Cardiovascular disease risk factors, weight, and the strategies to tackle future risk in school aged children

Thesis submitted for the degree of Doctor of Philosophy

University of Oxford

Trinity Term 2013

Claire Friedemann

B.Sc (Hons), M.Sc

Green Templeton College

Abstract

Background: Cardiovascular disease (CVD) can have its beginnings in childhood, especially if the child is overweight. Without intervention, increased risk factors in childhood track in adulthood, putting the individual at increased risk for early cardiovascular morbidity and mortality. As a result, childhood health outcomes are an increasingly popular area for health research. However, little progress has been made on the most effective way to enable children to lead healthy lives.

Methods: This thesis incorporated five studies. Firstly, a systematic review and meta-analysis of 63 papers involving nearly 50,000 school children examined the relationship between body mass index (BMI) categories and CVD risk factors. Secondly, a focus group study with 46 students to discuss their knowledge and attitudes towards health, health behaviours and health education. Thirdly, a focus group study with six mothers to discuss screening weight in childhood, and their perceptions of childhood health and health education. Fourthly, a component analysis to establish the characteristics of nine successful educational interventions on children's health. Finally, a pilot intervention and feasibility study involving 314 students.

Results: Overweight and obese BMI categories were associated with substantial increases in CVD risk factors measured and that the association with obesity was greater than that with being overweight. The focus group studies found that the depth of knowledge and the perceived depth of knowledge that participants had about CVD risk factors affected their attitudes and behaviours, although not in the same way. The pilot intervention was deemed feasible. A significant change was brought about in the students' knowledge of cardiovascular disease and raised their self-efficacy towards ensuring the health of their hearts.

Conclusion: The effect of obesity on cardiovascular risk factors is greater than that of being overweight. Additionally, studies in this area are hindered by inconsistent measurements and definitions of the BMI categories. Secondly, both parents and children need to be equipped with deep knowledge and understanding to facilitate attitude and behaviour change towards healthy living. Finally, the pilot intervention should be trialled in a randomised, controlled trial.

Acknowledgements

I would like to thank the following people without whom the completion of this thesis would not have been possible.

Firstly at the Department of Primary Care Health Sciences I would like to thank my supervisors, Professor Carl Heneghan and Dr Alison Ward. It was a privilege to work with two such well-respected researchers and I have benefited greatly from their experience and insight, and been inspired by their passion for health care research. Dr Rafael Perera, Dr Richard Stevens and the statistics group in general provided invaluable advice in analysing the results of the systematic review and questionnaire responses gathered to assess the feasibility intervention in Chapter 8. Dr Kamal Mahtani, for the time he put into being a second reviewer for the systematic review. For his help in producing the systematic review paper for the BMJ and for the media training he gave me for the media interest that surrounded it, I would like to thank Dr Matthew Thompson. I would also like to thank Dr Sian Harrison and Alice Tompson for travelling all over Oxfordshire with me to facilitate the focus groups and later for their help with checking the transcripts. Along with them I would like to thank Dr David Nunan, Dr Susannah Fleming, Abi Eccles, Victoria Hardy, Dr Rachel Brettell, Dr Helen Atherton and Dr Caroline Jones for their help with delivering the WE ♥ Health intervention, I could not have reached that number of children without you. I would also like to thank Professor Rod Jackson and the New Zealand Heart Foundation for allowing me to use their Heart Forecast internet tool. Finally, I would like to thank the researchers who have allowed me to get involved with their own projects, Dr Kamal Mahtani, Dr David Nunan and Dr Jeremy Howick. Expanding my research interests and learning how other researchers go about their work has only added to my experience and the quality of work I was able to produce here.

For the focus group studies and the intervention feasibility study I must thank the teachers that allowed me access to their students, space in their classrooms, and time from their lessons. The enthusiasm that they had for providing their students with a well-rounded education was incredible, and the energy that they have for delivering that education has given me new respect for them. I would also like to thank the children and parents who agreed to take part in the studies, they provided such useful information and a lot of laughs along with it.

More personally, I would like to thank the group of DPhil students that I have had the pleasure of getting to know over the last 3 years. I feel like I have made some great friends and finding our way through our DPhils together has been really enjoyable.

Last but not least I would like to thank my family and especially my parents for their constant love, support and interest in what I was doing, even after 3 years of hearing about it. I would like to thank my sister Bronwyn for being a great friend and provider of much needed distractions, and Colin who came along just as things were getting serious and was brilliant and supportive through the most challenging stage of this project. I could not have done it without any of you.

This work was funded by the Medical Research Council.

Claire Friedemann, 2013

Statement of Contribution

The studies, the analyses and the interpretation of the results are all the original work of the author, completed under the supervision of Professor Carl Heneghan and Dr Alison Ward, both of the Department of Primary Care Health Sciences, University of Oxford.

As the author, I contributed to all aspects of the thesis. Specifically, all aspects of the design and implementation of the search strategy, inclusion and exclusion criteria of the systematic review and meta-analysis, all stages of screening the papers, data extraction, imputation and analysis. I created all of the tables and figures, interpreted the results and wrote and edited the resulting chapter and BMJ paper.

I contributed to all parts of the focus group studies, the recruitment of the schools and either child or parent participants, I designed the focus group schedule and materials, and was the lead researcher during the focus groups. I transcribed all of the recorded data, and analysed and interpreted that data. I fed back the results of the studies to both the schools and the participants. I wrote and edited the resulting chapters and paper that is currently undergoing peer review.

I designed and implemented the search strategy, inclusion and exclusion criteria of the component analysis, carried out all stages of screening the papers, extracting the data and interpreting that data. I wrote and edited the resulting chapter.

I contributed to all aspects of the pilot intervention study. I recruited the school and designed the lesson plans after consulting with teachers. I recruited the nine researchers that helped to deliver the intervention and trained them in its delivery. I created the teacher and student workbooks and the slide presentations, compiled the lesson packs that accompanied the lessons and delivered the lesson. I compiled the questionnaires, input the data from them into the statistical package and carried out the analysis and interpretation. I fed back the results of the study to the school and wrote and edited the resulting chapter.

All tables and figures contained within this thesis are my own creation except where specified.

I hereby declare that no part of this thesis has been submitted for any other degree at this or any other university.

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Chapter 1: Introduction

1.1 Overview

Cardiovascular disease (CVD), one of the leading causes of mortality and morbidity worldwide, can have its beginnings in childhood and it is well-known that the weight of an individual has a strong influence on CVD risk factors.[1-7] Despite this, interventions to facilitate weight loss have met with mixed success. Conversely, interventions that target CVD risk factors in children are less frequently carried out. The aim of this thesis was to develop a method of improving health behaviours in school aged children by directly addressing CVD risk while recognising the role of, but not wholly focusing on, weight loss. As a result this thesis provides evidence of the strong links between body mass and CVD risk factors in children specifically, and designs an intervention to improve health behaviours based on education and understanding of those risk factors.

1.2 Objectives of the thesis

In order to do this the following objectives were set:

- to quantify the relationship between body mass index (BMI) categories and CVD risk factors in children through a systematic review;
- to identify what children understand by cardiovascular health, the factors that contribute to it and what they would like to be taught about it;
- to examine parents' and guardians' (hereafter parents') views about the current practice of measuring the BMI of primary school children, whether they find the measure understandable and useful, and their opinions on the health education that their children receive;
- to examine previous interventions aimed at improving or avoiding excess childhood weight and/or improving cardiovascular health, and identify the components that contribute to their successes and failures;

- to use the knowledge gained to design and pilot an intervention that aims to improve health behaviours by focusing specifically on educating children about CVD risk factors.

1.3 Structure of the thesis

Chapter 2: Background and literature review

This chapter outlines the problem of unhealthy weight in childhood in the context of the current literature. It begins with a description of the burden of excess weight on society and the government initiatives that have been put in place to address the problem. It discusses the predisposing factors of unhealthy weight in childhood, and the link between CVD risk and excess childhood weight. It explores the problems involved in measuring the weight of children, and describes previous efforts to improve weight-related childhood health. Lastly, the chapter looks at previous research on the knowledge and attitudes held by children and parents towards childhood health. The chapter concludes by laying out the rationale for the thesis.

Chapter 3: Systematic review and meta-analysis of the effect of BMI on cardiovascular disease risk factors in children aged 5-16 years

Chapter 3 reports on a systematic review and meta-analysis of the effect of BMI categories on CVD risk factors. This chapter sets out the protocol, methods, and results of the descriptive and meta-analyses and concludes with a summary of the main findings and implications for future research.

Chapter 4: A focus group study exploring students' heart health knowledge and views on health education: Introduction and methods

Chapter 4 describes in detail the methods of the student qualitative study of the Wellness Education for Heart Health study (WE ♥ Health). Focus groups were used to discuss heart health knowledge, attitudes and behaviours with year six (10-11 years of age) and year 11 (15-

16 years of age) school children. The chapter lays out the study question, aims and objectives, before describing the recruitment, data collection, and data analysis methods of the focus groups.

Chapter 5: A focus group study exploring students' heart health knowledge and views on health education: Results

Chapter 5 reports the results of the focus groups described in Chapter 4. The responses given by the children are detailed and compared to past literature. The effect of children's knowledge on their attitudes to health is explored, especially how this influences their subsequent behaviours.

Chapter 6: A focus group study exploring parents' perception of childhood health and health education

The final focus group study in the WE ♥ Health project is detailed in Chapter 6. This focus group explored parents' views and perceived usefulness of the BMI measure, and their opinions of childhood health and the education children receive in school. How the mother's attitudes affect the way they raise their children is also discussed. The results of the focus group are detailed and put in context of previous research.

Chapter 7: Component analysis of interventions to improve childhood weight and cardiovascular health

Chapter 7 begins by explaining the value of a component analysis to this study. The methods used in the literature search and component analysis are then described. Lastly, the findings of the analysis are explored and their implications for the intervention feasibility study that was carried out as the final piece of research in this thesis are discussed.

Chapter 8: Weight and Wellness Education for Heart Health (WE ♥ Health): a pilot intervention and feasibility study to improve the heart health knowledge of secondary school children

Chapter 8 describes design of the WE ♥ Health intervention, explains the theoretical underpinning of each of its constituent parts, and how they were influenced by the studies that preceded it. A description of the feasibility study is given and the findings that were gathered after it are reported and discussed. Finally, the chapter discusses the lessons learned and the implications for the feasibility of a full randomised controlled trial of the WE ♥ Health intervention.

Chapter 9: Discussion and conclusions

Chapter 9 summarises the findings of the pieces of research that has made up this thesis. How the thesis fits into the context of the existing literature and how it addresses a gap in the literature. The findings of each of the pieces of work are described individually and their collective implications for health policy and how future research can build on the findings are explored. Finally the conclusions that can be drawn from this thesis are described.

Table 1.1 Acronyms used in this thesis

Acronym	
BMI	Body Mass Index
BP	Blood Pressure
CDC	Centre for Disease Control
CVD	Cardiovascular Disease
CHD	Coronary Heart Disease
HDL-C	High Density Lipoprotein Cholesterol
IMT	Intima-Media Thickness
IPA	Interpretive Phenomenological Analysis
LDL-C	Low Density Lipoprotein Cholesterol
LVM	Left Ventricular Mass
NAO	National Audit Office
NCMP	National Child Measurement Program
NHLBI	National Heart, Lung and Blood Institute
NHS	National Health Service
WE ♥ Health	Wellness Education for Heart Health
WHO	World Health Organisation

1.4 References

1. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The Relation of Overweight to Cardiovascular Risk Factors Among Children and Adolescents: The Bogalusa Heart Study. *Pediatrics* 1999;103(6):1175-82.

2. Gunnell D, Frankel S, Nanchahal K, Peters T, Davey Smith G. Childhood obesity and adult cardiovascular mortality: a 57-y follow-up study based on the Boyd Orr cohort. *Am J Clin Nutr* 1998;67(6):1111-18.

3. Allebeck P, Bergh C. Height, body mass index and mortality: Do social factors explain the association? *Public Health* 1992;106(5):375-82.

4. Hoffmans MDAF, Kromhout D, de Lezenne Coulander C. The impact of Body Mass Index of 78,612 18-year old dutch men on 32-year mortality from all causes. *Journal of Clinical Epidemiology* 1988;41(8):749-56.

5. Mathers C, Stevens G, Mascarenhas M. Global Health Risks: Mortality and burden of diseaseattributable to selected major risks. Geneva: World Health Organisation, 2009.

6. World Health Organisation. Noncommunicable Diseases Factsheet, 2013.

7. World Health Organisation. *Obesity : preventing and managing the global epidemic : report of a WHO consultation*. Geneva: World Health Organisation, 2000.

Chapter Two: Background and Literature Review

2.1 Overview

Unhealthy weight and cardiovascular disease (CVD) have a substantial impact on mortality and morbidity of populations globally and are gaining interest as areas of research.[1] As such this thesis has a rich foundation of previous literature on which to build. A review of the existing literature was conducted and covers the following 10 areas:

2.2 The burden of unhealthy weight in childhood.

2.3 Childhood weight in government strategies for health.

2.4 Factors predisposing children to unhealthy weight.

2.5 The link between excess weight and cardiovascular disease risk.

2.6 Issues with measuring adiposity in children.

2.7 Efforts to improve weight related health in children.

2.8 School-based interventions.

2.9 Changing behaviour through knowledge and attitudes.

2.10 Knowledge and attitudes to health in childhood.

2.11 Summary of previous research.

2.12 Rationale of thesis.

2.2 The burden and cost of unhealthy weight in childhood

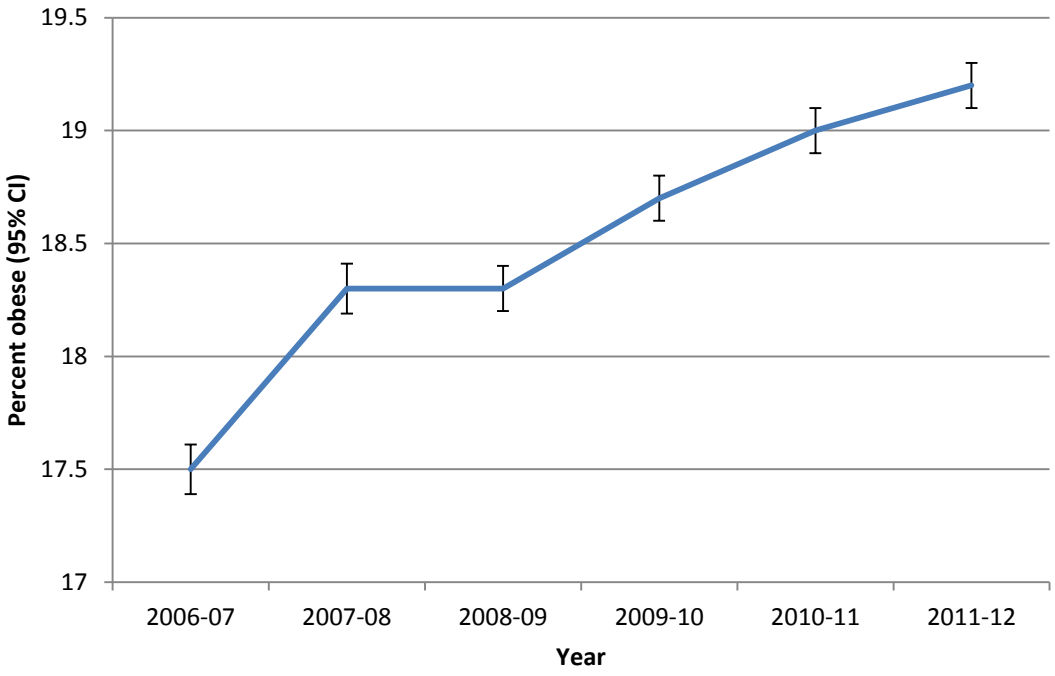
The problem of unhealthy weight in childhood is one that has received a lot of publicity in recent years and deservedly so. While in the past excess weight was a condition primarily associated with more prosperous nations, obesity is now a global health problem and the second largest single contributor to the global disease burden.[2 3]

Furthermore, this problem is not confined to any particular age group but has been growing in prevalence in childhood and adulthood alike. Health data from the late 1970s puts the rate of obesity amongst English adults at approximately 7%.[4] Today, that figure has tripled to just

under 25%.[4] The number of children worldwide who are overweight or obese is also increasing, accounting for over a third of the child population in many countries.[5 6]

The same trends apply in the United Kingdom. For example, in 2012 the English Public Health Observatories reported that the rate of obesity amongst Oxfordshire children was 16% higher than amongst adults, with average rates of 20% versus 16% amongst year six children (age 10 to 11) and adults respectively.[7] Furthermore, national data published by the National Child Measurement Program (NCMP) suggest that rates of obesity amongst children are increasing. NCMP data for the year 2011-2012 showed that nearly a fifth of English 10 to 11 year olds were obese, with a weight over the 95th centile when compared to the British 1990 Growth Reference age and sex adjusted growth curves.[8] As can be seen in Figure 2.1 this number had further increased by almost 2% since 2006.[9]

Figure 2.1 Change in the prevalence of obesity in year 6, England 2006 to 2012. NCMP Data[9-14]



Furthermore, the severity of the problem is worsening. By examining the change in childhood and adolescent mean body mass index (BMI), US studies have reported little change at the lean end of the BMI scale, while increases of two to six BMI points have been recorded in the mean BMI of the heaviest children.[5 15]

The financial burden of a high prevalence of obesity in the population is substantial. The Foresight Programme which is run by the UK's Government Office for Science has performed projections of the future cost of obesity.[16] These projections take into account the total cost of rising rates of obesity to the NHS and include the cost from greater incidence of common co-morbid conditions such as diabetes, coronary heart disease and stroke.[16] This model put the total cost of obesity to the NHS in 2050 at £49.9 billion per year, more than triple the £15.8 billion it cost in 2007[16] and almost half of the entire NHS budget for 2012-2013 of £108.4 billion.[17]

The financial burden may be exacerbated by an aging population coupled with the worsening health and reduced productivity of the working population through obesity related illness.[18] This could mean that while the numbers of elderly people drawing a state pension will remain stable or increase, the proportion of the population in employment and contributing to the state fund will decrease.[19]

2.3 Childhood weight in government strategies for health

It has become a priority for government health strategies to tackle the problem of childhood obesity due to the substantial costs involved and the strong evidence that obesity in adulthood often begins in childhood. [19-22]

Since the mid- to late 1990s there has been a surge in schemes to improve the health of the British public.[23] The policies and initiatives to address obesity, diet, and physical activity detailed in a report by the National Audit Office (NAO) include the NHS Plan (2000), which incorporated advice from the Health Development Agency and the newly formed Food

Standards Agency. The aim of this plan was to reduce obesity and inactivity, raise fruit and vegetable consumption, and reduce the levels of salt, fat and sugar in food.[23]

Other initiatives include a number of school-based schemes. Two of these are the Healthy Schools Programme (1998) and the National School Fruit Scheme.[23] Both of these initiatives have had success in increasing the consumption of fruit and vegetables in children attending schools engaged in them.[24 25] Additionally, the Safe and Sound Challenge scheme (2000/01) encouraged schools to develop innovative, safe, and active ways to get to school, although there is no assessment of the effectiveness of this scheme yet.[23]

Furthermore, in September 2000, Personal, Social and Health Education (PSHE) became part of the National Curriculum and covers topics such as diet, exercise, and the health risks of unhealthy weight. One major criticism of delivering health education as a part of PSHE is that it suffers as a result of the low priority frequently given to PSHE, and little has been done to strengthen the subject's status in the curriculum.[26]

More recent government initiatives include the National Child Measurement Programme (NCMP) established in 2006, which monitors and provides information about child BMI so that health promotion services can be targeted appropriately.[27] In addition, the programme also provides BMI feedback to parents along with healthy living advice. However, as will be described in section 2.6, the BMI measure is not without its critics and research has found that parents are frequently distrustful and disengage with information using BMI.[28 29] The lack of information on how BMI categories relate to common weight-related health problems may be a contributor to the confusion.

Unlike the NCMP, which focuses on primary school children, there are schemes in place such as Change4Life which was initiated in 2009 and provides healthy nutrition and physical activity advice from infancy.[30] Change4Life has been found to have little effect in its target audience so far. A cluster randomised trial amongst 3,774 families of 5 to 11 year old children examined the

change in parental attitudes and parent and child health behaviours before and after exposure to Change4Life. The researchers found that it had no impact on the attitudes or behaviours of the participant families.[31] The authors suggested reasons why there was a lack of an effect, two of which were that it is unclear whose behaviours (the parents' or the child's) are being targeted or because Change4Life addresses a number of activity and diet behaviours and so dilutes the effect on any one of these. Instead, they suggest that the participants focus on the behaviours they feel they already achieve rather than the areas for improvement.[31]

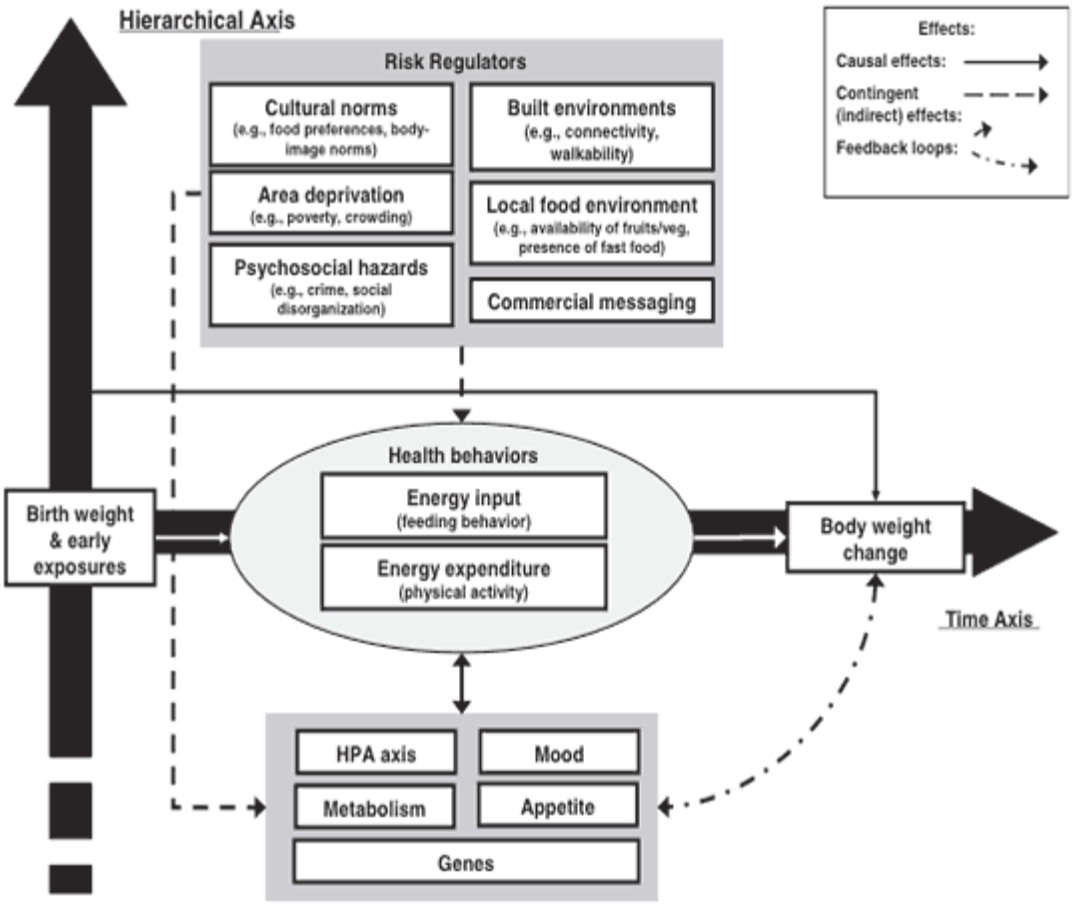
Another programme, the Healthy Child Programme, encourages health professionals to provide families with nutrition and physical activity advice from before the child is born.[27] As with the Safe and Sound Challenge scheme, it appears that the effect of this programme has not been assessed.

A 2011 DOH document highlighted the importance of central and local government working together to achieve their obesity reduction targets and the continued support and investment in schemes such as the NCMP.[19] This document underscores the importance of well-targeted research, data-analysis and best practice dissemination in informing policy on tackling obesity.[19]

2.4 Factors predisposing children to unhealthy weight

Obesity is a condition that is influenced by the interactions of numerous genetic and environmental factors, as shown in Figure 2.2.[32] This interaction adds to the complexity of reducing excess weight and maintaining weight loss.[33]

Figure 2.2. The interaction of factors influencing obesity. Reproduced from: Huang, T. T., Drewnowski, A., Kumanyika, S. K. & Glass, T. A. 2009. A Systems-Oriented Multilevel Framework for Addressing Obesity in the 21st Century. *Preventing Chronic Disease,* 6**,** A82.



2.4.1 Genetics

Two genes which are associated with obesity are the fat mass obesity associated FTO (FTO) gene and the melanocortin-4 receptor (MC4R) gene. In a 2008 study including 2,726 Scottish children, the presence of variants in the FTO gene was associated with both BMI and weight ($p=0.003$) and a nine centimetre increase in the sum of total skinfold thickness ($p=0.03$).[34] Carriers of the FTO gene were found to have an estimated fat mass 1.78 kilograms higher than non-carriers ($p=0.01$) and increased energy intake ($p=0.006$) independent of body weight.[34] Variants of the MC4R gene are associated with increased weight ($p=0.031$), BMI z-score

(p=0.032), and energy intake (p=0.036).[35] Furthermore, common variants of the MC4R gene have been reported to influence fat mass and obesity risk with odds for severe childhood obesity reaching 1.30 (95% CI 1.20-1.41, $p=8.0 \times 10^{-11}$).[36]

2.4.2 Ethnicity

Ethnicity has also been associated with BMI. In a study of over 4,500 6 to 11 year old children ethnicity emerged as the factor with the second strongest association with overweight and obesity after age.[37] Furthermore, children of African American ($\beta=1.20$, S.E.=0.26, $p<0.001$) or Mexican American ($\beta=0.85$, S.E.=0.33, $p=0.010$) descent where shown to have higher than average BMI and a greater prevalence of excess weight compared to white adolescents in a multivariate regression analysis on data from the Third National Health and Nutrition Examination Survey.[38]

Similarly, in the UK there is an association between ethnic groups and prevalence of obesity. Data taken from the Health Survey for England 2004 showed that after controlling for socio-demographic and regional differences respondents of Afro-Caribbean origin had the highest prevalence of obesity (25% of men and 32% of women). Respondents of Bangladeshi (6% of men and women) and Chinese (6% of men and women) had the lowest prevalence of obesity.[39]

The association between ethnicity and obesity prevalence may be, however, confounded by lifestyle factors that are strongly related to culture, such as varying levels of physical activity and diet.[39]

2.4.3 Early life factors

Early life factors that have an association with childhood obesity include parental BMI, early weight, and weight gain, and there is some compelling research which suggests that these, either by themselves or in combination with lifestyle factors, could predispose a child to excess weight.

Parental BMI and rapid weight gain in early childhood have been identified as risk factors for later obesity. The UK Millennium Cohort Study is a longitudinal study of, amongst other things, health factors of children born in the UK between September 2000 and January 2002. It found that at age 5 years, 63% of overweight and 88% of obese but only 13% of normal weight children had experienced rapid weight gain since age 3 years.[40] This study investigated the early growth of 11,653 children and found that rapid early growth was also associated with maternal overweight before pregnancy. Odds ratios adjusted for psychological, behavioural, and environmental factors of 1.56 (95% CI 1.36 to 1.79) were found for the mother being overweight before pregnancy, and maternal overweight post-pregnancy of 1.32 (95% CI 1.15 to 1.51). Furthermore an adjusted odds ratio of 1.56 (95% CI 1.34 to 1.81) was associated with paternal overweight.[40] There is, however, discussion around the relationship between rapid weight gain in childhood and parental BMI. Some authors have noted that this association could be confounded by lifestyle habits that tend to vary with BMI, and reliance on self-report measures.[41]

Another early life factor for obesity is birth weight. A review of 19 studies examining a baseline total of 229,856 children found birth weight to be related to being overweight in later childhood and adulthood.[42] The results should be viewed with caution as findings were inconsistent when potential confounding variables such as parental weight and social group were controlled for.[42] A more recent study of 532 children does however support these findings. This study reported relative risks of 2.17 (95% CI 1.22 to 3.87) for obesity in childhood and 2.01 (95% CI 1.10 to 3.68) for obesity in adulthood associated with a birth weight of more than 8.5 pounds.[43] A systematic review of 66 studies analysed the reasons put forward for the increased risk of later excess weight in high birth weight babies. They include pre-natal over nutrition leading to a disposition for insulin resistance, disruptions to the systems that regulate body weight and hormonal disturbances during in-utero development.[44]

2.4.4 Behavioural factors

A further group of factors that has been the subject of many investigations is behavioural factors, which include time spent in sedentary behaviour and low fitness.

Screen time as a measure of the time spent in sedentary activities is assessed by the US National Health and Nutrition Examination Survey (NHANES) and has been reported as being associated with excess weight. A study that examined the results of NHANES from 2001 to 2006 found that 45% of normal weight children, 51% of overweight and 59% of obese children engaged in two or more hours of screen time per day. [45] A consideration here should be that while screen time is the most common form of sedentary behaviour, it is not the only one and as such some sedentary time may be being missed.[46] Conversely sedentary behaviour measured in this way normally relies on self-reporting which could mean behaviours are not accurately reported.[46]

Furthermore, weight gain in childhood has been associated with low levels of cardiorespiratory fitness, independent of sex, age or baseline BMI.[47] McGavock et al. (2009) reported a 3.5 fold (95% CI 2.0 to 6.0, $p<0.0001$) increase in the risk of becoming overweight over 12 months in children with low fitness. Additionally at each decreasing level of fitness classification there was a 48% increase in becoming or remaining overweight.[47]

2.4.5 Socioeconomic factors

Socioeconomic status (SES) is a further important contributing factor to obesity in both children and adults. Adolescent BMI has been found to be negatively predicted by both family income ($\beta=-0.22$, $p<0.01$) and assets ($\beta=-0.27$, $p<0.001$) and correlated negatively with family income, assets, education and occupational status.[48]

In 2003, Goodman et al. calculated the population attributable risk, the amount of risk to a population of an exposure, for household income and parental education on obesity in 15,112 adolescents. They found lower income increased risk of obesity by one third and lower education increased the risk of obesity by two fifths.[49] Similarly, in European studies BMI has

been found to be associated with the SES of the participants in two cross-sectional surveys and a five year follow-up study. [50] [51] [52] Of the criteria used to distinguish the different socio-economic groups, education appeared to be the strongest predictor of BMI.[51]

2.4.6 Clustering of obesogenic behaviour

To further compound the increased risk for obesity of each of the above mentioned factors, obesogenic behaviours cluster in children as young as two. A survey of over 2,500 parents of two year old children found that reported time spent watching television was correlated to snacking ($r=0.22$, $p<0.01$) and consuming sugar sweetened beverages ($r=0.16$, $p<0.01$). Additionally television time was negatively correlated to the consumption of vegetables ($r=-0.15$, $p<0.01$) and fresh fruit ($r=-0.11$, $p<0.01$).[53] Furthermore, a clustering of two types of behaviours was noted. The first included time spent watching television or on a computer, snacking, and consuming sugar sweetened beverages, and the second included the consumption of healthy foods such as vegetables, fresh fruit, and brown bread. The two clusters were inversely correlated to each other and the obesogenic cluster was predicted by maternal obesity ($\beta=0.06$, $p<0.01$) and low education ($\beta=0.13$, $p<0.001$).[53]

Clustering of obesogenic behaviour was again found in a study that included a much wider range of ages. Pearson and Biddle found associations between behaviours such as sedentary behaviour, low fruit and vegetable consumption, high fast food consumption, and calorie dense snacking in both children and adolescents.[54]

Additionally, the clustering of these types of behaviour has been found in association with excess weight in children. A multinational European study reported clustering of high levels of television and computer screen time with reduced physical activity that were associated with being overweight in 9-14 year old boys (odds ratio 1.67, 95% CI 1.18 to 2.37) and girls (odds ratio 1.64, 95% CI 1.23 to 2.18).[55]

2.5 The link between excess weight and cardiovascular disease risk

In 2010, adult deaths attributable to high BMI globally were three times those attributable to malnutrition.[3] With the rates and severity of obesity among children also rising, researchers have suggested that diseases previously only found in adults could become childhood conditions as risk factors are found in increasingly young participants.[5 15] The co-morbid conditions associated with obesity are numerous and range from psychosocial problems to musculoskeletal and endocrine disorders.[5] One of the conditions that excess weight is known to impact greatly on is cardiovascular disease (CVD) and for children as well as adults the health consequences have been found to be substantial.

2.5.1 Association of obesity and physical and functional heart changes

Childhood obesity has been positively correlated with the presence of multiple risk parameters for CVD, which over time can be detrimental to heart health and increase mortality. [56-59]

Obesity has also been found to significantly increase the odds and the relative risk of physical and functional changes to the cardiovascular systems of obese compared to normal weight children.[56 60 61] Specifically, data from seven cross-sectional studies carried out by the Bogalusa Heart Study showed that obesity has a significant effect on blood pressure in 5-17 year olds with the odds of raised diastolic and systolic blood pressure at least doubled across all age groups. The only exception to this was in diastolic pressure in 15-17 year olds.[56] Furthermore, after 24-hour ambulatory blood pressure monitoring it was found that obesity raised the relative risk of hypertension in 93 obese adolescents to 6.8 (95% CI 1.7-27.3).[61]

A 2001 study that non-invasively measured the endothelial dysfunction in 48 obese children compared to 27 non-obese controls at age 12 years showed that obese children had reduced endothelial function. In the obese children flow-mediated dilation was 5% (95% CI 2 to 22) compared to 9% (95% CI 4 to 15) in normal children (p=0.0002) and glycerol trinitrate-

mediated dilation was 15.6% (95% CI 5 to 30) and 23% (95% CI 11 to 30) in obese and normal weight children respectively (p=0.00005).[62]

In addition, when 100 obese Italian children were compared to 47 normal weight, age-matched controls aged 6 to 14 years, the intima-media thickness of the obese children was significantly higher than that of the control children (0.55mm, S.D. 0.0.8, versus 0.49mm, S.D. 0.09, p=0.001).[63]

2.5.2 Association of obesity to biochemical CVD risk parameters

Childhood obesity has been linked to a number of CVD parameters such as raised triglycerides and elevated fasting insulin,[56] raised total and LDL- and lowered HDL cholesterol,[56 62 64] insulin resistance and dyslipidaemia.[65]

Elevated fasting insulin was examined in a cohort of 5,487 5-17 year olds in The Bogalusa Heart Study and an elevated fasting insulin odds ratio of 12.6 (95% CI 10-16) was found in the overweight children.[56]

Elevated median cholesterol concentration has been found in obese children of 4.70 mmol/L compared to 4.34 mmol/L in lean children ($p<0.005$) with a mean age of 12.3 years.[62] This supported a previous study reporting the odds ratio of being overweight and having an elevated total cholesterol between 1.4 and 3.4 ($p<0.05$) across the age groups measured.[56] Furthermore, a systematic review of the aetiology and consequences of childhood obesity found that obesity in children and adolescents was associated with raised LDL- and lowered HDL cholesterol and raised triglyceride levels.[64]

Dyslipidaemia and insulin resistance are not only risk parameters for CVD but also precursors to type II diabetes mellitus.[65] While historically type II diabetes has been an almost exclusively adult disease, in recent years the numbers of children being diagnosed has risen. In some populations type II diabetes now accounts for almost half of all new cases of diabetes in children and adolescents, and 90% of child sufferers are also obese.[65]

2.5.3 Association of obesity to impaired fitness

The cardiovascular fitness of children has been found to worsen with increasing BMI, with the obese group showing a significantly reduced anaerobic exercise capacity (mean=1.04, S.D. =0.27) compared to normal weight children (mean=0.94, S.D. =0.17).[66] In this study by Reybrouck et al., the oxygen uptake versus carbon dioxide exhalation of 29 obese and 16 control children with a mean age of 11 years was assessed using a treadmill test. Exercise tolerance in the obese children was 70% of the mean tolerance of the controls. Some of the obese children showed such low exercise capacity they exceeded the ventilatory threshold even before the onset of the exercise and were excluded.[66]

2.5.4 Clustering of CVD risk parameters

Childhood obesity is strongly correlated with a clustering of cardio-metabolic risk parameters and the cumulative risk associated with the presence of multiple risk parameters.[67] In 5-10 year olds the odds ratio was 9.7 for the presence of two risk parameters and 43.5 for the presence of three CVD parameters in those classified as overweight.[56]

2.5.5 The effect of obesity on morbidity and mortality

In 1998, Gunnell et al. analysed data from the Carnegie Survey of Family Diet and Health in pre-war Britain which recruited 1,165 male and 1,234 female children from 1937 to 1939, when they were between 2 and 14 years of age, and followed up for on average 57 years.[57] This study showed a linear increase in ischemic heart disease mortality with a two fold increase in the hazard ratio associated with a childhood BMI over the 75th percentile. The results of this study should, however, be viewed with caution as a cohort recruited in the late 1930s may not be comparable to a modern population. Factors such as diet, rates of cigarette smoke and health care have changed greatly over the 70 years since the children were recruited and so this study is at a high risk from confounding. Gunnell et al. also note that they do not have information on the adult BMI or behavioural risk factors which could have a large effect and that this result is

associated with wide confidence intervals. Despite these reasons for caution there exist studies that give precedent to the finding.[58 59]

There is a wealth of information on the relationship between weight as measured by BMI and CVD risk factors, but to date the magnitude of this relationship has not been formally described in a systematic review. Furthermore in the process of the review of the literature the author noted that the methods used and the quality of these studies varied greatly but as yet their quality has not been assessed.

2.6 Issues with measuring weight in children

BMI, although a commonly used and relatively simple way to measure the weight status of children, is not without its critics. Although frequently used as a definition of adult obesity, BMI cannot be used directly on a child population as the median BMI in childhood fluctuates substantially depending on age, from 13kg/m^2 at birth to 21kg/m^2 by age 20.[68]

As well as this consideration, previous studies have cautioned that BMI has been tested mainly on white, non-obese children and that the centiles on which the weight categories are frequently based have been formed on an American sample, measured years previously.[68 69] This has raised concerns over how internationally applicable the measure is.

