnaire ASAP to: Dr Emma Lancashire, WAVES Study, Public Health, Epidemiology & Biostatistics, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

- If you have any questions please contact Emma Lancashire on 0121 414 3999.

Section 1: Healthy eating in school

1. School name_____

Your name_____

Your role within the school_____

2. Which of the following does your school's policy relating to food cover? (please tick all that apply)

- ☐ School does not have a policy relating to food
- ☐ Curricular content
- ☐ Extra-curricular initiatives
- ☐ Participation in national initiatives (e.g. School Fruit & Vegetable scheme, Healthy Schools initiative)
- ☐ Provision of food in school
- ☐ Consumption of food in school
- ☐ School events (e.g. fetes)
- ☐ School educational visits
- ☐ Rewards to children
- ☐ Children's birthdays
- ☐ Pastoral care and welfare (e.g. Free school lunches)
- ☐ Other (please specify)_____

If your school does not have a policy relating to food, please indicate the main reason for this

_____

If your school has a policy relating to food, how effective do you believe the policy has been in promoting healthy eating?

☐ Very effective ☐ Moderately effective ☐ Has had no effect

Please attach a copy of any school policies relating to food to this questionnaire, indicating on the front when it was originally written and the dates of any revisions

3. Please rate the following statement by ticking one of the boxes below

"Healthy eating is high on our list of priorities in this school"

☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

4. How is healthy eating actively promoted in your school? (please tick all that apply)

☐ Not actively promoted
☐ Curricular sessions
☐ Lunchtime/after school activities
☐ Activities involving parents
☐ School educational visits
☐ School garden
☐ Outside visitors (e.g. school dietician)
☐ School cookery club
☐ Tuck shops
☐ Breakfast clubs
☐ Health weeks
☐ Posters/media
☐ Other (please specify)_____

If you have ticked any of the above, please give some details on what your school offers in relation to each of the items that have been ticked

_____

_____

_____

If healthy eating is not actively promoted please indicate the main reason for this

_____

5. In your opinion, to what extent do you think that healthy eating is supported by:

	Strongly supported	***Supported***	***Weakly supported***	***Not supported***
School governors	☐	☐	☐	☐
Senior Leadership Team	☐	☐	☐	☐
Teachers	☐	☐	☐	☐
Teaching support staff	☐	☐	☐	☐
Catering & lunchtime supervision staff	☐	☐	☐	☐
Other school staff	☐	☐	☐	☐
School Council	☐	☐	☐	☐
Pupils	☐	☐	☐	☐
Parents	☐	☐	☐	☐

6. What break time food provision does your school offer? (please tick all that apply)

☐ Tuck shop

☐ Vending machine

☐ Provision of free fruit and vegetables for children age 7+

☐ No provision other than fruit for 4-6 year olds

☐ Other (please specify)_____

If you have ticked 'tuck shop' or 'vending machine' above, please give examples of the sorts of foods available from these

_____

_____

7. Does your school provide water throughout the day to pupils? ☐Yes ☐No

If "Yes" please describe how water is provided to pupils

_____

8. How is lunch provided in schools? (please tick all that apply)

☐Hot school meals

☐Cold food provided in school (e.g. sandwiches)

☐Pupils can bring lunch from home (approximately what proportion do so? _____%)

☐Pupils can go home for lunch (approximately what proportion do so? _____%)

☐Other (please specify) _____

9. For school provided meals do pupils have a choice of what they can eat (other than provisions for dietary requirements?) ☐Yes ☐No

If Yes, please give details of this (eg. Choice of 2 main courses, and 2 puddings)

_____

_____

10. Do you have a contract with a school meals provider? ☐Yes ☐No

If "Yes":

Please state the name of the provider: _____

If "No", what is / are the reason(s)? (please tick all that apply)

☐ Control over what food is provided ☐ Practical issues

☐ Economic constraints ☐ Poor previous experience

☐ Other (Please specify)_____

11. How are school meals provided?

☐ Brought in ready prepared ☐ Prepared/Cooked on site

☐ Other (please specify) _____

12. Does the school have any income from school food provision? ☐Yes ☐No

If "Yes", how important is this as a source of funds for the school?

☐ Very important ☐ Important

☐ Limited importance ☐ Not at all important

13. Does the school receive sponsorship from any industry related to food or drink?

☐Yes ☐No

If "Yes" please describe_____

_____

14. Does your school have a breakfast club? ☐Yes ☐No

If "Yes":

Is this available for all pupils? ☐Yes ☐No

If "No" please give details of the breakfast club availability

_____

Is there a fee to attend the breakfast club? ☐Yes ☐No

If "Yes" please give details _____

What proportion of children in the school attend the breakfast club on an average day?

☐ 0-20% ☐ 21-40% ☐ 41-60%

☐ 61-80% ☐ 81-100%

15. Does your school have an after-school club providing childcare for working parents?

☐Yes ☐No

If "Yes", what proportion of children in the school attend this on an average day?

☐ 0-20% ☐ 21-40% ☐ 41-60%

☐ 61-80% ☐ 81-100%

What food is offered at the after-school club?

☐ None

☐ Cold snacks (please give examples)_____

☐ Warm food (please give examples)_____

☐ Drinks (please give examples)_____

☐ Other (please give examples)_____

Section 2: Physical activity in school

16. Which of the following does your school's policy relating to physical activity cover? (please tick all that apply)

☐ School does not have a policy relating to physical activity

☐ Having a designated physical activity co-ordinator

☐ Raising the profile of physical activity

☐ Playtime activity

☐ Training of staff with regard to physical activity

☐ Curricular physical activity

☐ Out of school hours activities

☐ School sports partnerships and community links

☐ Physical activities for staff

☐ Other (please specify)_____

If your school does not have a policy relating to physical activity, please indicate the main reason for this

_____

If your school has a policy relating to physical activity, how effective has the policy been in increasing participation in physical activity in the school?

☐ Very effective ☐ Moderately effective ☐ Has had no effect

Please attach a copy of any school policies relating to physical activity to this questionnaire indicating on the front when it was originally written and the dates of any revisions

17. Please rate the following statement by ticking one of the boxes below

"Physical activity is high on our list of priorities in this school"

☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

18. How is physical activity promoted in your school? (Please tick all that apply)

☐ Not actively promoted ☐ Curricular sessions

☐ Posters/media ☐ Lunchtime activities

☐ After school activities ☐ Activities involving parents

☐ School educational visits ☐ School garden

☐ Health weeks ☐ Walk to school campaigns/initiatives

☐ Other (please specify)_____

If you have ticked any of the above, please give some details on what your school offers in relation to each of the items that have been ticked

_____

_____

_____

If physical activity is not promoted in your school please indicate the main reason for this

_____

19. In your opinion, to what extent do you think promotion of physical activity is supported by:

	Strongly supported	***Supported***	***Weakly supported***	***Not supported***
School governors	☐	☐	☐	☐
Senior Leadership Team	☐	☐	☐	☐
Teachers	☐	☐	☐	☐
Teaching support staff	☐	☐	☐	☐
Lunchtime supervision staff	☐	☐	☐	☐
Other school staff	☐	☐	☐	☐
School Council	☐	☐	☐	☐
Pupils	☐	☐	☐	☐
Parents	☐	☐	☐	☐

20. What is the total curriculum time (in minutes) allocated to physical education for pupils in each year group per week, and how much time do pupils actually spend being physically active during this allocated time (excluding changing time, time to arrive at venue etc.)?