A number of other methods to assess adiposity exist, each of which has its own advantages and disadvantages (Table 2.1).[70] However, compared to many of these other measures BMI is inexpensive, easy to use and provides a good estimation of adiposity in most people. BMI has at least a medium correlation with measurements of percent body fat in boys and girls and across different ethnicities with measurements by Dual-energy X-ray Absorptiometry (DXA) scanning, smallest r= 0.44, largest r=0.83.[69] As such BMI is still the recommended method for measuring adiposity in the population, particularly if BMI's potential short comings are kept in mind. [68 71 72]

Table 2.1 Methods of measuring adiposity Goran, M.I. (1998), Measurement Issues Related to Studies of Childhood Obesity: Assessment of Body Composition, Body Fat Distribution, Physical Activity, and Food Intake, (pg. 514)

Method	Advantages	Limitations
Densitometry	• Direct measure of total body density	• Model of fat and fat-free mass • Underwater weighing may be impractical and/or distressing • Expensive equipment ($30 000) • Laboratory based
DXA	• Quick and simple • Separates bone tissue • Data on fat distribution • Accuracy versus known standards has been established	• Different machines and software for different subjects • Expensive equipment ($70 000) • Laboratory based
Skinfolds and anthropometry	• Quick and simple • Inexpensive • Useful for large studies • Information on fat pattern	• Need different equations to transform data to body composition
Bioelectrical resistance	• Quick and simple • Inexpensive • Useful for large studies	• Estimates body water, so need to have information on hydration of fat-free mass
CT/MRI scanning	• Measures tissue area in specific anatomic locations	• CT involves radiation • Expensive and limited availability • Research based

2.7 Efforts to improve weight-related health in children

The research community has responded to the global obesity crisis with a multitude of interventions to change behaviours, reduce weight, and improve the health outcomes of children. These interventions use a number of different approaches to attempt to achieve their aims including improvements in physical activity, diet, psychological approaches, role models, use of technology, cultural tailoring and targeting specific age groups.

2.7.1 Physical activity and sedentary behaviour

The consensus among researchers targeting obesity is that interventions aimed at children and adolescents should include the family or school year group as a whole in order to avoid further singling out the child and to help reinforce changes in behaviour.[5 73] It was also suggested in a review of international physical activity interventions that those based in school have the potential to reach children who are typically difficult to recruit due to the compulsory nature of school physical education lessons.[74]

Although many studies have followed this advice, the evidence suggests that school-based interventions to reduce levels of obesity through targeting physical activity are limited in their effectiveness.[75 76] None of the studies, whether using a combination of education, activity and behaviour modification[76] or physical activity alone,[75] were able to achieve long term improvements in BMI or body composition measures. School-based physical activity interventions are often at a further disadvantage due to time and financial restrictions. Once the intense and facilitated phase of the intervention passes, time pressures and small budgets in schools mean that physical activity is often given a low priority again.

Harris et al. were unable to find any improvements in BMI following the 15 interventions included in their meta-analysis with a mean change of just -0.05kg/m^2 (95% CI -0.19 to 0.10).[75] The included studies all aimed to improve their participants' physical activity habits, for example time spent in physical activity or increasing moderate to vigorous activity, as their primary intervention. A number included a health education component but this was always secondary. The authors of the meta-analysis therefore concluded that school-based physical activity interventions are ineffective in reducing obesity.[75] The authors raise the points that physical activity may not have a great effect if it is addressed in isolation; the diet of the children could have a mediating effect, and any effect it does have may be lost by analysis at the population level. They suggest that children with a higher baseline BMI could benefit more from increases in their physical activity but this result would be diluted if the children were analysed together.[75]

Another health behaviour that goes hand in hand with physical activity and is frequently the focus of weight interventions is sedentary behaviour. In a 2012 meta-analysis on the effects of sedentary behaviour interventions Van Grieken et al. reported that only 13 out of 34 papers reviewed achieved a significant reduction in participants' sedentary behaviour, mean difference -17.95 minutes per day (95% CI -26.61 to -9.28).[77] Additionally, only six papers reported a significant reduction in the children's BMI or BMI z-score. An issue raised by the authors of

this paper was that the majority of the measurements taken to assess the effectiveness of the intervention were done immediately after it was delivered, with only a few reporting follow-up measurements. Even when follow-up measures were reported, the time post intervention did not exceed three months in any of the papers. This makes it impossible to draw any conclusions about the longer term effects or sustainability of the short term effects of the studies.

A systematic review of 17 papers was able to report more positive outcomes from interventions to reduce sedentary behaviour in children. Biddle, O'Connell and Braithwaite reported that 15 out of 17 papers reduced sedentary behaviour in their participants with an average treatment effect size of g=-0.192, 95% CI -0.303 to -0.082, p=0.001.[78] This effect was, however, found in studies which addressed a combination of behaviours, 16 out of 17 targeted a combination of sedentary behaviour, physical activity and/or nutrition. Additionally, 12 out of the 17 had no follow-up measures. As such and like the above studies, it is therefore difficult to draw conclusions about whether interventions specifically targeting sedentary behaviour bring about health improvements, and whether any improvements seen are sustained in the long term.

2.7.2 Dietary improvements

Although dietary improvements are a common feature of weight reduction studies, diet is rarely used as an intervention on its own.[79] In an effort to assess the effectiveness of dietary interventions, Collins et al. conducted a systematic review of randomised controlled trials (RCT) in children that included a dietary component. In these, some significant reductions in the children's body fat percentage (-3% to -6% in one study) and weight (pooled standardised mean difference -1.82 kilograms, 95% CI -2.40 to -1.23) were reported. However, since the diet component was only a part of the full intervention it is difficult to draw any conclusions on the effectiveness of the diet change component itself. This review also examined how sustainable any changes were at follow-up and found that from the four studies that reported follow-up data, the effect of the intervention was reduced with a mean difference of -0.64 kilograms (95% CI -0.89 to -0.39).[79] Furthermore, the authors highlight that poor quality studies, which vary greatly

in design, treatment type, and follow-up length, prevent conclusions being made about the effectiveness of dietary interventions.

A 2011 systematic review of 24 school-based nutrition education RCTs reported that following nutrition education the consumption of fruit and vegetables increased amongst the children, although for most this was only by between 0.1 and 0.6 servings per day. Furthermore, only one out of the nine high quality studies reported a reduction in BMI.[80]

2.7.3 Psychological approaches

Techniques based in social cognitive theory such as motivational interviewing have been used but with limited success. Berg-Smith et al used a motivational interviewing component to assess and increase participants' motivation to adhere to a dietary intervention and to tailor that intervention to their motivation level.[81] In 127 adolescents a significant but small reduction was shown in the mean proportion of calories from fat, from 28% to 26% ($p<0.001$), and a decrease in the consumption of dietary cholesterol from 182.8 mg/1000 kcal to 157.3 mg/1000 kcal ($p<0.003$).[81] Despite these encouraging results, the participants were only followed up for an average of 3.3 months and the paper does not report on any weight change measures.

Another study conducted a decade later also employing a motivational interviewing method was carried out by Black et al with 11 to 16 year old black adolescents.[82] The Challenge! study was delivered by gender and race matched young adults with the aim of exposing the intervention group to healthy behaviours and giving them the confidence to adopt them. It was found that the proportion of overweight or obese adolescents in the intervention group decreased at 24 month follow-up from 45% to 39% while the proportion increased in the control group from 32% to 43%.[82] As well as this a reduction in the intervention group's total energy intake from 3058.5 kcal to 2216.6 kcal from baseline to 24 month follow-up was observed.[82] This study underscores the importance of long follow-up periods as the changes to BMI and body composition were only seen at the 24 month follow-up.

2.7.4 Role models

The role model component of the study by Black et al. has also been used elsewhere without the motivational interviewing aspect. A 2007 study paired young primary school children with older "healthy buddies".[83] The older primary school students were given instruction in healthy living which they then taught to their buddy. This was combined with integrated physical activity sessions. Through the use of a peer-led intervention the health knowledge, attitudes and behaviours of both the younger and older students improved.[83] Furthermore, the increase in weight and BMI was significantly smaller in the intervention group of the older children and was accompanied by a greater increase in the scores for health behaviour, knowledge and attitudes over that of the younger children.[83] It may be that by being taught whilst also teaching the material, the older children in the intervention group experienced a greater effect; however, the authors do not comment on this.

Continuing in the theme of role model led interventions; the celebrity status of professional sports bodies has also been explored as a method to induce behaviour change. One such study "Get Fit with the Grizzlies" involved collaborations between schools and a local basketball team to improve health by improving nutrition and physical activity.[84] This study measured significant post intervention improvements in the percentage of correct responses given to seven out of eight health knowledge items and seven out of ten health behaviour questions.[84] Although Get Fit with the Grizzlies was able to produce some positive effects, securing the assistance of sports personalities may not be practical more generally.

2.7.5 Technology

A method that is increasingly popular is the computer-based or internet-based component. A 2010 systematic review of interventions incorporating a computer- or web-based component found that it did have some positive effects in increasing healthy eating and physical activity in 11 out of the 14 included studies.[85] An advantage of interventions such as these is that they can be more easily tailored to the individual depending on the personal information they provide.

The authors of this review concluded that individually tailored, theory based interventions, carried out in a school setting, and involving parents were most likely to bring about positive outcomes.[85]

2.7.6 Cultural tailoring

Culturally tailored interventions which aim to reduce or prevent excess weight in minority and non-western children have also been run. The Pathways project was an intervention aimed at Native American children to encourage physical activity and healthy eating.[86 87] Despite showing significant increases in knowledge of healthy behaviours in all age groups, the Pathways intervention was unable to achieve its primary aim of reducing the rate of body fat gain over 3 years.[86]

Two recent studies have targeted Mexican American children with some success.[88 89] A 2007 intervention by Johnston et al. randomised 71 overweight 10 to 14 year olds into either an intense intervention or self-help group.[88] The intervention showed differences in the change scores of the two groups in weight and BMI ($p<0.05$) at three months and in weight and percent body fat ($p<0.05$), BMI percentile ($p<0.01$) and BMI ($p<0.001$) at six months.[88] No significant changes in the biomarkers measured, blood pressure, cholesterol, triglycerides, glucose and insulin, were found. In 2010 Johnston et al. reported the one and two year results of an instructor lead intervention compared to a self-help intervention.[89] This study showed a significant difference in the change in weight, zBMI, BMI, percent overweight ($p<0.001$), and BMI percentile ($p<0.05$) at one year. At two years a significant difference was only found in zBMI and BMI percentile ($p<0.05$). In the biomarkers measured, a significant difference in the change in total cholesterol and triglycerides ($p<0.05$) was reported at one year.[89]

Increasingly interventions are also being carried out in non-western countries. For example, studies carried out in Tonga, Chile and China have reported significant reductions in body fat percentage,[90] BMI z-score,[91] and a range of other adiposity measures.[92] However, these studies

also reported some common problems: mixed results- positive effects off-set by a similar number of negative effects;[90] a regression of initially positive changes towards baseline;[91] and methodological weaknesses such as poor reporting, lack of follow-up and failure to gain informed consent or ethical approval.[92]

2.7.7 Age

Lastly, the age at which interventions to prevent excess weight gain are being implemented is also varied. While the majority of studies are carried out with school-aged children, an increasing number are being aimed at pre-school children, again with varying levels of success. Two reviews of interventions in pre-school children reported reductions in weight or body fat or significant improvements to dietary intake, reduced sedentary behaviour and smaller increases in BMI in around half of the studies reviewed. [93] [94]

A review of weight management interventions for children under the age of five was carried out by Bond et al. (2011).[95] The authors of this review described a lack of high quality trials and large amounts of heterogeneity, which made analysis difficult. They concluded that while some decreases in the weight were achieved, these effects were small and not statistically significant.[95]

Similarly a paper reviewing interventions to decrease obesity in children younger than two reported high heterogeneity and low quality in its included papers.[96] Although half of the included papers achieved significant changes in activity level and fat consumption, significant changes in the weight status of the children was not reported in any of the studies.[96]

Encouragingly, interventions targeting young children can also have wider effects after the study is completed. The authors of the Romp & Chomp study assessed its impact after completion and found that in the intervention settings the capacity of the carers to provide a health-promoting environment for the children had been increased.[97] As such they reported that even post-intervention children were less sedentary and were eating more healthily. The key to

the Romp & Chomp study's success may have been in changing the children's environment and implementing rules by which they were cared for. As the children were aged 5 years and younger this was effective, however whether the same success could be had with older children is not clear.

2.8 School-based interventions

One of the most frequently used settings for interventions to improve childhood health is schools. The multitude of school-based interventions has given rise to many systematic reviews and meta-analyses that have attempted to establish whether this type of intervention is effective and, if so, which specific components are key to the success. However, the findings of school-based interventions are so varied that these summaries have been inconclusive.

A 2009 systematic review by Brown and Summerbell included 38 studies that aimed to prevent obesity in school children.[98] The designs of the included studies were cluster randomised controlled trials (19) and clinical controlled trials (18) as well as one individually randomised controlled trial. The authors reported inconsistent findings with only half the included interventions achieving a significant difference in BMI between the intervention and control groups. Furthermore, the authors concluded that because of differing results, no conclusions could be drawn as to the best intervention design, duration, underpinning theory, or behaviour to target. In general, the interventions were found to be highly heterogeneous and often underpowered to detect a significant effect with insufficient data reported to allow for a meta-analysis.

Other reviews of the literature have had similar findings. A 2009 review that included 18 studies also of cluster randomised, individually randomised or clinical controlled trial designs found that 14 out of 18 studies showed no significant reduction in the measures of adiposity, and one produced a worsening of these measures in its intervention group.[75] Two further reviews found BMI, skin fold thickness and waist circumference were lowered in the intervention groups of

their included papers but these results were again inconsistent and not sustained where long term follow-up was performed.[99 100]

A Cochrane review into school-based interventions to improve physical activity and fitness included 44 randomised controlled trials and over 36,000 children.[101] This review reported that school-based interventions had little effect on the physical activity, blood pressure, pulse rate, and BMI of the children. There was, however, a significant improvement in the amount of physical activity during school hours assessed by self-report or accelerometers with an odds ratio of 2.74 (95 % CI 2.01 to 3.75), more time spent in moderate to vigorous physical activity (5 to 45 minutes per day), and a reduction in television time (-5 to -60 minutes per day). Additionally these results were accompanied by an improvement in the children's fitness measures. Despite these positive results the authors highlight that many of the papers lacked methodological quality, all had at least a moderate risk for bias, and only half of the included studies described data collection methods that were deemed to be valid and reliable.[101]

Finally, a synthesis of the systematic reviews and meta-analyses was carried out in 2012.[102] This synthesis included five systematic reviews and three meta-analyses of school-based interventions to prevent or control obesity. Here again there were high levels of heterogeneity in almost every aspect of the interventions, including the systematic reviews and meta-analyses themselves. The synthesis found that half of the interventions were able to achieve significant reductions in weight-related measures, but criticised them for an over-focus on these and neglecting health-related measures. The authors of this synthesis concluded that there is not enough high quality evidence to make policy recommendations.[102]

The systematic reviews and meta-analyses detailed above make clear the lack of good quality evidence that exists on the effectiveness of school-based interventions to address obesity in children. While the design, duration, and participants vary among these studies they all aim to prevent or reduce obesity and perhaps this is where the cause of the inconsistent results lies. As

has been detailed elsewhere in this chapter, there are many health-related rather than weight-related outcomes that are more amenable to change, and this combined with the shortcomings of the interventions above suggests there is a need to move focus away from weight.

2.9 Changing behaviour through knowledge and attitudes

There are many theories and models of behaviour change, each with its own strengths and weaknesses, and it has been suggested that interventions based on these are often more effective.[103 104] Included in health behaviour change models is an understanding that changing behaviour is dependent on changing knowledge and attitudes. These frequently form the basis for health improvement interventions either as an explicit theoretical background or simply by the acceptance that behaviour change is dependent on the complex interactions of the knowledge and attitudes of the individual. Such interventions may aim to educate participants to know what the consequences of their actions are, encouraging them to realise that their health is at risk, changing their attitudes so that they want to make healthy changes and believe they can.[104] The British government has advocated the use of behaviour change strategies as cost effective ways to avoid poor health outcomes in future.[105] In its report it highlights heart disease as an area that is amenable to such a behaviour change approach.

Studies have been carried out to target the link between knowledge, attitude, and behaviour in order to improve the health of children. A study by Fardy et al. aimed to promote cardiovascular health through a combination of health education and physical activity lessons. They reported that the intervention achieved a 9% increase in the health knowledge of the children ($p=0.003$) accompanied by a 20% reduction in the consumption of foods high in saturated fat, salt and sugar ($p=0.006$) and an increase of 16% leisure time physical activity.[106] Additionally Fardy et al. found a significant decrease in the children's cholesterol ($p=0.007$) and body fat percentage ($p=0.04$).

The PATH programme combined health, exercise and nutrition education with a behaviour change course.[107] This study increased the percent of correct answers given by 4.5% ($p<0.001$) which was linked to a significant increase in the number of children who ate breakfast ($p<0.05$). When the change in the children's CVD risk parameters were examined, a 1.2% reduction in body fat percentage ($p<0.001$), a 5.3 mmHg in systolic blood pressure ($p<0.05$), and a 3.2 mmHg reduction in diastolic blood pressure ($p<0.001$) was found. No changes were observed in the control group.[107]

2.10 Knowledge of and attitudes to health in childhood

Despite the difficulties with measuring and improving childhood weight-related health, it is a crucial area of research as many of the related risk parameters are modifiable. If the behaviours of children are influenced positively before their health starts to suffer, there will be less need for interventions to make the difficult health improvements later. Indeed, the role that healthy living knowledge and skills play in enabling individuals to make healthy lifestyle choices has been recognised by both the Centres for Disease Control and Prevention (CDC) and the UK government.[108 109] Furthermore, the CDC has highlighted school as the ideal setting to encourage healthy lifestyles to prevent a range of illnesses, including CVD.[109] This has been supported by two papers which advocate targeting children early to promote lifelong healthy behaviour and heart health.[110 111]

2.10.1 Health knowledge of children

In spite of the recommendations to educate children about healthy lifestyles, studies have found that children's knowledge is poor. In a Polish study which tested 14 year olds' basic knowledge of heart disease risk factors none of the 167 teenagers questioned were able to answer all the questions correctly.[112] Another study examining the effect of a classroom-based education programme found that although the intervention group achieved higher scores than the control group, the level of nutrition and exercise knowledge remained low with the highest score achieved 68%.[113]

Health education does, however, seem to be effective in improving the health knowledge of children. Although still low, the education programme run by Harrell et al was able to bring about an improvement in knowledge.[113] Similarly, a study conducted in Iran which taught children about heart health over eight weeks was able to significantly improve the knowledge of the intervention compared to control children.[114] This finding supports an assertion by American researchers who stated that targeted health education on specific health issues may be more effective at improving knowledge than a broader style of health education.[115]

2.10.2 Health attitudes of children

There are only a few qualitative studies that have been carried out to assess children's awareness of and attitudes towards healthy living. One such study explored British teenagers' awareness of blindness caused by smoking.[116] The study included a selection of diseases associated with smoking, including heart disease, and it emerged from the interviews that only 27% of the teenagers thought that smoking definitely or probably caused heart disease. As well as this, the teenagers scored heart disease lowest when asked to rank smoking-related diseases according to how much they feared developing them.[116] It may be that what seems to be a dismissal of heart disease as a serious consequence of smoking is a sign of the teenagers' lack of knowledge. More encouragingly, 80% of those questioned said that they would quit smoking to avoid developing heart disease.

Another study carried out in the UK discussed healthy eating with primary school children and reported that the children had some basic knowledge of arterial disease in that a high fat diet could lead to blocked arteries.[117] In general Dixey et al. reported a good awareness of healthy eating messages amongst the children, even though this was accompanied by a tendency to make unhealthy choices.

2.10.3 Childhood health knowledge and attitudes of parents

The health knowledge and behaviours of children is only one influence of many on the healthy lifestyles of children. Parents exert control over the lifestyles of their children during their childhood and much of their teenage years. As such their concept of a healthy child and what their children need to be taught in order to grow into healthy adults is very important.

Despite this, previous studies have found that parents' perception of health in childhood, especially in relation to weight, does not always match the accepted medical definition. For example a 2006 Australian study measured children and asked their parents to assess their perception of their child's weight. It was reported that 90% of parents of overweight five to six year olds viewed the weight of their child as average, as did two thirds of parents of overweight ten to twelve year olds.[118]

Some research has suggested that parents do not always see being overweight as a threat to the child's health with studies finding parents rate the majority of overweight and obese children to be as healthy as normal weight children.[119] Furthermore there have been reports that, when questioned, only half of mothers identified a BMI over the 90th centile as carrying a risk to the child's physical health.[120]

Further to this, research suggests that some parents may downplay excess weight in childhood. A review broadly exploring parents' perceptions of overweight children found parents used terms such as "thick", "solid" and "strong" to describe an overweight child.[28 29] Additionally the parents of overweight children were generally unconcerned about the child's excess weight and the future risk it posed to their health. This lack of concern was especially true if the child was young with some mothers stating that their child would grow out of being overweight or that being heavier was a family trait.[28 29]

2.10.4 Parents' perceptions of health education and weight screening

There is a paucity, with the marked exception of sexual health, of studies that have investigated the views of parents on health education. One study that investigated the benefit that parents saw to healthy nutrition and exercise also reported that parents viewed schools as having a large part to play in health education.[121]

Schools do indeed play a crucial role, not only in actively educating students in health topics, but also in providing parents with information that may be useful when caring for their child. In order to achieve this the National Curriculum for England and Wales includes specifications for the health education of young people all through their school careers.[122] Additionally, primary schools take part in screening and reporting the body mass index of children.

A 2009 American study ran a screening programme similar to the NCMP in England, measuring the BMI of primary school children and sending the results home with the intention of interviewing parents about their reactions to BMI screening.[123] Johnson et al. found that 66% of parents were in favour of schools carrying out BMI screening and that receiving a letter stating that their child was overweight was predictive of concern. Receiving a letter stating that the child was overweight was also predictive of changing their diet (62.5%) and their activity level (55%).[123] Of those parents interviewed less than half would discuss the result with the child and discussion of results was often dependent on whether the child fell within the normal BMI range or not.

Despite this parents have claimed to dislike the BMI measure in qualitative and quantitative studies and do not think it relevant to their child.[28 29] As such there appears to be a mismatch between parents' awareness of the weight status of their child, the desire for schools to take a role in providing health information and the dislike for the information currently provided.

2.11 Summary of previous research

The volume and extent of the previous research detailed in this chapter shows that excess weight and the associated co-morbid conditions is an area that needs to be addressed with urgency. The problem of obesity and its association with CVD is a link between one of the biggest threats to modern health and one of the largest causes of mortality worldwide.[124 125]

Being overweight in childhood can have a deleterious effect on the future heart health of the individual. Yet the rate and the severity of obesity in children is increasing and the potential burden is substantial, not least due to the well-established links to CVD risk parameters.[126] In obese individuals it has been suggested that CVD can develop at a much younger age, worsening their health-related quality of life, removing them from the work force early, and placing pressure on health services. Over a decade of government schemes and interventions have been put in place to monitor, report on, and improve the weight status of British children but have had little impact on the growing obesity problem.

To date attempts to improve health outcomes have had a strong focus on weight loss and have been characterised by improvements that are rarely sustained at follow-up.[73 75 76 127] Meanwhile, interventions that have measured changes to CVD risk parameters have often reported greater success, even without an accompanying reduction in weight. Studies that have enjoyed the most success tend to incorporate a number of approaches, for example health education and attitude change with physical activity, and involve the child's family or peer group.

It has been demonstrated that both children and their parents hold levels of knowledge and attitudes that are not conducive to a healthy lifestyle. Studies that have used a strategy whereby improvements in health-related behaviours are brought about by improvements in knowledge and attitudes often also find accompanying reductions in CVD risk parameters and sometimes even weight.

2.12 Rationale of thesis

Due to the above points and literature gaps this thesis aimed to answer the following three questions:

What is the link between BMI and the risk parameters for CVD in childhood?

Could educating children specifically about their hearts lead to improvements in their attitudes to health?

Can an intervention be designed to improve their health behaviours in relation to CVD?

This thesis answered the above questions through the following studies:

- A systematic review and meta-analysis to quantify the link between BMI and CVD risk parameters so that the size of the problem may be understood.
- A focus group study with parents to establish their knowledge and attitudes towards BMI, childhood health and health education and how these might influence their parenting behaviours.
- A focus group study with students to establish their knowledge of and attitudes towards common CVD risk factors, how they are educated about health and how they would like health education to be improved.
- A component analysis of previous studies that have aimed to improve the health outcomes of children through education so that the most effective can be learnt from.
- A feasibility study of an education intervention to improve the heart health-related knowledge, attitudes and beliefs of children.

2.13 References

1. World Health Organisation. Obesity and Overweight Factsheet Number 311, 2011.

2. World Health Organisation. *Obesity : preventing and managing the global epidemic : report of a WHO consultation*. Geneva: World Health Organisation, 2000.

3. Lim S. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet* 2012(380):2224-60.

4. National Obesity Observatory. Trends in Obestiy Prevalence. In: Service NH, editor, 2010.

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

6. National Obesity Observatory. *International comparisons of obesity prevalance*. Observatories Association of Public Health Observatories, editor: NHS, 2009.

7. English Public Health Observatories. Health Profile 2012: Oxford: Department of Health, 2012.

8. Townsend N. *Obesity and Overweight Surveillance in England: What is measured and where are the gaps?* In: Mathrani S, Rutter H, editors. Oxford, 2009.

9. The NHS Information Centre. National Child Measurement Programme: England, 2011/12 school year: Department of Health, 2012.

10. The NHS Information Centre, Lifestyle Statistics. National Child Measurement Programme: England, 2008/09 school year: Department of Health, 2009.

11. The NHS Information Centre, Lifestyles Statistics. National Child Measurement Programme: 2006/07 school year: Department of Health, 2007.

12. The NHS Information Centre, Lifestyles Statistics. National Child Measurement Programme 2007/08 school year: Department of Health, 2008.

13. The NHS Information Centre, Lifestyles Statistics. National Child Measurement Programme: England, 2009/10 school year: Department of Health, 2010.

14. The NHS Information Centre, Lifestyles Statistics. National Child Measurement Programme: England, 2010/11 school year: Department of Health, 2011.

15. Flegal KM, Troiano RP. Changes in the distribution of body mass index of adults and children in the US population. *International Journal of Obesity* 2000;24(7):807-18.

16. McPherson K, Marsh T, Brown M. Tackling Obesities: Future Choices- Modelling Future Trends in Obesity and the Impact on Health. *Foresight*. 2nd Edition ed, 2007.

17. Department of Health. *Department of Health- Spending review* 2010, 2010.

18. The Pensions Commission. *A New Pensions Settlement for the Twenty-First Century, The Second report of the Pensions Commission*. London, 2005.

19. Department of Health. *Healthy Lives, Healthy People: A call to action on obesity in England*. London, 2011.

20. OCPT. *Oxfordshire's Children and Young People's Plan 2010-2013*, 2010.

21. Oxfordshire Primary Care Trust. *Oxfordshire's Joint Strategic Needs Assessment 2008: Using information to keep people well*. Oxford: Oxfordshire County Council, 2008.

22. Juhola J, Magnussen CG, Viikari JSA, Kähönen M, Hutri-Kähönen N, Jula A, et al. Tracking of Serum Lipid Levels, Blood Pressure, and Body Mass Index from Childhood to Adulthood: The Cardiovascular Risk in Young Finns Study. *The Journal of pediatrics* 2011;159(4):584-90.

23. Bourn J. *Tackling Obesity in England*. London: National Audit Office, 2001.

24. Keyte J, Harris S, Margetts B, Robinson S, Baird J. Engagement with the National Healthy Schools Programme is associated with higher fruit and vegetable consumption in primary school children. *Journal of Human Nutrition and Dietetics* 2012;25(2):155-60.

25. Wells L, Nelson M. The National School Fruit Scheme produces short-term but not longer-term increases in fruit consumption in primary school children. *British Journal of Nutrition* 2005;93:537-42.

26. Simpson K, Freeman R. Critical health promotion and education—a new research challenge. *Health Education Research* 2004;19(3):340-48.

27. National Audit Office. *An update on the government's approach to tackling obesity*. In: Department of Health, editor. London, 2012.

28. Jain A, Sherman SN, Chamberlin LA, Carter Y, Powers SW, Whitaker RC. Why don't low-income mothers worry about their preschoolers being overweight? *Pediatrics* 2001;107(5):1138-46.

29. Towns N, D'Auria J. Parental Perceptions of Their Child's Overweight: An Integrative Review of the Literature. *Journal of Pediatric Nursing* 2009;24(2):115-30.

30. Department of Health. *Change4Life One Year On*, 2010.

31. Croker H, Lucas R, Wardle J. Cluster-randomised trial to evaluate the 'Change for Life' mass media/ social marketing campaign in the UK. *BMC Public Health* 2012;12:404.

32. Huang TT, Drewnowski A, Kumanyika SK, Glass TA. A Systems-Oriented Multilevel Framework for Addressing Obesity in the 21st Century. *Preventing Chronic Disease* 2009;6(3):A82.

33. Haslam DW, James WPT. Obesity. *The Lancet* 2005;366(9492):1197-209.

34. Cecil JE, Tavendale R, Watt P, Hetherington MM, Palmer CNA. An Obesity-Associated FTO Gene Variant and Increased Energy Intake in Children. *New England Journal of Medicine* 2008;359(24):2558-66.

35. Cole S, Butte N, Voruganti V, Cai G, Haack K, Kent J, et al. Evidence that multiple genetic variants of MC4R play a functional role in the regulation of energy expenditure and appetite in Hispanic children. *American Journal of Clinical Nutrition* 2010;91:191-99.

36. Loos RJF, Lindgren CM, Li S, Wheeler E, Zhao JH, Prokopenko I, et al. Common variants near MC4R are associated with fat mass, weight and risk of obesity. *Nat Genet* 2008;40(6):768-75.

37. Long JM, Mareno N, Shabo R, Wilson AH. Overweight and obesity among White, Black, and Mexican American children: Implications for when to intervene. *Journal for Specialists in Pediatric Nursing* 2012;17(1):41-50.

38. Winkleby MA, Robinson TN, Sundquist J, Kraemer HC. Ethnic Variation in Cardiovascular Disease Risk Factors Among Children and Young Adults: Findings From the Third National Health and Nutrition Examination Survey, 1988-1994. *JAMA* 1999;281(11):1006-13.

39. Higgins V, Dale A. *Ethnic Differences in Physical Activity and Obesity*. Manchester: The Cathie Marsh Centre for Census and Survey Research, 2009.

40. Griffiths LJ, Hawkins SS, Cole TJ, Dezateux C. Risk factors for rapid weight gain in preschool children: findings from a UK-wide prospective study. *Int J Obes* 2010;34(4):624-32.

41. Vos M, Welsh J. Childhood Obesity: Update on Predisposing Factors and Prevention Strategies. *Current Gastroenterology Reports* 2010;12(4):280-87.

42. Parsons TJ, Power C, Logan S, Summerbell CD. Childhood predictors of adult obesity: a systematic review. *International Journal of Obesity Related Metabolic Disorders* 1999;23 Suppl 8:S1-107.

43. Rooney B, Mathiason M, Schauberger C. Predictors of Obesity in Childhood, Adolescence, and Adulthood in a Birth Cohort. *Maternal and Child Health Journal* 2011;15(8):1166-75.

44. Schellong K, Schulz S, Harder T, Plagemann A. Birth Weight and Long-Term Overweight Risk: Systematic Review and a Meta-Analysis Including 643,902 Persons from 66 Studies and 26 Countries Globally. *PloS one* 2012;7(10):e47776.

45. Sisson SB, Church TS, Martin CK, Tudor-Locke C, Smith SR, Bouchard C, et al. Profiles of sedentary behavior in children and adolescents: The US National Health and Nutrition Examination Survey, 2001–2006. *International Journal of Pediatric Obesity* 2009;4(4):353-59.

46. The Sedentary Behaviour and Obesity Expert Working Group. *Sedentary Behviour and Obesity: Review of the Current Scientific Evidence*. London: Department of Health, 2010.

47. McGavock JM, Torrance BD, McGuire KA, Wozny PD, Lewanczuk RZ. Cardiorespiratory Fitness and the Risk of Overweight in Youth: The Healthy Hearts Longitudinal Study of Cardiometabolic Health. *Obesity* 2009;17(9):1802-07.

48. Chen E, Paterson LQ. Neighborhood, family, and subjective socioeconomic status: How do they relate to adolescent health? *Health Psychology* 2006;25(6):704-14.

49. Goodman E, Slap GB, Huang B. The Public Health Impact of Socioeconomic Status on Adolescent Depression and Obesity. *American Journal of Public Health* 2003;93(11):1844-50.

50. Grøholt EK, Stigum H, Nordhagen R. Overweight and obesity among adolescents in Norway: cultural and socio-economic differences. *Journal of Public Health* 2008;30(3):258-65.

51. Groth MV, Fagt S, Stockmarr A, Matthiessen J, Biltoft-Jensen A. Dimensions of socioeconomic position related to body mass index and obesity among Danish women and men. *Scandinavian Journal of Public Health* 2009;37(4):418-26.

52. Eek F, Östergren P-O. Factors associated with BMI change over five years in a Swedish adult population. Results from the Scania Public Health Cohort Study. *Scandinavian Journal of Public Health* 2009;37(5):532-44.

53. Gubbels JS, Kremers SPJ, Stafleu A, Dagnelie PC, de Vries SI, de Vries NK, et al. Clustering of Dietary Intake and Sedentary Behavior in 2-Year-Old Children. *The Journal of Pediatrics* 2009;155(2):194-98.

54. Pearson N, Biddle SJH. Sedentary Behavior and Dietary Intake in Children, Adolescents, and Adults: A Systematic Review. *American Journal of Preventive Medicine* 2011;41(2):178-88.

55. te Velde S, De Bourdeaudhuij I, Thorsdottir I, Rasmussen M, Hagstromer M, Klepp K-I, et al. Patterns in sedentary and exercise behaviors and associations with overweight in 9-14-year-old boys and girls - a cross-sectional study. *BMC Public Health* 2007;7(1):16.

56. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The Relation of Overweight to Cardiovascular Risk Factors Among Children and Adolescents: The Bogalusa Heart Study. *Pediatrics* 1999;103(6):1175-82.

57. Gunnell D, Frankel S, Nanchahal K, Peters T, Davey Smith G. Childhood obesity and adult cardiovascular mortality: a 57-y follow-up study based on the Boyd Orr cohort. *Am J Clin Nutr* 1998;67(6):1111-18.

58. Allebeck P, Bergh C. Height, body mass index and mortality: Do social factors explain the association? *Public Health* 1992;106(5):375-82.

59. Hoffmans MDAF, Kromhout D, de Lezenne Coulander C. The impact of Body Mass Index of 78,612 18-year old dutch men on 32-year mortality from all causes. *Journal of Clinical Epidemiology* 1988;41(8):749-56.

60. Aggoun Y, Farpour-Lambert NJ, Marchand LM, Golay E, Maggio ABR, Beghetti M. Impaired endothelial and smooth muscle functions and arterial stiffness appear before puberty in obese children and are associated with elevated ambulatory blood pressure. *Eur. Heart J.* 2008;29(6):792-99.

61. Stabouli S, Kotsis V, Papamichael C, Constantopoulos A, Zakopoulos N. Adolescent Obesity is Associated with High Ambulatory Blood Pressure and Increased Carotid Intimal-Medial Thickness. *The Journal of Pediatrics* 2005;147(5):651-56.

62. Tounian P, Aggoun Y, Dubern B, Varille V, Guy-Grand B, Sidi D, et al. Presence of increased stiffness of the common carotid artery and endothelial dysfunction in severely obese children: a prospective study. *The Lancet* 2001;358(9291):1400-04.

63. Iannuzzi A, Licenziati MR, Acampora C, Salvatore V, Auriemma L, Romano ML, et al. Increased carotid intima-media thickness and stiffness in obese children. *Diabetes Care* 2004;27(10):2506-08.

64. Wabitsch M. Overweight and obesity in European children: definition and diagnostic procedures, risk factors and consequences for later health outcome. *Eur. J. Pediatr.* 2000;159(13):S8-S13.

65. Botero D, Wolfsdorf JI. Diabetes Mellitus in Children and Adolescents. *Archives of Medical Research* 2005;36(3):281-90.

66. Reybrouck T, Mertens L, Schepers D, Vinckx J, Gewillig M. Assessment of cardiorespiratory exercise function in obese children and adolescents by body mass-independent parameters. *European Journal of Applied Physiology and Occupational Physiology* 1997;75(6):478-83.

67. Goodman E, Dolan LM, Morrison JA, Daniels SR. Factor Analysis of Clustered Cardiovascular Risks in Adolescence: Obesity Is the Predominant Correlate of Risk Among Youth. *Circulation* 2005;111(15):1970-77.

68. 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.

69. Dietz WH, Bellizzi MC. Introduction: the use of body mass index to assess obesity in children. *The American Journal of Clinical Nutrition* 1999;70(1):123S-25S.

70. Goran MI. Measurement Issues Related to Studies of Childhood Obesity: Assessment of Body Composition, Body Fat Distribution, Physical Activity, and Food Intake. *Pediatrics* 1998;101(3):505-18.

71. Hall DMB, Cole TJ. What use is the BMI? *Archives of Disease in Childhood* 2006;91(4):283-86.

72. Himes JH. Challenges of Accurately Measuring and Using BMI and Other Indicators of Obesity in Children. *Pediatrics* 2009;124(Supplement_1):S3-22.

73. Barlow SE, Dietz WH. Obesity Evaluation and Treatment: Expert Committee Recommendations. *Pediatrics* 1998;102(3):e29-.

74. Heath GW, Parra DC, Sarmiento OL, Andersen LB, Owen N, Goenka S, et al. Evidence-based intervention in physical activity: lessons from around the world. *Lancet* 2012;380(9838):272-81.

75. Harris KC, Kuramoto LK, Schulzer M, Retallack JE. Effect of school-based physical activity interventions on body mass index in children: a meta-analysis. *CMAJ Canadian Medical Association Journal* 2009;180(7):719-26.

76. Shaya FT, Flores D, Gbarayor CM, Wang J. School-based obesity interventions: a literature review. *Journal of School Health* 2008;78(4):189-96.

77. van Grieken A, Ezendam NPM, Paulis WD, van der Wouden JC, Raat H. Primary prevention of overweight in children and adolescents: A meta-analysis of the effectiveness of interventions aiming to decrease sedentary behaviour. *International Journal of Behavioral Nutrition and Physical Activity* 2012;9(61).

78. Biddle SJ, O'Connell S, Braithwaite RE. Sedentary behaviour interventions in young people: a meta-analysis. *BJSM online* 2011;45(11):937-42.

79. Collins CE, Warren J, Neve M, McCoy P, Stokes BJ. Measuring effectiveness of dietetic interventions in child obesity: A systematic review of randomized trials. *Archives of Pediatrics and Adolescent Medicine* 2006;160 (9):906-22.