Year group	**Allocated curricular time per week for PE (minutes)**	**Actual time spent being physically active during PE sessions per week (minutes)**
Reception		
Year 1		
Year 2		
Year 3		
Year 4		
Year 5		
Year 6		

21. In practice, how difficult is it to deliver the allocated amount of curricular physical education per week?

	Very difficult	***Difficult***	***Mostly okay***	***Never a problem***
Reception	☐	☐	☐	☐
Year 1	☐	☐	☐	☐
Year 2	☐	☐	☐	☐
Year 3	☐	☐	☐	☐
Year 4	☐	☐	☐	☐
Year 5	☐	☐	☐	☐
Year 6	☐	☐	☐	☐

If you have answered ***difficult or very difficult*** for any of the year groups above, please give reasons for your answer:

_____

_____

_____

22. Who teaches physical education in the school? (Please tick all that apply)

☐ Specialist PE teacher

☐ Teacher who is not a specialist in PE

☐ Adult specialist from outside of the school

☐ Other (please specify) _____

23. Which sports/physical activities shown below are included in the timetabled PE curriculum? (please tick all that apply)

☐ Team sports (e.g. football, netball)
☐ Aerobics/keep fit
☐ Dance
☐ Gymnastics
☐ Racquet sports (e.g. tennis, badminton)
☐ Swimming
☐ Athletics (e.g. running, jumping, field games)
☐ Other (please specify) _____

24. Please give the duration of break times and lunchtime in school:

Foundation: Morning break _____minutes
Lunchtime _____minutes
Afternoon break _____minutes

Key Stage 1: Morning break _____minutes
Lunchtime _____minutes
Afternoon break _____minutes

Key Stage 2: Morning break _____minutes
Lunchtime _____minutes
Afternoon break _____minutes

25. During which of the following does the school offer any structured physical activity sessions? (please tick all that apply)

☐ Before school starts

☐ Morning break

☐ Lunchtime

☐ Afternoon break

☐ At the start of morning lessons

☐ At the start of afternoon lessons

☐ Other (excluding timetabled PE)

☐ During none of the above

Please give some details of the activities offered in relation to each of the boxes you have ticked above. Please indicate which year groups participate in each of the activities

_____

_____

_____

If structured physical activity sessions in addition to timetabled PE are not offered in your school, please give the main reason for this

_____

26. What facilities/equipment are available for physical activities during breaks and lunchtimes, and how often are they used? (please tick all that apply)

	Not available	***Available and used:***			
		Always	***Usually***	***Occasionally***	***Never***
Playground	☐	☐	☐	☐	☐
Playing field	☐	☐	☐	☐	☐
Hard court area (e.g. for tennis or basketball)	☐	☐	☐	☐	☐
Playground games	☐	☐	☐	☐	☐
Permanent playground equipment	☐	☐	☐	☐	☐
Portable play equipment	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

27. For how many sports/physical activities does the school provide or have links to clubs?_____

How many of these clubs are provided by the school?_____

Please list the type of club provided by the school, the year group(s) it is on offer to, and whether it takes place at lunchtime or after school

Type of club	Year group(s) it is on offer to	Lunchtime or after school

28. Are there any transport services for pupils provided by the school? ☐Yes ☐No

If "Yes" what services are provided? (Please tick all that apply)

☐School bus/taxi ☐Supervised walking/walking bus

☐Supervised cycling ☐Other (please specify)_____

If "No", has your school tried any of the above, or considered them in the past?

☐Yes ☐No

For each of the above that has been tried please indicate why they did not get implemented or were unsuccessful

_____

_____

_____

Section 3: Other healthy lifestyle initiatives

29. Is your school part of the National Healthy Schools Programme? ☐Yes ☐No

If "Yes", how long has your school been part of this programme? _____years

If "No", is there a reason why the school has not become part of this programme?

_____

30. Does the school offer any healthy lifestyle activities (e.g. healthy eating, physical activities) to: (please tick all that apply)

☐Parents ☐Members of the local community

If you have ticked any of the above, please give details of activities offered:

_____

_____

31. Have there been any other school activities or initiatives that might contribute to a healthy lifestyle for children and their families in the last year? ☐Yes ☐No

If "Yes", please give details _____

_____

32. Is the school planning to start any ***new*** such initiatives in the next 12 months?

☐Yes ☐No

If "Yes", please give details _____

_____

33. Is your school currently taking part in any other research studies related to health?

☐Yes ☐No

If "Yes", please give details _____

_____

34. In your opinion, to what extent is there room for improvement in relation to promoting ***healthy eating*** within each of the following areas in your school?

	None	***Little***	***Some***	***Substantial***
School curriculum	☐	☐	☐	☐
Extracurricular activities	☐	☐	☐	☐
School as medium for family education	☐	☐	☐	☐
School as medium for community education	☐	☐	☐	☐
School meal provision	☐	☐	☐	☐

35. In your opinion, to what extent is there room for improvement in relation to promoting ***physical activity*** within each of the following areas in your school?

	None	*Little*	*Some*	*Substantial*
School curriculum	☐	☐	☐	☐
Extracurricular activities	☐	☐	☐	☐
School as medium for family education	☐	☐	☐	☐
School as medium for community education	☐	☐	☐	☐
School sports/physical activity facilities	☐	☐	☐	☐

36. Does the school support staff development with regard to encouraging healthy lifestyles for children? ☐Yes ☐No

If "Yes", please give details of the available opportunities for staff development:

_____

_____

_____

Thank you very much for taking part in the WAVES study and for taking the time to complete this questionnaire

8 REFERENCES

(1) World Health Organisation. Global strategy on diet, physical activity and health: obesity and overweight. 2004. Available from: http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf (accessed 18 November 2015).

(2) World Health Organisation. Factsheet no. 311 Obesity and overweight. 2014. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/ (accessed 18 November 2015).

(3) Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. *Obes Rev* 2004;5:4-85.

(4) Cole TJ, Freeman JV, Preece MA. Body mass index reference curves for the UK, 1990. *Arch Dis Child* 1995;73(1):25-9.

(5) World Health Organisation. Physical status: the use of and interpretation of anthropometry. WHO Technical Report Series number 854. Geneva: WHO; 1995.

(6) Butland B, Jebb S, Kopelman P, McPherson K, Thomas S, Mardell J, et al. Foresight. Tackling obesities: future choices. Project report. 2007.

(7) Gatineau M, Mathrani S. Obesity and ethnicity. National Obesity Observatory: Oxford. 2011.

(8) Steering Committee. The Asia-Pacific perspective: Redefining obesity and its treatment. Melbourne: International Diabetes Institute. 2000.

(9) National Institute for Health and Care Excellence. Assessing body mass index and waist circumference thresholds for intervening to prevent ill health and premature death among adults from black, Asian and other minority ethnic groups in the UK. 2013. Available from:

http://www.nice.org.uk/proxy/?sourceUrl=http%3A%2F%2Fwww.nice.org.uk%2Fnicemedia%2Flive%2F14201%2F64332%2F64332.pdf (accessed 18 November 2015).

(10) Prentice AM, Jebb SA. Beyond body mass index. *Obes Rev* 2001;2(3):141-7.

(11) Rolland-Cachera MF, Sempe M, Guilloud-Bataille M, Patois E, Pequignot-Guggenbuhl F, Fautrad V. Adiposity indices in children. *Am J Clin Nutr* 1982;36(1):178-84.

(12) Reilly JJ. Descriptive epidemiology and health consequences of childhood obesity. *Best Pract Res Clin Endocrinol Metab* 2005;19(3):327-41.

(13) Centre for Public Health Excellence at NICE National Collaborating Centre for Primary Care. Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children. 2006.

(14) Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000;320(7244):1240.

(15) Onis Md, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ* 2007;85(9):660-7.

(16) World Health Organisation. Commission on ending childhood obesity. 2014. Available from: http://www.who.int/end-childhood-obesity/en/ (accessed 18 November 2015).

(17) NHS Information Centre for Health and Social Care. National Child Measurement Programme: England, 2013/4 school year. 2014. Available from: http://www.hscic.gov.uk/catalogue/PUB16070/nati-chil-meas-prog-eng-2013-2014-rep.pdf (accessed 18 November 2015).

(18) NHS Information Centre for Health and Social Care. Health Survey for England 2013, volume 1, chapter 11. Children's body mass index, overweight and obesity. 2014.

(19) Wabitsch M, Moss A, Kromeyer-Hauschild K. Unexpected plateauing of childhood obesity rates in developed countries. *BMC Med* 2014;12(1):17.

(20) Lobstein T, Jackson-Leach R, Moodie ML, Hall KD, Gortmaker SL, Swinburn BA, et al. Child and adolescent obesity: part of a bigger picture. *Lancet* 2015.

(21) Wang YC, Gortmaker SL, Taveras EM. Trends and racial/ethnic disparities in severe obesity among US children and adolescents, 1976–2006. *Int J Pediatr Obes* 2011;6(1):12-20.

(22) Skelton JA, Cook SR, Auinger P, Klein JD, Barlow SE. Prevalence and trends of severe obesity among US children and adolescents. *Acad Pediatr* 2009;9(5):322-9.

(23) Copley VRB, C. Changes in children's body mass index between 2006/7 and 2013/4: National Child Measurement Programme. London: Public Health England, 2015.

(24) Townsend P. Deprivation. *J Soc Policy* 1987;16(02):125-46.

(25) Kinra S, Nelder RP, Lewendon GJ. Deprivation and childhood obesity: a cross sectional study of 20 973 children in Plymouth, United Kingdom. *J Epidemiol Commun H* 2000;54(6):456-60.