80. Silveira JAC, Taddei JAAC, Guerra PH, Nobre MRC. Effectiveness of school-based nutrition education interventions to prevent and reduce excessive weight gain in children and adolescents: A systematic review. *Jornal de Pediatria* 2011;87 (5):382-92.

81. Berg-Smith SM, Stevens VJ, Brown KM, Van Horn L, Gernhofer N, Peters E, et al. A brief motivational intervention to improve dietary adherence in adolescents. The Dietary Intervention Study in Children (DISC) Research Group. *Health Education Research* 1999;14(3):399-410.

82. Black MM, Hager ER, Le K, Anliker J, Sonia Arteaga S, DiClemente C, et al. Challenge! health promotion/obesity prevention mentorship model among urban, black adolescents. *Pediatrics* 2010;126 (2):280-88.

83. Stock S, Miranda C, Evans S, Plessis S, Ridley J, Yeh S, et al. Healthy Buddies: A novel, peer-led health promotion program for the prevention of obesity and eating disorders in children in elementary school. *Pediatrics* 2007;120(4):e1059-E68.

84. Irwin CC, Irwin RL, Miller ME, Somes GW, Richey PA. Get Fit With the Grizzlies: A Community-School-Home Initiative to Fight Childhood Obesity. *Journal of School Health* 2010;80(7):333-39.

85. Hamel LM, Robbins LB, Wilbur J. Computer- and web-based interventions to increase preadolescent and adolescent physical activity: a systematic review. [Review]. *Journal of Advanced Nursing* 2011;67(2):251-68.

86. Caballero B, Clay T, Davis SM, Ethelbah B, Rock BH, Lohman T, et al. Pathways: A school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *American Journal of Clinical Nutrition* 2003;78 (5):1030-38.

87. Davis SM, Going SB, Helitzer DL, Teufel NI, Snyder P, Gittelsohn J, et al. Pathways: A culturally appropriate obesity-prevention program for American Indian schoolchildren. *American Journal of Clinical Nutrition* 1999;69 (4 SUPPL.):796S-802S.

88. Johnston CA, Tyler C, Fullerton G, Poston WSC, Haddock CK, McFarlin B, et al. Results of an intensive school-based weight loss program with overweight Mexican American children. *International Journal of Pediatric Obesity* 2007;2(3):144-52.

89. Johnston CA, Tyler C, McFarlin BK, Poston WSC, Haddock CK, Reeves RS, et al. Effects of a School-based Weight Maintenance Program for Mexican-American Children: Results at 2 Years. *Obesity* 2010;18(3):542-47.

90. Fotu KF, Millar L, Mavoa H, Kremer P, Moodie M, Snowdon W, et al. Outcome results for the Ma'alahi Youth Project, a Tongan community-based obesity prevention programme for adolescents. *Obesity Reviews* 2011;12 (SUPPL. 2):41-50.

91. Kain J, Leyton B, Cerda R, Vio F, Uauy R. Two-year controlled effectiveness trial of a school-based intervention to prevent obesity in Chilean children. *Public Health Nutrition* 2009;12(9):1451-61.

92. Li M, Li S, Baur LA, Huxley RR. A systematic review of school-based intervention studies for the prevention or reduction of excess weight among Chinese children and adolescents. *Obesity Reviews* 2008;9 (6):548-59.

93. Bluford DAA, Sherry B, Scanlon KS. Interventions to prevent or treat obesity in preschool children: A review of evaluated programs. *Obesity* 2007;15(6):1356-72.

94. Campbell KJ, Hesketh KD. Strategies which aim to positively impact on weight, physical activity, diet and sedentary behaviours in children from zero to five years. A systematic review of the literature. *Obesity Reviews* 2007;8(4):327-38.

95. Bond M, Wyatt K, Lloyd J, Taylor R. Systematic review of the effectiveness of weight management schemes for the under fives. *Obesity Reviews* 2011;12 (4):242-53.

96. Ciampa PJ, Kumar D, Barkin SL, Sanders LM, Yin HS, Perrin EM, et al. Interventions aimed at decreasing obesity in children younger than 2 years: A systematic review. *Archives of Pediatrics and Adolescent Medicine* 2010;164 (12):1098-104.

97. de Silva-Sanigorski A, Elea D, Bell C, Kremer P, Carpenter L, Nichols M, et al. Obesity prevention in the family day care setting: impact of the Romp & Chomp intervention on opportunities for children's physical activity and healthy eating. *Child: Care, Health and Development* 2011;37(3):385-93.

98. Brown T, Summerbell C. Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence. *Obesity Reviews* 2009;10(1):110-41.

99. Sharma M. School-based interventions for childhood and adolescent obesity. *Obesity Reviews* 2006;7(3):261-69.

100. Shaya FT, Flores D, Gbarayor CM, Wang J. School-Based Obesity Interventions: A Literature Review. *Journal of School Health* 2008;78(4):189-96.

101. Dobbins M, Husson H, DeCorby K, RL. L. School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database of Systematic Reviews* 2013(2).

102. Khambalia AZ, Dickinson S, Hardy LL, Gill T, Baur LA. A synthesis of existing systematic reviews and meta-analyses of school-based behavioural interventions for controlling and preventing obesity. *Obesity Reviews* 2012;13 (3):214-33.

103. Ory MG, Jordan PJ, Bazzarre T. The Behavior Change Consortium: setting the stage for a new century of health behavior-change research. *Health Education Research* 2002;17(5):500-11.

104. National Institute for Health and Clinical Excellence. Behaviour Change: Department of Health, 2007.

105. Halpern D, Bates, C., Mulgan, G., Aldridge, S., Beales, G., Heathfield, A. *Personal Responsibility and Changing Behaviour: the state of knowledge and its implications for public policy* In: Prime Minister's Strategy Unit, editor. London: Cabinet Office, 2004.

106. Fardy PS, White REC, Clark LT, Amodio G, Hurster MH, McDermott KJ, et al. Health promotion in minority adolescents: A healthy people 2000 pilot study. *Journal of Cardiopulmonary Rehabilitation* 1995;15 (1):65-72.

107. Bayne-Smith M, Fardy PS, Azzollini A, Magel J, Schmitz KH, Agin D. Improvements in heart health behaviors and reduction in coronary artery disease risk factors in urban teenaged girls through a school-based intervention: the PATH program. *American Journal of Public Health* 2004;94(9):1538-43.

108. Cross-Government Obesity Unit DoHaDoC, Schools and Families. Healthy Weight, Healthy Lives: A Cross Government Strategy for England. In: Health Do, editor. London: Department of Health Publictions, 2008:60.

109. Centers for Disease Control and Prevention. Guidelines for school health programs to promote lifelong healthy eating. . *Recommendations and reports : Morbidity and mortality weekly report* 1996;45:1-41.

110. Aggoun Y. Obesity, metabolic syndrome, and cardiovascular disease. *Pediatric Research* 2007;61(6):653-9.

111. Williams CL, Hayman LL, Daniels SR, Robinson TN, Steinberger J, Paridon S, et al. Cardiovascular health in childhood: A statement for health professionals from the Committee on Atherosclerosis, Hypertension, and Obesity in the Young (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation* 2002;106(1):143-60.

112. Bogdanska A, Maniecka-Bryla I, Szpak A. The evaluation of secondary school students' knowledge about risk factors of cardiovascular disease. *Rocz Akad Med Bialymst* 2005;50 Suppl 1:213-15.

113. Harrell JS, Gansky SA, McMurray RG, Bangdiwala SI, Frauman AC, Bradley CB. School-based interventions improve heart health in children with multiple cardiovascular disease risk factors. *Pediatrics* 1998;102 (2 I):371-80.

114. Iraj N, Syed RI, Mohammad MM, Gholamreza H, Fatemeh B, Fateheh A, et al. A school-based intervention to teach 3-4 grades children about healthy heart; The Persian Gulf Healthy Heart Project. *Indian Journal of Medical Sciences* 2004;58(7).

115. Skybo TA, Ryan-Wenger N. A school-based intervention to teach third grade children about the prevention of heart disease. *Pediatr Nurs* 2002;28(3):223-9, 35.

116. Moradi P, Thornton J, Edwards R, Harrison RA, Washington SJ, Kelly SP. Teenagers' perceptions of blindness related to smoking: a novel message to a vulnerable group. *British Journal of Ophthalmology* 2007;91(5):605-07.

117. Dixey R, Sahota P, Atwal S, Turner A. Children talking about healthy eating: Data from focus groups with 300 9-11-year-olds. 2001.

118. Crawford D, Timperio A, Telford A, Salmon J. Parental concerns about childhood obesity and the strategies employed to prevent unhealthy weight gain in children. *Public Health Nutr* 2006;9(7):889-95.

119. Wake M, Salmon L, Waters E, Wright M, Hesketh K. Parent-reported health status of overweight and obese Australian primary school children: a cross-sectional population survey. *Int J Obes Relat Metab Disord* 2002;26(5):717-24.

120. Warschburger P, Kroller K. Childhood overweight and obesity: maternal perceptions of the time for engaging in child weight management. *BMC Public Health* 2012;12(1):295.

121. Hart KH, Herriot A, Bishop JA, Truby H. Promoting healthy diet and exercise patterns amongst primary school children: a qualitative investigation of parental perspectives. *Journal of Human Nutrition and Dietetics* 2003;16(2):89-96.

122. Department of Education. Review of the National Curriculum, 2011.

123. Johnson SB, Pilkington LL, Lamp C, He J, Deeb LC. Parent reactions to a school-based body mass index screening program. *Journal of School Health* 2009;79 (5):216-23.

124. Kavey R, Simons-Morton D, de Jesus J. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report. *Pediatrics* 2011;128(Supplement 5):S213-S56.

125. Office for National Statistics. *Statistical Bulletin: Deaths registered in England and Wales in 2010, by cause*, 2011.

126. McWilliam J. *Director of Public Health for Oxfordshire Annual Report IV*, 2010.

127. Epstein LH, Myers MD, Raynor HA, Saelens BE. Treatment of Pediatric Obesity. *Pediatrics* 1998;101(3):554-70.

Chapter 3. Systematic review and meta-analysis of the effect of BMI on cardiovascular disease risk parameters in children aged 5-16 years

The following chapter is based on a paper published in the British Medical Journal.[1] The author worked on all aspects of this systematic review but had assistance in the form of a second reviewer and four other researchers who were consulted in the analysis and interpretation of the results.

3.1 Background

Excess weight is strongly linked to cardiovascular disease (CVD) and together they are two of the greatest causes of morbidity and mortality worldwide.[2-4] Body Mass Index (BMI) is a measure commonly used to evaluate the physical health of children and so understanding the link between BMI categories and CVD risk parameters is important. Yet no systematic review of the literature to assess this relationship in children and adolescents existed. Systematic reviews provide the highest level of evidence to guide future studies by pooling the results of previous research to give an indication of the current state of the knowledge base and gaps to be filled.[5] As such a systematic review and meta-analysis of the current literature to establish the relationship between BMI categories and commonly measured CVD risk parameters was conducted. The question this review aimed to answer was: *What is the relationship between BMI categories and cardiovascular disease risk parameters in otherwise healthy children?*

3.2 Aim and objectives

The primary aim of this review was to:

- Describe the effect and the magnitude of any effect of BMI categories on a set of predefined biochemical and physiological CVD risk factors in healthy children.

The secondary objectives were to:

- Ascertain whether CVD risk factors are affected more in any one BMI category.
- Ascertain whether sex influences how parameters are affected by BMI.
- Discuss the definition the BMI categories, of normal or acceptable levels of risk factors in children and the data from which they are derived.

3.3 Methods

3.3.1 Review search strategy

The databases searched were EMBASE, PubMed, EBSCOHost's Cumulative Index to Nursing and Allied Health Literature, and Web of Science. The 18 search terms relating to underweight, overweight and obesity were combined with 33 cardiovascular and metabolic outcomes truncated with wildcard characters where necessary. If the search terms were not covered under the MeSH tree they were searched as keywords. Finally the reference lists of the identified articles were searched for further studies. To understand the current relationship between weight and CVD for children the search was limited to studies published between January 2000 and December 2011. This limit was placed on the literature search to ensure that the lifestyles of the children participating in the included studies would be as comparable to the lifestyles of present day children as possible. The search was not limited by language of publication. See Appendix 3.1 for a list of the search terms and limits.

3.3.2 Inclusion criteria

Databases were searched for studies in healthy children aged 5 years to 15 years inclusive. Children of school age were selected because the end aim of this thesis was to design and test an educational intervention. Therefore by using school-aged children the findings of the systematic review would contribute to the evidence base of the intervention. Those studies which included participants that fell outside this age range were excluded. Only studies from the 42 countries defined as highly developed by the UN's Human Development Index were included.[6] This increased the comparability of the children in the studies as they would be more likely to have similar lifestyles. Eligible studies had to include an objective measure of weight and one or more of the following CVD risk factors: systolic or diastolic blood pressure (BP), high density lipoprotein (HDL), low density lipoprotein (LDL) or total cholesterol, triglyceride, fasting glucose, fasting insulin, insulin resistance as measured by the Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) test, carotid intima-media thickness, and left ventricular

mass. These parameters were chosen because they are either markers for atherosclerosis, for example carotid intima-media thickness, or CVD risk factors, for example BP and cholesterol. Left ventricular mass and carotid intima-media thickness were chosen as the physiological parameters of interest because both provide evidence for the development of atherosclerosis in adolescents aged 12 to 18 and have been correlated with other risk factors for coronary heart disease.[7] Furthermore, left ventricular mass was chosen over, for example, left ventricular hypertrophy because it is more commonly assessed in child samples and has been found to be correlated to a predisposition for future hypertension in children, adolescents, and young adults.[8]

Included studies had a prospective or retrospective cohort, cross-sectional, case-control, or randomised controlled trial design administered in school, outpatient or community settings. A minimum sample size of 20 participants for cross-sectional or cohort studies and 20 participants per study arm in intervention studies was specified in order to limit the amount of any observed effect that could be attributed to individual differences in the children. A summary of the inclusion criteria follows below.

- The study sample is made up of healthy children aged 5 to 15 years inclusive, in a highly developed country as defined by the UN's Human Development Index (HDI).[6] The HDI is an indication of the level of development of a country based on a combination of life expectancy, education and gross national income scores. Through this combination the HDI is a measure of both social and economic development. Studies carried out in the 42 countries achieving very high human development in the 2010 rankings met this inclusion criterion.
- Studies must have an objective measure of weight and one or more objective measures of the CVD risk factors of interest. The parameters of interest are: blood pressure, cholesterol, triglyceride, fasting glucose and insulin levels, insulin resistance as measured by HOMA-IR test, intima-media thickness and left ventricular mass.

- Use a prospective or retrospective longitudinal, cross-sectional, case control or randomised controlled trial (RCT) design.
- Interventions should be administered in a school, outpatient or community setting.
- Minimum sample size of 20 participants for cross sectional or longitudinal studies and 20 participants per study arm in intervention studies.

3.3.3 Exclusion criteria

Studies were excluded if the children had another diagnosed chronic physical or mental medical condition including, Polycystic Ovary Syndrome, AIDs, Prader Willi Syndrome, diabetes mellitus I or II, all cancers and any kind of mental illness or disability. This was to limit any confounding of the results from the effects that the other conditions or their medications on the risk factors of interest. In addition, if another condition associated with excess weight, such as psychosocial problems, asthma, or sleep disordered breathing was the primary outcome, the study was excluded. This was again to limit confounding from these conditions. Studies were also excluded if they were conducted in inpatient settings as these children may already be at a more advanced stage of unhealthy weight, used a pharmacological treatment as these may also affect the cardiovascular factors of interest, or were a protocol or pilot study. A summary of the exclusion criteria follows below.

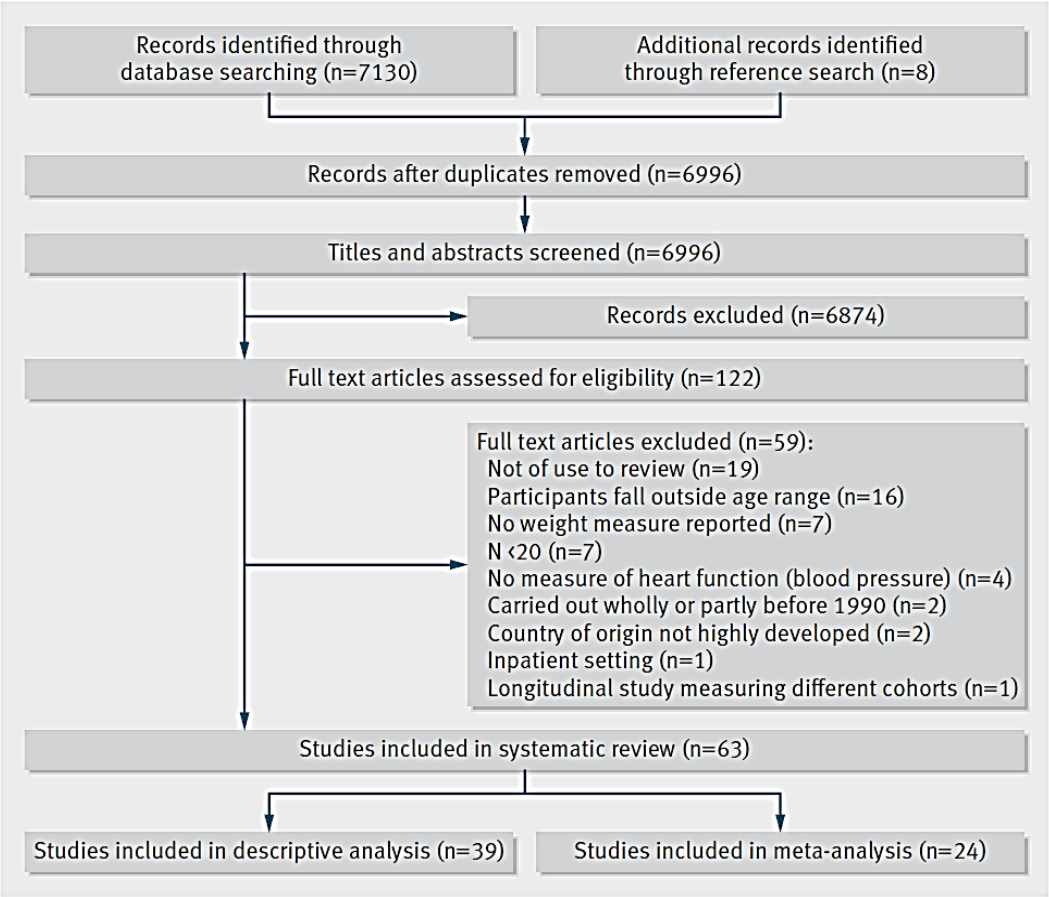
- The participants had another chronic medical condition.
- Another condition associated with overweight and obesity was the primary outcome measured.
- The study was conducted in an inpatient setting.
- The study used a pharmacological treatment to achieve weight loss.
- The paper was a protocol or pilot study as the data is more likely to be incomplete.

3.3.4 Selection procedure

Following the database and reference list searches the identified papers were imported into Endnote. After the removal of duplicates, titles were reviewed by the author and studies that clearly did not meet the inclusion criteria were excluded. The author and one other reviewer independently reviewed the abstracts of the remaining papers and removed any that did not meet the inclusion criteria. Both read the full texts of the papers and extracted the data of the papers that met the inclusion criteria. Any disagreements regarding the inclusion or exclusion of papers were resolved through discussion with a third reviewer. Figure 3.1 contains a figure of the flow of papers through the review process.

Figure 3.1 Progression of studies through the review

Reproduced from Friedemann et al. (2012) Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ,* 345.



3.3.5 Data analysis

The included papers were analysed descriptively and through meta-analysis. Studies were included in the meta-analysis if they reported data for the normal BMI category as well as for at least one of the three unhealthy BMI categories at a level of detail sufficient for the pooled analysis. All relevant data was extracted by the author, checked by a second reviewer and summarised in a data extraction table using mean and standard deviation where possible. The conversion factors presented in Appendix 3.2 were used to convert reported values to standard international units and a standard formula for combining subgroup means was used.[9] Any study that was not suitable for the meta-analysis was analysed descriptively and a full list of reasons for exclusion from the meta-analysis can be found in Appendix 3.3.

Analysis of CVD risk factors was to be performed in four BMI categories; underweight, normal weight, overweight, and obese according to the international age and sex specific BMI curves defined by Cole et al.[10 11] Using these definitions the underweight curve passed through BMI value 17, normal weight through BMI 25, overweight through BMI 30, and obese above 30. Where studies reported the mean weight of their sample rather than the mean BMI, or the definitions of the cut-off points used did not match those used in this review, the data was reclassified according to the cut-off points of Cole et al.

Review Manager Version 5.1 was used for the analysis of the mean differences in the CVD risk factors in each BMI category compared to normal weight children, where possible stratified by sex. Random rather than fixed effects models were used to allow for variation in study effects due to a real dispersion in the effect sizes across studies, which were expected due to the varying ages, ethnicities, and methods in the included studies. In addition, a random effects model is more appropriate for balancing weights across large and small studies.[9 12] Heterogeneity was measured by I^2 which indicates the amount of variability in the data due to heterogeneity rather than error.[13 14] The effect sizes calculated for each of the comparisons.

Due to the high number of CVD risk factors used, the results are reported with the 99% confidence interval as a more stringent measure of significance. Subgroup analyses were carried out based on sex where possible but due to insufficient data subgroup analyses on different age categories could not be performed.

3.3.6 Quality assessment

Since there is no standard quality assessment tool that could be applied to all included studies, the quality assessment was based on the Cochrane risk of bias tool (Review Manager Version 5.1, Cochrane Collaboration).[15] Risk of bias was assessed in the three areas that were relevant to all types of study: blinding of outcome assessment; incomplete outcome data; and selective reporting. Two further categories were added; measurement methods that were not suitable or reliable, and use of an unrepresentative sample.[5 15] Papers were moderate risk for bias if the level of bias was unclear from the paper or if their rate of participation was between 60% and 80%. In order to assess the influence that low quality studies identified in the quality assessment had on the results, a sensitivity analysis was carried out excluding them from the pooled analysis.

3.3.7 Ethical approval

Ethical approval was not required for this review.

3.4 Results

3.4.1 Study characteristics

Out of 6,996 papers, 63 papers involving 49,220 children in 23 countries were included. Figure 3.1 shows the number of papers excluded at each stage of review. The number of children in included studies varied between 38 and 7,589 (age range 5 to 15 years). Three countries contributed 25 (40%) of the included studies; U.S. (11), Italy (eight) and Denmark (six). The remaining papers were conducted in: Sweden, Cyprus, Israel, Belgium, Japan, Greece, and Iceland (one each), Hong Kong, Hungary, South Korea, Norway and France (two), Spain,

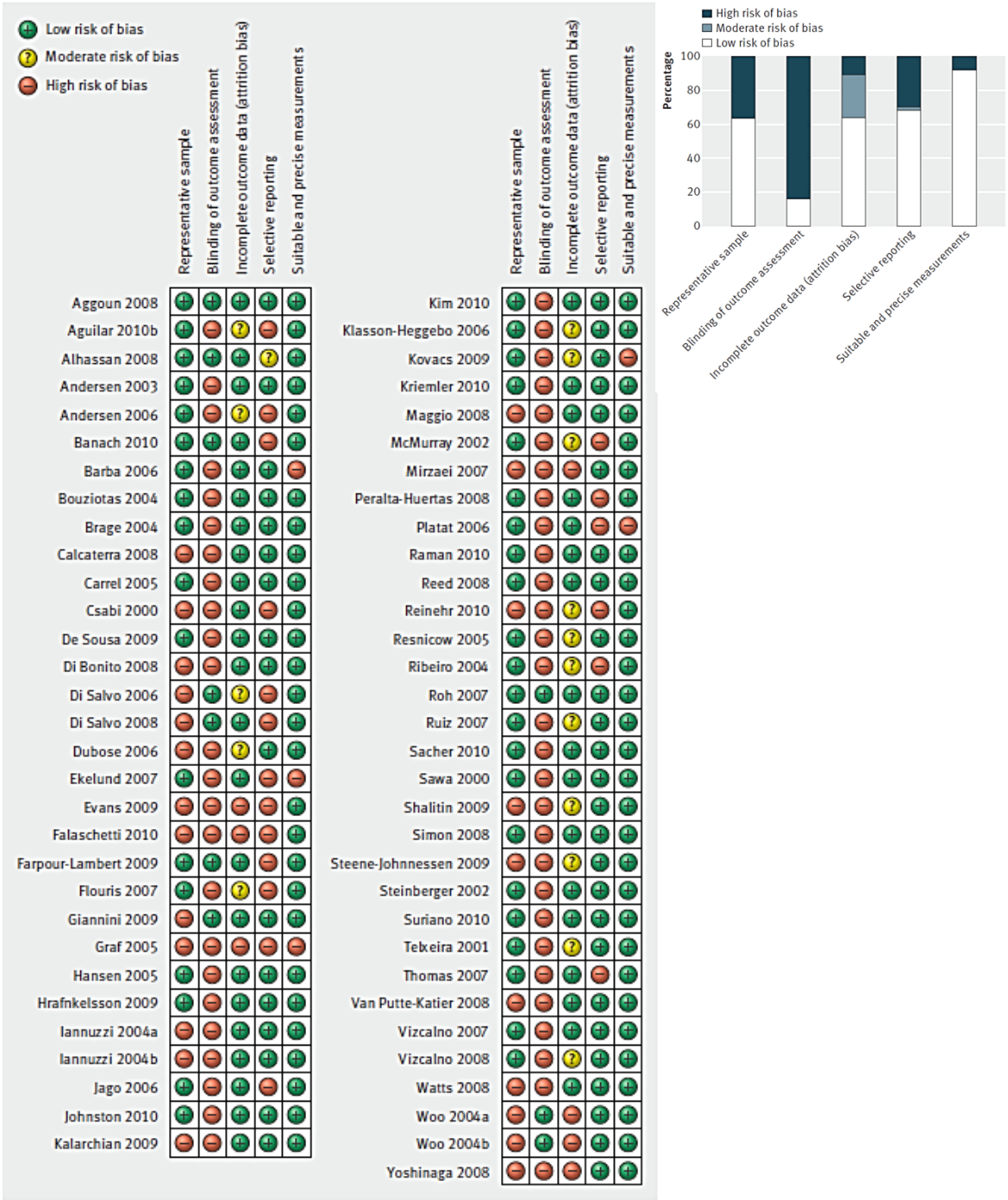
Germany, the UK and Australia (three), Switzerland, Estonia and Canada (four) and Portugal (five). The designs of the included studies were; 42 cross-sectional, 19 RCT, one cohort and one case control study. The majority of studies were performed in school (34) or clinical out-patient (23) settings, with fewer in community settings (five) and one multi-centre study. Of the 63 included papers 24 supplied data for the meta-analysis (Appendix 3.4). The most common reason for a paper to be excluded from the meta-analysis was the lack of a normal weight comparison group, which was required in order to calculate the mean differences in CVD risk factors. Two of the papers included in the meta-analysis reported geometric means or least mean squares rather than arithmetic means but sensitivity analysis excluding these found no difference in significance or heterogeneity so they were included in the final analyses.[16 17]

3.4.2 Study quality

Figure 3.2 shows the result of the risk of bias assessment. Only two studies scored low risk in all five of the bias categories.[18 19] Fifty-seven studies were described as moderate risk; scoring low risk in two to four of the categories, and four were described as high risk; scoring a low risk for bias in one or fewer of the categories.[16 20-22] The most common source of bias was a lack of blinding of the outcome assessors, that is, the researchers analysing the risk factor levels were frequently not blinded to the BMI of the child. The risk of bias from unsuitable or imprecise measurement methods was generally small with only five studies judged to be at high risk, most frequently due to failure to repeat and take the average of measurements carried out by hand. Sensitivity analysis excluding the one low quality study found little effect on most measures with the exception of diastolic BP measured in overweight compared to normal weight girls where the test for overall effect became insignificant. No studies were excluded due to low quality.

Figure 3.2. Risk of bias assessment

Reproduced from Friedemann et al. (2012) Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ*, 345.



3.4.3 Descriptive analysis

Thirty nine studies did not provide data for the meta-analysis and are included here as a descriptive analysis. In these papers it was found that in general CVD risk factors were worsened by high BMI. BMI was positively associated with systolic BP in five studies,[21 23-26] diastolic BP in four studies,[23-26] total cholesterol in one study,[27] LDL-cholesterol in three studies,[24 26 27] triglycerides in three studies,[24 26 27] and left ventricular mass in one study.[28] BMI was inversely associated with HDL-cholesterol in two studies.[26 27] BMI was also associated with CVD risk factors clustering[24 25 29-32] and one study found the metabolic syndrome to be present in a significant number of its overweight sample.[29]

With regards to weight predicting CVD risk, it was found that BMI was predictive of BP,[23-25] however some studies reported waist circumference or waist to height ratio being as good[33] or better[24] predictors of a broader range of CVD risk factors.

No studies reported the CVD risk associated with underweight as defined by the BMI cut-offs used in this review. In the study reporting the risk parameter levels in very lean children it was found that lipids, insulin resistance, IMT and blood pressure levels were similar to those in overweight children.[34]

For a detailed description of the main findings of the papers included in the descriptive analysis see Table 3.1.

3.4.4 Meta-analysis

A detailed description of the main findings of the papers included in the meta-analysis can be found in Table 3.2.

Systolic, diastolic and 24 hour ambulatory of BP were significantly higher in overweight and obese participants compared with normal weight participants (Table 3.3). Resting systolic BP increased in overweight children (8 studies, 12,169 children) by 4·54 mmHg (99% CI, 2·44 to 6·64, p<0·00001) and in obese children (15 studies, 8,074 children) by 7·49 mmHg (99% CI,

3·36 to 11·62, p<0·00001). Systolic BP increased to a greater degree in girls than boys in both overweight and obese categories. Diastolic BP increased by 2·57 mmHg (99% CI, 1·55 to 3·58, p<0·00001) and 4·06 mmHg (99% CI, 2·05 to 6·08, p<0·00001) in overweight (7 studies, 11,529 children) and obese children (16 studies, 8,140 children) respectively. As with systolic BP, girls had a greater increase in diastolic BP than boys. 24 hour ambulatory systolic BP increased by 11·55mmHg (99% CI, 1·26 to 21·84, p=0·004) from normal weight to obese children (5 studies, 823 children) but with a wide confidence interval.

Total cholesterol was significantly higher in all obese children (9 studies, 5,072 children) by 0·15mmol/L (99% CI, 0·04 to 0·25, p=0·0002) and in obese girls (3 studies, 2,213 children) by 0·31mmol/L (99% CI, 0·08 to 0·54, p=0·0006), but no statistically significant effect was found in overweight children. HDL-cholesterol decreased significantly in overweight (5 studies, 5,752 children) by 0·17mmol/L (99% CI, -0·22 to -0·13, p<0·00001) and obese children (8 studies, 4,915 children) by 0·22mmol/L (99% CI, -0·39 to -0·06, p=0·0003) and obese boys (2 studies, 2,470 children) by 0·29 (99% CI, -0·34 to -0·24, p=0·55) but not girls. Triglycerides were raised in overweight children (5 studies, 6,515 children) by 0·21mmol/L (99% CI, 0·14 to 0·27, p<0·00001), obese children (10 studies, 5,138 children) by 0·26mmol/L (99% CI, 0·13 to 0·39, p<0·00001), obese girls (3 studies, 2,213 children) by 0·28mmol/L (99% CI, 0·04 to 0·51, p=0·002), and boys (3 studies, 2,557 children) by 0·30mmol/L (99% CI, 0·19 to 0·41, p<0·00001); see Table 3.4.

Fasting glucose, insulin and insulin resistance were significantly raised only in the obese children (Table 3.5). Obese boys (2 studies, 345 children) had significantly higher levels of fasting glucose 0·29mmol/L (99% CI, 0·12 to 0·46, p<0·00001). Fasting insulin levels were significantly higher in obese girls (2 studies, 221 children) by 70·90pmol/L (99% CI, 49·52 to 92·28, p<0·00001) and boys (2 studies, 345 children) by 77·03pmol/L (99% CI, 41·70 to 112·36, p<0·00001) when compared to normal weight children.

Finally for physiological parameters, obesity was associated with a significant increase in children's left ventricular mass by 19·12g (99% CI, 12·66 to 25·59, p<0·00001) (3 studies, 223 children) and this effect was still significant when left ventricular mass was adjusted by height 11·29g (99% CI, 6·49 to 16·10, p<0·00001) (5 studies, 918 children), see Table 3.6.

On the advice of a statistician, approximations had to be made of the number of participants per group for two of the papers in the meta-analysis. For Aguilar et al. the number reported for each BMI category was halved to approximate the number in the intervention and control groups.[35] Falaschetti et al. had the proportion of the total children in each measurement calculated.[16] The number for each measure under each BMI category was that proportion of the total number of children in each category. Analyses were repeated excluding these papers but this did not significantly affect the results and so they were included.

Half of the papers in the meta-analysis adjusted for confounding factors such as age, sex, birth weight, physical activity, parental weight or education, baseline measures, or the various risk parameters for CVD. Such adjustments were made when the study went on to further analyse the data to answer a research objective. The data used in this meta-analysis was taken only from the baseline results of the papers and as such all data used was unadjusted with the exception of height adjusted left ventricular mass.

Table 3.1. Main findings of papers included in the descriptive analysis

Paper	Number of Participants	Age of participants	Type of study	Main findings relevant to the review
Alhassan 2008[36]	208	8-10	Cross-sectional	Physical activity was inversely associated with BMI and fasting insulin. After adjustment for pubertal stage only the association with fasting insulin remained significant. No association found between physical activity and lipids, BP, or glucose.
Andersen 2003[29]	1020	9-16	Cross-sectional	BMI and fitness significantly associated with number of CHD risk factors present in children and adolescents. The average fitness in children with clustering was 1.2 SD lower and BMI was 1.6 SD higher than the mean.
Andersen 2006[37]	1732	9 and 15	Cross-sectional	Negative association found between physical activity and clustering of CVD risk factors. Risk was raised in the three less active groups compared with the most active group.
Bouziotas 2004[38]	210	11-14	Cross-sectional	Primary CHD risk factors were associated with physical activity levels, independent of fitness, fatness, and/or fat intake. Specifically, physical activity was associated positively with HDL-C and negatively with systolic BP.
Brage 2004[39]	589	8-10	Cross-sectional	Physical activity was inversely related to metabolic risk and significantly related to risk factor clustering. A significant interaction was found between physical activity and fitness suggesting a stronger relationship between activity and risk in children with low fitness
Carrel 2005[40]	50	12 (0.5)	RCT	Improved body fat percentage, fasting glucose and insulin levels and fitness seen in the intervention group without similar improvement in BMI. Only 1 follow-up at 9 months
Du Bose 2006[41]	375	7-9	Cross-sectional	The metabolic syndrome is prevalent at similar rates in young children and in adolescents. The prevalence of the metabolic syndrome in primary school-aged children was 5%. Half of the children had at least one component of the metabolic syndrome. Raised blood pressure was the most common component.
Ekelund 2007[42]	1746	9 and 15	Cross-sectional	Physical activity and fitness are separately and independently associated with indicators of insulin resistance, hyperglycaemia, hyperlipidaemia and clustered metabolic risk. The association between fitness and clustered risk was partly mediated by adiposity, whereas the association between activity and clustered risk was independent of adiposity.
Evans 2009[20]	168	13.4 (1.8)	RCT	No reduction in BMI but fitness increased. Percent body fat reduced, total cholesterol reduced and LDL- cholesterol reduced at 6 months.
Flouris 2007[43]	3293	14-15	Cross-sectional	Higher fitness was associated with lower BMI, diastolic BP and total cholesterol in boys and lower BMI, systolic and diastolic blood pressure in girls.

Graf 2005[21]	1677	5.4-12	Cross-sectional	Obese children had the highest values for systolic and diastolic BP. There were no significant differences between girls and boys. After 9 months of intervention, the reduction in the standard deviation score for BMI was higher in those undergoing intervention than in controls. The increase in the BMI tended to be lower in those undergoing intervention and there was a reduction of systolic BP and diastolic BP after the intervention.
Hansen 2005[44]	696	6-7	RCT	Mean BMI, BP and blood lipids were not different between girls and boys. Peak VO2 and physical activity were higher in boys than in girls. Peak VO2 was associated with fatness independently of weight. Fitness was associated with HDL-cholesterol. Fatness assessed by skinfold was associated with blood pressure, fasting glucose and insulin. Fatness weakly associated with BP, fasting insulin and glucose.
Jago 2006[30]	1717	13.6 (0.6)	Cross-sectional	12.8% of children were pre-hypertensive, 23.9% had high BP. Boys were more likely to have high BP and low HDL-cholesterol, girls were more likely to have borderline total cholesterol. The prevalence of risk factors was associated with the overweight group and increasing BMI group worsened all risk factors in both genders, except total cholesterol where this was only seen in boys.
Johnston 2010[45]	54	10-14	RCT	The school-based instructor-led intervention resulted in reductions in zBMI in 79% of children at yr. 1 and most maintained to yr. 2 but the effect size was smaller. Children in the instructor-led intervention group also significantly lowered their total cholesterol at 1 year compared with those in the self-help group. Differences were not found for BP, LDL and HDL-cholesterol.
Kalarchian 2009[46]	192	8-12	RCT	Intervention was associated with weight reduction at 6 months but no significant reductions at 12 or 18 months. Some small reductions in systolic BP and diastolic BP seen at 6 months but these level off at 12 months. Sustained decreases in overweight were observed only among children with attendance ≥75%.
Kim 2010[47]	405	9-10	Cross-sectional	BMI thresholds at which CVD risk and insulin resistance begin to increase in Korean children were lower than proposed by the international obesity task force. The BMI centile at which CVD risk started was 71.3 in boys and 77.1 in girls. The BMI centiles at which insulin resistance started was 66.3 for boys and 67.9 for girls.
Klasson-Heggebo 2006[48]	4072	9 and 15	Cross-sectional	Relationship between fitness, waist circumference, sum of skin folds and systolic and diastolic BP was curvilinear. The difference in systolic blood pressure between the least and most fit was 6mmHg
Kovacs 2009[49]	38	6.5-12.5	RCT	Systolic BP, LDL-cholesterol, number of children with elevated triglyceride, hypertension and abdominal obesity decreased significantly. Cardiovascular fitness parameters improved.
Kriemler 2010[50]	502	6.9 (0.3) and 11.1 (0.5)	RCT	Children in the intervention group showed smaller increases or larger reductions in BMI, triglycerides, HDL-cholesterol, and glucose. The cardiovascular risk score decreased more in the intervention than in the control group.
McMurray 2002[51]	1140	11-14	RCT	Systolic and diastolic BP increased more in the control group but BMI did not change significantly in any of the groups. A small increase in VO2max in the combined exercise and education group was found and was significantly greater than the education

				only group.
Mirzaei (2007)[23]	1230	8-10	Longitudinal	Weight was significantly associated with SBP and DBP in boys and girls at baseline and follow-up. Longitudinal BMI change significantly associated with systolic BP and diastolic BP. BMI was a predictor of BP
Raman 2010[33]	121	9-13	Cross-sectional	BMIz was significantly associated with diastolic BPz, HDL-cholesterol and triglycerides. Waist circumference was good a predictor of risk factors as BMIz.
Reed 2008[52]	268	9-11	RCT	Intervention children had a 20% greater increase in fitness, a 4.6% greater reduction in total cholesterol and a 5.7% smaller increase in BP compared with control children. 45% of children had at least one elevated risk factor out of fitness, BP or BMI at baseline. There were no significant differences between groups for change in BMI or in any of the blood variables
Reinehr 2010[22]	66	11.6 (1.6) and 11.4 (1.7)	RCT	Intervention group showed a 94% reduction in degree of overweight so 24% were normal weight by the end of the trial, independent of age and sex. BMI, SBP and DBP decreased significantly in the intervention group. Diary records of the intervention group showed improvements to their eating habits.
Resnicow 2005[53]	123	13.6 (1.43)	RCT	The intervention was not effective in reducing BMI with a 0.5 point difference between groups at 6 months. There were some positive findings among high attenders where a greater reduction in BMI was seen. At 6 months there were no significant differences in the secondary outcomes BP, insulin, lipids and glucose.
Ribeiro 2004[31]	1461	8-15	Cross-sectional	A clustering between high BP and high total cholesterol was found in both sexes but especially females. More than half the sample had at least one CVD risk factor.
Ruiz 2007[54]	873	9-10	Cross-sectional	Fitness was associated with clustering of metabolic risk factors. Higher fitness was associated with lower triglyceride and insulin in girls and insulin in boys.
Sacher 2010[55]	116	8-12	RCT	Participants in the intervention group reduced BMIz at 6 months when compared with the controls. Significant between-group differences were also found in fitness and diastolic BP. Intervention group showed a reduction in sedentary behaviour and increase in physical activity and self-esteem. At 12 months, children in the intervention group had reduced their BMI z-scores by 0.23 ($P < 0.0001$) and benefits in fitness were sustained
Savva 2000[24]	1987	10-14	Cross-sectional	All CVD risk factors were worse in those in the >75th compared with <75th BMI percentile for boys and girls. Obese children had higher risk for the presence of CVD risk factors. Systolic BP, diastolic BP, LDL-cholesterol and triglycerides were correlated to BMI. Waist to height ratio and waist circumference were better predictors of risk factors than BMI. BMI was a useful predictor of triglycerides and BP.