(26) Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity: public-health crisis, common sense cure. *Lancet* 2002;360(9331):473-82.

(27) Reilly JJ, Methven E, McDowell ZC, Hacking B, Alexander D, Stewart L, et al. Health consequences of obesity. *Arch Dis Child* 2003;88(9):748-52.

(28) Public Health England. Causes of obesity. 2014. Available at: https://www.noo.org.uk/NOO_about_obesity/causes (accessed 18 November 2015).

(29) Lustig RH. The neuroendocrinology of childhood obesity. *Pediatr Clin North Am* 2001;48(4):909-30.

(30) Rennie KL, Johnson L, Jebb SA. Behavioural determinants of obesity. *Best Pract Res Clin Endocrinol Metab* 2005;19(3):343-58.

(31) Maes HH, Neale MC, Eaves LJ. Genetic and environmental factors in relative body weight and human adiposity. *Behav Genet* 1997;27(4):325-51.

(32) Allison DB, Matz PE, Pietrobelli A, Zannolli R, Faith MS. Genetic and environmental influences on obesity. *Primary and secondary preventive nutrition: Springer* 2001:147-64.

(33) Gregory J, Lowe S, Bates CJ, Britain G. National Diet and Nutrition Survey: Young People Aged 4 to 18 Years; *Volume 1: Report of the Diet and Nutrition Survey.* Stationery Office; 2000.

(34) Department of Health. The Diets of British Schoolchildren. *Sub-committee on Nutritional Surveillance; Committee on Medical Aspects of Food Policy.* London: Her Majesty's Stationery Office: 1989.

(35) Cavadini C, Siega-Riz AM, Popkin BM. US adolescent food intake trends from 1965 to 1996. *Arch Dis Child* 2000;83(1):18-24.

(36) Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination Surveys. *Am J Clin Nutr* 2000;72(5):1343s-53s.

(37) National Institute for Health and Care Excellence. Maintaining a healthy weight and preventing excess weight gain in children and adults – partial

update of CG43. *Evidence review 1: An evidence review of modifiable diet and physical activity components, and associated behaviours*. 2014.

(38) Moreno LA, Rodríguez G. Dietary risk factors for development of childhood obesity. *Curr Opin Clin Nutr Metab Care* 2007;10(3):336-41.

(39) World Health Organisation. Global recommendations on physical activity for health. 2010. Available at: http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979_eng.pdf (accessed 18 November 2015).

(40) Chief Medical Officers of the UK. Factsheet 3. Physical activity guidelines for children and young people (5-18 years) 2011.

(41) NHS Information Centre for Health and Social Care. Health Survey for England 2012. Physical Activity in children. 2013.

(42) Corder K, Brage S, Ekelund U. Accelerometers and pedometers: methodology and clinical application. *Curr Opin Clin Nutr Metab Care* 2007;10(5):597-603.

(43) Griffiths LJ, Cortina-Borja M, Sera F, Pouliou T, Geraci M, Rich C, et al. How active are our children? Findings from the Millennium Cohort Study. *BMJ Open* 2013;3(8):e002893.

(44) Ekelund U, Luan J, Sherar LB, et al. Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *JAMA* 2012;307(7):704-12.

(45) Riddoch CJ, Andersen LB, Wedderkopp N, Harro M, Klasson-Heggebo L, Sardinha LB, et al. Physical activity levels and patterns of 9-and 15-yr-old European children. *Med Sci Sports Exerc* 2004;36(1):86-92.

(46) Parsons TJ, Power C, Logan S, Summerbelt C. Childhood predictors of adult obesity: a systematic review. *Int J Obes* 1999;23.

(47) Jimenez-Pavon D, Kelly J, Reilly JJ. Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. *Int J Pediatr Obes* 2010;5(1):3-18.

(48) Marques A, Minderico C, Martins S, Palmeira A, Ekelund U, Sardinha LB. Cross-sectional and prospective associations between moderate to vigorous physical activity and sedentary time with adiposity in children. *Int J Obes* 2015.

(49) Prentice-Dunn H, Prentice-Dunn S. Physical activity, sedentary behavior, and childhood obesity: a review of cross-sectional studies. *Psychol Health Med* 2012;17(3):255-73.

(50) Tremblay MS, LeBlanc AG, Kho ME, Saunders TJ, Larouche R, Colley RC, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act* 2011;8(1):98.

(51) Andersen RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children: Results from the Third National Health and Nutrition Examination Survey. *JAMA* 1998;279(12):938-42.

(52) Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. Television viewing as a cause of increasing obesity among children in the United States, 1986-1990. *Arch Pediatr Adolesc Med* 1996;150(4):356-62.

(53) Hancox R, Poulton R. Watching television is associated with childhood obesity: but is it clinically important? *Int J Obes* 2005;30(1):171-5.

(54) Kautiainen S, Koivusilta L, Lintonen T, Virtanen SM, Rimpelä A. Use of information and communication technology and prevalence of overweight and obesity among adolescents. *Int J Obes* 2005;29(8):925-33.

(55) Crespo CJ, Smit E, Troiano RP, Bartlett SJ, Macera CA, Andersen RE. Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988-1994. *Arch Pediatr Adolesc Med* 2001;155(3):360-5.

(56) Robinson TN. Television viewing and childhood obesity. *Pediatr Clin North Am* 2001;48(4):1017-25.

(57) Lake A, Townshend T. Obesogenic environments: exploring the built and food environments. *J R Soc Promot Health* 2006;126(6):262-7.

(58) Bray GA. The epidemic of obesity and changes in food intake: the Fluoride Hypothesis. *Physiol Behav* 2004;82(1):115-21.

(59) Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med* 1999;29(6):563-70.

(60) Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med* 1997;337(13):869-73.

(61) Lake JK, Power C, Cole TJ. Child to adult body mass index in the 1958 British birth cohort: associations with parental obesity. *Arch Dis Child* 1997;77(5):376-80.

(62) Wiecha JL, Sobol AM, Peterson KE, Gortmaker SL. Household television access: associations with screen time, reading, and homework among youth. *Ambul Pediatr* 2001;1(5):244-51.

(63) Gillman MW, Rifas-Shiman SL, Frazier AL, Rockett HR, Camargo Jr CA, Field AE, et al. Family dinner and diet quality among older children and adolescents. *Arch Fam Med* 2000;9(3):235.

(64) Rasmussen M, Krølner R, Klepp K-I, Lytle L, Brug J, Bere E, et al. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. *Int J Behav Nutr Phys Act* 2006;3(1):22.

(65) Ventura AK, Birch LL. Does parenting affect children's eating and weight status? *Int J Behav Nutr Phys Act* 2008;5(1):15.

(66) Collins C, Duncanson K, Burrows T. A systematic review investigating associations between parenting style and child feeding behaviours. *J Hum Nutr Diet* 2014;27(6):557-68.

(67) Vollmer RL, Mobley AR. Parenting styles, feeding styles, and their influence on child obesogenic behaviors and body weight. A review. *Appetite* 2013;71(0):232-41.

(68) Davison KK, Cutting TM, Birch LL. Parents' activity-related parenting practices predict girls' physical activity. *Med Sci Sports Exerc* 2003;35(9):1589.

(69) Verloigne M, Van Lippevelde W, Maes L, Brug J, De Bourdeaudhuij I. Family- and school-based correlates of energy balance-related behaviours in 10–12-year-old children: a systematic review within the ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project. *Public Health Nutr* 2012;15(08):1380-95.

(70) Seabra AC, Seabra AF, Mendonça DM, Brustad R, Maia JA, Fonseca AM, et al. Psychosocial correlates of physical activity in school children aged 8–10 years. *Eur J Public Health* 2013;23(5):794-8.

(71) Ferreira I, Van Der Horst K, Wendel-Vos W, Kremers S, Van Lenthe FJ, Brug J. Environmental correlates of physical activity in youth–a review and update. *Obes Rev* 2007;8(2):129-54.

(72) Scarborough P, Bhatnagar P, Wickramasinghe KK, Allender S, Foster C, Rayner M. The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to 2006–07 NHS costs. *J Public Health* 2011;33(4):527-35.

(73) Singh AS, Mulder C, Twisk JW, Van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev* 2008;9(5):474-88.

(74) Dietz W, Gortmaker S. Preventing obesity in children and adolescents. *Annu Rev Publ Health*. 2001;22:337-53.

(75) Bandura, A. Self-efficacy: The exercise of control. Macmillan, 1997.