Shalitin 2009[56]	162	6-11	RCT	At 12 weeks all risk factors improved in all groups. BMI, systolic BP, diastolic BP, glucose, total cholesterol, HDL-cholesterol, LDL-cholesterol, HOMA-IR and insulin all regressed to no significant differences between groups after 9 months. BMI-SDS and LDL-cholesterol were lower compared to baseline. Intervention arms that involved diet or diet and exercise were more successful than exercise alone.
Simon 2008[57]	954	9.9-13.8	RCT	Intervention children had a lower increase in BMI over time than controls. The intervention significantly prevented excessive weight gain in initially normal weight children and the incidence of overweight in the intervention group was lower than in the control group. Changes in BMI in the initially overweight children did not persist.
Steene-Johannessen 2009[32]	2299	9 and 15	Cross-sectional	No differences found in systolic BP between sexes in 9 year olds. In 15 year olds boys had higher systolic BP. Girls had higher levels of total cholesterol and lower HDL-cholesterol than boys across both age groups. CVD risk clustering was found in 11·4% of the study population.
Steinberger 2002[58]	322	12-14	Cross-sectional	LVM is strongly related to BMI in boys and girls, but is not related to insulin sensitivity. LVM was significantly associated with fasting insulin in boys and girls and with total cholesterol and LDL-cholesterol in boys only.
Teixeira 2001[27]	159	10-15	Cross-sectional	Body mass index was associated with triacylglycerol, low density LDL-cholesterol and HDL-cholesterol. Obese children had higher total cholesterol and LDL-cholesterol than lean children and adolescents had a worse lipid profile.
Thomas 2007[25]	208	12.9 (0.3)	Cross-sectional	An inverse relationship was found between fitness and fatness (BMI and sum of skin folds) in both sexes. Fitness was related to triglycerides and diastolic BP in both sexes. In a multiple regression fatness was an independent predictor of triglycerides and diastolic BP. Fatness was also a predictor of systolic BP only in girls. Fatness was related to a greater number of risk factors than fitness.
Vizcaino 2007[26]	1280	8-11	Cross-sectional	No CV risk factors out of total cholesterol, triglycerides, HDL-cholesterol, LDL-cholesterol, systolic BP and diastolic BP were significantly associated with BMI in the lowest BMI quartile. In quartiles 2-3 BMI was significantly associated with triglycerides, HDL-cholesterol and diastolic BP. In quartiles 3-4 BMI was significantly associated with all risk factors except total cholesterol.
Vizcaino 2008[59]	1119	9-11	RCT	Intervention was not associated with changes in total cholesterol, triglycerides or BP in either sex, apart from an increase in diastolic BP in boys. A significant interaction was found between the intervention effects, sex and systolic BP.
Woo 2004a[28]	82	9-12	RCT	At 6 weeks, both diet only and diet and exercise interventions were associated with decreased total cholesterol level. Diet and exercise was associated with a decrease in LDL-cholesterol. At 1 year, there was significantly less thickening of the carotid wall exercise program group. Exercise was associated with a significant reduction in LDL-cholesterol, increase in HDL-cholesterol but no change in BMI.
Yoshinaga 2008[60]	319	6-11	Cross-sectional	An increase in the total number of CVD risk factors was associated with a worsening of each CVD risk factor level over 1 year in a multivariate regression analysis after adjusting for age and gender. Fasting glucose in boys was higher than in girls and fasting

	insulin was higher in girls than in boys. Over 1 year triglyceride, insulin, and HOMA-IR levels significantly worsened.
Total: 33,033	

Table 3.2. Main findings of papers included in the meta-analysis

Paper	Number of Participants	Age of participants	Type of study	Main findings relevant to the review
Aggoun 2008[18]	71	6-11	Cross-sectional	24H Ambulatory Systolic BP and Ambulatory Diastolic BP significantly higher in obese children. 18 out of 38 obese children hypertensive on the Ambulatory BP measure- none of the lean were. Obese had lower HDL and higher insulin and HOMA-IR. Correlations between BMI, systolic BP, diastolic BP (ambulatory and resting), HDL-cholesterol, triglyceride, insulin and HOMA-IR all significant. BMI not associated with IMT.
Aguilar 2010b[35]	921	10-12	RCT	The intervention resulted in a reduction of total cholesterol across all baseline BMI categories without a reduction in endpoint BMI. No statistically significant differences were seen between the intervention and control group in the other factors.
Banach 2010[61]	65	9-12	Cross-sectional	No significant difference found in SBP and DBP between overweight and normal weight children. Found that the distensibility if the common carotid artery was related to BMI and systolic BP.
Barba 2006[62]	3923	6-11	Cross-sectional	Blood pressure z scores were significantly related to BMI z scores. Overweight and obesity significantly associated with higher risk of hypertension, almost all normal weight children were normotensive.
Calcaterra 2008[63]	267	6-15	Cross-sectional	The prevalence of the metabolic syndrome is higher in obese than non-obese children and increases with severity of obesity. Hyperinsulinaemia was found in overweight children without metabolic syndrome suggesting that insulin resistance might precede it. The most prevalent risk factors amongst obese children were HDL-cholesterol $\leq 5^{th}$ centile and BP $\geq 95^{th}$ centile.
Csabi 2000[64]	419	9-15	Cross-sectional	CVD risk factors already cluster in childhood and are strongly associated with obesity. Study found a significantly higher clustering of cardiovascular risk factors among obese children than in controls. Only 14· 4% of the obese children were free of any risk factor. Significant differences were found in the levels of risk factors present in the obese compared with the control children, with the exception of HDL-cholesterol.
De Sousa 2009[65]	82	11 +-2	RCT	Obese children had significantly higher systolic BP and lower exercise capacity than controls which improved after the intervention. BMI, systolic SBP, diastolic BP, triglycerides, fasting insulin and HDL-cholesterol all improved after intervention
Di Bonito 2008[66]	141	7-14	Cross-sectional	Obese children show an increased LVM. Central fat is the only independent predictor of increased LVMi. All other measured risk factors were worse in obese vs. control and worse in the highest tertile of obesity vs. lowest tertile.
Di Salvo 2006[67]	300	6-15	Cross-sectional	Significant increase in LVM was found in overweight but otherwise healthy children. cIMT was significantly correlated with 24 h-systolic BP, but without a significant difference between obese and lean children. The findings suggest that obesity, in the absence of hypertension, is a risk factor for later CVD and is associated with significant impairment of ventricle functioning.

Di Salvo 2008[68]	320	6-15	Cross-sectional	LVMi increased in the obese children. Significant changes in the right and left atrial myocardial function in children with excess weight. BP and 24h BP similar between obese and control children
Falaschetti 2010[16]	7589	9-12	Cross-sectional	In pre-pubertal children there is a largely linear relationship of BMI with each of the risk factors and biomarkers evaluated. A higher BMI was found to be associated with worsened CVD risk factors and an at least ten-fold increased risk ratio for hypertension in both girls and boys.
Farpour-Lambert 2009[69]	66	6-11	RCT	Obese children had higher BP, weight, BMI, abdominal fat, HOMA-IR and lower fitness and HDL-cholesterol levels than lean subjects The physical activity program reduced BP, arterial stiffness, and abdominal fat; increased fitness; and could delay arterial wall remodelling in obese children. Training did not improve LDL-cholesterol or triglycerides, insulin and HOMA-IR became worse.
Giannini 2009[34]	120	6-10	Cross-sectional	Pre-pubertal lean and obese children were found to have increased cIMT compared with controls with the mean value of the left and the right carotid artery showing a J-shaped curve but no difference was found between the 2 groups. Lean and obese children had higher fasting insulin, fasting glycaemia, HOMA-IR compared with controls but no differences were found between lean and obese. A negative effect of both lower and higher adipose tissue on carotid arterial wall in lean and severe obese pre-pubertal children was seen.
Hrafnkelsson 2009[70]	267	7	Cross-sectional	Overweight children had unfavourable levels of HDL-cholesterol, LDL-cholesterol, glucose, triglycerides, insulin, systolic BP and diastolic BP. Skinfold thickness, higher triglyceride and glucose levels, and being female were associated with increased serum insulin.
Iannuzzi 2004a[71]	147	6-14	Cross-sectional	Obese children had significantly increased carotid IMT and stiffness, BP, triglycerides, glucose, cholesterol and HOMA-IR when compared with control children. All CVD risk factors were found to be worse in obese compared with control group regardless of sex.
Iannuzzi 2004b[72]	143	10 (2.6)	Cross-sectional	Compared with controls, obese children had higher blood pressure and higher total cholesterol, triglycerides, fasting glucose and insulin. Preclinical changes in the aortic elastic properties were found in obese children. This combined with insulin resistance was found in obese girls and worsen the impact on pre-clinical arterial changes.
Maggio 2008[73]	66	8.8 (1.5)	Cross-sectional	Ambulatory systolic hypertension found in almost half of the obese children. 24-hour ambulatory systolic BP, diastolic BP, and LVMI were significantly higher in obese than in lean children. Fatness, lean tissue mass and 24 hour ambulatory BP were correlated positively with LVMi.
Peralta-Huertas 2008[74]	63	9-12	Cross-sectional	Systolic BP and diastolic BP higher in overweight boys and girls than normal children except diastolic BP in girls where the reverse was true. LVM and LVMi were significantly higher in overweight boys and girls compared with normal children.
Platat 2006[17]	640	11.2-11.79	Cross-	Physical activity was inversely related to HOMA-IR. Metabolic syndrome was present in 26% of the overweight children but none of the normal weight children. Overweight children with the metabolic syndrome had worse results for systolic BP, HDL-

			sectional	cholesterol, triglycerides and HOMA-IR than both overweight children without metabolic syndrome and normal controls.
Roh 2007[19]	83	14-16	Cross-sectional	Obese children had significantly increased IMT compared with controls. Obese children had significantly higher systolic BP, diastolic BP, LDL-cholesterol, triglycerides, and lower HDL-cholesterol than the control group. IMT was significantly correlated to BMI, systolic BP and diastolic BP and inversely correlated to HDL-cholesterol.
Suriano 2010[75]	180	6-13	Cross-sectional	Females had lower diastolic BP and glucose, no other significant effect of sex was found. Increasing BMIz associated with higher systolic BP, diastolic BP triglycerides, insulin and HOMA-IR and lower HDL-cholesterol. Waist circumference z-score was the only significant predictor of cardiovascular risk factors Within the normal weight children, high fitness was associated with significantly reduced triglyceride levels, and lower fasting glucose, insulin and HOMA-IR
Van Putte-Katier 2008[76]	94	8-14	Cross-sectional	Obese children were found to have increased systolic BP, diastolic BP, left ventricular wall dimensions and mass. LVMi was significantly predicted by BMI SDS. Glucose, total cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol were not predictors of LVM/LVMi.
Watts 2008[77]	148	6-13	Cross-sectional	Waist circumference was the only significant predictor of HDL-cholesterol, triglycerides, systolic blood pressure, fasting insulin, HOMA-IR. Increased waist circumference was associated with increased CVD risk. BMIz was significantly associated with systolic BP, diastolic BP, HDL-cholesterol, triglycerides, insulin, fasting glucose and HOMA-IR in a univariate model but none in the multivariate model.
Woo 2004b[78]	72	7-12	Case-control	BMI, fasting insulin and triglycerides were higher in obese children. Overweight was associated with increased cIMT. The degree of endothelial dysfunction correlated with BMI on univariate and multivariate analysis.
	Total in meta-analysis: 16,187			

Table 3.3. Mean differences in blood pressure

Parameter	N Studies	N Participants	Mean difference, Random Effects, 99% CI	Test for heterogeneity	Test for overall effect
Resting Systolic Blood Pressure (mmHg)[a]					
		Obese compared with normal weight			
All	15	8074	7.49 (3.36 to 11.62)	χ^2=188.82 I^2=93%	Z=4.67 p<0.00001
Girls	4	4739	12.72 (7.08 to 18.37)	χ^2=38.77 I^2=92%	Z=5.80 p<0.00001
Boys	4	5013	10.81 (7.75 to 13.86)	χ^2=11.72 I^2=74%	Z=9.11 p<0.00001
		Overweight compared with normal weight			
All	8	12169	4.54 (2.44 to 6.64)	χ^2=50.26 I^2=86%	Z=5.57 p<0.00001
Girls	3	5160	6.03 (4.61 to 7.46)	χ^2=3.07 I^2=35%	Z=10.90 p<0.00001
Boys	3	5160	5.67 (3.32 to 8.03)	χ^2=7.28 I^2=73%	Z=6.20 p<0.00001
Resting Diastolic Blood Pressure (mmHg)[a]					
		Obese compared with normal weight			
All	16	8140	4.06 (2.05 to 6.08)	χ^2=104.36 I^2=86%	Z=5.19 p<0.00001
Girls	4	4723	7.40 (3.85 to 10.95)	χ^2=34.39 I^2=91%	Z=5.37 p<0.00001
Boys	4	5013	6.09 (3.78 to 8.40)	χ^2=16.04 I^2=81%	Z=6.80 p<0.00001
		Overweight compared with normal weight			
All	7	11529	2.57 (1.55 to 3.58)	χ^2=17.96 I^2=67%	Z=6.49 p<0.00001
Girls	3	5160	2.66 (1.20 to 4.13)	χ^2=5.39 I^2=63%	Z=4.68 p<0.00001
Boys	3	5160	2.36 (1.74 to 2.98)	χ^2=1.35 I^2=0%	Z=9.80 p<0.00001
24 Hour Ambulatory Blood Pressure (mmHg)					
		Obese compared with normal weight			
24H Ambulatory Systolic All	5	823	11.55 (1.26 to 21.84)	χ^2=114.62 I^2=97%	Z=2.89 p=0.004
24H Ambulatory Diastolic All	5	823	6.09 (-0.11 to 12.29)	χ^2=135.72 I^2=97%	Z=2.53 p=0.01

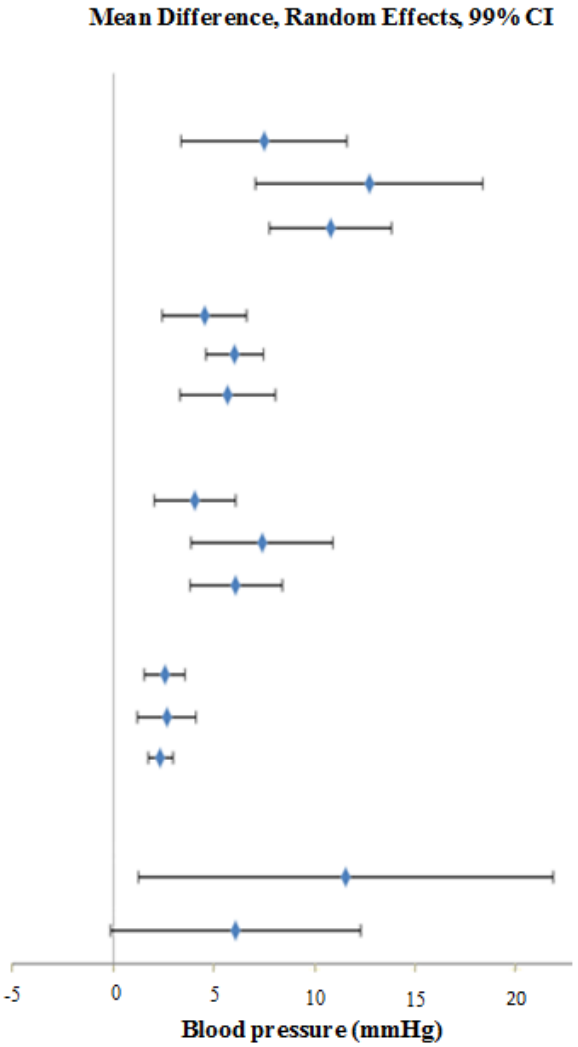


Table 3.4. Mean differences in blood lipids

Parameter	N Studies	N Participants	Mean difference, Random Effects, 99% CI	Test for heterogeneity	Test for overall effect
Total Cholesterol (mmol/L)[a]					
Obese compared with normal weight					
All	9	5072	0.15 (0.04 to 0.25)	X^2= 8.31 I^2=4%	Z=3.67 p=0.0002
Girls	3	2213	0.31 (0.08 to 0.54)	X^2=3.65 I^2=45%	Z=3.44 p=0.0006
Boys	3	2557	0.14 (-0.11 to 0.39)	X^2=5.95 I^2=66%	Z=1.49 p=0.14
Overweight compared with normal weight					
All	5	5949	0.02 (-0.21 to 0.17)	X^2=17.16 I^2=77%	Z=0.29 p=0.77
LDL Cholesterol (mmol/L)[b]					
Obese compared with normal weight					
All	7	4773	0.18 (0.09 to 0.26)	X^2=5.62 I^2=0%	Z=5.27 p<0.00001
Overweight compared with normal weight					
All	3	5036	-0.02 (-0.41 to 0.37)	X^2=18.55 I^2=89%	Z=0.12 p=0.91
HDL Cholesterol (mmol/L)[b]					
Obese compared with normal weight					
All	8	4915	-0.22 (-0.39 to -0.06)	X^2=61.82 I^2=89%	Z=3.60 p=0.0003
Girls	2	2153	-0.10 (-0.66 to 0.47)	X^2=29.07 I^2=97%	Z=0.44 p=0.66
Boys	2	2470	-0.29 (-0.34 to -0.24)	X^2=25 I^2=96%	Z=0.60 p=0.55
Overweight compared with normal weight					
All	5	5752	-0.17 (-0.22 to -0.13)	X^2=4.68 I^2=15%	Z=10.63 p<0.00001
Triglycerides (mmol/L)[a]					
Obese compared with normal weight					
All	10	5138	0.26 (0.13 to 0.39)	X^2=42.25 I^2=79%	Z=5.08 p<0.00001
Girls	3	2213	0.28 (0.04 to 0.51)	X^2=15.12 I^2=87%	Z=3.06 p=0.002
Boys	3	2557	0.30 (0.19 to 0.41)	X^2=3.06 I^2=35%	Z=7.03 p<0.00001
Overweight compared with normal weight					
All	5	6515	0.21 (0.14 to 0.27)	X^2=10.50 I^2=62%	Z=8.01 p<0.00001

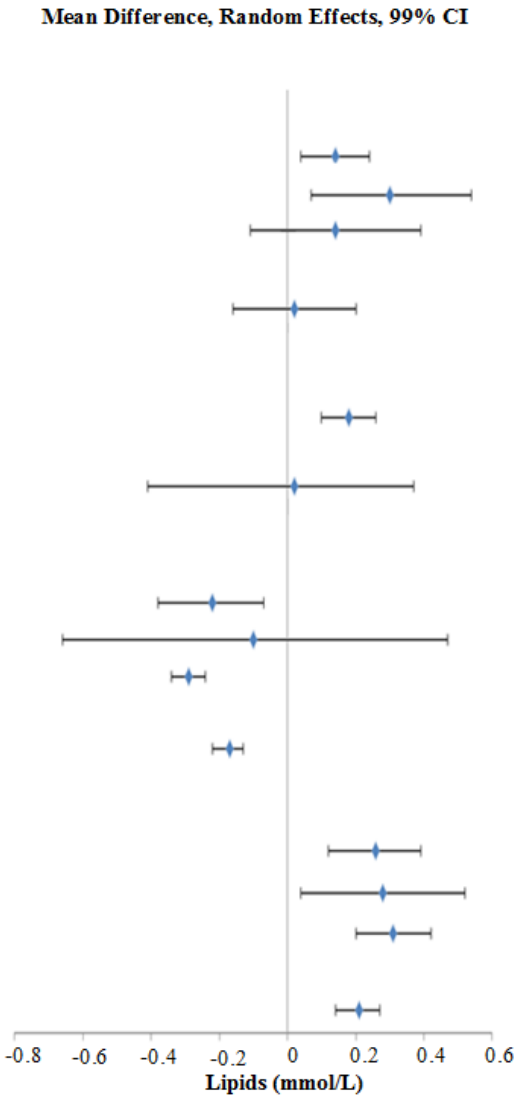


Table 3.5. Mean differences in fasting insulin, glucose and insulin resistance

Parameter	N Studies	N Participants	Mean difference, Random Effects, 99% CI	Test for heterogeneity	Test for overall effect
Fasting Glucose (mmol/L)					
			Obese compared with normal weight		
All	8	771	0.10 (-0.03 to 0.23)	X^2=17.05 I^2=59%	Z=1.96 p=0.05
Girls	2	221	0.15 (-0.03 to 0.33)	X^2=0.37 I^2=0%	Z=2.20 p=0.03
Boys	2	345	0.29 (0.12 to 0.46)	X^2=0.18 I^2=0%	Z=4.48 p<0.00001
			Overweight compared with normal weight		
All	3	348	0.13 (-0.04 to 0.31)	X^2=3.99 I^2=50%	Z=1.99 p=0.05
HOMA-IR					
			Obese compared with normal weight		
All	7	779	1.32 (0.83 to 1.82)	X^2=26.89 I^2=78%	Z=6.89 p<0.00001
			Overweight compared with normal weight		
All	2	760	0.88 (-0.08 to 1.85)	X^2=16.53 I^2=94%	Z=2.36 p=0.02
Fasting Insulin (pmol/L)					
			Obese compared with normal weight		
All	6	629	48.47 (31.96 to 64.97)	X^2=18.98 I^2=74%	Z=7.56 p<0.00001
Girls	2	221	70.90 (49.52 to 92.28)	X^2=2.10 I^2=52%	Z=8.54 p<0.00001
Boys	2	345	77.03 (41.70 to 112.36)	X^2=3.45 I^2=71%	Z=5.62 p<0.00001
			Overweight compared with normal weight		
All	3	924	21.82 (-1.44 to 45.08)	X^2=23.28 I^2=91%	Z=2.42 p=0.02

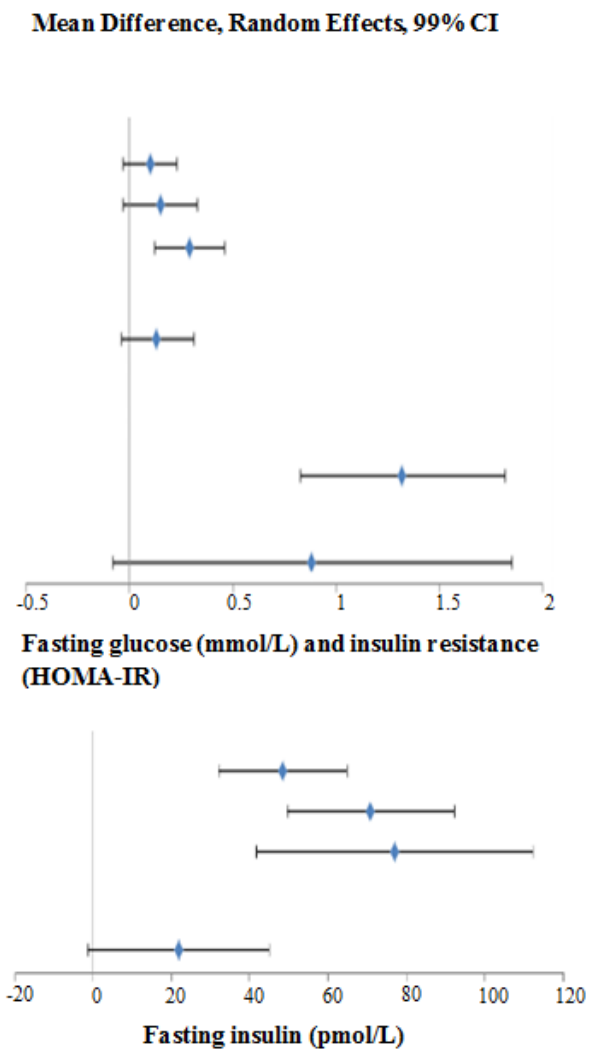
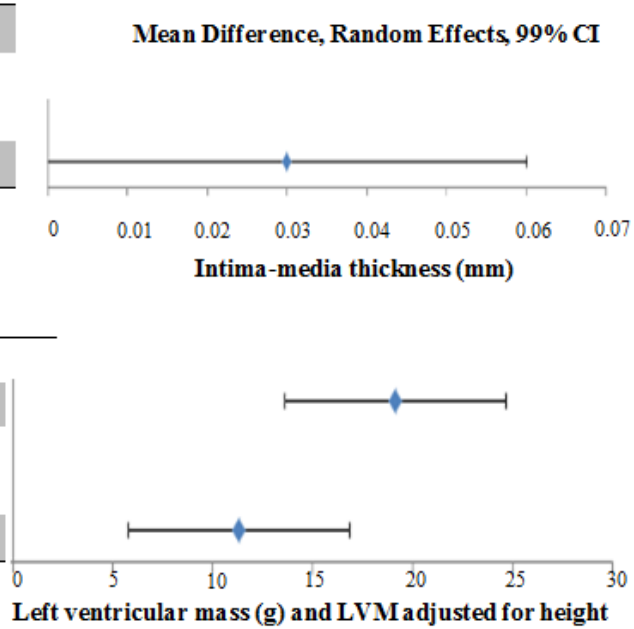


Table 3.6. Mean differences in intima media thickness, left ventricular mass and left ventricular mass indexed for height

Parameter	N Studies	N Participants	Mean difference, Random Effects, 99% CI	Test for heterogeneity	Test for overall effect
Intima-media thickness (mm)					
Obese compared with normal weight					
All	5	592	0.03 (0.00 to 0.06)	X^2=34.07 I^2=88%	Z=2.61 p=0.009
Left ventricular mass (g)					
Obese compared with normal weight					
All	3	223	19.12 (12.66 to 25.59)	X^2=0.27 I^2=0%	Z=7.62 p<0.00001
Left ventricular mass adjusted for height					
Obese compared with normal weight					
All	5	918	11.29 (6.49 to 16.10)	X^2=39.50 I^2=90%	Z=6.06 p<0.00001



Tables 3.3 to 3.6 were reproduced from Friedemann et al. (2012) Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ*, 345.

3.5 Discussion

3.5.1 Main findings

This systematic review found that, in school-aged children, being obese was associated with having significantly higher CVD risk factors than normal weight children. This was also true for overweight children but the effect was strongest in those defined as obese. The effect sizes found were substantial and concerning given their potential impact on the risk of future CVD. As an example of the gradient effect of increased weight on CVD risk factors, the mean difference in systolic BP between normal weight and obese children was 40% higher than the difference between normal and overweight children. Additionally total cholesterol and LDL-cholesterol were found to be 7.5 times (0.15 vs. 0.02 mmol/L) and 9 times (0.18 vs. 0.02 mmol/L) higher respectively in obese than the overweight comparisons. The increase in the mean difference in BMI from the normal to overweight comparison to the normal to obese comparison was approximately five points for both the total cholesterol and LDL-cholesterol analyses. This translates to an increase of 0.026 mmol/L in total cholesterol and 0.036 mmol/L in LDL-cholesterol for each BMI point gained.

A 2011 review carried out by an expert panel and funded by the National Institutes of Health suggested that in the next 25 years obesity will increase the incidence of coronary heart disease (CHD) in adults by 5% to 16%.[79] This may still be an underestimate as the data used was a decade old at the time the simulation was performed and were based on obese adolescents. As such the data did not take into account the effect that being overweight may also have. Raised concentration of fasting insulin has been linked to a two-fold increase in the future incidence of type II diabetes mellitus,[80] and this review found fasting insulin to be 2.2 times higher in obese to normal than overweight to normal comparisons.

As well as fasting insulin, raised triglyceride levels are an independent risk factor for type II diabetes in men and increase the incidence rate of CHD in men 3·6 to 4.7 fold.[81 82] Raised triglycerides also double the relative risk of myocardial infarction in woman.[83] This review

found that lipid levels were significantly more abnormal in the overweight and obese children. Levels of HDL-cholesterol in obese children were lowered to such an extent that an equivalent reduction from the acceptable level as defined by expert panels from the National Heart, Lung and Blood Institute and the National Cholesterol Education Program would result in a child falling under the 10th percentile for HDL-cholesterol.[79 84] This suggests that these children will enter the adult abnormal lipid levels earlier and may experience the associated atherosclerotic damage and illness end points at a younger age.

Lastly, left ventricular mass and left ventricular mass adjusted for height were found to be significantly raised in obese children. In children height adjusted left ventricular mass has been correlated to both BMI and systolic BP and has been suggested to be an indicator for the need for pharmacological treatment of paediatric hypertension.[85 79] What is clear from the findings being discussed here and the work of previous researchers is weight, and especially obesity has a significant effect on the CVD risk factors present in children from five years.

There are two issues regarding the potential impacts of the elevations identified in CVD risk factors in overweight and obese children on cardiovascular related outcomes in adulthood. Firstly, the extent to which these elevated levels continue into adulthood. There is evidence that risk factors can track into adulthood and these increase the risk of numerous conditions in addition to CVD, for example type II diabetes, musculoskeletal, pulmonary, and psychosocial complications.[79 86-89] In particular it has been reported that tracking occurs for elevated BP, although correlation coefficients are moderate and related to baseline BP, age and method of measurement.[87 90]

Secondly, given the evidence that tracking occurs, there are questions around whether the magnitude of the difference in CVD risk parameters between normal, overweight and obese children continues unchanged into adulthood. If this does occur, the effect of excess weight on CVD risk parameters as has been seen here, particularly in obese children, is likely to have a

profound effect in adulthood. For instance, in adults a 10mmHg reduction in systolic BP or a 5mmHg reduction in diastolic BP has been linked to a 30% to 40% reduction in stroke mortality risk and a 30% reduction in mortality from ischemic heart disease.[91 92] Even a reduction of 2mmHg in systolic BP was associated with a 10% reduction in stroke and a 7% reduction in ischemic heart disease risk.[91] This association in adulthood was linear at all levels of blood pressure, true at all ages and unaffected by sex. In this review obese children had systolic BP 7.5 mmHg and diastolic BP 4.1 mmHg higher than normal weight children. Obese 24 hour ambulatory systolic BP was also significantly higher by 11.55 mmHg and previous research has shown this measurement method to be more accurate than both clinic and home measures of BP.[93] Given this, it could be postulated that if these are allowed to track unchecked into adulthood, obese children will already be at an approximately 30-40% higher risk of future stroke and ischemic heart disease than their normal weight classmates.

3.5.2 Limitations

A number of limitations to this review are worth noting. Firstly, a high level of heterogeneity was present between studies in some of the risk parameters. While care was taken to define the inclusion criteria so that the participants of included studies were as similar as possible, factors such as ethnicity, pubertal status, and age still varied. Few restrictions were placed on the type of study that could be included in this review and so influencing factors such as setting and measurement methods could have added to the heterogeneity. Additionally reporting methods such as units of measurement, summary statistics, and cut-off points varied between studies often without the necessary information, for example tolerance factors, for conversions to be made.

Secondly, the influence of age and pubertal status could not be assessed as too few of the papers reported data at a level of detail necessary for this. This suggests a need for more primary research into the effect that weight has on CVD risk in different age groups.

Thirdly, this review is limited by missing data either from potentially eligible studies that were missed, or due to data that was not reported in the included studies. However, it is the belief of the author that the search strategy was robust and unlikely to have missed eligible studies, and had a low risk of selective reporting as the majority of the included studies were scored as low risk for reporting bias.

Fourthly, the conclusions that can be drawn from this review are limited in that it only provides a picture of the CVD risk of the children at the time they were measured. As such the relationship of CVD risk parameters to on-going changes in weight in the same individual and how the risk in those individuals might progress into adulthood has not been established by this review.

Finally, there was a risk of misclassification for two of the papers included in the meta-analysis in which the children had a BMI that fell close to or on the cut-off point for a weight category, or whose BMI category required reclassification in the analysis.[66 75] This was due to discrepancies between the definitions of the BMI category boundaries used by each study and those used in the review, and was necessary in order to pool and analyse the data. However, it is not thought that any misclassification would lead to significant errors in the analyses as both papers had comparatively small samples, ≤180 children, and only one had its sample reclassified as it grouped all overweight and obese children together.[75]

3.5.3 Conclusions

This review suggests that the extent of the association between BMI and CVD risk in children may not be fully appreciated and highlights the shortcomings in the current definitions and methods of measurement of risk parameters. Without standardising these and ensuring that weight is taken into account in the calculation of acceptable levels, future research could be hindered by error and poor comparability between studies. It was found that overweight and obesity have a significant and damaging effect on the CVD risk factors of school-aged children,

in particular on their blood pressure, lipids, insulin levels and resistance and left ventricular mass. This effect was greatest in obese children and the implications for their future health may be greater than has been previously suggested.

All of the parameters described here are however modifiable. If a child were to make healthy changes to their lifestyle there is evidence that these risk factors can be reduced even to the level of an individual who has never been obese.[86] The importance of equipping children with the information to make these changes is thus underscored.

3.6 Summary points

- The effect that excess weight has on the CVD risk of school aged children may be bigger than previously thought.
- In order to increase comparability between studies the cut-off points for BMI categories and acceptable levels of CVD risk factors in childhood and the methods used to measure them need to be standardised.
- In order to reduce the risk of error, definitions of acceptable levels of CVD risk factors in childhood must take weight into account when they are calculated.
- The effect of BMI on CVD risk in children in middle and low developed countries needs to be reviewed and compared to that in highly developed countries.
- The long term link between BMI and CVD risk parameters in childhood and CVD related morbidity and mortality in adulthood should be investigated.
- The risk parameters for CVD have been shown to be more amenable to change than weight.
- Attempts need to be made to tackle the modifiable risk parameters for CVD in the young.

3.7 References

1. Friedemann C, Heneghan C, Mahtani K, Thompson M, Perera R, Ward AM. Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ* 2012;345.

2. World Health Organisation. Noncommunicable Diseases Factsheet, 2013.

3. World Health Organisation. *Obesity : preventing and managing the global epidemic : report of a WHO consultation*. Geneva: World Health Organisation, 2000.

4. Lim S. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet* 2012(380):2224-60.

5. Heneghan C, Badenoch D. *Evidence Based Medicine Toolkit*. 2nd Edition ed. Oxford: Blackwell Publishing, 2006.

6. United Nations. *Human Development Report 2010*. 2nd ed. ed: Palgrave Macmillan, 2010.

7. Kelishadi R, Sabri M, Motamedi N, Ramezani MA. Factor analysis of markers of inflammation and oxidation and echocardiographic findings in children with a positive family history of premature coronary heart disease. *Pediatric Cardiology* 2009;30:477-81.

8. Dekkers JC, Treiber FA, Kapuku G, Snieder H. Differential Influence of Family History of Hypertension and Premature Myocardial Infarction on Systolic Blood Pressure and Left Ventricular Mass Trajectories in Youth. *Pediatrics* 2003;111(6):1387-93.

9. Higgins JPT, (eds) GS. *Cochrane Handbook for Systematic Reviews of Interventions*, 2011.

10. 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.

11. Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ* 2007;335(7612):194.

12. Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. *Introduction to Meta-Analysis*. Chichester, U.K.: John Wiley and Sons Ltd, 2009.

13. Higgins JPT, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine* 2002;21(11):1539-58.

14. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003;327(7414):557-60.

15. Altman DG. Systematic reviews of evaluations of prognostic variables. *BMJ* 2001;323(7306):224-28.

16. Falaschetti E, Hingorani AD, Jones A, Charakida M, Finer N, Whincup P, et al. Adiposity and cardiovascular risk factors in a large contemporary population of pre-pubertal children. *European Heart Journal* 2010;31(24):3063-72.

17. Platat C, Wagner A, Klumpp T, Schweitzer B, Simon C. Relationships of physical activity with metabolic syndrome features and low-grade inflammation in adolescents. *Diabetologia* 2006;49(9):2078-85.

18. Aggoun Y, Farpour-Lambert NJ, Marchand LM, Golay E, Maggio ABR, Beghetti M. Impaired endothelial and smooth muscle functions and arterial stiffness appear before puberty in obese children and are associated with elevated ambulatory blood pressure. *European Heart Journal* 2008;29(6):792-99.