(76) Icek A. The theory of planned behavior. *Organ Behav Hum Dec* 1991;50(2):179-211.

(77) Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot* 1997;12(1):38-48.

(78) Budd GM, Volpe SL. School-Based Obesity Prevention: Research, Challenges, and Recommendations. *J Sch Health* 2006;76(10):485-95.

(79) Egger G, Swinburn B. An" ecological" approach to the obesity pandemic. *BMJ* 1997;315(7106):477.

(80) Sacks G, Swinburn B, Lawrence M. Obesity Policy Action framework and analysis grids for a comprehensive policy approach to reducing obesity. *Obes Rev* 2009;10(1):76-86.

(81) World Health Organisation. Ottawa Charter for Health Promotion. 1986. Available at: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/ (accessed 18 November 2015).

(82) Whitelaw S, Baxendale A, Bryce C, MacHardy L, Young I, Witney E. 'Settings' based health promotion: a review. *Health Promot Int* 2001;16(4):339-53.

(83) World Health Organisation. Population-based approaches to childhood obesity prevention. 2012. Available at: http://www.who.int/dietphysicalactivity/childhood/approaches/en/ (accessed 18 November 2015).

(84) World Health Organisation. Obesity: preventing and managing the global epidemic: Report of a WHO Consultation (WHO Technical Report Series 894). World Health Organization; 2000.

(85) Johnson B, Kremer P, Swinburn B, de Silva-Sanigorski A. Multilevel analysis of the Be Active Eat Well intervention: environmental and behavioural influences on reductions in child obesity risk. *Int J Obes* 2012;36(7):901-7.

(86) Rose G. Strategy of prevention: lessons from cardiovascular disease. *BMJ (Clinical research ed)* 1981;282(6279):1847-51.

(87) Swinburn B, Egger G. Preventive strategies against weight gain and obesity. *Obes Rev* 2002;3(4):289-301.

(88) Butte NF, Ellis KJ. Comment on "Obesity and the environment: where do we go from here?". *Science* 2003;301(5633):598.

(89) Rose G, Day S. The population mean predicts the number of deviant individuals. *BMJ* 1990;301(6759):1031-4.

(90) Bucher Della Torre S, Akre C, Suris JC. Obesity Prevention Opinions of School Stakeholders: A Qualitative Study. *J Sch Health* 2010;80(5):233-9.

(91) Story M, Nanney MS, Schwartz MB. Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. *Milbank Q* 2009;87(1):71-100.

(92) Wechsler H, Devereaux RS, Davis M, Collins J. Using the School Environment to Promote Physical Activity and Healthy Eating. *Prev Med* 2000;31(2):S121-S37.

(93) Katz DL, O'Connell M, Njike VY, Yeh MC, Nawaz H. Strategies for the prevention and control of obesity in the school setting: systematic review and meta-analysis. *Int J Obes* 2008;32(12):1780-9.

(94) Karnik S, Kanekar A. Childhood obesity: a global public health crisis. *Int J Prev Med* 2012;3(1):1.

(95) Carter MA, Swinburn B. Measuring the obesogenic food environment in New Zealand primary schools. *Health Promot Int* 2004;19(1):15-20.

(96) Robinson V, Lear J, Eichner N. The role of school health professionals in preventing childhood overweight. *Center for Health and Health Care in Schools* 2006.

(97) National Institute for Health and Clinical Excellence. Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children. London: 2006.

(98) Kropski JA, Keckley PH, Jensen GL. School-based Obesity Prevention Programs: An Evidence-based Review. *Obesity* 2008;16(5):1009-18.

(99) Healey K. Linking children's health and education: Progress and challenges in London: King's Fund; 2004.

(100) World Health Organisation. The status of school health. 1996. Available at: http://www.searo.who.int/nepal/mediacentre/1996_the_status_of_school_health.pdf (accessed 18 November 2015).

(101) Bonell C, Farah J, Harden A, Wells H, Parry W, Fletcher A, et al. Systematic review of the effects of schools and school environment interventions on health: evidence mapping and synthesis. *Public Health Res* 2013;1(1).

(102) Powney J, Malcolm H, Lowden K. Health and attainment: a brief review of recent literature. *Edinburgh: Scottish Council for Research in Education* 2000.

(103) Murray NG, Low BJ, Hollis C, Cross AW, Davis SM. Coordinated school health programs and academic achievement: A systematic review of the literature. *J Sch Health* 2007;77(9):589-600.

(104) Sorhaindo A, Feinstein L, Britain G. What is the relationship between child nutrition and school outcomes?: *Institute of Education, Centre for Research on the Wider Benefits of Learning* 2006.

(105) Bellisle F. Effects of diet on behaviour and cognition in children. *Brit J Nutr* 2004;92(S2):S227-S32.

(106) Caird J, Kavanagh J, Oliver K, Oliver S, O'Mara A, Stansfield C, et al. Childhood obesity and educational attainment: a systematic review: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London 2011.

(107) World Health Organisation. What is a health promoting school? 2013. Available at: http://www.who.int/school_youth_health/gshi/hps/en/ (accessed 18 November 2015).

(108) Lee A. Health-promoting schools. *Appl Health Econ Health Policy* 2009;7(1):11-7.

(109) World Health Organisation. Promoting Health Through Schools (WHO Technical Report Series No. 870, ISBN: 92 4 129870 8). Geneva: World Health Organisation Expert Committee on Comprehensive School Health Education and Promotion, 1997.

(110) Langford R, Bonell CP, Jones HE, Pouliou T, Murphy SM, Waters E, et al. The WHO Health Promoting School framework for improving the health and well-being of students and their academic achievement. *The Cochrane Library* 2014.

(111) Langford R, Bonell C, Jones H, Campbell R. Obesity prevention and the Health promoting Schools framework: essential components and barriers to success. *Int J Behav Nutr Phys Act* 2015;12(1):167.

(112) Veugelers PJ, Fitzgerald AL. Effectiveness of School Programs in Preventing Childhood Obesity: A Multilevel Comparison. *Am J Public Health* 2005;95(3):432-5.

(113) Bleich SN, Segal J, Wu Y, Wilson R, Wang Y. Systematic review of community-based childhood obesity prevention studies. *Pediatrics* 2013;132(1):e201-e10.

(114) Waters E, Silva-Sanigorski A, Hall B, Brown T, Campbell K, Gao Y, et al. Interventions for preventing obesity in children (Review). *Cochrane Database Syst Rev* 2011(12).

(115) Dobbins M, Husson H, DeCorby K, LaRocca RL. School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database Syst Rev* 2013(2).

(116) Van Cauwenberghe E, Maes L, Spittaels H, van Lenthe FJ, Brug J, Oppert J-M, et al. Effectiveness of school-based interventions in Europe to promote

healthy nutrition in children and adolescents: systematic review of published and 'grey' literature. *Brit J Nutr* 2010;103:781-97.

(117) Rainer P, Cropley B, Jarvis S, Griffiths R. From policy to practice: the challenges of providing high quality physical education and school sport faced by head teachers within primary schools. *Phys Educ Sport Pedag* 2011:1-18.

(118) Lissau I. Prevention of overweight in the school arena. *Acta Paediatr* 2007;96:12-8.

(119) Booth M, Okely A. Promoting physical activity among children and adolescents: the strengths and limitations of school-based approaches. *Health Promot J Aust* 2005;16(1):52-4.

(120) Whitby K (ed). Tackling childhood obesity within schools: lessons learned from school-based interventions. CfBT Education Trust: Reading, UK, 2010.

(121) Birch LL, Ventura AK. Preventing childhood obesity: what works? *Int J Obes* 2009;33(S1):S74-S81.

(122) Wells L, Nelson M. The National School Fruit Scheme produces short-term but not longer-term increases in fruit consumption in primary school children. *Brit J Nutr* 2005;93(04):537-42.

(123) Ransley J, Greenwood D, Cade J, Blenkinsop S, Schagen I, Teeman D, et al. Does the school fruit and vegetable scheme improve children's diet? A non-randomised controlled trial. *J Epidemiol Commun H* 2007;61(8):699-703.

(124) Department of Education and Employment. Statutory Instrument 2000 No. 1777. The Education (Nutritional Standards for School Lunches) (England) Regulations 2000. Available at: http://www.uklaws.org/statutory/instruments_24/doc24078.htm (accessed 18 November 2015).

(125) Department for Education and Skills. Healthy Living Blueprint for Schools. 2004. Available at: http://webarchive.nationalarchives.gov.uk/20130401151715/http://education.gov.uk/publications/eorderingdownload/0781-2004.pdf (accessed 18 November 2015).

(126) Department of Health. Choosing Health: making healthy choices easier. 2004. Available at: http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/@ps/documents/digitalasset/dh_133489.pdf (accessed 18 November 2015).

(127) Department for Education and Skills. Nutritional standards for school lunches and other school food. 2006. Available at: http://www.legislation.gov.uk/uksi/2006/2381/pdfs/uksi_20062381_en.pdf (accessed 18 November 2015).

(128) School Food Trust. A guide to introducing the Government's new food-based standards for all school food other than lunches. 2007. Available at: http://webarchive.nationalarchives.gov.uk/20100307074708/http://schoolfoodtrust.org.uk/UploadDocs/Library/Documents/sft_non-lunch_guidance.pdf (accessed 18 November 2015).

(129) Adamson A, Spence S, Reed L, Conway R, Palmer A, Stewart E, et al. School food standards in the UK: implementation and evaluation. *Public Health Nutr* 2013;16(06):968-81.

(130) Dimbleby H, Vincent J. The school food plan. Department for Education: London. 2013. Available at: http://www.schoolfoodplan.com/wp-

content/uploads/2013/07/School_Food_Plan_2013.pdf (accessed 18 November 2015).

(131) Department for Education. School Food Standards. 2015. Available at: http://www.schoolfoodplan.com/wp-content/uploads/2014/09/School-Food-Standards-Guidance-FINAL-140911-V2C.pdf (accessed 18 November 2015).

(132) Department for Education and Employment. National Healthy School Standard guidance. 1999. Available at: http://www.beyondbullying.com/uploads/nationalhealthyschoolsstrategy.pdf (accessed 18 November 2015).

(133) Department of Health. Healthy Lives, Healthy People: A call to action on obesity in England. 2011. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213720/dh_130487.pdf (accessed 18 November 2015).

(134) Department for Education. PE and sport premium for primary schools. 2014. Available at: https://www.gov.uk/guidance/pe-and-sport-premium-for-primary-schools (accessed 18 November 2015).

(135) Adab P, Pallan MJ, Lancashire ER, Hemming K, Frew E, Griffin T, et al. A cluster-randomised controlled trial to assess the effectiveness and cost-effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6-7 year old children: the WAVES study protocol. *BMC Public Health* 2015;15(1):488.

(136) Carter BR, Hood K. Balance algorithm for cluster randomized trials. *BMC Med Res Methodol* 2008;8(1):65.

(137) Raab GM, Butcher I. Balance in cluster randomized trials. *Stat Med* 2001;20(3):351-65.

(138) Activate in the classroom 2nd edition. Val Sabin publications. 2007 Available at: http://www.valsabinpublications.com/publications/activate/ (accessed 18 November 2015).

(139) Positive Play 3rd edition. Val Sabin publications. 2011. Available at: http://www.valsabinpublications.com/publications/positive-play (accessed 18 November 2015).

(140) Take 10 Fit to Suceed. 2004. Available at http://www.take10.org.uk/ (accessed 18 November 2015).

(141) Wake Up Shake Up by Ruth Mitchell. 2009. Available at: http://www.wakeupshakeup.com (accessed 18 November 2015).

(142) NHS Information Centre for Health and Social Care. National Child Measurement Programme: England, 2011/12 school year. 2012. Available from: http://www.hscic.gov.uk/catalogue/PUB09283/nati-chil-meas-prog-eng-2011-2012-rep.pdf (accessed 18 November 2015).

(143) Ridler C, Dinsdale H, Rutter H. National Child Measurement Programme: Changes in children's body mass index between 2006/07 and 2011/12. *National Obesity Observatory: Oxford*. 2013.

(144) Whitlock EP, O'Connor EA, Williams SB, Beil TL, Lutz KW. Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF. *Pediatrics* 2010:peds. 2009.

(145) Booth A. Clear and present questions: formulating questions for evidence based practice. *Libr Hi Tech* 2006;24(3):355-68.

(146) Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med* 2009;151(4):264-9.

(147) Critical Appraisal Skills Programme (CASP). Critical Appraisal Skills Programme: making sense of evidence about clinical effectiveness; 11 questions to help you make sense of a trial (14 October 2010). 2010. Available at: http://library.mch.org.tw/EBM/tool/CASP/CASP_RCT_Appraisal_Checklist_14oct10.pdf (accessed 18 November 2015).

(148) Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual. 2011. Available at: http://joannabriggs.org/assets/docs/sumari/reviewersmanual-2011.pdf (accessed 18 November 2015).

(149) Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol* 2008;8(45).

(150) Pagnini D, King L, Booth S, Wilkenfeld R, Booth M. The weight of opinion on childhood obesity: recognizing complexity and supporting collaborative action. *Int J Pediatr Obes* 2009;4(4):233-41.

(151) Booth ML, King LA, Pagnini DL, Wilkenfeld RL, Booth SL. Parents of school students on childhood overweight: The Weight of Opinion Study. *J Paediatr Child Health* 2009;45(4):194-8.

(152) Wilkenfeld R, Pagnini D, Booth M, Booth S, King L. The Weight of Opinion: Perceptions of school teachers and secondary students on child and adolescent overweight and obesity. NSW Centre for Overweight and Obesity. 2007.

(153) Bathgate K, Begley A. 'It's very hard to find what to put in the kid's lunch': What Perth parents think about food for school lunch boxes. *Nutr Diet* 2011;68(1):21-6.

(154) Borra ST, Kelly L, Shirreffs MB, Neville K, Geiger CJ. Developing health messages: Qualitative studies with children, parents, and teachers help identify communications opportunities for healthful lifestyles and the prevention of obesity. *J Am Diet Assoc* 2003;103(6):721-8.

(155) Cox M, Schofield G, Kolt GS. Responsibility for children's physical activity: Parental, child, and teacher perspectives. *J Sci Med Sport* 2010;13(1):46-52.

(156) Gosling R, Stanistreet D, Swami V. If Michael Owen drinks it, why can't I?'—9 and 10 year olds' perceptions of physical activity and healthy eating. *Health Educ J* 2008;67(3):167-81.

(157) Hesketh K, Waters E, Green J, Salmon L, Williams J. Healthy eating, activity and obesity prevention: a qualitative study of parent and child perceptions in Australia. *Health Promot Int* 2005;20(1):19-26.

(158) Huberty J, Dinkel D, Coleman J, Beighle A, Apenteng B. The role of schools in children's physical activity participation: staff perceptions. *Health Educ Res* 2012:cys071.

(159) Korwanich K, Sheiham A, Srisuphan W, Srisilapanan P. Opinions of parents, teachers and school board members regarding healthy eating: a qualitative investigation of lay Thai people's perspectives. *J Med Assoc Thai* 2007;90(5):1014-20.

(160) Kubik MY, Story M, Rieland G. Developing school-based BMI screening and parent notification programs: findings from focus groups with parents of elementary school students. *Health Educ Behav* 2007;34(4):622-33.

(161) MacLellan D, Holland A, Taylor J, McKenna M, Hernandez K. Implementing school nutrition policy: student and parent perspectives. *Can J Diet Pract Res* 2010;71(4):172-7.

(162) Massey-Stokes M, Meaney KS. Understanding Our Service-Learning Community: An Exploratory Study of Parent, Teacher, and Student Perceptions about Childhood Obesity. *Health Educator* 2006;38(2):53-60.

(163) Morrison-Sandberg LF, Kubik MY, Johnson KE. Obesity Prevention Practices of Elementary School Nurses in Minnesota: Findings from Interviews with Licensed School Nurses. *J Sch Nurs* 2011;27(1):13-21.

(164) Patino-Fernandez AM, Hernandez J, Villa M, Delamater A. School-based health promotion intervention: parent and school staff perspectives. *J Sch Health* 2013;83(11):763-70.

(165) Schetzina K, Dalton III W, Lowe E, Azzazy N, vonWerssowetz K, Givens C, et al. Developing a coordinated school health approach to child obesity prevention in rural Appalachia: results of focus groups with teachers, parents and students. *Rural Remote Health* 2009;9(1157).

(166) Van Lippevelde W, Verloigne M, De Bourdeaudhuij I, Bjelland M, Lien N, Fernandez-Alvira4 JM, et al. What do parents think about parental participation in school-based interventions on energy balance-related behaviours? A qualitative study in 4 countries. *BMC Public Health* 2011;11(881).