19. Roh EJ, Lim JW, Ko KO, Cheon EJ. A useful predictor of early atherosclerosis in obese children: Serum high-sensitivity C-reactive protein. *J. Korean Med. Sci.* 2007;22(2):192-97.

20. Evans RK, Franco RL, Stern M, Wickham EP, Bryan DL, Herrick JE, et al. Evaluation of a 6-month multi-disciplinary healthy weight management program targeting urban, overweight adolescents: Effects on physical fitness, physical activity, and blood lipid profiles. *International Journal of Pediatric Obesity* 2009;4(3):130-33.

21. Graf C, Rost SV, Koch B, Heinen S, Falkowski G, Dordel S. Data from the StEP TWO programme showing the effect on blood pressure and different parameters for obesity in overweight and obese primary school children. *Cardiology in the Young*, 2005:291-98.

22. Reinehr T, Schaefer A, Winkel K, Finne E, Toschke AM, Kolip P. An effective lifestyle intervention in overweight children: Findings from a randomized controlled trial on "Obeldicks light". *Clinical Nutrition* 2010;29(3):331-36.

23. Mirzaei M, Taylor R, Morrell S, Leeder SR. Predictors of blood pressure in a cohort of school-aged children. *European Journal of Cardiovascular Prevention & Rehabilitation* 2007;14(5):624-29.

24. Savva SC, Tornaritis M, Savva ME, Kourides Y, Panagi A, Silikiotou N, et al. Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *International Journal of Obesity* 2000;24(11):1453-58.

25. Thomas N-E, Cooper SM, Williams SP, Baker JS, Davies B. Relationship of fitness, fatness, and coronary-heart-disease risk factors in 12- to 13-year-olds. *Pediatric Exercise Science* 2007;19(1):93-101.

26. Vizcaino VM, Aguilar FS, Martinez MS, Lopez MS, Gutierrez RF, Rodriguez-Artalejo F. Association of adiposity measures with blood lipids and blood pressure in children aged 8-11 years. *Acta Paediatrica* 2007;96(9):1338-42.

27. Teixeira PJ, Sardinha LB, Going SB, Lohman TG. Total and Regional Fat and Serum Cardiovascular Disease Risk Factors in Lean and Obese Children and Adolescents. *Obesity* 2001;9(8):432-42.

28. Woo KS, Chook P, Yu CW, Sung RYT, Qiao M, Leung SSF, et al. Effects of diet and exercise on obesity-related vascular dysfunction in children. *Circulation* 2004;109(16):1981-6.

29. Andersen LB, Wedderkopp N, Hansen HS, Cooper AR, Froberg K. Biological cardiovascular risk factors cluster in Danish children and adolescents: the European Youth Heart Study. *Preventive Medicine* 2003;37(4):363-67.

30. Jago R, Harrell JS, McMurray RG, Edelstein S, El Ghormli L, Bassin S. Prevalence of abnormal lipid and blood pressure values among an ethnically diverse population of eighth-grade adolescents and screening implications. *Pediatrics* 2006;117(6):2065-73.

31. Ribeiro JC, Guerra S, Oliveira J, Teixeira-Pinto A, Twisk JWR, Duarte JA, et al. Physical activity and biological risk factors clustering in pediatric population. *Preventive Medicine* 2004;39(3):596-601.

32. Steene-Johannessen J, Kolle E, Anderssen SA, Andersen LB. Cardiovascular disease risk factors in a population-based sample of Norwegian children and adolescents. *Scand. J. Clin. Lab. Invest.* 2009;69(3):380-86.

33. Raman A, Sharma S, Fitch MD, Fleming SE. Anthropometric correlates of lipoprotein profile and blood pressure in high BMI African American children. *Acta Paediatrica* 2010;99(6):912-19.

34. Giannini C, de Giorgis T, Scarinci A, Cataldo I, Marcovecchio ML, Chiarelli F, et al. Increased carotid intima-media thickness in pre-pubertal children with constitutional leanness and severe obesity: The speculative role of insulin sensitivity, oxidant status, and chronic inflammation. *European Journal of Endocrinology* 2009;161 (1):73-80.

35. Aguilar FS, Martinez-Vizcaino V, Lopez MS, Martinez MS, Gutierrez RF, Martinez SS, et al. Impact of an After-School Physical Activity Program on Obesity in Children. *Journal of Pediatrics* 2010;157(1):36-42.

36. Alhassan S, Robinson TN. Objectively Measured Physical Activity and Cardiovascular Disease Risk Factors in African American Girls. *Ethnicity & disease* 2008;18(4):421-26.

37. Andersen LB, Harro M, Sardinha LB, Froberg K, Ekelund U, Brage S, et al. Physical activity and clustered cardiovascular risk in children: a cross-sectional study (The European Youth Heart Study). *The Lancet* 2006;368(9532):299-304.

38. Bouziotas C, Koutedakis Y, Nevill A, Ageli E, Tsigilis N, Nikolaou A, et al. Greek adolescents, fitness, fatness, fat intake, activity, and coronary heart disease risk. *Archives of Disease in Childhood* 2004;89(1):41-44.

39. Brage S, Wedderkopp N, Ekelund U, Franks PW, Wareham NJ, Andersen LB, et al. Features of the metabolic syndrome are associated with objectively measured physical activity and fitness in Danish children: the European Youth Heart Study (EYHS). *Diabetes Care* 2004;27(9):2141-8.

40. Carrel AL, Clark RR, Peterson SE, Nemeth BA, Sullivan J, Allen DB. Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: A randomized, controlled study. *Archives of Pediatrics and Adolescent Medicine* 2005;159 (10):963-68.

41. Dubose KD, Stewart EE, Charbonneau SR, Mayo MS, Donnelly JE. Prevalence of the metabolic syndrome in elementary school children. *Acta Paediatrica* 2006;95(8):1005-11.

42. Ekelund U, Anderssen SA, Froberg K, Sardinha LB, Andersen LB, Brage S, et al. Independent associations of physical activity and cardiorespiratory fitness with metabolic risk factors in children: the European youth heart study. *Diabetologia* 2007;50(9):1832-40.

43. Flouris AD, Canham CH, Faught BE, Klentrou P. Prevalence of cardiovascular disease risk in Ontario adolescents. *Archives of Disease in Childhood* 2007;92(6):521-23.

44. Hansen SE, Hasselstrom H, Gronfeldt V, Froberg K, Andersen LB. Cardiovascular disease risk factors in 6-7-year-old Danish children: the Copenhagen school child intervention study. *Preventive Medicine* 2005;40(6):740-46.

45. Johnston CA, Tyler C, Fullerton G, McFarlin BK, Poston WS, Haddock CK, et al. Effects of a school-based weight maintenance program for Mexican-American children: results at 2 years. *Obesity*, 2010:542-7.

46. Kalarchian MA, Levine MD, Arslanian SA, Ewing LJ, Houck PR, Cheng Y, et al. Family-based treatment of severe pediatric obesity: Randomized, controlled trial. *Pediatrics* 2009;124 (4):1060-68.

47. Kim C, Kim B, Joo N, Park Y, Lim H, Ju Y, et al. Determination of the BMI threshold that predicts cardiovascular risk and insulin resistance in late childhood. *Diabetes Research and Clinical Practice* 2010;88(3):307-13.

48. Klasson-Heggebo L, Andersen LB, Wennlof AH, Sardinha LB, Harro M, Froberg K, et al. Graded associations between cardiorespiratory fitness, fatness, and blood pressure in children and adolescents. *BJSM online* 2006;40(1):25-9.

49. Kovacs VA, Fajcsak Z, Gabor A, Martos E. School-based exercise program improves fitness, body composition and cardiovascular risk profile in overweight/obese children. *Acta physiologica Hungarica* 2009;96(3):337-47.

50. Kriemler S, Zahner L, Schindler C, Meyer U, Hartmann T, Hebestreit H, et al. Effect of school based physical activity programme (KISS) on fitness and adiposity in primary schoolchildren: cluster randomised controlled trial. *BMJ* 2010;340:c785.

51. McMurray RG, Harrell JS, Bangdiwala SI, Bradley CB, Deng S, Levine A. A school-based intervention can reduce body fat and blood pressure in young adolescents. *Journal of Adolescent Health* 2002;31 (2):125-32.

52. Reed KE, Warburton DE, Macdonald HM, Naylor PJ, McKay HA. Action Schools! BC: a school-based physical activity intervention designed to decrease cardiovascular disease risk factors in children. *Preventive Medicine,* 2008:525-31.

53. Resnicow K, Taylor R, Baskin M, McCarty F. Results of go girls: a weight control program for overweight African-American adolescent females. *Obes. Res.* 2005;13(10):1739-48.

54. Ruiz JR, Ortega FB, Rizzo NS, Villa I, Hurtig-Wennlof A, Oja L, et al. High cardiovascular fitness is associated with low metabolic risk score in children: The European Youth Heart Study. *Pediatric Research* 2007;61(3):350-55.

55. Sacher PM, Kolotourou M, Chadwick PM, Cole TJ, Lawson MS, Lucas A, et al. Randomized controlled trial of the MEND program: a family-based community intervention for childhood obesity. *Obesity* 2010;18 Suppl 1:S62-8.

56. Shalitin S, Ashkenazi-Hoffnung L, Yackobovitch-Gavan M, Nagelberg N, Karni Y, Hershkovitz E, et al. Effects of a twelve-week randomized intervention of exercise and/or diet on weight loss and weight maintenance, and other metabolic parameters in obese preadolescent children. *Hormone Research* 2009;72(5):287-301.

57. Simon C, Schweitzer B, Oujaa M, Wagner A, Arveiler D, Triby E, et al. Successful overweight prevention in adolescents by increasing physical activity: a 4-year randomized controlled intervention. *Int J Obes* 2008;32(10):1489-98.

58. Steinberger J, Jacobs DR, Moran A, Hong CP, Rocchini AP, Prineas RJ, et al. Relation of insulin resistance and body composition to left ventricular mass in children. *American Journal of Cardiology* 2002;90(10):1177-+.

59. Vizcaíno VM, Salcedo Aguilar F, Franquelo Gutiérrez R, Solera Martínez M, Sánchez López M, Serrano Martínez S, et al. Assessment of an after-school physical activity program to prevent obesity among 9- to 10-year-old children: a cluster randomized trial. *International journal of obesity (2005)* 2008(1):12-22.

60. Yoshinaga M, Sameshima K, Tanaka Y, Arata M, Wada A, Takahashi H. Association between the number of cardiovascular risk factors and each risk factor level in elementary school children. *Circ. J.* 2008;72(10):1594-97.

61. Banach AM, Peralta-Huertas J, Livingstone K, Petrella N, Klentrou P, Faught B, et al. Arterial distensibility is reduced in overweight pre- and early pubescent children. *European journal of pediatrics* 2010;169(6):695-703.

62. Barba G, Troiano E, Russo P, Strazzullo P, Siani A, Grp APS. Body mass, fat distribution and blood pressure in southern Italian children: Results of the ARCA project. *Nutr. Metab. Carbiovasc. Dis.* 2006;16(4):239-48.

63. Calcaterra V, Klersy C, Muratori T, Telli S, Caramagna C, Scaglia F, et al. Prevalence of metabolic syndrome (MS) in children and adolescents with varying degrees of obesity. *Clinical Endocrinology* 2008;68(6):868-72.

64. Csabi G, Torok K, Jeges S, Molnar D. Presence of metabolic cardiovascular syndrome in obese children. *European journal of pediatrics* 2000;159(1-2):91-94.

65. de Sousa G, Hussein A, Trowitzsch E, Andler W, Reinehr T. Hemodynamic Responses to Exercise in Obese Children and Adolescents before and after Overweight Reduction. *Klinische Padiatr.* 2009;221(4):237-40.

66. Di Bonito P, Carldo B, Forziato C, Sanguigno E, Di Fraia T, Scilla C, et al. Central adiposity and left ventricular mass in obese children. *Nutr. Metab. Carbiovasc. Dis.* 2008;18(9):613-17.

67. Di Salvo G, Pacileo G, Del Giudice EM, Natale F, Limongelli G, Verrengia M, et al. Abnormal myocardial deformation properties in obese, non-hypertensive children: an ambulatory blood pressure monitoring, standard echocardiographic, and strain rate imaging study. *European Heart Journal* 2006;27(22):2689-95.

68. Di Salvo G, Pacilco G, Del Giudice EM, Natale F, Limongelli G, Verrengia M, et al. Atrial myocardial deformation properties in obese nonhypertensive children. *J. Am. Soc. Echocardiogr.* 2008;21(2):151-56.

69. Farpour-Lambert NJ, Aggoun Y, Marchand LM, Martin XE, Herrmann FR, Beghetti M. Physical Activity Reduces Systemic Blood Pressure and Improves Early Markers of Atherosclerosis in Pre-Pubertal Obese Children. *Journal of the American College of Cardiology* 2009;54 (25):2396-406.

70. Hrafnkelsson H, Magnusson KT, Sigurdsson EL, Johannsson E. Association of BMI and fasting insulin with cardiovascular disease risk factors in seven-year-old Icelandic children. *Scandinavian Journal of Primary Health Care* 2009;27(3):186-91.

71. Iannuzzi A, Licenziati MR, Acampora C, Salvatore V, Auriemma L, Romano ML, et al. Increased carotid intima-media thickness and stiffness in obese children. *Diabetes Care* 2004;27(10):2506-08.

72. Iannuzzi A, Licenziati MR, Acampora C, Salvatore V, De Marco D, Mayer MC, et al. Preclinical changes in the mechanical properties of abdominal aorta in obese children. *Metabolism: Clinical & Experimental* 2004;53(9):1243-6.

73. Maggio ABR, Aggoun Y, Marchand LM, Martin XE, Herrmann F, Beghett M, et al. Associations among obesity, blood pressure, and left ventricular mass. *Journal of Pediatrics* 2008;152(4):489-93.

74. Peralta-Huertas J, Livingstone K, Banach A, Klentrou P, O'Leary D. Differences in left ventricular mass between overweight and normal-weight preadolescent children. *Appl. Physiol. Nutr. Metab.* 2008;33(6):1172-80.

75. Suriano K, Curran J, Byrne SM, Jones TW, Davis EA. Fatness, Fitness, and Increased Cardiovascular Risk in Young Children. *Journal of Pediatrics* 2010;157(4):552-58.

76. Van Putte-Katier N, Rooman RP, Haas L, Verhulst SL, Desager KN, Ramet J, et al. Early cardiac abnormalities in obese children: Importance of obesity Per se versus associated cardiovascular risk factors. *Pediatric Research* 2008;64(2):205-09.

77. Watts K, Bell LM, Byrne SM, Jones TW, Davis EA. Waist circumference predicts cardiovascular risk in young Australian children. *Journal of paediatrics and child health* 2008;44(12):709-15.

78. Woo KS, Chook P, Yu CW, Sung RYT, Qiao M, Leung SSF, et al. Overweight in children is associated with arterial endothelial dysfunction and intima-media thickening. *Int J Obes* 2004;28(7):852-57.

79. Kavey R, Simons-Morton D, de Jesus J. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report. *Pediatrics* 2011;128(Supplement 5):S213-S56.

80. Dankner R, Chetrit A, Shanik MH, Raz I, Roth J. Basal-State Hyperinsulinemia in Healthy Normoglycemic Adults Is Predictive of Type 2 Diabetes Over a 24-Year Follow-Up. *Diabetes Care* 2009;32(8):1464-66.

81. Tirosh A, Shai I, Bitzur R, Kochba I, Tekes-Manova D, Israeli E, et al. Changes in Triglyceride Levels Over Time and Risk of Type 2 Diabetes in Young Men. *Diabetes Care* 2008;31(10):2032-37.

82. Tirosh A, Rudich A, Shochat T, Tekes-Manova D, Israeli E, Henkin Y, et al. Changes in Triglyceride Levels and Risk for Coronary Heart Disease in Young Men. *Ann Intern Med* 2007;147(6):377-85.

83. Lindquist P, Bengtsson C, Lissner L, Björkelund C. Cholesterol and triglyceride concentration as risk factors for myocardial infarction and death in women, with special reference to influence of age. *Journal of internal medicine* 2002;251(6):484-89.

84. NCEP Expert Panel on Blood Cholesterol Levels in Children Adolescents. National Cholesterol Education Program (NCEP): Highlights of the Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. *Pediatrics* 1992;89(3):495-501.

85. Richey PA, DiSessa TG, Hastings MC, Somes GW, Alpert BS, Jones DP. Ambulatory blood pressure and increased left ventricular mass in children at risk for hypertension. *Journal of Pediatrics* 2008;152(3):343-48.

86. Juhola J, Magnussen CG, Viikari JSA, Kähönen M, Hutri-Kähönen N, Jula A, et al. Tracking of Serum Lipid Levels, Blood Pressure, and Body Mass Index from Childhood to Adulthood: The Cardiovascular Risk in Young Finns Study. *The Journal of pediatrics* 2011;159(4):584-90.

87. Chen X, Wang, Y.,. Tracking of Blood Pressure from Childhood to Adulthood: A systematic review and meta-regression analysis. *Circulation* 2008;117:3171-80.

88. Webber LS, Srinivasan SR, Wattigney WA, Berenson GS. Tracking of Serum Lipids and Lipoproteins from Childhood to Adulthood. *American Journal of Epidemiology* 1991;133(9):884-99.

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

90. Chen X, Wang Y, Appel LJ, Mi J. Impacts of Measurement Protocols on Blood Pressure Tracking From Childhood Into Adulthood. *Hypertension* 2008;51(3):642-49.

91. Prospective Studies Collaboration. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *The Lancet* 2002;360(9349):1903-13.

92. Lawes CMM, Bennett DA, Feigin VL, Rodgers A. Blood Pressure and Stroke. *Stroke* 2004;35(3):776-85.

93. Hodgkinson J, Mant J, Martin U, Guo B, Hobbs FDR, Deeks JJ, et al. Relative effectiveness of clinic and home blood pressure monitoring compared with ambulatory blood pressure monitoring in diagnosis of hypertension: systematic review. *BMJ* 2011;342.

Chapter 4. A focus group study exploring students' heart health knowledge and views on health education: Introduction and methods.

4.1 Introduction

The reviews in Chapters 2 and 3 clearly show that cardiovascular disease (CVD) risk factors can begin to develop in childhood and that there is a growing need to find an effective intervention to address the risks. Previous interventions designed to encourage healthy living in children have focussed on weight loss and nutrition and have thus far seen little success. Therefore, it was hypothesised that children were educated specifically about heart health and its relationship to healthy living, they would be more likely to change their behaviour and avoid early development of CVD.

As was described in Chapter 2, there are well-established links between childhood weight, CVD risk in childhood and illness in adulthood, as well as the apparent lack of knowledge in children about their own heart health.[1-7] Additionally, it is recognised that childhood is the best time to develop healthy habits.[4 8 9] In order to design an educational intervention, baseline levels of knowledge and behaviours as well as current and preferred lesson styles needed to be ascertained.

This chapter lays out the methods of the focus groups that were carried out with primary and secondary school students to acquire the above information. The results of these discussions, which can be seen in the Chapter 5, were then used to guide the design of a new intervention that had heart health as its focus.

4.2 Aim and objectives

The aim of these focus groups was to explore the level of knowledge students had of common CVD risk factors, their attitudes towards these risk factors and their own health, the resulting healthy living behaviours, and the delivery of health education in schools. The specific objectives were:

- To establish the amount of knowledge students have about common risk factors for CVD.
- To explore the attitudes they take towards these risk factors and their own health.
- To discuss how their knowledge and attitudes influence their health behaviours.
- To discuss who they think is at risk for heart disease.
- To determine where the students get their health information from.
- To discuss what, if anything, students are taught about CVD in school
- To discuss how they would like health education lessons to be delivered.

4.3 Methods and Analysis

4.3.1 Design

The sample consisted of students in school years 6 (aged 10 to 11) and 11 (aged 15 to 16). These year groups were chosen because the students were coming to the end of their time at either primary or secondary school and so would be able to reflect back on the health education they had received.

A semi-structured focus group method was used so that the interaction of the group could help to stimulate discussion, allowing the participants to express themselves more fully.[10] This was especially useful as the topic of conversation may not have been familiar to the students and so could prompt them to make connections and express opinions that they otherwise would not have thought of. Focus groups have also been used successfully to explore the views of parents and children of the amount of health knowledge children have, barriers to child obesity prevention and the best methods of delivery for prevention programmes.[11 12]

It has been suggested that if the topic of discussion is complex or could be sensitive to members of the group, smaller numbers are preferable so that the participants do not feel intimidated or discouraged from sharing their thoughts.[10] Therefore the focus group size was limited to between five and seven participants. The focus groups were to be single sex which has been

recommended when conducting focus groups with child participants as it helps children feel more comfortable and so be more open.[6 13 14] As such single sex focus groups have become the method of choice when discussing sensitive topics, as was found in a review which found that out of 93 studies reviewed only 28 used mixed groups.[15]

4.3.2 Participant Recruitment

Schools

The head teacher of every Oxfordshire primary and secondary state school was contacted with a study information sheet inviting them to participate (Appendix 4.1). After a three week response period, the responding schools were ranked according to their Index of Multiple Deprivation scores and schools were then selected from each of the deprivation levels to take part.[16] The Index of Multiple Deprivation score is based on Census data and uses postcodes to rank geographical areas in England by their level of deprivation. There are a total of 32,482 rankings with 1 being the most deprived and 32,482 the least.[16]

Students

Students were recruited through the host school. A convenience sampling strategy was used, which allows any willing participant who meets the inclusion criteria to take part.[10] This method was chosen because the topic could affect all students and so all of their views are of equal interest. This method also allows recruitment to be completed in a shorter time which limited the disruption to the host school. The lead researcher (CF) visited the target year groups during an assembly or form group session to introduce the study and answer any immediate questions. Students were given an information pack to share with their parents including details of the study, consent forms, and the contact details of the primary researcher (Appendix 4.2). Students and parents were asked to sign consent forms and return both in a pre-paid envelope. Participants were not asked to provide demographic data in part because it was not necessary for the aim of the study to be met and in part to protect their anonymity. In addition, as all of the

students were in the same year group, at the same school, and of the same sex, basic demographic information was known or could be inferred. No incentives were offered for participation.

4.3.3 Focus groups

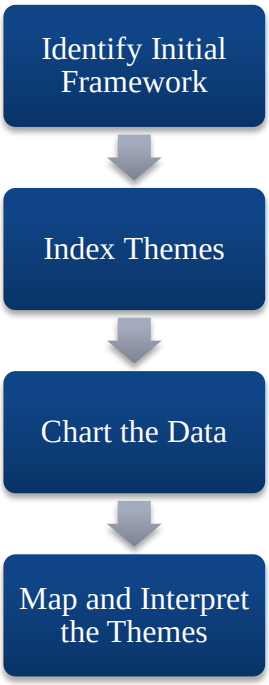
The focus groups were held at the host school and ran for up to an hour, keeping to within one lesson so as to limit disruption to the school day. At the start of the focus groups the students were asked to respect each other's views and feelings and to keep what was said in the discussion to themselves. A short quiz at the beginning of the discussion served as an ice breaker and as a starting point for each topics of discussion. The quiz included pictures of CVD risk factors and a pictorial BMI chart. After the quiz the focus group discussed the answers given to each question in turn, followed by questions that brought in the students' own experiences (Appendix 4.3).

The focus groups were led by the primary researcher (CF) whilst another researcher facilitated and kept notes. The focus groups were digitally recorded and transcribed verbatim by the primary researcher and checked by the facilitator from that group to ensure all transcripts were accurate. To protect the anonymity of the participants all details from which a school or individual could be identified were removed from the transcripts. The transcripts each totalled approximately 50 pages in length and have been archived securely.

4.3.4 Data analysis and storage

The data was stored and organised using the NVIVO software package (QSR International Pty Ltd), which allows the data to be organised and accessed quickly. Some researchers have however said that its use may result in the researcher losing the familiarity with the text that is critical for thorough analysis of qualitative data.[10 17] With this in mind steps were taken such as re-reading transcripts and ensuring that theories did not arise from just one section of the data.[10]

A Framework Analysis approach was used to analyse the data.[18 19] This method has been chosen as it allows pre-specified theories to be explored in a specific sample by the researcher as well as iteratively allowing themes to emerge from the data.[18] It also permits the researcher to answer a specific question. The process of Framework Analysis follows four clear steps which make it an efficient but comprehensive method of qualitative research so the richness of the data it is being used to analyse is not lost.[19] Briefly, the steps of Framework Analysis are as follows;



1. Identifying the initial framework: the researcher immerses themself in the data and is able to identify the emerging themes from the text. These are added to the themes laid out *a priori* to form an initial thematic framework. At this stage the researcher should refrain from interpreting the participants' contributions and accurately capture their views.

2. Indexing the themes: the themes are then sorted into main and sub-themes again staying as close to the wording in the data as possible.

3. Charting the data: illustrative quotes are taken from the data and added to the themes with a record of the participant and point in the text they came from.

4. Mapping and interpretation: key themes are analysed to provide a picture of the phenomenon under investigation and an answer to the research question that accurately reflects the views of the participants.[18 19]

When analysing focus group data using Framework Analysis a decision needs to be taken as to whether it will be done on an individual or group basis.[19] Analysis done on an individual level follows the contributions of each of the participants through the text whereas group analysis treats the text as a whole. As this study was concerned with developing an intervention that suited the greatest number of students, analysis was done on a group basis. The sub-themes

emerging from each of the focus groups were collated on one sheet of paper per group and grouped into main themes.[20]

Participants were not asked to validate the transcripts and the full set of transcripts and audio recordings are only available to the research team. Audio recordings, transcripts and participant consent forms have been marked confidential and are being stored securely and in accordance with the Data Protection Act 1998.[21] Instructions for the disposal of the data after the minimum period specified by the University of Oxford's Ethics Committee, ten years, have been included with the data should the original researchers no longer work at the University.

4.4 Ethics

This study was designed with reference to the Medical Research Council's *MRC Ethics Guide: Medical Research Involving Children* and the guidelines of the University of Oxford's Central University Research Ethics Committee (CUREC).[22] All three of the researchers also completed a Criminal Records Bureau check, copies of which were made available to the participating schools. Ethical approval was granted by the University of Oxford's Research Ethics Committee and representatives from the host schools were also invited to examine the study protocol.

Although the subject matter of the focus groups was not anticipated to cause distress to the students, they were told at the beginning of the discussion that they were free to withdraw from the group at any time and did not have to give a reason why. The students were also reminded that what they said in the focus groups would be kept anonymous and that their participation or withdrawal would not affect any aspect of their school work or grades. Finally the students were told that if they had any questions or concerns following the focus group they could contact the research team using the details provided in their information packs.

4.5 Reporting and Dissemination

At the time of printing the results of this study were under peer review at the Qualitative Health Research journal. In addition, the head teacher of the host school was sent a summary of the findings to share with the school as they saw fit (Appendix 4.4).

4.6 References

1. Rosner B PR, Daniels SR, Loggie J,. Blood pressure differences between blacks and whites in relation to body size among US children and adolescents. *Am J Epidemiol* 2000;151(10):1007-19.

2. Chu NF, Rimm EB, Wang DJ, Liou HS, Shieh SM. Clustering of cardiovascular disease risk factors among obese schoolchildren: The Taipei children heart study. *Am J Clin Nutr* 1998;67 (6):1141-46.

3. Daniels SR, Loggie JMH, Khoury P, Kimball TR. Left ventricular geometry and severe left ventricular hypertrophy in children and adolescents with essential hypertension. *Circulation* 1998;97 (19):1907-11.

4. Aggoun Y. Obesity, metabolic syndrome, and cardiovascular disease. *Pediatric Research* 2007;61(6):653-9.

5. Friedemann C, Heneghan C, Mahtani K, Thompson M, Perera R, Ward AM. Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ* 2012;345.

6. Dixey R, Sahota P, Atwal S, Turner A. Children talking about healthy eating: Data from focus groups with 300 9-11-year-olds. 2001.

7. Moradi P, Thornton J, Edwards R, Harrison RA, Washington SJ, Kelly SP. Teenagers' perceptions of blindness related to smoking: a novel message to a vulnerable group. *Br J Ophthalmol* 2007;91(5):605-07.

8. Williams CL, Hayman LL, Daniels SR, Robinson TN, Steinberger J, Paridon S, et al. Cardiovascular health in childhood: A statement for health professionals from the Committee on Atherosclerosis, Hypertension, and Obesity in the Young (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation* 2002;106(1):143-60.

9. Centers for Disease Control and Prevention. Guidelines for school health programs to promote lifelong healthy eating. . *Recommendations and reports : Morbidity and mortality weekly report* 1996;45:1-41.

10. Holloway I, Wheeler S. *Qualitative Research in Nursing and Health Care*. 3rd Edition ed. Chichester: Wiley-Blackwell, 2010.

11. 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 Promotion International* 2005;20(1):19-26.

12. McGarvey EL, Collie KR, Fraser G, Shufflebarger C, Lloyd B, Norman Oliver M. Using Focus Group Results to Inform Preschool Childhood Obesity Prevention Programming. *Ethn Health* 2006;11(3):265-85.

13. Hoppe MJ, Wells EA, Morrison DM, Gillmore MR, Wilsdon A. Using Focus Groups to Discuss Sensitive Topics with Children. *Evaluation Review* 1995;19(1):102-14.

14. Davis A, Jones L. Environmental constraints on health: listening to children's views. *Health Educ J* 1996;55(4):363-74.

15. Heary CM, Hennessy E. The Use of Focus Group Interviews in Pediatric Health Care Research. *J Pediatr Psychol* 2002;27(1):47-57.

16. Census Dissemination Unit. *National Statistics Postcode Directories*. In: Programme CoP, editor: ESRC Census Program, Mimas, University of Manchester, 2001.

17. Reid AO. Computer Management Strategies for Text Data. In: Crabtree BF, Miller WL, editors. *Doing Qualitative Research. Research methods for primary care*. London: Sage Publications, 1992.

18. Srivastava A, Thomson SB. Framework Analysis: A Qualitative Methodology for Applied Policy Research. *Journal of Administration and Governance* 2009;4(2):72-79.

19. Ritchie J, Lewis J, editors. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London: Sage Publications Ltd., 2003.

20. Ziebland S, MacPherson A. Making sense of qualitative data analysis: an introduction with illustrations from DIPEx (personal experiences of health and illness). *Medical Education* 2006;40:405-14.

21. Her Majesty's Stationary Office. *Data Protection Act: The National Archives*, 1998.

22. Medical Research Council. *MRC Ethics Guide: Medical Research Involving Children*. 2004.

Chapter 5. A focus group study exploring students' heart health knowledge, attitudes and behaviours, and views on health education: Results.

5.1 Introduction

This chapter reports the results of the eight focus groups carried out with year 6 and year 11 students, the methods of which were described in Chapter 4. The chapter begins with a description of the themes that emerged in the discussion groups before detailing the similarities with past research and what new knowledge this study adds.

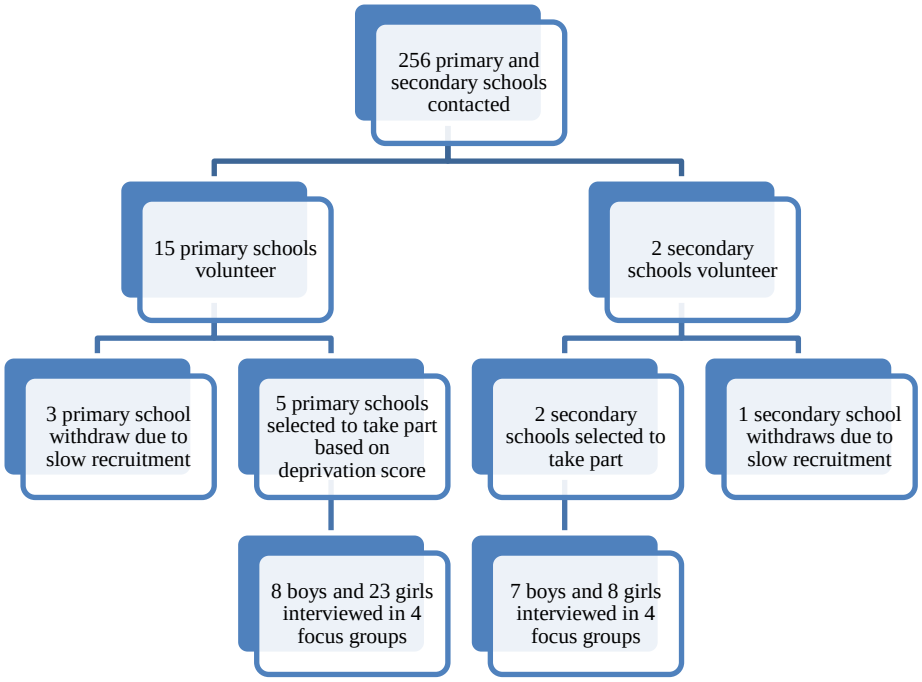
5.2 Results

5.2.1 Characteristics of participants and focus groups

After all 256 Oxfordshire primary and secondary schools had been contacted, 17 agreed to take part in the focus group study. The participating primary schools were ranked according to their integrated deprivation score[1] and five schools, two from the most, one from the middle and two from the least deprived, were selected. Only two secondary schools agreed to take part, so both were admitted into the study, rather than being ranked in this way.

Of the seven schools, three primary and one secondary withdrew due to slow student recruitment. By the end of the recruitment, stage 31 year 6 pupils and 15 year 11 pupils had been recruited into four focus groups across two primary schools and one secondary school (Figure 5.1).

Figure 5.1 Recruitment process



The focus groups lasted between 45 and 50 minutes and were all single sex apart from one which included one boy with a group of year 6 girls. On arrival at one of the primary schools the lead researcher was told that one more student had brought in his consent forms. As only girls had volunteered there was a reluctance to allow him to take part as the protocol dictated that groups should be single sex. However, after having spoken to the boy he was very keen to take part and said that he did not mind being with a group of girls. Before the focus group started the lead researcher confirmed with the girls that they were happy for him to be included and so he was allowed to take part.

As expected, the contributions from the students were uneven. Previous researchers have highlighted that uneven contributions are common in focus groups as levels of extroversion and salience of the topic under discussion differ between the participants.[2] When this was noticed the researchers made an effort to bring the quieter members of the group into the discussion and as a result all of the students made a valuable contribution.

Four themes emerged from the focus groups;

5.2.2 Causes and risk factors for cardiovascular disease (CVD)

5.2.3 Knowledge impacting attitudes and behaviours

5.2.4 Information seeking and behaviour

5.2.5 Education

All quotes from the students are given in italics, where sections of superfluous text have been removed this is marked with … . Additional quotes can be found in Appendices 5.1 to 5.6. Where additions have been made by the author to clarify the point these are given in square brackets [ ].

5.2.2 Causes and risk factors for cardiovascular disease

As a warm up exercise at the start of the discussion the students were asked to name things that a person could do that would give them an unhealthy heart. While they named behaviours that could harm heart health such as smoking, being overweight and not exercising the year 6 students also made a large number of suggestions that confused injury with ill health. These included drink driving, firearms, and mistakes during surgery.

There was also a lack of consensus in both age groups around how the risk factors for CVD affected blood pressure, with suggestions being made that alcohol, inactivity and being overweight raise, lower and have no effect on blood pressure. In addition, the year 6 students made generalisations that healthy and unhealthy activities could all either raise or lower blood pressure although again no consensus was reached on in which direction for either.

5.2.3 Knowledge impacting attitudes and behaviours

The most extensive theme to emerge from the focus groups was that of the impact that different levels of knowledge about a risk factor for CVD had on attitudes towards it and if the students

might seek to change their behaviours and the behaviours of others related to it. This theme was broken down into smaller subthemes each covering a different CVD risk factor for reporting.

Smoking

The students had good knowledge of smoking and were able to conceptualise the link between smoking and the mechanisms through which it is harmful to the cardiovascular system. Furthermore they used the correct terms for the harmful ingredients in cigarettes and often repeated terms such as nicotine and tar:

> "*…Because you're putting unneeded toxins into your body and that starts to harm … they go into your lungs and it doesn't get oxygen onto the blood" [year 6 boy].*
> *"…If you can only get a certain amount of oxygen in and you need so much oxygen, if your lungs aren't working to full efficiency then … you're going to have to pump more blood round to get the same amount of oxygen" [year 11 girl].*
> *"…and it [cigarette] has all of that black stuff" "tar" "tar" "tar" "and nicotine" [year 6 girls].*

Additionally both the younger and older students showed an understanding of addiction, that smoking was not a behaviour that could be stopped easily and that smokers felt they needed to keep smoking. The students could also relate this to feelings of withdrawal if the smoker did not smoke and discussed methods used to break addiction, such as nicotine replacement therapies:

> *"…If you like smoke it's … like drugs so you continue and continue and continue" "Because you become addicted to it" [year 6 girls],*
> *"…You've got to go through the dip though haven't you, like nicotine debt" [year 11 girl].*

It emerged that the high level of smoking knowledge shown by the students of both ages was linked to strong negative attitudes towards it. The students expressed being upset and disgusted at smoking and its effects, frequently expressing confusion as to why an individual would start or continue to smoke. These attitudes were expressed even to the extent that the smoker was driven "mad" by the addiction and there was a general opinion that smoking should therefore be made illegal:

> *"…I really don't see the point in smoking, why someone would start" [year 11 girl].*
> *"…It's on the packet anyway. Don't smoke. Smoking kills so I don't know why people do it" [year 6 boy].*

> *"…Why doesn't she throw the cigarettes in the bin?" "It takes time" "… because then you'd probably just you'd go mad because of the addiction and you'd just go and get them out the bin" [year 6 girls].*

The high levels of knowledge and negative attitudes towards smoking resulted in the students being willing to take positive action towards encouraging those close to them who smoked, to stop, sometimes repeating the health warnings common to cigarette packaging such as "Smoking Kills":

> *"…I'm trying to get my mom to stop smoking but she tried a patch and she's allergic to it so straight back to square one" [year 11 girl].*
> *"…I have four sisters all over 18 and they all smoke. Well they'll walk past and I'll say "smoking kills!" [year 6 boy].*

Diet

When a healthy diet was discussed, the year 11 students had a better understanding of why a healthy diet was important than the year 6 students, although the knowledge of the mechanisms by which certain foods contribute to health were only understood at a basic level:

> *"…It's because your muscles need like nutrition to work and stuff and if they're not getting enough of it the um cardiovascular system won't work to its full capacity" [year 11 boy].*

While in the discussion around smoking greater knowledge lead to healthier attitudes, the lower levels of knowledge about diet were linked to some unhealthy attitudes that were often described as general attitudes held by the peer group:

> "*…When you're a teenager everybody thinks you can't eat because you have to be skinny" [year 6 girl].*
> *"…I think people think as well because they're young then it's fine to eat lots of stuff and it doesn't really affect you" [year 11 girl].*

Additionally, there were discussions about deliberate unhealthy behaviours, particularly in the year 11 students, who would probably have had greater freedom to make their own choices, which were often linked to descriptions of rebelling against strict health advice:

> *"…I think the reason why I eat like rubbish food when I go out is she [mum] ain't going to give it me [sic] at home so I'm just going to buy it …" [year 11 girl].*

Alcohol

When questioned about alcohol and alcohol consumption the students in both age groups had much weaker knowledge about the long term impact than they had about smoking and diet. Both year 6 and year 11 were unsure what the effects of alcohol were on the body and often saw them as being temporary, confusing them with being drunk:

> *"…Does it [alcohol] get into your blood stream or something? I'm not sure." [year 11 girl].*
> *"… I don't know what damage it does, but the actual effect of alcohol wears off after like you've had your hangover? … the effects of what it does on your heart might be there I don't know" [year 6 girl].*

The lack of knowledge about the effects of alcohol led to an attitude that downplayed its health risk as one that could be easily resolved by reducing consumption. The students expressed attitudes that a drink after work was nice and even talked of consuming alcohol themselves on social occasions:

> *"…And like you can stop drinking alcohol or drink it little" [year 6 girl],*
> *"… they don't tell you that it's OK to drink moderately like which I think they should" [year 11 girl].*
> *"…I love Baileys" "I drink bucks fizz at Christmas" "I only have like half a glass [of Baileys]" "I had wine but I put straws in it" [year 6 girls].*

When asked about their behaviours towards alcohol and those consuming it the year 6 students in particular were reluctant to confront someone about their drinking, except with their parents:

> *"… Drinking too much alcohol I wouldn't really say anything" [year 6 girl].*
> *"…Um well dad was drinking too much … so we asked him to stop and we kept on pestering him until he did" [year 6 boy].*

Weight

Although the students showed a reasonable understanding of some of the risks of unhealthy weight, they also showed more misunderstandings than with smoking and diet. For example, when asked why being over- or underweight was unhealthy, neither the year 6 or year 11 students were able to give a correct reply and spoke of systems unrelated to weight such as the

respiratory system or the physical burden of excess weight damaging health. However, some correct responses were given, particularly by the older students:

> *"…They don't have um like fat on them so they can't like breathe" [year 6 girl].*
> *"…[Excess weight] Putting pressure on your heart … if you're just like slumped up it's going to be like pushing it all like onto your heart" Researcher: "So you mean the actual weight?" "Resting on your heart" [year 11 girls].*
> *"… if you're skinny and you have like zero muscle then surely your heart is going to be really weak … would you get a really kind of weak heart in the same way that you'd get like weak body muscles? Like cardiac muscles?" [year 11 girl].*

The attitudes towards unhealthy weight reflected a belief that weight was a simple issue to resolve through changing diet and exercise habits. Some of the ways in which the younger students suggested underweight individuals should regain their health could potentially be damaging in themselves, for example, changing their diet to eat unhealthy foods and not exercising:

> *"…[Fat people should] Eat more proper food" "Go to a gym" [year 6 boys].*
> *"…They [overweight people] can make, do more exercise and then eat a better diet. I think they [underweight people] should also exercise but have a good diet as well" [year 11 girl].*
> *"…[Thin people should] Eat fatty things and don't do exercise" [year 6 boy].*

In general there was a tendency in both age groups to see people at the thin end of the BMI scale as being unhealthier than those at the overweight end. This emerged when the students were asked to indicate which individuals they thought might be unhealthy on a pictorial BMI scale. The students generally started their healthy ranges well into what is medically defined as the range of healthy BMIs and included all of the overweight (BMI 25 to 29) and occasionally some of the obese range (BMI over 30):

> *"…I might go to [BMI] 29 actually I think 33 is a bit round-y" "24 to 29" "is the most normal" [year 11 girls],*
> *"…[Unhealthy BMI range] 37 to 40 and 17 to 19" [year 11 girl].*
> *"…The fourth or third [BMI 22-24] are about average size because my mom's about that" "The third [BMI 22] is too skinny"[year 6 girls].*

The older students also showed an understanding that some behaviours could have effects later on in life. However, there were only two instances when weight-related behaviour was

mentioned and these were both by year 11 students. One of the year 11 boys said that while he didn't consider his health, "aesthetics" were an influence on the activities he chose to do. Additionally, one year 11 girl said she had an exercise plan in order to "look good" on holiday. Neither age group were very willing to raise the issue of weight with others as it was a sensitive subject and would only do so if the problem was severe:

> *"…Um well if you can see people getting like overweight … it does, like I say, have a knock on effect for later in life" [year 11 boy].*
> *"…If they were scarily overweight I would say something" [year 6 girl].*
> *"…Probably not because it's quite a touchy subject" [year 11 girl].*

Heart function

The heart function, specifically blood pressure, as a risk factor for CVD was discussed. In both age groups the level of knowledge about blood pressure was particularly poor compared to the other factors, and a number of misperceptions were raised by both the year 6 and year 11 students. When the students had some basic knowledge of heart function this was often incomplete with the definitions of related terms frequently being interchanged:

> *"…Works it harder [hypertension]? And why is that bad for it do you think?" [Researcher] "Because it's unnecessary for it to do that and if it does it can just, blow up" [year 6 boys].*
> *"…and is it a good thing to do to raise your heart rate for short amounts of time?" [Researcher] "I don't know it could confuse your heart" [year 11 girl].*
> *"…What is your blood pressure?" [Researcher] "Maybe it's how many beats your heart does" [year 6 girls].*
> *"…Systolic's like … when your hearts relaxed and then diastolic is when it's contracted, … it's something to do with … how much blood you can pump out when its contracted and how much you can fill when its relaxed" [year 11 girl].*

The lack of knowledge shown especially by the younger students resulted in them not expressing any attitudes or behaviours that were related to heart health. Whenever the researcher attempted to elicit a response about their heart related attitudes or behaviours the year 6 students would instead discuss risk factors that were more familiar to them, specifically smoking, diet or weight.

The older students, however, did express some attitudes towards healthy heart function and blood pressure. In general these were negative although the students frequently mentioned how hypertension and CVD did not affect them and so were not things that they paid any attention to. The year 11 students said that because none of the health messages about heart disease were aimed at them, it was not something that they felt was relevant:

> *"… If I like see bolognaise and it's really oily I go urgh [laughter] high blood pressure" [year 11 girl].*
> *"…Yeah it's just something that happens later in life [CVD] when your body just stops doing things as efficiently" [year 11 boy].*
> *"…There's nothing like on TV unless you're like 80" [year 11 girl].*

Again, as with the year 6 students, when asked about any heart health-related behaviours the year 11 students instead answered the questions in relation to more familiar risk factors. When asked directly, a year 11 student said that he did not think about his or anyone else's heart health, instead focussing on outward appearance:

> *"…do you ever think about things like your heart health?" [Researcher] "Mmm not really you usually think like, outside" [year 11 boy].*

Cholesterol

As with heart function the students were aware of cholesterol, but their knowledge of it was relatively poor. This may have been because they mentioned television advertisements as the source of their information and these only give basic information about cholesterol and its effects. Both year groups were able to give some account of how cholesterol acts on the cardiovascular system, although neither year group was able to describe the difference between 'good' or 'bad' cholesterol:

> *"…I've heard of it before but I didn't know what it was. I knew there was a good and a bad but I didn't know how they were good or bad" [year 6 boys].*
> *"…if you have a bit of cholesterol fat um it can like keep you warm but if you have too much" "it just is unhealthy" "you get too hot [laughter]" "yes you get, you do get sweaty" [year 6 girls].*
> *"… if the artery is all like blocked up and there's loads of pressure, isn't it like um if it blocks up the coronary artery then your heart can be cut off of oxygen or something. So you can have like a heart attack" [year 11 girl].*

As with heart function no descriptions of attitudes or behaviours towards cholesterol were offered by the students. This again could have been because of little knowledge or a belief that it is only a problem in old age. Despite this, one of the younger girls said that if she knew more about cholesterol she may change the way she behaved:

> *"…Well because we know what could happen if we eat it so maybe it will make us think before we do … I might get you know some cholesterol if I eat this so I maybe won't eat it and switch to a carrot" [year 6 girl].*

5.2.4 Information seeking and behaviour

Information seeking was split into information that is gained passively, for example through the media, actively, for example by internet searches, or a combination of the two, such as being told by and asking parents.

Passively gained information

This type of information is gained without the intention of getting answers to questions. Information was gained passively most frequently through television, film and other media. Television programmes such as Supersize vs. Superskinny, The Biggest Loser and Embarrassing Bodies were often mentioned by both year groups as sources of passive information. These programmes are primarily aimed at an adult audience and often feature obese individuals seeking weight loss advice. Where information was received passively in this way it emerged that misperceptions and misinformation often followed, which could lead to unhealthy behaviours or unhealthy motivation for behaviours:

> *"…I heard it on the radio they like will try and get you to smoke" [year 6 girl].*
> *"…Your arteries will be clogged up with cholesterol" "like that advert" [year 11 girls].*
> *"…I saw on the news that this lady cried for an hour and she lost two stone … I'm totally crying for an hour now" [year 6 girl].*
> *"…It [Embarrassing Bodies] scares me into doing exercise" [year 11 girl].*

When the information was aimed specifically at their age group, however, it could have a positive effect on the students' attitudes and behaviours:

> *"…We had an immersion day about like smoking and drugs, like a whole day on it … I'd never ever do it after watching stuff like that" [year 11 girl].*

Actively sought information

Actively accessed sources of information included parents and other family members, especially if they were seen to have some expertise in health, doctors, and teachers. Use of the internet was also mentioned but only by the year 11 students:

> *"…Um I would speak to my aunt, she works at a hospital" [year 6 boy].*
> *"…If you thought you had something wrong with you then I think I would go to a GP" [year 11 girl].*
> *"…The internet?" "That's where I'd go I'd Google it" "Think most people would actually Google it" [year 11 girls].*
> *"…I went on the NHS website once to find something out" [year 11 boy].*

A new source of information and influence on behaviour emerged from the focus groups with both age groups. The Nintendo Wii game console was seen by both the year 6 and year 11 students as an effective and fun way to exercise, one that could even take the place of more traditional activities like going to the gym:

> *"…Use the Wii" "Yeah it's pretty good" "I've never done my BMI any other way" [year 11 girls].*
> *"…What I do in my spare time is jog 3000 meters on my Wii fit" [year 6 girl].*
> *"…I'm a member so I go to the gym" "Yeah but if you go on the Wii Fit that's also free and it's fun" [year 6 girls].*

The students did not mention any behaviours resulting from information gained in this way except when advice was too strict, which could result in rebelling against it:

> *"…when they say completely cut it out everyone sort of like [thinks] "no why would I do that?" and then completely go against what they are saying" [year 11 girl].*

5.2.5 Education

In both year groups there was a view that health is not taught enough in school. The older students also spoke of how health education was often restricted to optional subjects that were frequently more popular with girls than boys and this resulted in only a small proportion of the year group receiving it:

> *"…We just don't do much [health education] in PE" [year 6 boy].*
> *"…No there are like, about 15 people in my class, all girls though, there's no boys that do it." [year 11 girl].*

"…because we're in GCSE we have to pick our topics so I suppose if you don't pick … subjects that include that sort of stuff you might not get taught as much as people who do" [year 11 boy].

Where health was taught the topics that the students said were covered in the lessons were generally restricted to diet and exercise. Lessons on the cardiovascular system focussed on its basic biology with only occasional mentions of the risk factors for CVD:

"…What sort of things do you get taught in PSHE?" [Researcher] "A healthy diet" " Um being active and sport" [year 6 boys].
"…We do a bit on like don't smoke it's bad for you" "yeah we've done stuff on smoking and alcohol" [year 11 girls].
"…60-100. 90 [heart rate] is healthy we learnt that" [year 6 boy].
"…Well we've learnt about our heart but not about healthiness just what it is" [year 11 girl].

Finally the students were asked about how they would prefer to be taught about health. All expressed an enjoyment of lessons that included activities that were interactive and wanted more detail to be given in class to help them understand the concepts that were being taught, as well as giving them a reason to follow the advice provided. The year 11 students also spoke of how health messages should not only explain the end outcomes of behaviours and disease, but should also be applicable to them now:

"…I like this sort of lesson because you have quizzes and you talk … we're not just sitting down and you're not just telling us things" [year 6 girl].
"…Anything hands on is better … something visual or something we can poke" [year 11 girl].
"…It's got to explain it, give it more reason why more people might actually follow the advice" [year 11 boy].
"…But sometimes that just doesn't have any affect unless you realise … this could have some consequences, you can apply it to yourself rather than just thinking oh some people have died because of this" [year 11 girl].

5.3 Discussion

5.3.1 Main findings and their implications for the pilot intervention

There were eight main findings from these focus groups;

1. Deeper knowledge about a health risk factor was associated with healthier attitudes and greater willingness to change one's own and others' behaviours.

2. Societal norms affected how the children perceived a health risk.
3. Information about heart health is generally aimed at adults and so is seen as a part of aging.
4. Passively gained information is often from sources not aimed at children and this leads to misperceptions and unhealthy attitudes.
5. The students enjoy active video games and use them as a legitimate form of exercise.
6. The students felt that health is not taught enough or restricted to optional subjects in schools.
7. CVD rarely enters into health discussions either at school or at home.
8. The students would like health messages that are detailed and they can apply to themselves now.

Firstly, it was found that varying levels of knowledge about the individual risk factors for CVD impact greatly on children's attitude and behaviours towards them. This was most clearly demonstrated when the students discussed smoking compared to heart function and cholesterol. All of the students had a good understanding of the effect of smoking and all, without exception, were anti-smoking. These high knowledge levels and negative attitudes resulted in a willingness to confront loved ones who smoked and a desire to avoid smoking themselves, that was on one occasion even described as a fear of smoking. In contrast low levels of knowledge about heart function and cholesterol resulted in the younger students being unable to offer any attitudes towards either, and older students taking the attitude that they were issues that are not relevant to them now, but rather inevitable problems of old age. No behaviours relating to these risk factors were described, except for one instance, where a year 11 boy dismissed heart health saying instead he was more concerned with appearance.

To the best of the author's knowledge this is a new finding. A German study by Schmidt et al. administered questionnaires to 9 to 13 year olds and found an association between the attitude

and health behaviour scales but none with health knowledge.[3] Schmidt et al., however, included a different range of health issues and may have restricted the responses their participants were able to give with a questionnaire format. Additionally the questionnaires used only assessed the children's surface knowledge. Here, while all the students had some basic knowledge about the various risk factors, the differences in deeper understanding were found to be key.

In contrast to Schmidt et al. above, a study by Lin et al. found a small positive association between nutrition knowledge, attitudes and caring about nutrition behaviours.[4] However, this association was not always consistent when eating behaviours were assessed. The present study had a similar finding in that while the students had some knowledge about good diet practices compared to many of the other CVD risk factors; they also expressed a desire and practice of going against their own knowledge and consuming 'junk food'. A similar finding was reported in a study that used focus groups to gather information on children's and parents' perceptions of healthy eating and activity.[5] This Australian study with 119 children and 17 parents found that children had conflicting views on the healthiness of certain foods and activities and the reason for this put forward by their parents was the mixed messages and appealing marketing strategies that children are exposed to.[5] It may be that messages around diet are therefore harder to understand for a child and so deep knowledge is not formed and does not impact on their attitudes and behaviours. Instead the appeal of these foods overrules children's perception of what a healthy diet is. Encouragingly, students agreed that more knowledge would influence their attitudes and behaviours in particular with relation to healthy eating.

Secondly, societal norms were found to be an influence on how unhealthy the students viewed risk factors to be. This was particularly evident when they were asked to define a range of BMI that was unhealthy based on a pictorial chart. All of the students began their ranges well into what is medically considered normal and included all of the overweight and, in some cases, part of the obese range. It has been found previously that when children have overweight family

members and friends they tend to underestimate their own weight since being overweight seems normal.[6] This was supported by one of the girls who claimed that a BMI of around 24 was normal because this was how her mother looked. While she was correct and 24 is within the normal BMI range, it raises the question of what her response would have been if her mother had a BMI of, for example, 30. With the increasing prevalence of obesity it may be that the students included here, being exposed to people with excess weight on a regular basis, see what is becoming a societal norm as medically normal.

A similar analysis could be made of the students' views on smoking and alcohol. The included schools were all in areas of low deprivation and it is well established that while smoking in higher socio-economic groups is uncommon, moderate drinking is the norm.[7] While the students had a very negative view of smoking, their attitudes towards alcohol consumption were much more lenient.

Thirdly, the children in this study thought of CVD as a disease that was a part of aging. As such they gave very little thought to the health of their hearts and said instead that physical appearance was more important to the young. To the best of the author's knowledge this is a new finding as existing studies have examined children's perceptions of health rather than their perceptions of CVD.

Fourthly, while the main sources of information described by the students in this study were similar to those found previously in the same age group, a distinction appeared between passively and actively gained information that has not been reported before.[8] The acquiring of health information has been described as passive or active before, but the implications of the two ways have not been explored.[9]

Passively gained information tended to be through media sources such as television. The specific television programmes that were discussed frequently in both age groups were Supersize vs. Superskinny, Embarrassing Bodies and The Biggest Loser. Where these programmes were discussed, a number of misperceptions about health also arose, for example unhealthy eating practices and beliefs that being thin was attractive. One girl even stated that watching Embarrassing Bodies scared her into exercising. While watching programmes such as these may not necessarily be harmful, that they are aimed at an adult audience and frequently feature weight loss advice for obese adults may have a harmful influence on an ill-informed child who applies it to themselves.

The fifth new finding that this study adds to the literature is the students' use of new technology as a source of information and exercise. The Nintendo Wii was recommended as an enjoyable way to exercise that could even be preferable to more traditional activities and while this is encouraging as a potential way of engaging young people in future, the evidence is not wholly supportive. In a 2012 laboratory-based study it was shown that the Wii Sports boxing game was able to raise the energy expenditure, heart rate and perceived excursion of 10-13 year olds to a level similar only to moderate intensity walking.[10] Another study carried out with young adults in Scotland found that although the participants' energy expenditure was approximately four times that of resting expenditure, they did not reach a level of exertion that could improve fitness.[11] Furthermore an Irish study also carried out with young adults found that when the Nintendo Wii boxing, tennis, baseball or jogging games were played only light to moderate intensity activity was achieved.[12] In light of these findings, active video games may not yet be a replacement for traditional sports and gym activities, but new technologies could be exploited in future interventions to improve child health.

The sixth finding was that the children believed that health was not taught enough in school and spoke of how health lessons were infrequent, primarily biology-based, and often delivered to a

small proportion of the year group. Furthermore the students described a lack of discussion around health topics among their family and friends. That health education faces competition for both time and funding is known and has been reported in both government reports and papers discussing the state of health education with teachers.[13 14] To the author's knowledge no studies have examined children's perceptions of health education specifically, although two have found that they rank health and fitness education highly when it is discussed in the context of other subjects. Birtwistle and Brodie found that when they asked over 600 British primary and secondary school children to rank school subjects in order of preference, physical education was ranked highly across age groups and by both genders.[15] Furthermore, when the children were asked to rank the reasons why they thought physical education was important health and fitness was the most highly ranked response in all subgroups.[15] A more recent study carried out in Northern Ireland surveyed 8 to 11 year old children about their perceptions of school science lessons.[16] When asked to indicate if they liked 16 different topics commonly taught in science lessons, at least 75% of the children liked healthy living topics.[16] That health education is given a low priority, and that children enjoy and would welcome more of it in schools highlights the shortcomings of the way in which health is taught currently.

The seventh finding was that the students did not encounter much heart health education, even in health lessons, and where they did study the heart it was usually in the context of its physiology rather than health. It may be that to date heart health has not been seen as an area of importance when educating children about health- the national curriculum only mentions exercise, diet, drugs, and sexual health specifically.[17] Given that the modifiable risk factors for CVD can begin to develop in childhood and are greatly influenced by lifestyle, as discussed in Chapter 2, heart health should be mentioned explicitly in strategies for health education.[18 19]

It is also important to note that the risk factors with the least knowledge were high blood pressure and the causes and actions of cholesterol. These have been found to be the most

common cardiovascular risk factors in multiple populations including adolescents, patients with coronary heart disease, and diabetic patients.[20-23] As a result, the pilot intervention that followed from these focus groups aimed to increase its students' knowledge and improve their attitudes towards heart health, in particular their knowledge of blood pressure and cholesterol.

Finally, the eighth main finding was that while the students were interested in the end points of disease, they wanted greater detail about how behaviours affect them *now* as they maintained that this would give them more motivation to follow healthy living advice. Eiser et al. also reported that, when interviewed, 6 to 11 year old children wanted the detail of why things are good or bad, but it appears that even three decades later children are not getting the level of detail they would like.[24] The younger students in the focus groups also expressed the difficulty that they had in understanding processes happening inside them. This is supported by the findings of Eiser et al., that children are better at understanding and reasoning about illness that is visible and less so at internal illness.[24] According to the Health Belief Model of behaviour change an individual needs to perceive themselves as being susceptible to an illness, with barriers that can be overcome, to achieve a greater health benefit before they will change their behaviour.[25 26] At the moment these students maintain that they are only being taught about the consequences to actions that could happen decades in the future, which makes it difficult for them to be motivated to adopt healthier behaviours. If this is truly the case then health lessons should help students to recognise that they themselves can influence greatly their chances of, or delay the age at which they begin to be at risk of CVD.

The current study also replicated the findings of some previous research. The year 6 students interviewed here appeared to confuse the causes of heart disease with possible causes of heart injury. Previous studies have also found that children tend to see the causes or influencing factors of disease as external. One such study carried out in Hungary in 2006 questioned children about their understanding of the causation of disease.[27] Many gave explanations that

involved contagions from the environment such as car fumes, mentioning behavioural factors for example substance abuse and unhealthy diet less frequently. Children in two 1995 studies also mention violence which included stabbing, guns, and fighting, and this was raised in the present study as well although it was more common among the boys than girls.[8 28]

5.3.2 Strengths and limitations

The strength of this study lies in the contribution it makes to this area of research as to date very few studies have discussed heart health with children. The rising rates of obesity in children suggest that, among other factors, they are not being properly equipped to make the best choices for health. By assessing what they need and want to know and how best to deliver it this may be improved. Additionally, the new finding that the depth of knowledge about a health risk factor impacts greatly on attitudes and behaviours towards it, and the students enjoyment and use of technology to stay healthy provides a valuable insight for future health improvement attempts.

There are a number of limitations of this study that are worth noting. Firstly, for pragmatic reasons all of the schools included in the study were in the same region of England and although it was intended to recruit from schools in areas of differing deprivation only schools in more affluent areas took part. This was due to slow recruitment forcing schools from other deprivation levels to withdraw from the study. Despite this, some high quality data was gained from the focus groups, much of which was consistent across the groups.

Secondly, only children from two year groups were targeted. Although the generalisability of the findings reported in this chapter would have been improved if a wider range of ages had been recruited, year 6 and 11 were chosen specifically because they were reaching the end of their time at that school.[29] As such the students could speak about their experience of health education throughout that stage of schooling.

Thirdly, as the children were self-selected there is a possibility that they were more interested in health or had greater health knowledge than their peers who did not volunteer for the study. There is a particular danger of a self-selection bias among the year 11s as the majority of them mentioned studying an optional subject in which health is routinely taught such as PE or Health and Social Studies. This is however a known consideration of the convenience sampling method. This study was still able to contribute new findings to this area of research as well as supporting previous research, some of which did not use this method of recruitment, therefore suggesting that self-selection bias may not be significant.

Finally, because the research team could have been perceived as authority figures by the students they may have given answers that they think are correct rather than their own opinions. By using focus groups rather than one-on-one interviews, an attempt was made to avoid this as the researcher would be just one member of a larger group and the students could relax with their peers. There may be evidence of this in that one of the year 6 focus groups discussed the alcohol they liked to drink which is clearly not behaviour that would be seen as appropriate to their age group.

5.4 Conclusion

This study found that year 6 and year 11 students have some knowledge of the risk factors for CVD but it is often incomplete or inaccurate. When the depth of knowledge about a risk factor was greater the students were more inclined to express healthy attitudes and behaviours in relation to it. There is also a desire for more interactive, detailed and applicable health education. If this were provided there is an opportunity for behaviour and attitude change in relation to cardiovascular health. The pilot intervention that will be reported on in Chapter 8 takes the lessons learned and recommendations from this study with the aim of designing an effective education intervention.

5.5 Summary points

- Health education should focus on providing students with in depth knowledge about disease risk factors.
- Health education should show students that CVD is not a disease of the elderly and that many of the risk factors are affected by modifiable lifestyle choices.
- Health lessons should equip students to be able to interpret the health information they are exposed to.
- Health education should make use of new technology to assist learning.
- There is a need for more and more-inclusive health education in schools.
- Health education should place higher importance on heart specific knowledge, in the first instance on blood pressure and cholesterol.
- Lessons should be interactive with full explanations of the functions of the heart and risk factors for CVD with emphasis on how the students are affected now.
- Avoid talk of weight loss. Supporting written materials should talk of maintaining a healthy weight for their age and sex and must include the contact details of body image or eating disorder charities.

Reflexive box.

- Anti-smoking attitudes. I was surprised at the level of anti-smoking attitude that both age groups showed in the focus groups. My experience of being a year 11 student was that smoking was more widely accepted than it appeared to be in the focus groups. The anti-smoking attitude here could be due to a self-selection bias where these students are more interested in health and are more health conscious. Nevertheless it is positive for the health of these students.
- Preoccupation with weight. During the focus groups I noticed a preoccupation with weight and diet, in particular among the girls. Upon receiving the quizzes with the BMI chart on the back the majority of the female focus groups of both ages began making comparisons to themselves and others. As well as this the conversation was often brought back to discussions of weight even if the question asked had been specifically about heart health. Having spent time researching body image and obesogenic behaviour I noticed this perhaps more than others without this background would have. This has also lead to my specification that talk of weight loss to avoid heart disease will not be included in the pilot intervention. Where weight must be discussed all information will be accompanied by the contact details of body image and/or eating disorder charities.
- Television as a source of information. Both year groups spoke of enjoying television programmes such as Supersize versus Superskinny, Embarrassing Bodies and The Biggest Loser. These programmes are primarily aimed at an adult audience and offer advice to adult participants who are often obese. My concern would be that if children are watching these programmes without the background knowledge provided by an effective health education, they may take on advice not aimed at their BMI or age group. This point underlines the need for effective health education in this age group.

5.6 References

1. Census Dissemination Unit. *National Statistics Postcode Directories*. In: Programme CoP, editor: ESRC Census Program, Mimas, University of Manchester, 2001.

2. Ritchie J, Lewis J, editors. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London: Sage Publications Ltd., 2003.

3. Schmidt CO, Fahland RA, Franze M, Splieth C, Thyrian JR, Plachta-Danielzik S, et al. Health-related behaviour, knowledge, attitudes, communication and social status in school children in Eastern Germany. *Health Education Research* 2010;25(4):542-51.

4. Lin W, Yang HC, Hang CM, Pan WH. Nutrition knowledge, attitude, and behavior of Taiwanese elementary school children. *Asia Pac J Clin Nutr* 2007;16 Suppl 2:534-46.

5. 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 Promotion International* 2005;20(1):19-26.

6. Maximova K, McGrath, J J, Barnett, T, O'Loughlin, J, Paradis, G, Lambert, M. Do you see what I see? Weight status misperception and exposure to obesity among children and adolescents. *International Journal of Obesity* 2008;32(6).

7. Marmot M. Inequality, deprivation and alcohol use. *Addiction* 1997;92(3s1):13-20.

8. Oakley A, Bendelow G, Barnes J, Buchanan M, Husain OA. Health and cancer prevention: knowledge and beliefs of children and young people. *British Journal of Medicine* 1995;310:1029-33.

9. Gray NJ, Klein JD, Noyce PR, Sesselberg TS, Cantrill JA. Health information-seeking behaviour in adolescence: the place of the internet. *Soc Sci Med* 2005;60(7):1467-78.

10. Graf DL, Pratt LV, Hester CN, Short KR. Playing Active Video Games Increases Energy Expenditure in Children. *Pediatrics* 2009;124(2):534-40.

11. Thin A, Poole N. Dance-Based ExerGaming: User Experience Design Implications for Maximizing Health Benefits Based on Exercise Intensity and Perceived Enjoyment. In: Pan Z, Cheok A, Müller W, Zhang X, Wong K, editors. *Transactions on Edutainment IV*: Springer Berlin Heidelberg, 2010:189-99.

12. O'Donovan C, Hussey J. Active video games as a form of exercise and the effect of gaming experience: a preliminary study in healthy young adults. *Physiotherapy* 2012;98(3):205-10.

13. Action for Healthy Kids. *Progress or Promises? What's Working For and Against Healthy Schools*, 2008.

14. McCaughtry N, Martin JJ, Fahlman M, Shen B. Urban health educators' perspectives and practices regarding school nutrition education policies. *Health Education Research* 2012;27(1):69-80.

15. Birtwistle GE, Brodie DA. Children's attitudes towards activity and perceptions of physical education. *Health Education Research* 1991;6(4):465-78.

16. Murphy C, Beggs J. Children's perceptions of school science. *School Science Review* 2003;84(308).

17. Department of Education. *Review of the National Curriculum*, 2011.

18. Juhola J, Magnussen CG, Viikari JSA, Kähönen M, Hutri-Kähönen N, Jula A, et al. Tracking of Serum Lipid Levels, Blood Pressure, and Body Mass Index from Childhood to Adulthood: The Cardiovascular Risk in Young Finns Study. *The Journal of pediatrics* 2011;159(4):584-90.

19. Expert Panel On Integrated Guidelines For Cardiovascular Health Risk Reduction In Children Adolescents: Summary Report. *Pediatrics* 2011;128(Supplement 5):S213-S56.

20. May AL, Kuklina EV, Yoon PW. Prevalence of Cardiovascular Disease Risk Factors Among US Adolescents, 1999−2008. *Pediatrics* 2012;129(6):1035-41.

21. Flouris AD, Canham CH, Faught BE, Klentrou P. Prevalence of cardiovascular disease risk in Ontario adolescents. *Archives of Disease in Childhood* 2007;92(6):521-23.

22. Rinkuniene E, Petrulioniene Z, Laucevicius A, Ringailaite E, Laucyte A. Prevalence of conventional risk factors in patients with coronary heart disease. *Medicina (Kaunas)*. 2009;45 (2): 140-6

23. Jurado J, Ybarra J, Solanas P, Caula J, Gich I, Pou JM, et al. Prevalence of cardiovascular disease and risk factors in a type 2 diabetic population of the North Catalonia diabetes study. *Journal of the American Academy of Nurse Practitioners* 2009;21(3):140-48.

24. Eiser C, Patterson D, Eiser JR. Children's knowledge of health and illness: implications for health education. *Child: Care, Health and Development* 1983;9(5):285-92.

25. Becker MH, Maiman LA, Kirscht JP, Don PH, Drachman RH. The Health Belief Model and Prediction of Dietary Compliance: A Field Experiment. *Journal of Health and Social Behavior* 1977;18(4):348-66.

26. Janz NK, Becker MH. The Health Belief Model: A decade later. *Health Educ Q* 1984;11(1):1-47.

27. Piko BF, Bak J. Children's perceptions of health and illness: images and lay concepts in preadolescence. *Health Education Research* 2006;21(5):643-53.

28. Pridmore P, Bendelow G. Images of health: exploring beliefs of children using the 'draw-and-write' technique. *Health Education Journal* 1995;54(4):473-88.

29. Holloway I, Wheeler S. *Qualitative Research in Nursing and Health Care*. 3rd Edition ed. Chichester: Wiley-Blackwell, 2010.

Chapter 6. Mothers' knowledge and attitudes towards childhood health, screening and health education: A focus group study

6.1 Introduction

A child's health and the development of the risk factors examined in Chapter 3, depend in part on the lifestyle of the child which can be influenced by parents, school, and their peers, in addition to the child's own choices.

Thus, any intervention that aims to affect the early development of cardiovascular disease (CVD) risk in children also has to take into account the influence and information provided by parents and schools. However, as was described in Chapter 2, the information that children currently receive from these sources may not be adequately equipping them for a healthy future. Reports of parents playing down the effects of being overweight in childhood, having perceptions of a healthy child that do not always agree with a medical view, or simply not recognising a child as being overweight are common.[1-6] In addition, schools have been reported to fail to provide health education because of a lack of training and resources.[7 8]

Since this thesis is building towards designing and testing the feasibility of a health education intervention it was decided that the knowledge and attitudes of parents about the health of their child should be considered. Additionally the parents' views on health education were explored.

Through a literature search only a small number of studies were found that assessed British parents' knowledge and perceptions of childhood health, and these were all focused on weight-related health. Two studies assessed parents' knowledge and attitudes to child weight-related health with a British sample, and a systematic review of perceptions of overweight status in children included only two British papers out of 17 reviewed.[4 6 9] Furthermore to the author's knowledge no studies have questioned British parents about heart health, as such this study aimed to address this knowledge gap.[6]

6.2 Aim and objectives

The aim of the study was to explore the knowledge and attitudes of parents on health and health education in childhood. The specific objectives were:

- To ascertain the level of knowledge and attitudes parents have about their children's weight-related health and how these may affect their parenting behaviours.
- To ascertain the level of knowledge and attitudes parents have about the BMI measure and the National Child Measurement Programme (NCMP) and how these may affect their parenting behaviours.
- To discuss the health advice the parents give to their children.
- To discuss what, if anything, their children are taught about health in school and if they feel it is effective.

6.3 Methods and analysis

6.3.1 Design

This study, like the child focus group study detailed in Chapters 4 and 5, was run to build a knowledge base on which to design a pilot intervention to improve child cardiovascular health knowledge and behaviour.

6.3.2 Participant Recruitment

Schools

The head teacher of every Oxfordshire state primary school was sent information sheets and a request to allow parents to be recruited through the school (Appendix 6.1). After a three week response period, the responding schools were ranked according to their integrated measure of deprivation score and schools from each of the deprivation levels were selected.[10] This was to ensure that parents from a range of backgrounds and neighbourhoods can be recruited.

Parents

The parents of children in reception year (age 5 to 6 years) and year 6 (age 10 to 11 years) of primary school were sampled. The parents of children in these two year groups were chosen because it is in these years that the NCMP measures and reports children's BMI, so the process was more likely to be fresh in the parents' minds. All parents with children in the two target years were contacted with information packs sent home with the students (Appendix 6.2).

The focus groups were conducted towards the middle and end of the summer term after the children had been measured by the NCMP and the parents had received their feedback. A convenience sampling strategy was used because it allows any willing participant who met the inclusion criteria to be recruited and so would limit the disruption caused in the host school.[11] The topic under discussion was also one that was relevant to all of the children and their parents, so all of their views were of interest. The parents were asked to sign a consent form included in their information packs and return it in the pre-paid envelope provided.

6.3.3 Focus group

A semi-structured focus group was used to elicit the views of the parents. Focus groups were chosen as the method of data collection as the interaction of the group may help to stimulate discussion, especially as the topic of BMI and health education may not be very familiar to some of the parents.[11] Focus groups have also been used successfully with similar studies investigating childhood obesity and obesity prevention, although these studies did experience difficulty in recruiting participants from certain minority groups.[12 13]

The parents were to be interviewed in groups of between six and eight as this is the recommended number of participants because it is small enough to allow each participant to contribute but big enough to stimulate conversation.[11] The focus group took place at a primary school in Oxfordshire during the school day. As some of the parents may have had younger

children that they would normally be caring for, it was requested that the school allocated a room with enough space for any children to play while the discussions were taking place.

6.3.4 Data analysis and storage

A framework analysis approach was used to analyse the data collected in this study.[14 15] This method allows *a priori* questions to be explored but also has the ability to allow novel ideas and themes to emerge from the text.[14] As this study had a set of specific aims and questions to be answered in addition to seeking the unique experiences of the parents, a framework analysis approach was chosen.

The computer package NVIVO (QSR International Pty Ltd) was used to store and organise the data collected. This software facilitates the analysis of qualitative data and the organisation of findings. As mentioned in previous chapters, this kind of software has been criticised for removing the researcher from the text they are analysing and reducing their familiarity with it.[11 16] As detailed in Chapter 4, steps were taken in light of these criticisms.

Demographic data was not collected from the participants as it was not necessary for the aims of the study to be met. Basic information such as the number of parents present and the sex of their children were noted during the focus groups. The focus groups were audio recorded and the group facilitator kept notes on the discussion while it was taking place. The discussions were transcribed in full by the primary researcher and checked by the group facilitator to ensure accuracy. All names, place names and details which could be used to identify individuals or schools were removed from the transcriptions to protect the anonymity of the participants. The participants were not asked to validate the transcripts and the raw data is only available to the research team. The focus group data and consent forms will be marked confidential, stored securely and securely destroyed after ten years as specified by the University of Oxford's Ethics Committee.

6.4 Ethics

This study was designed in accordance to the University of Oxford's Central University Research Ethics Committee (CUREC) guidance and the teachings of the Introduction to Research Ethics course attended by the author. Ethical approval was granted by CUREC. Representatives from the host schools also examined the study protocol and no issues were raised.

6.5 Outcomes

This focus group provides a picture of how parents use their own knowledge and judgement as well as information provided to them to care for their child's health. Additionally, how they and schools educate children to look after themselves is discussed. This adds to the background information gained from the student focus groups detailed in Chapters 4 and 5 on which a pilot intervention will be designed. This pilot intervention will aim to teach children about the cardiovascular system and the factors that protect and harm. By paying attention to the experiences of the parents the intervention can be designed to complement the information the children receive at home and fill any gaps identified through the discussions.