(167) Pocock M, Trivedi D, Wills W, Bunn F, Magnusson J. Parental perceptions regarding healthy behaviours for preventing overweight and obesity in young children: a systematic review of qualitative studies. *Obes Rev* 2010;11(5):338-53.

(168) Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, et al. The global obesity pandemic: shaped by global drivers and local environments. *Lancet* 2011;378(9793):804-14.

(169) Jaime PC, Lock K. Do school based food and nutrition policies improve diet and reduce obesity? *Prev Med* 2009;48(1):45-53.

(170) Rasberry CN, Lee SM, Robin L, Laris B, Russell LA, Coyle KK, et al. The association between school-based physical activity, including physical education, and academic performance: a systematic review of the literature. *Prev Med* 2011;52:S10-S20.

(171) Trudeau F, Shephard RJ. Physical education, school physical activity, school sports and academic performance. *Int J Behav Nutr Phys Act* 2008;5(10):5868-5.

(172) Center for Evidence Based Management. Critical appraisal of a survey form. Available at: http://www.cebma.org/wp-content/uploads/Critical-Appraisal-Questions-for-a-Survey.pdf (accessed 18 November 2015).

(173) Price JH. Elementary Physical Education Teachers' Perceptions of Childhood Obesity. *Health Educ* 1990;21(6):26-32,63.

(174) Price JH, And O. School Nurses' Perceptions of Childhood Obesity. J Sch Health. 1987;57(8):332-6.

(175) Price JH, And O. Parents' Perceptions of Childhood Obesity and the Role of Schools. *J Health Educ* 1992;23(1):32-8.

(176) Price JH, Desmond SM, Stelzer CM. Elementary School Principals' Perceptions of Childhood Obesity. *J Sch Health* 1987;57(9):367-70.

(177) Price JH, Telljohann SK. School food-service directors' perceptions of childhood obesity. *Psychol Rep* 1994.

(178) Crawford D, Timperio A, Campbell K, Hume C, Jackson M, Carver A, et al. Parent's views of the importance of making changes in settings where

children spend time to prevent obesity. *Asia Pac J Clin Nutr* 2008;17(1):148-58.

(179) Frongillo EA, Olson CM, Schardt DG. Administrators' views on school-based nutrition education. *J Nutr Educ* 1990;22(2):74-80.

(180) Jaballas E, Clark-Ott D, Clasen C, Stolfi A, Urban M. Parents' Perceptions of Their Children's Weight, Eating Habits, and Physical Activities at Home and School. *J Pediatr Health Care* 2011;25(5):294-301.

(181) Kubik MY, Fulkerson JA, Story M, Rieland G. Parents of elementary school students weigh in on height, weight, and body mass index screening at school. *J Sch Health* 2006;76(10):496-501.

(182) Kubik MY, Story M, Davey C. Obesity prevention in schools: current role and future practice of school nurses. *Prev Med* 2007;44(6):504-7.

(183) Moyers P, Bugle L, Jackson E. Perceptions of School Nurses regarding Obesity in School-Age Children. *J Sch Nurs* 2005;21(2):86-93.

(184) Murnan J, Price JH, Telljohann SK, Dake JA, Boardley D. Parents' Perceptions of Curricular Issues Affecting Children's Weight in Elementary Schools. *J Sch Health* 2006;76(10):502-11.

(185) Murphy M, Polivka B. Parental Perceptions of the Schools' Role in Addressing Childhood Obesity. *J Sch Nurs* 2007;23(1):40-6.

(186) Pettigrew S, Pescud M, Donovan RJ. Stakeholder perceptions of a comprehensive school food policy in Western Australia. *Health Policy* 2012;108(1):100-4.

(187) Stalter AM, Kaylor M, Steinke JD, Barker RM. Parental Perceptions of the Rural School's Role in Addressing Childhood Obesity. *J Sch Nurs* 2011;27(1):70-81.

(188) Sutherland R, Gill T, Binns C. Do parents, teachers and health professionals support school-based obesity prevention? *Nutr Diet* 2004.

(189) Vereecken C, Van Houte H, Martens V, Wittebroodt I, Maes L. Parents' and teachers' opinions about the school food policy in Belgian Flemish Nursery Schools. *Int J Environ Res Public Health* 2009;6(3):1268-81.

(190) Kubik MY, Lytle LA, Story M. Schoolwide food practices are associated with body mass index in middle school students. *Arch Pediatr Adolesc Med* 2005;159(12):1111-4.

(191) Finkelstein DM, Hill EL, Whitaker RC. School Food Environments and Policies in US Public Schools. *Pediatrics* 2008;122(1):e251-e9.

(192) Mâsse LC, Naiman D, Naylor P-J. From policy to practice: implementation of physical activity and food policies in schools. *Int J Behav Nutr Phys Act* 2013;10(71):1-12.

(193) Eyre ELJ, Duncan MJ, Birch SL, Cox V. Environmental and school influences on physical activity in South Asian children from low socio-economic backgrounds: A qualitative study. *J Child Health Care* 2013:1367493513508845.

(194) Griffin TL, Clarke JL, Lancashire ER, Pallan MJ, Passmore S, Adab P. Teacher experiences of delivering an obesity prevention programme (The WAVES study intervention) in a primary school setting. *Health Educ J* 2014:0017896914556907.

(195) Howard-Drake EJ, Halliday V. Exploring primary school headteachers' perspectives on the barriers and facilitators of preventing childhood obesity. *J Public Health* 2015.

(196) Rawlins E, Baker G, Maynard M, Harding S. Perceptions of healthy eating and physical activity in an ethnically diverse sample of young children and their parents: the DEAL prevention of obesity study. *J Hum Nutr Diet* 2013;26(2):132-44.

(197) Mohammadpour-Ahranjani B, Pallan MJ, Rashidi A, Adab P. Contributors to childhood obesity in Iran: the views of parents and school staff. *Public Health* 2013(0).

(198) Mohammadpour-Ahranjani B, Abdollahi M, Pallan MJ, Adab P. Perceptions of Local Parents and School Staff on Childhood Obesity Prevention Interventions in Iran. *Nutr Food Sc Res* 2014.

(199) Odum M, McKyer ELJ, Tisone CA, Outley CW. Elementary School Personnel's Perceptions on Childhood Obesity: Pervasiveness and Facilitating Factors. *J Sch Health* 2013;83(3):206-12.

(200) Riggs N, Tewari A, Stigler M, Rodrigues L, Arora M, Khubchandani J, et al. Indian Students' Perspectives on Obesity and School-Based Obesity Prevention A Qualitative Examination. *Health Promot Pract* 2013;14(6):816-23.

(201) NHS Information Centre for Health and Social Care. National Child Measurement Programme: England, 2012/3 school year. 2013. Available from: http://www.hscic.gov.uk/catalogue/PUB13115/nati-chil-meas-prog-eng-2012-2013-rep.pdf (accessed 18 November 2015).

(202) Clarke J, Fletcher B, Lancashire E, Pallan M, Adab P. The views of stakeholders on the role of the primary school in preventing childhood obesity: a qualitative systematic review. *Obes Rev* 2013;14(12):975-88.

(203) Office of National Statistics. National Statistics Postcode Directory: 2010 User Guide. 2010.

(204) McLeod J. Qualitative research in counselling and psychotherapy: Sage; 2011.

(205) Fairclough N. Critical discourse analysis: The critical study of language: Routledge; 2013.

(206) Riessman CK. Narrative methods for the human sciences: Sage; 2008.

(207) Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3(2):77-101.

(208) Gale NK, Heath G, Cameron E, Rashid S, Redwood S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol* 2013;13(1):117.

(209) Ritchie J, Spencer L. Qualitative data analysis for applied policy research. In: Bryman ABR(ed.). Analyzing Qualitative Data. London: Routledge; 1994. p.173-94.

(210) St Leger L, Nutbeam D. Research into health promoting schools. *J Sch Health* 2000;70(6):257-9.

(211) Feinstein L, Sabates R, Sorhaindo A, Rogers I, Herrick D, Northstone K, et al. Dietary patterns related to attainment in school: the importance of early eating patterns. *J Epidemiol Commun H* 2008;62(8):734-9.

(212) Brandstetter S, Klenk J, Berg S, Galm C, Fritz M, Peter R, et al. Overweight prevention implemented by primary school teachers: a randomised controlled trial. *Obes Facts* 2012;5(1):1-11.

(213) World Health Organisation. Health Promoting Schools: a healthy setting for living, learning, working. Geneva: 1998. Available from:

http://www.who.int/school_youth_health/media/en/92.pdf (accessed 18 November 2015).

(214) Dawson B, Taylor C, Scholefield G, Egerton-Jones M. Healthy body: healthy mind: how headteachers are managing their schools to help improve children's health. *National College for School Leadership.* 2008.

(215) Pawson R, Tilley N. Realistic evaluation: Sage; 1997.

(216) Kingry MJ, Tiedje LB, Friedman LL. Focus groups: a research technique for nursing. *Nurs Res* 1990;39(2):124-5.

(217) Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. *BMJ* 2015;350:h1258

(218) Pallan M, Parry J, Cheng K, Adab P. Development of a childhood obesity prevention programme with a focus on UK South Asian communities. *Prev Med* 2013;57(6):948-54.

(219) Moore G, Audrey S, Barker M, Bond L, Bonell C, Cooper C, et al. Process evaluation in complex public health intervention studies: the need for guidance. *J Epidemiol Commun H* 2013:jech-2013-202869.

(220) Griffin TL, Pallan MJ, Clarke JL, Lancashire ER, Lyon A, Parry JM, et al. Process evaluation design in a cluster randomised controlled childhood obesity prevention trial: the WAVES study. *Int J Behav Nutr Phys Act* 2014;11(112):0112-1.

(221) Elliott R, Timulak L. Descriptive and interpretive approaches to qualitative research. A handbook of research methods for clinical and health psychology. 2005:147-59.

(222) Stewart DW, Shamdasani PN. Focus groups: Theory and practice: Sage Publications. 2014.

(223) Morgan M, Gibbs S, Maxwell K, Britten N. Hearing children's voices: methodological issues in conducting focus groups with children aged 7-11 years. *Qual Res* 2002;2(1):5-20.

(224) He FJ, Wu Y, Feng X-X, Ma J, Ma Y, Wang H, et al. School based education programme to reduce salt intake in children and their families (School-EduSalt): cluster randomised controlled trial. *BMJ* 2015;350:h770.

(225) Dovey TM, Staples PA, Gibson EL, Halford JC. Food neophobia and 'picky/fussy'eating in children: A review. *Appetite* 2008;50(2):181-93.

(226) Birch LL. Effects of peer models' food choices and eating behaviors on preschoolers' food preferences. *Child Dev* 1980:489-96.

(227) Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci* 2011;6(1):42.

(228) Brown J, Michie S, Geraghty AW, Yardley L, Gardner B, Shahab L, et al. Internet-based intervention for smoking cessation (StopAdvisor) in people with low and high socioeconomic status: a randomised controlled trial. *Lancet Respir Med* 2014;2(12):997-1006.

(229) Gulliford M, Charlton J, Bhattarai N, Rudisill C. Social and material deprivation and the cost-effectiveness of an intervention to promote physical activity: cohort study and Markov model. *J Public Health (Oxf)* 2014;36(4):674-83.

(230) Sonneville KR, La Pelle N, Taveras EM, Gillman MW, Prosser LA. Economic and other barriers to adopting recommendations to prevent childhood obesity: results of a focus group study with parents. *BMC Pediatr* 2009;9(1):81.

(231) Sánchez-Carracedo D, Neumark-Sztainer D, López-Guimera G. Integrated prevention of obesity and eating disorders: barriers, developments and opportunities. *Public Health Nutr* 2012;15(12):2295-309.

(232) O'Dea JA. Prevention of child obesity: 'First, do no harm'. *Health Educ Res* 2005;20(2):259-65.

(233) Stenhammar C, Wells M, Åhman A, Wettergren B, Edlund B, Sarkadi A. 'Children are exposed to temptation all the time'–parents' lifestyle-related discussions in focus groups. *Acta Paediatr* 2012;101(2):208-15.

(234) Procter KL, Rudolf MC, Feltbower RG, Levine R, Connor A, Robinson M, et al. Measuring the school impact on child obesity. *Soc Sci Med* 2008;67(2):341-9.

(235) Pallan MJ, Adab P, Sitch AJ, Aveyard P. Are school physical activity characteristics associated with weight status in primary school children? A multilevel cross-sectional analysis of routine surveillance data. *Arch Dis Child* 2014;99(2):135-41.

(236) Williams AJ, Wyatt KM, Williams CA, Logan S, Henley WE. A repeated cross-sectional study examining the school impact on child weight status. *Prev Med* 2014;64(0):103-7.

(237) van Stralen MM, Yıldırım M, Wulp A, te Velde SJ, Verloigne M, Doessegger A, et al. Measured sedentary time and physical activity during the school day of European 10- to 12-year-old children: The ENERGY project. *J Sci Med Sport* 2014;17(2):201-6.

(238) Kristensen PL, Olesen LG, Ried-larsen M, Grøntved A, Wedderkopp N, Froberg K, et al. Between-school variation in physical activity, aerobic fitness,

and organized sports participation: A multi-level analysis. *J Sports Sciences* 2013;31(2):188-95.

(239) Fairclough SJ, Beighle A, Erwin H, Ridgers ND. School day segmented physical activity patterns of high and low active children. *BMC Public Health* 2012;12(1):406.

(240) Faulkner G, Zeglen L, Leatherdale S, Manske S, Stone M. The relationship between school physical activity policy and objectively measured physical activity of elementary school students: a multilevel model analysis. *Arch Public Health* 2014;72(1):20.

(241) Williams AJ, Henley WE, Williams CA, Hurst AJ, Logan S, Wyatt KM. 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* 2013;10(1):101.

(242) Williams AJ, Wyatt KM, Hurst AJ, Williams CA. A systematic review of associations between the primary school built environment and childhood overweight and obesity. *Health Place* 2012;18(3):504-14.

(243) Harrison F, Bentham G, Jones AP, Cassidy An, van Sluijs EMF, Griffin SJ. School level correlates with adiposity in 9-10 year old children. *Health Place* 2011;17(3):710-6.

(244) Richmond TK, Elliott MN, Franzini L, Kawachi I, Caughy MO, Gilliland MJ, et al. School Programs and Characteristics and Their Influence on Student BMI: Findings from Healthy Passages. *PloS One* 2014;9(1).

(245) Li J, Hooker NH. Childhood Obesity and Schools: Evidence From the National Survey of Children's Health. *J Sch Health* 2010;80(2):96-103.

(246) Townsend N, Rutter H, Foster C. Age differences in the association of childhood obesity with area-level and school-level deprivation: cross-classified multilevel analysis of cross-sectional data. *Int J Obes* 2012;36(1):45-52.

(247) Cawley J, Frisvold D, Meyerhoefer C. The impact of physical education on obesity among elementary school children. *J Health Econ* 2013;32(4):743-55.

(248) Miller DP. Associations between the home and school environments and child body mass index. *Soc Sci Med* 2011;72(5):677-84.

(249) Pate RR, O'Neill JR, McIver KL. Physical Activity and Health: Does Physical Education Matter? *Quest* 2011;63(1):19-35.

(250) Carlson JA, Sallis JF, Norman GJ, McKenzie TL, Kerr J, Arredondo EM, et al. Elementary school practices and children's objectively measured physical activity during school. *Prev Med* 2013;57(5):591-5.

(251) Moller N, Tarp J, Kamelarczyk E, Brond J, Klakk H, Wedderkopp N. Do extra compulsory physical education lessons mean more physically active children - findings from the childhood health, activity, and motor performance school study Denmark (The CHAMPS-study DK). *Int J Behav Nutr Phys Act* 2014;11(1):121.

(252) Ridgers ND, Salmon J, Parrish A-M, Stanley RM, Okely AD. Physical Activity During School Recess: A Systematic Review. *Am J Prev Med* 2012;43(3):320-8.

(253) McKenzie TL, Sallis JF, Elder JP, Berry CC, Hoy PL, Nader PR, et al. Physical activity levels and prompts in young children at recess: a two-year study of a bi-ethnic sample. *Res Q Exerc Sport* 1997;68(3):195-202.

(254) Ridgers ND, Stratton G, Fairclough SJ, Twisk JW. Children's physical activity levels during school recess: a quasi-experimental intervention study.*Int J Behav Nutr Phys Act* 2007;4(1):19.

(255) Mantjes JA, Jones AP, Corder K, Jones NR, Harrison F, Griffin SJ, et al. School related factors and 1yr change in physical activity amongst 9–11 year old English schoolchildren. *Int J Behav Nutr Phys Act* 2012;9(153):10.1186.