6.6 Reporting and Dissemination

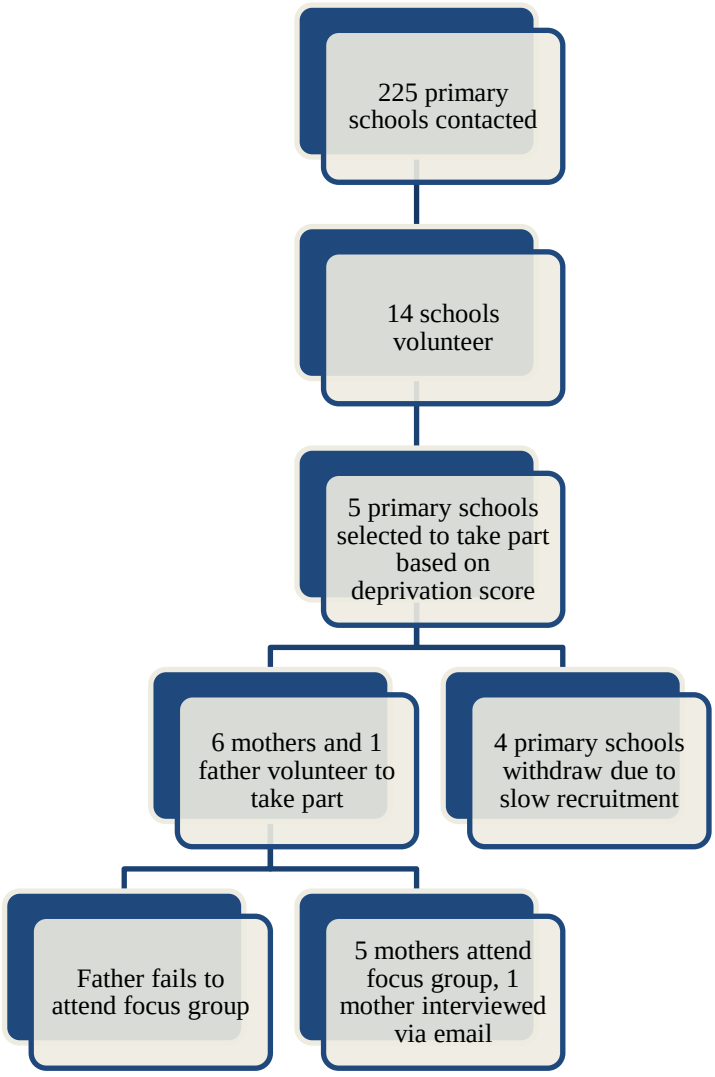
The results of this study were sent to the corresponding teacher from each school to disseminate as they saw fit, as well as all those parents who indicated on their consent forms that they would like a copy of a newsletter detailing the results.

6.7 Results

Information packs were sent to 225 Oxfordshire primary schools. At the end of the recruitment period 14 schools had agreed to take part. These were ranked according to their deprivation scores calculated using postcode data.[10] Two schools from the least, one from the middle and two from the most deprived postcodes were selected to take part. Four of these five schools pulled out of the study due to slow recruitment. Seven parents, six mothers and one father, were

recruited from the remaining school. One of the mothers was no longer available on the study day but wished to contribute to the study and so answered the questions (Appendix 6.3) via email. The father failed to attend the focus group despite a reminder being given. The remaining five mothers were interviewed in one focus group that lasted one hour and 17 minutes. Figure 6.1 shows the full recruitment process.

Figure 6.1. Study recruitment process



The five main themes were identified in the text;

6.7.1 Knowledge and attitudes to childhood health and the impact on parenting behaviours.

6.7.2 Other sources of advice and information.

6.7.3 Child behaviour.

6.7.4 Teaching health at home.

6.7.5 Formal health education.

Below is a description of the themes emerging from the focus group. Where the author has removed text this is marked with … and where additions have been made to clarify the point these appear in square brackets []. See Appendices 6.4 to 6.8 for the full list of the main themes, the sub-themes that formed them and additional supporting quotes.

6.7.1 Knowledge and attitudes to childhood weight-related health and the impact on parenting behaviours

Knowledge and attitudes towards general health

The mothers spoke with confidence about the issue of excess childhood weight. The general attitude was that children being overweight not a cause for concern. The mothers spoke of overweight children who, because they were young and active, they regarded as being healthy. Excess weight was seen as a temporary issue that would be grown out of. The effect that excess weight could have on children's hearts when they are still children was not mentioned in the focus group. The mothers were aware that there could be an effect of excess weight on the future health of their children, but they were not sure what the effects would be. Furthermore, while the mothers mentioned such outcomes as reduced life expectancy associated with excess weight, no intermediate effects, such as increased risk of cardiometabolic disease were discussed. When cardiometabolic factors were mentioned by one mother they were in relation to cholesterol levels in thin adults:

> *"…In 5 years' time you will probably be eating just the same portions and have just stretched up and this is just a waste of time" [Mother 4].*
>
> *"…I am unaware of the impact on her future heart health, although if she was overweight I know this would have an effect" [Mother 6].*
>
> *"…We all got our um fat measured and she had the highest cholesterol of anyone in the office and she was a stick, she was so thin but she was deeply unhealthy … she was a, you know, a stroke waiting to happen" [Mother 5].*

A greater concern for underweight children emerged when the mothers discussed whether they would change their parenting behaviour because of their child's weight. Whereas an overweight child would be cared for in the same way, an underweight child would be more likely to cause their mother to take action. A difference could also be seen when the mothers talked about how they would approach underweight and overweight children. For the underweight child the behaviour would involve others. When the same question was posed for a child that was overweight the mothers were much more confident that they could deal with the problem themselves:

> *"…If your child though came up and was underweight you would do something about it" [Mother 4].*
>
> *"…What sort of things might you do [if child was underweight]?" [Researcher] "Ah consult school probably and work out if they were having school dinners and lunches and what else you could pack in" [Mother 4].*

It emerged from the focus group that mothers were fairly comfortable with talking about the issue of excess weight; perhaps because it is more common and they are likely to have come into contact with overweight individuals. As such, they said they would not be concerned about an obese child, and tactics to avoid or improve excess weight involved simple healthy eating and exercise advice.

The attitude held by the mothers was that there were more serious threats to their child's health than excess weight, for example poor mental health. The exception to this was being underweight. In general, if the health issue was less common or less familiar to them such as being underweight, experiencing mental health problems or having the risk factors for CVD the mothers stated that their concern would be greater. Additionally the mothers agreed that these

other issues would be more likely to make them take positive action to ensure their child's health:

> *"…I think I worry more about the bigger things that could happen rather than things like this [being overweight]" [Mother 3].*
>
> *"… I think their mental health's more important … if you want a good physical health you need to have a good mental health" [Mother 2].*
>
> *"…If you were told your child had high cholesterol you would look into it" [Mother 4] "Absolutely yes" [Mother 3].*

Knowledge and attitudes to BMI and the National Child Measurement Programme and the impact on parenting behaviours

The mothers' knowledge of the National Child Measurement Programme (NCMP) was low. While some were aware that the NCMP had taken place, others were not, and neither were they aware that they should be receiving a letter or what the data were to be used for. Some found it confusing and all saw little value in it for themselves personally. The mothers placed greater value on their own perception of the health of their child rather than any measurement data.

The mothers' attitudes towards the NCMP's letters to parents and the measurement programme in general was that it was a waste of time, not least because it uses the BMI. When the mothers who had received the NCMP letter described their reactions to it they ranged from amusement to finding the letter worrying and upsetting. The mothers' main complaint was the wording of the letter, which some found to be too "harsh". They described how using terms such as obese may make some parents defensive and therefore disregard any health advice the material was trying to impart:

> *"…Also I think the wording, when you see that word obese; I'm like gosh I mean … is that even necessary?" [Mother 3].*
>
> *"…Because parents, if they are told their child is obese or even overweight they shut down, the shutters come down and they become very defensive, they are so unlikely to hear any of your healthy eating advice" [Mother 5].*

The desire to avoid the negative connotations of the terms obese and overweight could also be seen in the way the mothers used euphemistic descriptors such as *"chunky fella" [Mother 5], "solid" [Mother 4],* and *"rounded" [Mother 2].*

The mothers in general were concerned about the measurement process causing unhealthy perceptions of weight in children:

> *" ... I think the school screening is raising the awareness to the child more ... when girls especially get very you know..." [Mother 2] "body conscious" [Mother 4].*

Regarding BMI, levels of knowledge were limited, with some mothers having an understanding of how BMI is calculated and others not:

> *"...It is a sense of playing off the weight against the height and coming up with a figure" [Mother 5].*
>
> *"...Is BMI relevant to children?" [Mother 5].*
>
> *"... I've heard of BMI um and I know that it's something to do with your body mass isn't it against, measured against bone?" [Mother 3].*

The low levels of understanding of BMI that the mothers showed corresponded to perceptions of it being arbitrary and abstract at best, and deceptive at worst. The mothers commented that BMI could not be used to determine if a child was healthy and that it was just a superficial measure that did not give an in-depth picture of their state of health. There was also a feeling among the group that the measure was unfair, particularly in relation to muscle weighing more than fat and the cut off points between the weight categories. As one mother put it "it's like, oh, you're all of a sudden overweight". To illustrate this point they used common examples of sportsmen to show how it can be unreliable. All of the mothers expressed concern that measuring and reporting children's BMI could damage their body image:

> *"...This is surface screening isn't it really" [Mother 3].*
>
> *"...But BMI is very skewed anyway isn't it? I mean I know for example like Matthew Pinsent and Steve Redgrave, they're considered obese aren't they?" [Mother 1].*

A difference of opinion was noted between the mothers who attended the focus group and the one mother who was not present. Mother 6, who responded to the focus group questions via e-mail, considered BMI to be useful provided it was used with other information. Despite her more positive attitude Mother 6 reported that she would not be concerned nor change her parenting behaviours if her child was classed as overweight:

> "*… [BMI] as a good indication of a healthy weight range, to be used with other info [sic]" [Mother 6]*.

Again when asked if they would adjust the way they cared for their child based on an unhealthy BMI score the mothers said they would not, the exception being if the child was underweight.

6.7.2 Other sources of advice and information

The focus group discussed the other sources of information that the mothers came into contact with. Other health campaigns were mentioned and in particular the Change for Life initiative was discussed. One mother who worked as a child minder and received information from Change for Life expressed dissatisfaction with that advice:

> *"… I got a letter from them [Change for Life] saying a child should have one fish finger per five years of their life … my dad was really chuffed that he could have 32 fish fingers!" [Mother 2].*

The mothers also discussed how they would like health information to be delivered to them and by whom. There was agreement that the person delivering the health information was a factor in whether it would be taken on board:

> *"…I've never been able to take advice off of somebody who is very overweight, telling me how to keep my children slim" [Mother 2].*

6.7.3 Child behaviour

A theme that emerged from the text that was not defined *a priori* was that of Child Behaviour. In this theme the mothers discussed how the child's own behaviour is sometimes the issue. The mothers mentioned how children, particularly older children, behave how they want to without

giving thought to health or despite knowing they are behaving unhealthily. Additionally, it was suggested that if the parent tries to control the behaviour of their child too strictly this could lead to deviant behaviour:

> *"…It's a case of knowing to make healthy choices." [Mother 2] "Yeah but 11 year olds are, I, I knew what was healthy and what wasn't but when I was at secondary school it was all rubbish food" [Mother 3].*
>
> *"…If you hold back too much then I've come across children who will sneak it and they get pocket money and they'll buy their own." [Mother 4] "And they'll swap it at lunchtime, my son's already done that and he's 4!" [Mother 3].*

This finding replicates a finding of the child focus groups detailed in Chapter 5, where the children themselves admitted to purposefully getting themselves the junk foods that were not allowed at home and rebelling against health advice that was seen as too strict. This theme highlights the importance of nurturing healthy attitudes towards health in childhood and adolescence.

6.7.4 Teaching health at home

The previous theme illustrates how important teaching children about health and attempting to change their attitudes towards it is. The theme of teaching health at home aimed to find out how the mothers tried to teach their children, the benefits of giving the child a health education, and how health conversations arise.

Firstly, the mothers were asked whether health conversations happen at home and what influences them. When the mothers spoke of the conversations initiated by them, they frequently focused on healthy diet and exercise. The main factor influencing what health topics were raised by the children was what was affecting the child at the time, be that their own health directly or the health of others known to the family:

> *"…You know not heart health but yeah they do talk about other things like we've had the period conversation and that's kind of lead into, for my oldest daughter, sexual thing" [Mother 5].*
>
> *"…I've come into contact with you know families who, who've lost people through cancer and things so therefore you end up talking to them about things" [Mother 1].*

One mother also spoke of how her health behaviour affected her daughter and how she learnt by observing her mother:

> *"…I've been doing Slimming World and because we've been doing that I've been very open with her, she will talk about healthy food, unhealthy food that it's ok to eat crisps from time to time … that there is a good weight to be" [Mother 1].*

When it came to educating their children themselves, concerns were raised about ill-informed parents who may not be able to do this and how this problem could be tackled. Despite recognising that there were parents whose level of health knowledge would prevent them from passing on the right information to their child the mothers were not sure how useful parental education could be:

> *"…You will only get parents that are, that are interested in doing it" [Mother 4].*

6.7.5 Formal health education

The mothers agreed that school needs to take a bigger role in educating children. This was mentioned in relation to the NCMP especially, as it raises the issue of weight to children at a formative age. The mothers thought that the main aim of health education should be to create independent children who will be able to care for themselves. They also said schools were failing their children when it came to health education because of the low priority it is given:

> *"…This is where the school needs to be brought in you know, it's [NCMP] being done in school and it needs to be discussed as a part of PSHE" [Mother 1].*
>
> *"…I mean it [health lessons] was on the curriculum but it's, you know, it gets squeezed out doesn't it because you've got your maths, your literacy…and that's the very first thing if you, you know have to miss a lesson for something else" [Mother 1].*

In addition to the failings in school, the mothers mentioned the attitudes of peers, money, time and society's attitude towards food as the main barriers they face to providing a healthy lifestyle and education to their children.

Finally the participants spoke at length about the ways in which health education should be delivered. There was a consensus that both home and school have a part to play in delivering the information and children need to take an active role as well:

> *"…Because young people are making their own choices the conversation has to be with them." [Mother 5].*

Ways in which learning and teaching could be facilitated were also mentioned. It was suggested that information be delivered in a way that is non-threatening to avoid unnecessary worry, and by focusing on changing attitudes so that being healthy was something that was enjoyable. Furthermore, interactive or concrete examples were recommended by the mothers rather than using abstract concepts:

> *"…I think it's about something really concrete and measureable…a percentile of the BMI, it's a very abstract concept whereas if you talk about an artery where the bore is only that small and it's all furry then that's a very concrete image for people to visualise" [Mother 5].*

6.8 Discussion

6.8.1 Main findings and implications for pilot intervention

The main findings of this study are as follows;

1. The mothers had a poor understanding of the NCMP and what the data is used for.
2. The mothers generally disliked and did not fully understand the BMI measure.
3. The mothers were not concerned about an overweight child and saw excess weight as a problem that would be grown out of, so would not change the way they raised their child if they were overweight.
4. There was concern about the effect that labelling a child as overweight or obese could have on their self-esteem.
5. The mothers said they would be more concerned about a child that was experiencing a health issue that was less familiar such as being underweight or having poor mental health.

6. The mothers were dissatisfied with the health information and advice that is currently supplied to them and would like to be given more information.
7. The topics of health discussion at home centre on health issues that are most salient to the child at the time.
8. The mothers thought health education could be improved by taking the focus away from weight and instead using less abstract disease outcomes to illustrate the issues.

Firstly, the mothers were not fully aware of the NCMP, that it was being carried out in their children's school, or how the data gathered by it is used. To the author's knowledge there are no studies that have examined the awareness of English parents of the NCMP. Following a literature search, only papers that assessed parents' perceptions or awareness of their child's weight status, or opinions on the measurement and reporting process of the NCMP were found. No papers assessed whether the parents were aware of the extent to which the NCMP was taking place or how the data is used. As the programme is run on an opt-out basis, and the mothers in the focus group detailed in this chapter expressed concern that the programme raises the issue of weight to children at a vulnerable age, it is important that they are made fully aware of the programme. This is so that they are prepared to deal with any issues and can exercise their right to opt-out if they choose.

Secondly, the mothers' opinion of the BMI measure was poor. They described BMI as having arbitrary cut offs that made it an unfair and deceptive measure that didn't give any useful information about the child's health status. It has been reported that mothers do not find definitions of weight status useful when they are based on BMI growth charts, dislike weight as an indicator of health, and distrust screening programmes that use it as a proxy for health.[4 5] The use of sports people to illustrate how BMI is unreliable has also been reported previously in a report detailing English parents' responses to the NCMP.[17] In the report a parent commented that Jonny Wilkinson would be categorised as obese because of his high muscle mass, which was very similar to the response given by the mothers in this focus group.[17] This finding

underscores the importance of moving focus away from weight when seeking to improve the health outcomes of children. With the home being such a strong influence on the child, education methods need to be used that are acceptable to parents so that their support can be gained.

The third finding was that the mothers would be unconcerned about a child classified as overweight, believing that it was an issue that would be "grown out of", and so would not change their parenting habits. Low levels of concern for overweight children and the belief that excess weight will be grown out of has been found previously. In an Australian cross-sectional survey, 42% of parents of an obese child and 81% of parents of an overweight child said that they were unconcerned about the weight of the child. Similar low levels of concern were found in another Australian study by Crawford et al., who suggest this is because the parents think children will grow out of excess weight.[1 2] This theory has been put forward by several other authors and confirmed by this study.[1 5 18 19 20]

Additionally, the mothers stated unanimously that an overweight result from the NCMP would not make them change their parenting habits. In general, there seemed to be an association between how familiar a health issue was to the mothers, how much concern they would feel, and whether they would feel compelled to take action. In the case of excess weight, the mothers felt that they understood the issue and its implications, they were comfortable discussing strategies to deal with it and felt confident that they could do so without help. There was, however, a mismatch between the mothers' perceived and actual levels of knowledge about the wider implications of excess weight in childhood. These were low and similar to the less familiar health issues of underweight, mental health and cardiometabolic risk, yet they were more comfortable tackling an overweight problem alone and without changing the way they cared for their child. Another interpretation of this attitude could be that the mothers are defending either their own parenting, as an overweight child could be viewed as a result of poor parenting and to change their parenting would mean accepting some responsibility, or defending

the child to avoid upsetting them. This is a new finding and as such there are no studies that can give precedent to these interpretations.

This was seen again when the mothers were questioned about their knowledge and perceptions of the NCMP and BMI. As before, if the result here was that the child was overweight the mothers would be unconcerned and not change their parenting behaviours. It could be suggested that because being overweight is becoming a social norm, the high levels of exposure to excess weight is reducing any concern the mothers feel and leading them to believe it is not a serious health risk. It has been suggested previously that parents who are motivated to improve the weight status of their child understand the risk that excess weight puts on their health, understand that their child is at risk and are aware of the steps to take.[21] The mothers in this focus group did not appear to be aware of the wider health implications of excess weight or that their child is at risk even if they were aware of the healthy living advice. It is therefore suggested by the author that these gaps in the parents' knowledge are resulting in a failure to consider the future consequences of excess weight and so are preventing action being taken.

Fourthly, the mothers agreed that they disliked labelling a child as overweight or obese. This confirms a similar finding from Kubik et al. whose parent focus groups also discouraged the use of the terms 'overweight' or 'obese'.[22] A reason given for the dislike of these terms by the mothers in focus group detailed in this chapter was that the terms were "harsh". This finding agrees with a report on parents' perceptions of the NCMP, which found that the wording was too direct.[17] In a study that asked American parents to indicate how desirable, blaming, stigmatising, or motivating 10 terms commonly used to describe weight are, the terms obese and fat were rated significantly less desirable and the most stigmatising.[23]

Just as the mothers included here expressed a dislike of labelling children as overweight, they too avoided these terms, using words such as "chunky" and "rounded" instead. This has support from past research, which reported parents using terms such as thick, solid and strong.[5] This

could be associated with the assertion of the mothers that the mental well-being of their child is at least as important as their physical well-being and so less offensive euphemisms are used. The issue here is that the mothers were not linking the euphemisms they used to the negative health consequences of excess weight, and so are again denying that there is a problem with a child being overweight.

The fifth finding was the greater concern for under- rather than overweight children which echoes the findings of previous studies.[1 2 24] In contrast to their assertion that an overweight child would not prompt changes in their parenting, the mothers interviewed here said they would be more likely to change their parenting behaviour if a child was categorised as being underweight. The mothers said they would take positive steps, sometimes involving the school, if the child was underweight and this was also true for health issues that were less of a societal norm and therefore less familiar to them. These less familiar health issues were the risk factors for CVD and mental health, and while the mothers' knowledge of excess weight did not appear to be any greater, their perceived knowledge was what seemed to drive their willingness to change behaviour. In fact, while the mothers said that they thought excess weight could have implications for future health, they were not sure what those might be, were unconcerned, and even stated that they hadn't considered the future heart health of their children. To the author's knowledge this is a new finding and warrants further investigation.

The sixth finding was that mothers felt they needed more child health promotion information than that currently supplied with the NCMP letter, as has been reported previously.[22] They suggested that extra information about the wider implications of excess weight could help parents to recognise it as a health risk and take action. Despite these criticisms the mothers said that the information supplied with the NCMP's letters was understandable and not "blaming", and so were in agreement with parents surveyed in a previous study where over 80% found the information useful and understandable.[17]

The seventh finding was that discussions around health at home are generally focussed on topics that are most relevant to the child at the time. Whether through their own health experience, observing their parents, or hearing about the health of someone known to them, the mothers stated that children raised health topics that were salient. As was shown in Chapter 3, CVD is an issue that is relevant to school children as young as 6 years, although it appears not to be perceived that way by their parents and by the students themselves, as described in Chapter 5. The salience of health issues is acknowledged to be an important factor in health maintenance and disease avoidance and as such is an important aspect of health promotion.[25] By targeting CVD and explaining the risks to the students now, the salience of CVD could be raised to both children and their parents, thereby facilitating health-promoting behaviour.

The eighth finding was the recommendations that the mothers gave for how health education could be improved. The mothers suggested that the focus of health education should move away from weight and use a non-threatening approach to information delivery. They agreed that examples should be taken from the risk factors for heart disease, saying that the concrete examples and potential visual aids that these provide could facilitate learning. Furthermore, the mothers advocated recognising that the child, particularly the older child or adolescent, has control over their own health and so should be enabled by education to make healthy decisions. The agency of children in their health behaviours has been recognised particularly in those investigating smoking behaviour.[26] Here, it is recognised that children have great influence over their health behaviours, even though it is accepted that there are restrictions on children's choices.[26] The recommendations of the mothers fit closely with those of the students, as detailed in Chapter 5. Like the mothers, the students suggested health education made use of real examples using strong visual aids, which gave them the means and motivation to change their behaviour now. The pilot intervention forming the final part of this thesis met these recommendations, addressing CVD in a way which was direct but not alarmist, moving focus away from weight and by equipping the students to make healthy choices.

6.8.2 Strengths and limitations

The strengths of this study lie in the new findings that it has contributed to this area of research. Firstly, to the author's knowledge this is the only study conducted in the UK to have discussed both BMI screening and how parents view the health and health education of their children. To date, there have been a number of, mostly American, studies that have investigated one of these areas, but this is the first to combine childhood screening and parents' views and practices of child health.

This study has also provided valuable insight into what influences parental concern and prompts behaviour change. If greater perceived familiarity with a health issue does indeed reduce concern, this study has provided a potentially important new direction of investigation into a factor that could facilitate or hinder health behaviour change.

There are, however, a number of noteworthy limitations. Firstly the focus group method could have inhibited some participants from sharing their true views due to pressures from the group. One example of this is, when questioned, all of the parents in the focus group stated that they did not use the NCMP letter to guide care. Conversely, the one mother who responded to the focus group's schedule of questions via email said that she would. This could simply be due to genuine differences in opinion, but the desire to avoid contradicting the group opinion should nevertheless be considered when interpreting these results.

Secondly, only six parents were recruited to this study and all were female. It maybe that the lack of concern about excess childhood weight and the low saliency of heart health in childhood that were reported in this chapter resulted in few parents being willing to take part in the focus group. Furthermore the daily commitments that parents have may have meant that they felt unable to spare the time to contribute. This limitation emphasises in particular the difficulty of recruiting and retaining fathers in research involving parents.[27] Mitchell et al. (2007) suggest that for working fathers sacrificing their leisure time to participate in research is a disincentive

to participation and suggest that researchers place strong emphasis on the importance of fathers' views in research.[27] As such targeting fathers should be a consideration in future health research involving parents. In addition to the low numbers of volunteers, recruitment had to be stopped before data saturation was reached because of time pressures within the host schools and slow recruitment.[11] As was highlighted by Daly et al. in their hierarchy of qualitative health research, a small study and its results should not be dismissed as they provide support for the findings of previous larger studies and suggest new areas of investigation.[28] The study detailed in this chapter supports the findings of many studies that have gone before, provided advice for the intervention study detailed in Chapter 8, and has highlighted new directions for research and as such has made a valuable contribution to this thesis.

Thirdly, although an attempt was made to recruit participants from a range of backgrounds, the schools of middle and high deprivation withdrew from the study in the recruiting stage. Recruitment from these schools was particularly slow and as such they felt they could no longer help. Recruitment of parents with higher levels of deprivation has been acknowledged previously as an area of difficulty in a behaviour change research.[29] The lack of middle and low socio-economic status parents could have meant that those included in this chapter were more responsive and open to the health messages that were discussed than a more diverse group would have been.[30] Furthermore, a higher socio-economic status could be indicative of higher educational achievements and health literacy that would have shaped the participants' responses. As such parents of middle and low socio-economic status should also be targeted in future studies so that a more balance picture of parental attitudes towards health can be gained.

Additionally this study is at risk from bias, specifically self-selection bias as the mothers were volunteers and so could have had higher levels of knowledge and understanding of BMI, the NCMP and childhood health. In fact, one of the mothers made this point during the focus group when she stated that the mothers present all cared about the topic under discussion and that was the reason they were there. Risk of bias from self-selection is, however, unavoidable in studies

such as this one using a convenience sampling method and so the reader should interpret the results herein with this in mind.

Finally, simply by using a semi-structured format in which the participants are asked questions could result in biased responses. It could be that the positive response that CVD risk factor education got was prompted by the questions and would not have happened in an unstructured discussion. This study has shown that heart health is not high on the agenda of parents, so they may never have discussed it without being prompted by the researcher. Therefore as this topic was one of the specific areas that required an answer the slight prompting was unavoidable.

6.9 Conclusion

This study set out to explore the knowledge and attitudes of parents regarding their children's health, screening by the NCMP, and how these may affect their parenting. Furthermore it aimed to discuss what the parents thought of the health education their children are currently receiving and how it could be improved. What was revealed was that regardless of actual knowledge, if the mothers felt confident in the knowledge they had about a risk factor they would be less concerned about a child with that risk. As such, the mothers were generally unconcerned about children who were overweight and stated that abnormal cardiometabolic risk factors would be more likely to cause concern and prompt lifestyle change. The mothers supported health education that promoted an independent child, spent less time discussing weight, and instead focused on more concrete health problems such as CVD.

This study has shown the importance of health education and attitude change even at a very young age as the mothers highlighted that deviant behaviour can begin in children as young as four. The mothers in this study advocated a joint effort from themselves and their children's school to teach them that being healthy can be enjoyable and to equip them to make healthy decisions in the future. The lessons learned in both this focus group and the focus groups with

the student samples will be taken forward in the following chapters to design an education intervention aimed at achieving this.

6.10 Summary points

- Parents need to be made more aware of the NCMP and the BMI measure.
- The familiarity of health issues should be investigated as a potential facilitator or hindrance to behaviour change.
- Parents need to be made aware of the long term consequences of excess weight in childhood.
- The information provided to parents with the NCMP letter should be increased.
- Raising the salience of heart health in children could facilitate health discussions at home.
- Health education should no longer focus on weight and should recognise and support the agency of the student.

Reflexive box

- When I approached this study I expected the parents we interviewed to be very concerned about the weight of their children. In fact this was not the case. It is possible that having studied the beginnings of cardiovascular disease in childhood, I am more aware of the long-term risks of being at an unhealthy weight, whereas to our participants the problem with being over- or underweight is aesthetic and one that the child is expected to grow out of.
- The mothers in this study stated that they would rate the mental wellbeing of their child as an equal or higher priority than their physical health. This finding was again unexpected. Coming from a psychology background I am aware of the importance of mental well-being as it impacts on all aspects of an individual including their physical health. Given that it is reported that mental health problems often go undiagnosed in young people I find it encouraging that these mothers are trying to ensure the psychological wellbeing of their children.
- Despite the above point I did however notice contradictions in the mothers' responses when discussing healthy foods. Although they said that children's palates should be educated so that healthy foods are seen as something desirable to eat they also often spoke of feeling bad when they tried to restrict sweets or that children who were given the 'perfect diet' were being deprived in some way. The mothers seemed to mix up the temporary happiness felt by the child when they are given a treat with their general mental health. This could highlight a need for attitude change among parents as well as children.

6.11 References

1. Crawford D, Timperio A, Telford A, Salmon J. Parental concerns about childhood obesity and the strategies employed to prevent unhealthy weight gain in children. *Public Health Nutr* 2006;9(7):889-95.

2. Wake M, Salmon L, Waters E, Wright M, Hesketh K. Parent-reported health status of overweight and obese Australian primary school children: a cross-sectional population survey. *Int J Obes Relat Metab Disord* 2002;26(5):717-24.

3. Warschburger P, Kroller K. Childhood overweight and obesity: maternal perceptions of the time for engaging in child weight management. *BMC Public Health* 2012;12(1):295.

4. Towns N, D'Auria J. Parental Perceptions of Their Child's Overweight: An Integrative Review of the Literature. *Journal of Pediatric Nursing* 2009;24(2):115-30.

5. Jain A, Sherman SN, Chamberlin LA, Carter Y, Powers SW, Whitaker RC. Why don't low-income mothers worry about their preschoolers being overweight? *Pediatrics* 2001;107(5):1138-46.

6. Park MH, Falconer CL, Saxena S, Kessel AS, Croker H, Skow Á, et al. Perceptions of health risk among parents of overweight children: A cross-sectional study within a cohort. *Preventive Medicine* 2013(0).

7. Action for Healthy Kids. Progress or Promises? What's Working For and Against Healthy Schools, 2008.

8. McCaughtry N, Martin JJ, Fahlman M, Shen B. Urban health educators' perspectives and practices regarding school nutrition education policies. *Health Education Research* 2012;27(1):69-80.

9. Jeffery AN, Voss LD, Metcalf BS, Alba S, Wilkin TJ. Parents' awareness of overweight in themselves and their children: cross sectional study within a cohort (EarlyBird 21). *BMJ* 2004;330(7481):23-24.

10. Census Dissemination Unit. *National Statistics Postcode Directories*. In: Census of Population Programme, editor: ESRC Census Program, Mimas, University of Manchester, 2001.

11. Holloway I, Wheeler S. *Qualitative Research in Nursing and Health Care*. 3rd Edition ed. Chichester: Wiley-Blackwell, 2010.

12. 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 Promotion International* 2005;20(1):19-26.

13. McGarvey EL, Collie KR, Fraser G, Shufflebarger C, Lloyd B, Norman Oliver M. Using Focus Group Results to Inform Preschool Childhood Obesity Prevention Programming. *Ethnicity and Health* 2006;11(3):265-85.

14. Srivastava A, Thomson SB. Framework Analysis: A Qualitative Methodology for Applied Policy Research. *Journal of Administration and Governance* 2009;4(2):72-79.

15. Ritchie J, Lewis J, editors. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London: Sage Publications Ltd., 2003.

16. Reid AO. Computer Management Strategies for Text Data. In: Crabtree BF, Miller WL, editors. *Doing Qualitative Research. Research methods for primary care*. London: Sage Publications, 1992.

17. Mooney A, Statham J, Boddy J, Smith M. *The National Child Measurement Programme: Early experiences of routine feedback to parents of children's height and weight.* London: Institute of Education University of London, 2010.

18. 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. *Journal of School Health* 2006;76 (10):496-501.

19. Rich SS, DiMarco NM, Huettig C, Essery EV, Andersson E, Sanborn CF. Perceptions of health status and play activities in parents of overweight Hispanic toddlers and preschoolers. *Fam Community Health* 2005;28(2):130-41.

20. 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. *Journal Of The American Dietetic Association* 2003;103(6):721-28.

21. Etelson D, Brand DA, Patrick PA, Shirali A. Childhood Obesity: Do Parents Recognize This Health Risk? *Obes. Res.* 2003;11(11):1362-68.

22. 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 Education & Behavior* 2007;34(4):622-33.

23. Puhl RM, Peterson JL, Luedicke J. Parental Perceptions of Weight Terminology That Providers Use With Youth. *Pediatrics* 2011;128(4):e786-e93.

24. Moore LC, Harris CV, Bradlyn AS. Exploring the Relationship Between Parental Concern and the Management of Childhood Obesity. *Maternal and Child Health Journal* 2012;16:902-08.

25. Schlinger MJ. The Role of Mass Communications in Promoting Public Health. *Advances in Consumer Research* 1976;3:302-05.

26. Rugkåsa J, Kennedy O, Barton M, Abaunza PS, Treacy MP, Knox B. Smoking and symbolism: children, communication and cigarettes. *Health Education Research* 2001;16(2):131-42.

27. Mitchell SJ, See HM, Tarkow AKH, Cabrera N, McFadden KE, Shannon JD. Conducting studies with fathers: Challenges and Opportunities. *Applied Development Science* 2007;11(4):239-44.

28. Daly J, Willis K, Small R, Green J, Welch N, Kealy M, et al. A hierarchy of evidence for assessing qualitative health research. *Journal of Clinical Epidemiology* 2007;60(1):43-49.

29. Heinrichs N, Bertram H, Kuschel A, Hahlweg K. Parent Recruitment and Retention in a Universal Prevention Program for Child Behavior and Emotional Problems: Barriers to Research and Program Participation. *Prev Sci* 2005;6(4):275-86.

30. Ribisl KM, Winkleby MA, Fortmann SP, Flora JA et al. The interplay of socioeconomic status and ethnicity on Hispanic and White men's cardiovascular disease risk and health communication patterns. *Health Education Research* 1998; 13 (3):407-417.

Chapter 7. Component analysis of interventions to improve childhood weight and/or cardiovascular health

7.1 Introduction

As the preceding chapters have shown, cardiovascular disease (CVD) risk factors are present in overweight and obese children. Yet evidence suggests that while childhood is the best time to form lifelong healthy behaviours, the education system does not prioritise health and focuses too narrowly on certain aspects of it, as was shown in Chapters 5 and 6. Children have substantial knowledge gaps but importantly they also have a desire for more health education. In Chapter 6, Mothers also discussed how they believe that schools are not providing the necessary health education and see limited value in focussing on weight as the main indicator of health. There is a great need to address these shortcomings and move away from the approaches that have had limited, short term success.

Finding new and innovative ways to either treat or reduce the prevalence of overweight and obesity in children has become a popular area for study. Interventions are becoming more targeted, investigating particular age groups,[1 2] specific health-related behaviours,[3-5] and individual cultures[6] in an attempt to improve the health outcomes of children.

Despite these attempts, studies are still subject to the same shortcomings that pervade this area of research. Systematic reviews of interventions have reported, for example, dissimilar groups at baseline,[2] a lack of high quality trials,[2 4] lack of allocation concealment and randomisation,[2 7] large amounts of heterogeneity,[2 4] small and not statistically significant effects,[2 4 5] effects not sustained at follow-up,[3] lack of follow-up,[5 6] and poor reporting.[2 6]

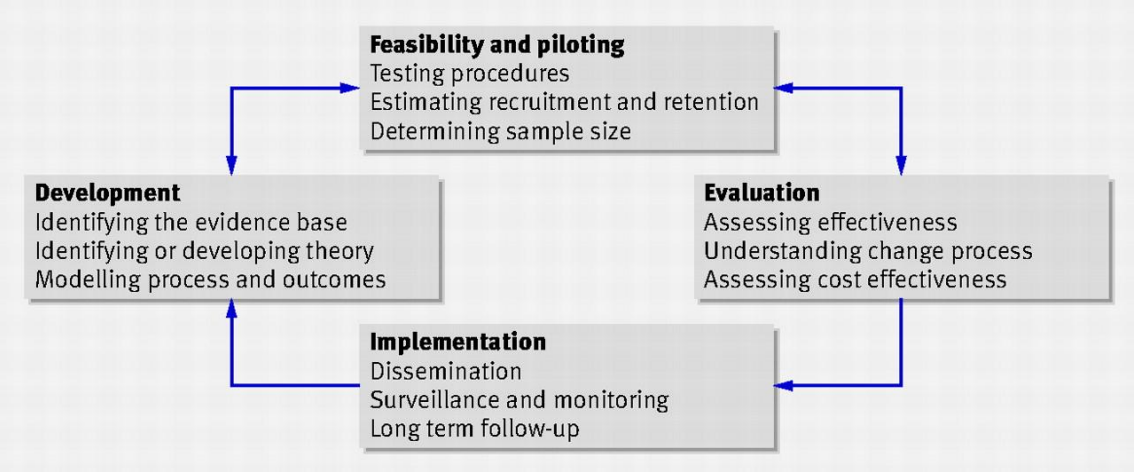
The components of the studies summarised by the reviews above, such as dietary education, increasing moderate to vigorous physical activity and parent education, are some of the most widely studied and reported but form only a small part of the total variation of intervention components. These reviews were also all carried out with studies looking either exclusively or at least primarily at the effect of the intervention on weight-related outcomes such as weight

loss, BMI reduction or a reduction in the prevalence of being overweight. As the rationale for the WE ♥ Health intervention was to move focus from weight loss to cardiovascular health, a component analysis was carried out with the intention of exploring aspects of interventions that most frequently lead to improvements in child cardiovascular health outcomes. When designing a new complex intervention, it was recommended by Campbell et al. that a phase in which the effective components of related interventions are identified be included.[8] This provides an evidence base on which to build the components of the new intervention and, crucially, it provides evidence that an intervention is well designed and that it has a good chance of achieving its aims.[8]

7.2 Conducting a component analysis

In line with the above recommendation a component analysis was used to inform and provide evidence for the pilot intervention that formed the final part of this thesis. It is important to evaluate interventions to determine their effectiveness so that those which are successful might be continued and the short comings of those that are unsuccessful are not repeated. The practice of performing a component analysis before an intervention is designed is also recommended formally as best practice to researchers. In 2008 the Medical Research Council (MRC) issued a guidance document to assist researchers designing complex interventions by outlining the process as it should be done to ensure quality.[9] Complex interventions are defined as those which incorporate a number of components and include interventions to change behaviour, that involve groups of people and are carried out in a school or community setting, as the WE ♥ Health intervention was.[8] The MRC report recommends identifying an evidence base and using it to "develop interventions systematically, using the best available evidence and appropriate theory" (Craig et al., 2008, pg 8).[9] The researchers may also use the evidence to define the way in which their intervention will fulfil the theory on which it is based, and identify the appropriate outcomes that will be used as markers of the success or failure of the intervention, Figure 7.1.[9]

Figure 7.1. Developing and evaluating complex interventions: the new Medical Research Council guidance. Key elements of the development and evaluation process **Reproduced from Craig et al., 2008**.[10]



Kirkpatrick and Kirkpatrick also created a system for evaluating workplace learning from which guidance was taken as the methods and reasoning were applicable to the current component analysis.[11] This system suggests that when evaluating teaching programs the following are considered:

- What results is the program trying to achieve?
- What behaviours are needed to achieve the desired results?
- What knowledge, skills and attitudes are necessary to facilitate the target behaviours?