(256) Kobel S, Kettner S, Erkelenz N, Kesztyus D, Steinacker JM. Does a higher incidence of break times in primary schools result in children being more physically active? *J Sch Health* 2015;85(3):149-54.

(257) Rowland TW. The biological basis of physical activity. *Med Sci Sports Exerc* 1998;30(3):392-9.

(258) Metcalf B, Henley W, Wilkin T. Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54). *BMJ* 2012;345.

(259) Gomersall S, Rowlands A, English C, Maher C, Olds T. The ActivityStat Hypothesis. *Sports Med* 2013;43(2):135-49.

(260) Ekelund U, Hildebrand M, Collings PJ. Physical activity, sedentary time and adiposity during the first two decades of life. *Proc Nutr Soc* 2014;73(02):319-29.

(261) Treuth MS, Catellier DJ, Schmitz KH, Pate RR, Elder JP, McMurray RG, et al. Weekend and Weekday Patterns of Physical Activity in Overweight and Normal-weight Adolescent Girls. *Obesity* 2007;15(7):1782-8.

(262) Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc* 2009;41(5):998-1005.

(263) Owen N, Bauman A, Brown W. Too much sitting: a novel and important predictor of chronic disease risk? *Br J Sports Med* 2009;43(2):81-3.

(264) Mutz DC, Roberts DF, Van Vuuren D. Reconsidering the Displacement Hypothesis Television's Influence on Children's Time Use. *Comm Res* 1993;20(1):51-75.

(265) Pearson N, Braithwaite RE, Biddle SJH, van Sluijs EMF, Atkin AJ. Associations between sedentary behaviour and physical activity in children and adolescents: a meta-analysis. *Obes Rev* 2014;15(8):666-75.

(266) Hale D, Patalay P, Fitzgerald-Yau N, Hargreaves D, Bond L, Görzig A, et al. School-Level Variation in Health Outcomes in Adolescence: Analysis of Three Longitudinal Studies in England. *Prev Sci* 2013:1-11.

(267) O'Malley PM, Johnston LD, Delva J, Bachman JG, Schulenberg JE. Variation in Obesity Among American Secondary School Students by School and School Characteristics. *Am J Prev Med* 2007;33(4, Supplement):S187-S94.

(268) O'Malley PM, Johnston LD, Delva J, Terry-McElrath YM. School Physical Activity Environment Related to Student Obesity and Activity: A National Study of Schools and Students. *J Adolesc Health* 2009;45(3, Supplement):S71-S81.

(269) Cesa CC, Sbruzzi G, Ribeiro RA, Barbiero SM, de Oliveira Petkowicz R, Eibel B, et al. Physical activity and cardiovascular risk factors in children: meta-analysis of randomized clinical trials. *Prev Med* 2014;69:54-62.

(270) Office of National Statistics. Ethnic Group: What is the recommended ethnic group question for use on a survey in England? Available at: http://www.ons.gov.uk/ons/guide-method/measuring-equality/equality/ethnic-nat-identity-religion/ethnic-group/index.html#8 (accessed 18 November 2015).

(271) McLennan D, Barnes H, Noble M, Davies J, Garratt E, Dibben C. The English indices of deprivation 2010. London: Department for Communities and Local Government. 2011.

(272) Adolph AL, Puyau MR, Vohra FA, Nicklas TA, Zakeri IF, Butte NF. Validation of uniaxial and triaxial accelerometers for the assessment of physical activity in preschool children. *J Phys Act Health* 2012;9(7):944.

(273) De Bock F, Menze J, Becker S, Litaker D, Fischer J, Seidel I. Combining accelerometry and HR for assessing preschoolers' physical activity. *Med Sci Sports Exerc* 2010;42(12):2237-43.

(274) Corder K, Brage S, Mattocks C, Ness A, Riddoch C, Wareham NJ, et al. Comparison of two methods to assess PAEE during six activities in children. *Med Sci Sports Exerc* 2007;39(12):2180-8.

(275) Brage S, Brage N, Franks P, Ekelund U, Wareham N. Reliability and validity of the combined heart rate and movement sensor Actiheart. *Eur J Clin Nutr* 2005;59(4):561-70.

(276) Penpraze V, Reilly JJ, MacLean CM, Montgomery C, Kelly LA, Paton JY, et al. Monitoring of physical activity in young children: how much is enough? *Pediatr Exerc Sci* 2006;18(4):483.

(277) Acebo C, Sadeh A, Seifer R, Tzischinsky O, Hafer A, Carskadon MA. Sleep/wake patterns derived from activity monitoring and maternal report for healthy 1-to 5-year-old children. *Sleep* 2005;28(12):1568.

(278) Hesketh KR, McMinn AM, Ekelund U, Sharp SJ, Collings PJ, Harvey NC, et al. Objectively measured physical activity in four-year-old British children: a cross-sectional analysis of activity patterns segmented across the day. *Int J Behav Nutr Phys Act* 2014;11(1):1.

(279) Collings PJ, Wijndaele K, Corder K, Westgate K, Ridgway CL, Dunn V, et al. Levels and patterns of objectively-measured physical activity volume and intensity distribution in UK adolescents: the ROOTS study. *Int J Behav Nutr Phys Act* 2014;11:23.

(280) Merlo J, Chaix B, Yang M, Lynch J, Råstam L. A brief conceptual tutorial of multilevel analysis in social epidemiology: linking the statistical concept of clustering to the idea of contextual phenomenon. *J Epidemiol Commun H* 2005;59(6):443-9.

(281) Hjorth M, Chaput J-P, Michaelsen K, Astrup A, Tetens I, Sjodin A. Seasonal variation in objectively measured physical activity, sedentary time, cardio-respiratory fitness and sleep duration among 8-11year-old Danish children: a repeated-measures study. *BMC Public Health* 2013;13(1):808.

(282) Corder K, Sharp SJ, Atkin AJ, Griffin SJ, Jones AP, Ekelund U, et al. Change in objectively measured physical activity during the transition to adolescence. *Br J Sports Med* 2013:bjsports-2013-093190.

(283) Van Sluijs EMF, Jones NR, Jones AP, Sharp SJ, Harrison FLO, Griffin SJ. School-level correlates of physical activity intensity in 10-year-old children. *Int J Pediatr Obes* 2011;6(2Part2):e574-e81.

(284) Harrison F, Jones AP, Bentham G, van Sluijs EM, Cassidy A, Griffin SJ. The impact of rainfall and school break time policies on physical activity in 9–10 year old British children: a repeated measures study. *Int J Behav Nutr Phys Act* 2011;8(1):47.

(285) Katz DL. School-based interventions for health promotion and weight control: not just waiting on the world to change. *Annu Rev Publ Health* 2009;30:253-72.

(286) Kriemler S, Meyer U, Martin E, van Sluijs EMF, Andersen LB, Martin BW. Effect of school-based interventions on physical activity and fitness in children and adolescents: a review of reviews and systematic update. *Br J Sports Med* 2011;45(11):923-30.

(287) Van Lippevelde W, Verloigne M, De Bourdeaudhuij I, Brug J, Bjelland M, Lien N, et al. Does parental involvement make a difference in school-based nutrition and physical activity interventions? A systematic review of randomized controlled trials. *Int J Public Health* 2012;57(4):673-8.

(288) Nixon CA, Moore HJ, Douthwaite W, Gibson EL, Vogele C, Kreichauf S, et al. Identifying effective behavioural models and behaviour change strategies underpinning preschool- and school-based obesity prevention interventions aimed at 4-6-year-olds: a systematic review. *Obes Rev* 2012;13(s1):106-17.

(289) Kipping RR, Jago R, Lawlor DA. Developing parent involvement in a school-based child obesity prevention intervention: a qualitative study and process evaluation. *J Public Health* 2011.

(290) Rabiee F. Focus-group interview and data analysis. *Proc Nutr Soc* 2004;63(04):655-60.

(291) Johnston BM, Milligan S, Foster C, Kearney N. Self-care and end of life care—patients' and carers' experience a qualitative study utilising serial triangulated interviews. *Support Care Cancer* 2012;20(8):1619-27.

(292) Ruby J. Exposing yourself: reflexivity, anthropology, and film. *Semiotica* 1980;30(1-2):153-80.

(293) Cooper AR, Goodman A, Page AS, Sherar LB, Esliger DW, van Sluijs EM, et al. Objectively measured physical activity and sedentary time in youth: the

International children's accelerometry database (ICAD). *Int J Behav Nutr Phys Act* 2015;12(1):113.