Kirkpatrick and Kirkpatrick outline a four stage process for evaluating programs:

- Level 1- Evaluation. Did the participants find the program acceptable?
- Level 2- Learning. Did the participants learn from the program?
- Level 3- Behaviour. Did the behaviour of the participants change?
- Level 4- Results. Did the program achieve the results it was aiming to?[11]

In addition, it is recommended that those evaluating the program make a note of their own opinions of the strengths and weaknesses of the program.[11] These suggestions were used to

evaluate both the studies identified in the component analysis as well as the pilot intervention detailed in Chapter 9.

7.3 Methods

This component analysis was methodologically similar to paper that analysed the components of self-monitoring interventions for CVD.[12] The component analysis was carried out in six stages:

1. A literature search for relevant interventions.
2. Description of the included interventions.
3. Extraction of the intervention components into a pre-defined template.
4. Extraction of further information about the included interventions such as theoretical basis and the results achieved.
5. Authors contacted to provide missing information if any of the previous stages are not able to be completed from the papers.
6. Finally the extracted information will be examined for components that are most frequently associated with success in interventions.

The author searched the following databases: EMBASE 1974-week 1 June 2012, Ovid Medline 1946-Present, and PsychINFO 1967-Present in the week commencing the 4th June 2012. The search terms detailed in Table 7.1 were truncated with wild card characters where necessary and searched in each of the databases.

Table 7.1 Component analysis search terms

OR

Population	Intervention	Outcomes	Exclude
Terms: Children	Terms: School, Community, Church, Clinic, Intervention, Trial, Education	Terms: Blood pressure Cholesterol Weight Body mass index Overweight Obese Heart disease Cardiovascular disease Atherosclerosis Triglyceride Insulin HOMA-IR Knowledge Attitude Behaviour	All co-morbid conditions including: Prader Willi Syndrome Polycystic Ovary Syndrome AIDS Cerebral Palsy All disabilities All mental illness All eating disorders Cancer Pharmacological treatments Pain
Synonyms: School aged children, schoolchildren, adolescents, teenagers	Synonyms: Place of worship	Synonyms: Hypertension Diastolic blood pressure Systolic blood pressure BMI Perception	Synonyms: HIV Drugs

AND

7.3.1 Inclusion and exclusion criteria

Studies included in the component analysis had to be reporting on an intervention carried out in healthy young people under the age of 18 and use a control group so that the likelihood of any results occurring due to the effect of the intervention could be judged. Included papers had to report on at least one of the CVD risk parameters searched as an outcome. In addition the paper had to report on the change in at least one non-biological outcome from knowledge, attitudes or behaviours. As the intervention resulting from the component analysis was to be an education intervention, the interventions analysed had to also contain an education component. Finally, included papers had to have been carried out in groups of children in a community, school, or clinical setting. The inclusion criteria are summarised below:

- Intervention studies.
- Must have a control group.
- Must be group interventions.
- Interventions must be carried out in a school, community or clinical setting.
- The intervention must have an education component.

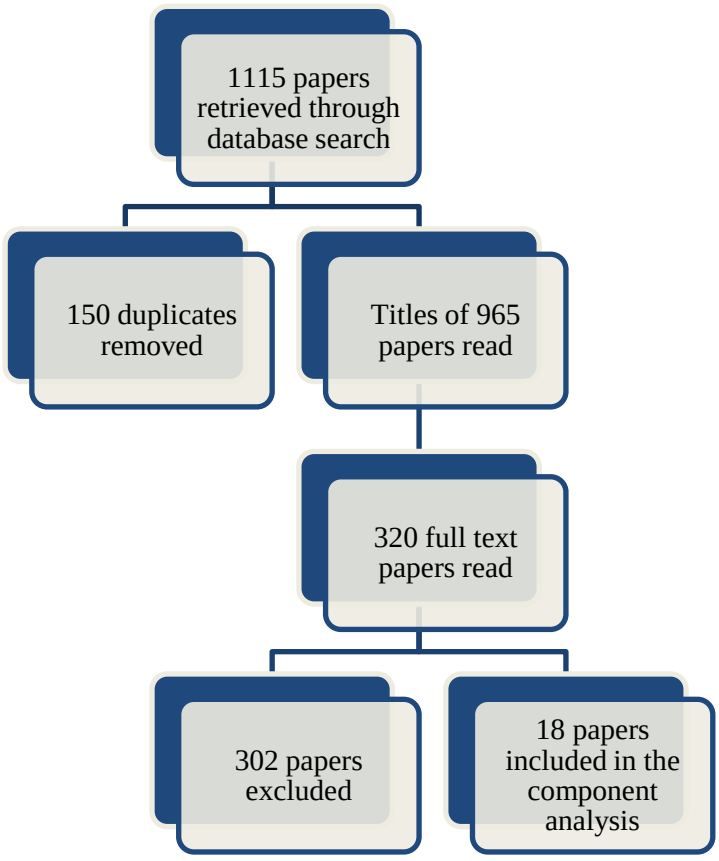
- Must measure at least one CVD risk parameters searched.
- Must measure change in at least one of knowledge, attitudes or behaviours.

Studies were excluded if they contained a pharmacological element or if the paper did not report on changes in both the CVD risk parameters and the change in the knowledge, attitudes, or behaviours of the children. Papers were not excluded based on country of origin or date or language of publication. The exclusion criteria are summarised below:

- Use of a pharmacological treatment.
- Participants have a known co-morbid condition.
- Failure to report sufficient outcome data.

7.4 Results

Figure 7.2 Selection process of papers included in the component analysis



The database search retrieved 1115 papers, which were de-duplicated to leave 965 papers. The titles of these papers were read by the author and any that did not meet the inclusion criteria were excluded. The full text of the remaining 320 papers were read and excluded if any exclusion criteria were met. The most common reasons for exclusion from the component analysis were a lack of control group and a failure to report changes to CVD risk parameters as well as knowledge, attitudes or behaviours. Finally 12 studies (18 papers) which met all of the inclusion criteria and reported their data in sufficient detail were selected (Figure 7.2).

7.4.1 Main findings of papers

Table 7.2 shows the main characteristics of the included studies. The studies ran interventions that lasted between six weeks and two years. Those which measured the maintenance of their results had follow-up periods of between six weeks and one year post intervention. A number of the studies were based on theoretical models such as the Theory of Planned Behaviour,[13] Cognitive Behavioural Therapy,[14-19] Social Cognitive Theory,[15-19] and Cognitive Theory.[20-22]

The studies reported some improvements in the outcomes of interest following the interventions. The weight of the intervention group was improved in one study[23] while reductions in BMI and BMIz score were seen in three[15-19 23 24] and two[15-19 25 26] studies respectively. The biochemical and functional parameters of CVD were improved by some of the interventions. Specifically, systolic blood pressure was improved in two studies, [25-27] and diastolic blood pressure was reduced in two studies.[13 27] Furthermore, improvements were also seen in the children's high density lipoprotein (HDL) cholesterol in one study,[14] low density lipoprotein (LDL) cholesterol in four studies,[15-24] total cholesterol in three studies,[15-19 23 24] triglycerides in two studies,[14-19] and insulin and insulin resistance measured by the homeostasis model assessment of insulin resistance (HOMA-IR) in one study.[23]

The non-biological outcomes also saw some improvements after the interventions. Health behaviours were improved in eight studies,[13 15-22 24-29] healthy beliefs were increase in one

study,[14] health knowledge was increased in five studies,[14 20-22 27 29 30] and the children's attitudes to health were improved in one study.[29]

The included studies were not without shortcomings in their methods and data.[3-8] The most common of these being improvements that were not sustained at follow-up or when confounding factors were controlled for, changes seen in only one age or gender group, and short follow-up periods.

Table 7.2 Characteristics of included studies

Author	Study name	Country of origin	Number of participants	Age	Setting	Design	Duration	Achieved improvements in biological and non-biological outcomes
Taylor et al. (2007)[25 26]	APPLE	New Zealand	730	6-9 years	School	Non-randomised, controlled physical activity, nutrition and educational intervention	2 years	Yes
Angelopoulos et al. (2009)[13]	CHILDREN	Greece	646	9-10 years	School	Cluster randomised, controlled nutrition and physical activity intervention	1 year	Yes
Melnyk et al. (2009)[14]	COPE TEEN	USA	19	14-15 years	School	Cluster randomised, controlled educational intervention	9 weeks	Yes
Schofield et al. (2005)[28]	GSOP	Australia	85 girls	15 years	School	Non-randomised, controlled physical activity self-monitoring and education intervention	6 weeks, 6 week follow-up	No
Stock et al. (2007)[29]	Healthy Buddies	Canada	383	4-11 years	School	Non-randomised, controlled health promotion intervention	21 weeks	Yes
Johnson et al. (1991)[30]	Heart Smart Program	USA	19 children 23 parents	9-13 years	School	Non-randomised, controlled education, physical activity and nutrition intervention involving parents	12 weeks	Yes
Nguyen et al. (2012)[15 16 18 19]	LOOZIT	Australia	151	13-16 years	Local community health centre and children's hospital	Randomised, controlled lifestyle modification intervention	7 weeks, 24 month follow-up	Yes
Sacher et al. (2010)[31]	MEND	UK	116	9-11	Community (e.g. schools and sports centres)	Randomised, controlled healthy lifestyle intervention	9 weeks, 12 week follow-up	No
Bayne-Smith et al. (2004)[27]	PATH	USA	442 girls	14-17 years	School	Randomised, controlled heart health education and physical activity intervention	12 weeks	Yes
Nemet et al. (2005)[24]	-	Israel	46	8-14 years	Child health and sports centre, Meir General Hospital, Tel Aviv University	Randomised, controlled diet, behaviour and physical activity intervention	3 months, 1 year follow-up	Yes
Park et al. (2007)[23]	-	Korea	44	13-15 years	School	Randomised, controlled lifestyle and education and exercise intervention	12 weeks	No
Tershakovec et al. (1998)[20-22]	-	USA	342	6 years	Home	Randomised, controlled nutrition education intervention	10 weeks, 12 months follow-up	Yes

7.4.2 Components common to changes in outcomes

In order to ascertain which components were present in studies that brought about a positive change in the outcomes of interest, any papers which failed to do this in at least one biological and one non-biological outcome were excluded. This left nine out of the twelve included studies remaining.[13-19 22 24-27 29 30]

Table 7.3 shows the components common to the nine studies that had achieved an improvement in both biological and non-biological outcomes. The components were grouped into component themes and each theme is discussed below.

Table 7.3 Component Themes

Main theme	Sub-components
Health Behaviours	Diet, physical activity, lifestyle compatible activities, focus on fitness, familiarity with fruit and vegetables
Self-Concept	Self-esteem, body image, self-efficacy
Practical and Cognitive Tools	Goal setting, problem solving, stress management, practical skills (e.g. interpreting nutrition labels and food preparation)
Intervention Characteristics	Take home materials, deliverer resources, focus away from weight, involvement of others (e.g. parents, peers, community), interactive, homework, focus on behaviour, attitude and knowledge change, professional involvement (e.g. dietician).

Health behaviours

The subcomponents of this theme focussed on instructing the children in healthy eating[13-22 24-27 29 30] and physical activity.[13-19 24-27 29 30] The healthy eating component included learning about the food pyramid,[24] setting targets like reducing the consumption of sugar sweetened drinks and increasing the consumption of fruit and vegetables,[25] and increasing the children's familiarity with different fruit and vegetables.[13] Physical activity included encouraging the children to increase the amount of time they spent being active,[24] physical education (PE) lessons that placed greater importance on fitness[13 24 29] and activities that could easily be incorporated into the children's lifestyles.[14 25] Out of the studies that included instruction in healthy eating or

physical activity, all of the nine and seven out of eight studies improved children's diet and activity levels respectively.

Self-concept

This theme included three sub-components; self-esteem, healthy body image,[13-19 29] and encouraging the children to see themselves as being able to make the changes necessary to lead healthy lives.[13 30] Self-esteem and healthy body image was addressed through discussions to change self-concept, role-modelling, education in growth and development, and introducing techniques such as positive thinking and self-talk. Self-esteem and body image were assessed using a pictorial current-self and ideal-self rating scale, the Beck Youth Inventory,[32] which includes a sub-scale on self-concept, or the Harter Self-Perception Profile.[33] Significant improvements in self-esteem or body satisfaction were only reported in the LOOZIT study (global self-worth; 0.21, 95% CI 0.01 to 0.32, $p<0.001$ and body shape dissatisfaction; -0.56, 95% CI -0.74 to -0.38, $p<0.001$).[16] However, both in the studies where improvements were found and not found, there were improvements to the children's attitudes towards their health, which could have been facilitated by attempts to improve self-esteem.

Increasing self-efficacy to lead healthy lives was targeted specifically by the CHILDREN and Heart Smart programmes.[13 30] In the Heart Smart Programme, one of the group session modules was given to self-efficacy. Group sessions were 90 minutes long and included presentations, activities and exercise components.[30] In the CHILDREN programme, self-efficacy was targeted through techniques such as modelling, enactment and guided practice in weekly sessions that lasted one to two hours.[13] Neither of these two studies measured the change in self-efficacy, instead, change in diet, physical activity and sedentary behaviour were measured.

Practical and cognitive tools

The practical and cognitive tools theme included components such as goal setting, where the children had to make goals for themselves and report back at a later time whether these were

achieved or not.[13 15-19] Where they were not achieved, discussions were held about the reasons why this may be and ways in which problems arising could be dealt with. Children were given practical skills such as how to read nutrition labels on food packaging, how to modify recipes to make them healthier, and how to make healthy choices, for example when eating at a restaurant.[24 30] Cognitive skills, such as ways in which stress could be managed more effectively through improving the children's communication skills, were also used by some studies.[15-19 30]

All of the studies that aimed to provide children with practical or cognitive skills achieved improvements in either one or both of their physical activity levels and diet.

Intervention characteristics

Unlike the preceding three themes, the theme of intervention characteristics summarises the ways in which the successful interventions were delivered rather than what they delivered. A common characteristic was that interventions were interactive, the children were encouraged to discuss, play games and use role play to facilitate their learning.[13 30] Another was that both children and the researchers delivering the intervention were provided with practical materials, often workbooks.[13 15-22 24 25] The children's workbooks contained physiological and health information, activities, and space to enter their own thoughts that they could keep after the intervention had finished. Materials given to the researchers were often provided with the intention of keeping the delivery of the intervention consistent across lessons and were made up of instructions on delivering the intervention, reproducible materials for the children, and guidance on how the intervention should be assessed.

The APPLE study moved focus away from weight management and the issue of obesity to focus on healthy eating and increasing extra-curricular physical activity every day by changing the knowledge, attitudes, and behaviours of the children.[25]

A common component was the involvement of parents, peers or the community so that general knowledge could be increased and support given to the children participating in the

intervention.[15-22 24-26 30] Finally, some of the studies used professionals, such as dieticians, in the design and delivery of the intervention.[20-22 24]

7.5 Discussion

The ways in which researchers have attempted to improve the health outcomes of school aged children, despite being varied in their delivery, tend to fall into three groups: (1) improving diet (2) increasing physical activity and (3) reducing sedentary activity. There was a focus on diet and physical activity in the majority of the studies in this component analysis. Researchers are, however, finding new ways in which to deliver standard diet and exercise messages by trying to increase the children's familiarity with healthy foods and introducing them to non-competitive activities that can fit easily into their lives. Furthermore, there is recognition that in this age group the children's self-image and self-efficacy are key to encouraging them to live healthily and make the necessary changes to do so.

7.5.1 Implications for further research

The purpose of this component analysis was to, in combination with the results of the focus groups described in Chapters 4 to 6; inform the design of an education intervention to improve the cardiovascular health of school children. Through examining the methods used by previous studies which have had similar aims, lessons can be learnt from their successes and failures. This component analysis found four component themes that were present in studies that were successful, at least in the short term, in bringing about improvements in the biological and non-biological factors of interest. These component themes were (1) Health Behaviours, (2) Self-Concept, (3) Practical and Cognitive Tools, and (4) Intervention Characteristics (Table 7.3). These themes and their sub-themes were modified and used in the pilot intervention described in Chapter 9 to address the rationale set out at the beginning of this thesis.

1) Health behaviours. A very strong emphasis on healthy eating and exercise to the extent that only one of the included studies did not instruct the children in both of these was found. There

was very little information given to the children about the internal mechanisms that are affected by these behaviours and only two of the included studies gave specific instruction on cardiovascular health.[27 30] An interest in the internal mechanisms that are involved in health and disease was a theme of the child focus group studies that were conducted and described in Chapters 4 and 5. This was also mentioned as a more tangible, engaging way of educating children by the mothers taking part in the focus group in Chapter 6. Furthermore, as was shown in Chapter 3, the risk factors for CVD can begin to emerge in childhood and so it is important they are aware of the behaviours that can contribute to them. As such, the pilot intervention that is detailed in the following chapter put an emphasis on how internal, cardiovascular health is affected by health behaviours as it is a component that has been recommended by children and parents alike.

2) Self-concept. Encouraging self-esteem and improving self-efficacy were components that were common to a number of the studies. These were also factors that were raised in both the child and parent focus groups in Chapters 5 and 6 and an issue that was highlighted in the author's reflexive analysis after the focus groups. The children taking part in the intervention will therefore be encouraged to see themselves as being able to influence their health outcomes. They will also be given information that will allow them to have conversations with their parents about health without the concern of not being taken seriously, a concern raised by a student in Chapter 5.

3) Practical and Cognitive tools. Providing children with tools to assist in their health decision making will be included in the pilot education intervention. Eight studies aimed to provide children with skills and knowledge through instruction in such areas as cooking, reading nutrition labels and making healthy decisions when away from home.[13 15-19 24 30] Furthermore, cognitive skills, for example, goal setting, problem solving and communication skills, were addressed by five studies.[14 16 23 28 30] Providing children with practical skills was also highlighted as an area of importance by the mothers who took part in the earlier focus group. As the

intervention was a pilot study the time allowed to it was short, so the focus was on reading nutrition labels. This is because, as many of the children in the focus groups explained, they rarely prepare food for themselves and are more likely to buy it and so being able to interpret nutrition labels would be the more useful skill.

4) Intervention characteristics. Finally, many of the characteristics of the studies analysed were carried forward to the WE ♥ Health intervention. Being interactive and hands-on was supported strongly by all of the participants in Chapters 5 and 6 and was a key feature of many of the studies analysed here. The majority of the included studies also provided materials for children and deliverers. As the intervention was a pilot study the time allowed to it was short and so providing the students with materials they were able to keep meant they were free to look back at them at any time. This also addresses the issue raised by one of the older male focus groups that as exams approach they are unable to retain much new information because they are having to revise for exams (Chapter 5). The provision of student materials removed the need for them to absorb all of the information during the 45 minute classes and ensured they were provided with more information than there was time to cover during the lesson alone. As the intervention was run with whole year groups at once, separate classes had to be run simultaneously and so the researchers delivering the lessons were provided with a detailed lesson scheme to ensure that they were reproduced consistently.

7.6 Conclusion

Interventions aimed at school children are able to bring about some improvements in children's health outcomes. While these are not often in relation to weight or BMI measures, positive results appear to be more achievable in the bio-chemical and functional parameters of CVD and children's health-related knowledge, attitudes and beliefs. This component analysis highlighted the components common to successful interventions and where possible, these were incorporated into the WE ♥ Health intervention. The aim was to capitalize on their successes

while avoiding their shortcomings. The pilot and feasibility study is described in detail in Chapter 8.

7.7 Summary points

- The intervention will include instruction on health behaviours such as physical activity and diet, and the benefits of these will be described with direct reference to cardiovascular health.
- The intervention will aim to increase the students' self-efficacy in ensuring their own health by providing them with practical tools and coping skills. In particular, interpreting nutrition labels and goal setting have been identified as useful skills.
- The intervention will encourage active learning through discussion and games.
- Students will be provided with materials that they are able to keep for future reference.
- Those delivering the intervention will be provided with materials so that it can be delivered consistently across the classes.

7.8 References

1. Ciampa PJ, Kumar D, Barkin SL, Sanders LM, Yin HS, Perrin EM, et al. Interventions aimed at decreasing obesity in children younger than 2 years: A systematic review. *Archives of Pediatrics and Adolescent Medicine* 2010;164 (12):1098-104.

2. Bond M, Wyatt K, Lloyd J, Taylor R. Systematic review of the effectiveness of weight management schemes for the under fives. *Obesity Reviews* 2011;12 (4):242-53.

3. Collins CE, Warren J, Neve M, McCoy P, Stokes BJ. Measuring effectiveness of dietetic interventions in child obesity: A systematic review of randomized trials. *Archives of Pediatrics and Adolescent Medicine* 2006;160 (9):906-22.

4. Silveira JAC, Taddei JAAC, Guerra PH, Nobre MRC. Effectiveness of school-based nutrition education interventions to prevent and reduce excessive weight gain in children and adolescents: A systematic review. *Jornal de Pediatria* 2011;87 (5):382-92.

5. van Grieken A, Ezendam NPM, Paulis WD, van der Wouden JC, Raat H. Primary prevention of overweight in children and adolescents: A meta-analysis of the effectiveness of interventions aiming to decrease sedentary behaviour. *International Journal of Behavioral Nutrition and Physical Activity* 2012;9(61).

6. Li M, Li S, Baur LA, Huxley RR. A systematic review of school-based intervention studies for the prevention or reduction of excess weight among Chinese children and adolescents. *Obesity Reviews* 2008;9 (6):548-59.

7. Campbell K, Waters E, O'Meara S, Summerbell C. Interventions for preventing obesity in childhood. A systematic review. *Obesity Reviews* 2001;2(3):149-57.

8. Campbell M, Fitzpatrick R, Haines A, Kinmonth AL, Sandercock P, Spiegelhalter D, et al. Framework for design and evaluation of complex interventions to improve health. *BMJ* 2000;321(7262):694-96.

9. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: new guidance: Medical Research Council, 2008.

10. Craig, P, Dieppe, P, Macintyre, S, Nazareth, I, and Petticrew, M. Developing and Evaluating Complex Interventions: the new Medical Research Council guidance. *British Medical Journal* 2008;337:a1655.

11. Kirkpatrick D, Kirkpatrick J. *Evaluating Training Programs: the four levels*. 3rd ed. San Francisco; California: Berrett-Koehler 2006.

12. Ward A, Heneghan C, Perera R, Lasserson D, Nunan D, Mant D, et al. What are the basic self-monitoring components for cardiovascular risk management? *BMC Medical Research Methodology* 2010;10.

13. Angelopoulos PD, Milionis HJ, Grammatikaki E, Moschonis G, Manios Y. Changes in BMI and blood pressure after a school based intervention: The CHILDREN study. *European Journal of Public Health* 2009;19 (3):319-25.

14. Melnyk BM, Jacobson D, Kelly S, O'Haver J, Small L, Mays MZ. Improving the Mental Health, Healthy Lifestyle Choices, and Physical Health of Hispanic Adolescents: A Randomized Controlled Pilot Study. *Journal of School Health* 2009;79 (12):575-84.

15. Nguyen B, Shrewsbury VA, O'Connor J, Steinbeck KS, Lee A, Hill AJ, et al. Community-based adolescent weight management with additional therapeutic contact: Twelve month outcomes of the Loozit RCT. *Obesity Reviews* 2011; 12:278-79.

16. Nguyen B, Shrewsbury VA, O'Connor J, Steinbeck KS, Lee A, Hill AJ, et al. Twelve-Month Outcomes of the Loozit Randomized Controlled Trial A Community-Based Healthy Lifestyle Program for Overweight and Obese Adolescents. *Archives of Pediatrics & Adolescent Medicine* 2012;166(2):170-77.

17. O'Connor J, Steinbeck K, Hill A, Booth M, Kohn M, Shah S, et al. Evaluation of a community-based weight management program for overweight and obese adolescents: The Loozit study. *Nutr. Diet.* 2008;65(2):121-27.

18. Shrewsbury VA, Nguyen B, O'Connor J, Steinbeck KS, Lee A, Hill AJ, et al. Short-term outcomes of community-based adolescent weight management: The Loozit Study. *Bmc Pediatrics* 2011;11:13.

19. Shrewsbury VA, O'Connor J, Steinbeck KS, Stevenson K, Lee A, Hill AJ, et al. A randomised controlled trial of a community-based healthy lifestyle program for overweight and obese adolescents: the Loozit study protocol. *BMC Public Health* 2009;9:119.

20. Shannon B, Greene G, Stallings V, Achterberg C, Berman MK, Gregoire J, et al. A dietary education program for hypercholesterolemic children and their parents. *J Am Diet Assoc* 1991;91(2):208-12.

21. Shannon BM, Tershakovec AM, Martel JK, Achterberg CL, Cortner JA, Smiciklas-Wright HS, et al. Reduction of elevated LDL-cholesterol levels of 4- to 10-year-old children through home-based dietary education. *Pediatrics* 1994;94(6 Pt 1):923-7.

22. Tershakovec AM, Shannon BM, Achterberg CL, McKenzie JM, Martel JK, Smiciklas-Wright H, et al. One-year follow-up of nutrition education for hypercholesterolemic children. *American Journal of Public Health* 1998;88(2):258-61.

23. Park TG, Hong HR, Lee J, Kang HS. Lifestyle plus exercise intervention improves metabolic syndrome markers without change in adiponectin in obese girls. *Annals of Nutrition & Metabolism* 2007;51(3):197-203.

24. Nemet D, Barkan S, Epstein Y, Friedland O, Kowen G, Eliakim A. Short- and long-term beneficial effects of a combined dietary-behavioral- physical activity intervention for the treatment of childhood obesity. *Pediatrics* 2005;115 (4):e443-e49.

25. Taylor RW, McAuley KA, Barbezat W, Strong A, Williams SM, Mann JI. APPLE Project: 2-y findings of a community-based obesity prevention program in primary school-age children. *American Journal of Clinical Nutrition* 2007;86 (3):735-42.

26. Taylor RW, McAuley KA, Williams SM, Barbezat W, Nielsen G, Mann JI. Reducing weight gain in children through enhancing physical activity and nutrition: the APPLE project. *International Journal of Pediatric Obesity* 2006;1(3):146-52.

27. Bayne-Smith M, Fardy PS, Azzollini A, Magel J, Schmitz KH, Agin D. Improvements in heart health behaviors and reduction in coronary artery disease risk factors in urban

teenaged girls through a school-based intervention: the PATH program. *American Journal of Public Health* 2004;94(9):1538-43.

28. Schofield L, Mummery WK, Schofield G. Effects of a controlled pedometer-intervention trial for low-active adolescent girls. *Medicine and Science in Sports and Exercise* 2005;37 (8):1414-20.
29. Stock S, Miranda C, Evans S, Plessis S, Ridley J, Yeh S, et al. Healthy buddies: A novel, peer-led health promotion program for the prevention of obesity and eating disorders in children in elementary school. *Pediatrics* 2007;120 (4):e1059-e68.
30. Johnson CC, Nicklas TA, Arbeit ML, Harsha DW, Mott DS, Hunter SM, et al. Cardiovascular intervention for high-risk families: the Heart Smart Program. *Southern Medical Journal* 1991;84(11):1305-12.
31. Sacher PM, Kolotourou M, Chadwick PM, Cole TJ, Lawson MS, Lucas A, et al. Randomized Controlled Trial of the MEND Program: A Family-based Community Intervention for Childhood Obesity. *Obesity* 2010;18:S62-S68.
32. Beck JS, Beck A, Jolly J. *Beck Youth Inventories for Children and Adolescents: Manual*. 2nd ed. San Antonio, Texas: Harcourt Assessment, 2005.
33. Harter S. *Manual for the Self Perception Profile for Adolescents*. Denver: University of Denver, 1988.

Chapter Eight. WE ♥ Health: A pilot intervention and feasibility study to educate children about heart health.

8.1 Introduction

As there is a link between excess weight in childhood and cardiovascular disease (CVD), and attempts to improve health outcomes through reducing weight have had limited success previously, there is still a need for an effective intervention to be developed. This intervention was designed to approach the problem by educating students about CVD risk reduction rather than weight loss.

Chapters 2 and 7 showed that interventions to improve the health of children may not always achieve or sustain their aims, but that childhood health education can be effective. Through the use of a component analysis, Chapter 7 presented a number of factors that are common to successful childhood health interventions. These factors, along with the knowledge gained in Chapter 3 about cardiovascular disease (CVD) risk factors in childhood, and the perceptions of health education of children and mothers in Chapters 4 to 6, were then used to design a pilot intervention.

8.2 Aims

The aim of this study was to assess the feasibility of a full size trial of the WE ♥ Health intervention. The aim of the intervention is to improve the cardiovascular knowledge and health attitudes of students in order to improve their health behaviours. In order to do this a number of objects need to be met:

- To demonstrate to students that their actions directly affect their cardiovascular system.
- To provide the students with an insight into how both healthy and unhealthy behaviours could be affecting their cardiovascular health now.
- To demonstrate to students how behaviours could affect their cardiovascular health in the future.

- To do all this in a way that is interactive and encourages discussion.
- To assess the feasibility of running a full scale intervention.

8.3 Methods

8.3.1 Designing the intervention

The pilot intervention was developed between July and October 2012. Lesson plans were written that incorporated requirements from the national curriculum, the lessons learned from the student and parent focus groups, and the results from the component analysis.

The national curriculum requires children to be taught the importance of and how to maintain a healthy lifestyle. This includes specific objectives for learning, including facts like the heart is a pump, and the effect of exercise on pulse rate.[1] The national curriculum also requires children to be taught how to make informed health decisions that include diet, physical activity, and the effects of drugs and alcohol on the body. For more detail on the sections of the curriculum that this intervention met refer to Appendix 8.1.

Once the lessons plans had been drafted a meeting was held with a number of teachers from the host school who taught subjects that included a health element, such as PE, or were tutors of the year groups the intervention was to be piloted in. The teachers were very positive about the lesson plans and had no concerns about the content or level of difficulty.

Finally, the lesson materials were checked by a general practitioner working at the Department of Primary Care Health Sciences to ensure that all of the information was correct and appropriate to the age of the participants.

8.3.2 Knowledge, Attitudes and Behaviours questionnaire

The effect of the intervention was assessed through the Knowledge, Attitudes and Behaviours (KAB) questionnaire. The KAB questionnaire was created for this study and was based on a number of existing, validated questionnaires. The questionnaire was completed a week before

the first lesson, immediately after the second lesson and then again six weeks later to measure how any changes were sustained.

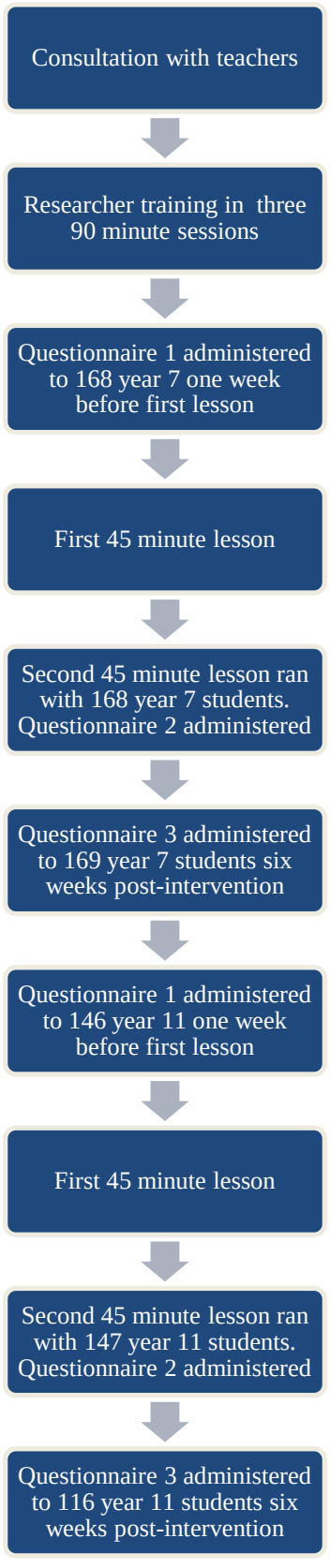
The KAB questionnaire was divided into four sections. The first section asked the student to indicate whether they were male or female and whether they enjoyed the lessons.

The second section assessed the student's heart and CVD knowledge with 11 questions asking them to indicate whether statements were true, false or they didn't know. The knowledge section included items such as *All cholesterol is bad for your heart* and *The heart is a pump* and was based on the 30 item heart disease knowledge questionnaire developed by Bergman et al.[2]

The third section contained eleven questions and assessed the attitudes that the students held towards heart disease. This section included items such as *I only need to worry about heart disease when I'm older* and *I know enough about heart disease to make decisions that are healthy for my heart.* There is no known instrument for assessing the heart health attitudes of children in the literature and as such this section was based on the heart disease risk factor attitudes and habits survey created by Smalley, Wittler and Oliverson.[3] Additional items were added based on the focus group studies described in Chapters 4 to 6. The items in the attitudes section fell into three subgroups; *attitude towards future health, attitude towards CVD risk* and *self-efficacy.*

The fourth section assessed the health-related behaviours of the students. This section was included in the questionnaire to give an indication of any immediate changes to behaviour even though significant changes were not expected. Behaviour changes were not expected because the time required has been found to be longer than the time allowed to this study.[4 5] Ten items such as *I use the labels on food packages to decide what to eat* and *I spend an hour or more in front of the TV or computer most days in the week* were included. The students had to indicate which behaviours applied to them in the last week. The items in this section were based on the Health Behaviour in School-aged Children (HBSC) questionnaire developed by the World Health Organisation.[6] The HBSC questionnaire is designed to be self-administered in a school

Figure 8.1 The process of the pilot intervention



setting and was validated in children aged between seven and twelve. In this instrument children are required to indicate the frequency with which they carry out such behaviours as eating breakfast, physical activity or spending time in front of a television or computer.

Each of the items included in the above sections were assessed using a four point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (4). A four point rather than a five point scale was chosen to avoid the students using the neutral option as a way to complete the questionnaire quickly.

In all of the sections, additional questions were added to specifically assess some of the topics that would be covered in the lessons. An example of the KAB questionnaires is available in Appendix 8.2.

8.3.3 Participants

The host school was the same secondary school that the Year 11 focus group studies detailed in Chapters 4 and 5 were carried out in. It was decided to use this school because a good relationship had already been formed with the assistant head teacher who was enthusiastic about being involved in the pilot intervention.

The intervention was delivered to year 7 (11 to 12 years) and year 11 (15 to 16 years). These two year groups were chosen because there is evidence that children at these ages are especially at risk from negative influences on their health and

so there is an opportunity to have a positive effect on the child's health.[7]

Consent was given on an opt-out basis, which studies have shown is an acceptable way to maximise participation.[8] Additional benefits were that it limited the amount of self-selection bias and also removed the inconvenience of the school having to arrange separate lessons for those who did not volunteer. As well as this the head teacher felt the lessons were valuable to all.

The children or their parents were given 2 weeks in which to return the opt-out slip and if they had not done so by the response date on the letter they were included in the intervention lessons. No child in either year 7 or 11 opted out of the lessons.

8.3.4 Delivering the intervention

The intervention was delivered in December 2012 for the Year 7s and in January 2013 for the Year 11s during their scheduled Personal, Social, and Health Education (PSHE) classes. For the PSHE lessons the year groups were split into six classes of 20-30 students.

Due to the number of students being taught, a team of ten researchers was recruited from the University of Oxford's Department of Primary Care Health Sciences. The researchers were trained in the department in delivering the intervention and use of the equipment over three 90 minute sessions. These sessions involved the author delivering the lessons, answering questions and discussing any areas of potential difficulty, and the interactive features being tried by the researchers. Eight of the researchers taught the lessons in pairs and two taught the lessons alone. The two researchers who taught alone were those with the most experience in delivering health messages to a young audience, and included the author. The regular teachers of each of the classes were present during the lessons to facilitate the lessons only.

Following each lesson, the researchers were asked to fill in a feedback form including items such as how easy they found the lessons to teach, quality of the materials and whether the level of difficulty was appropriate for the students. This form was also used to record any adverse

outcomes should they arise. Figure 8.1 shows the process of the pilot intervention and its assessment.

Lesson One components

The intervention was comprised of elements such as videos, teaching slides, physical activities, computer-based activities and quizzes. Each class was supplied with a pack containing workbooks for the students, a lesson plan for the tutors, KAB questionnaires, three blood pressure monitors, and four game show buzzers.

Lesson One of the pilot intervention began with a short video created by the British Heart Foundation that showed an animation of a healthy heart working.[9] This video was chosen as a way to introduce the topic to the students primarily because it gave a good depiction of a working heart with an explanation of the vessels and pumping action and was designed for a young audience. Furthermore, animation avoided the graphic pictures that the Year 11 girls stressed they disliked in the focus groups. During the video the students were asked to note down one fact they found particularly interesting that they could share with the class. This was to encourage the students to pay attention rather than passively watching the video.

This was followed by an introduction of the terms systolic and diastolic, an explanation of how to use a blood pressure monitor, and how to interpret the results.

This explanation was followed by an activity to demonstrate how different physical activities affect blood pressure using a blood pressure monitor. The class was split into three groups each of which was given a monitor. These three groups were then instructed to select three students from the group to do one action from star jumps, standing still, or lying down. The action was done for one minute after which the students were told to help put the cuff on those doing the action, measure their blood pressure and heart rate, and record the results. The class then came back together to discuss the differences each action made to the students' blood pressures and the reasons why they thought this might be the case.

After the discussion the researcher introduced the term cardiovascular disease and explained that there are some behaviours that damage the heart's ability to pump blood efficiently around the body. The researchers distributed a game show buzzer to each of the three groups from the previous activity and explained the next one. The next activity was a picture-reveal quiz where a picture showing a risk factor for CVD would be slowly revealed and the teams should buzz in when they knew what the risk factor was. Points were scored for each correct answer. Following each correct answer the researchers discussed how each risk factor damages the heart.

The final part of Lesson One took a more in depth look at the effect that hypertension and atherosclerosis have on the heart. The students were shown medical photographs of normal and enlarged hypertensive hearts and atherosclerotic plaques in artery cross sections and the researchers explained the process that lead to these diseased organs. Although these were pictures of real organs care was taken to select images that were the least graphic. It was felt that it was important to show the class these images because during the focus groups there was a desire for real examples and descriptions of disease. In addition, the focus group of mothers supported the use of concrete examples and visuals to help children understand health messages.

The lesson ended with the researchers telling the students that the next lesson would be covering CVD risk in greater detail and the things that people can do to stay healthy. The class was asked to think about their own lives and to try to select one health-related thing that they would like to change and the barriers to making that change.

Lesson Two components

Lesson Two was carried out a week later. It began by revisiting the risk factors for CVD using two case studies of fictional hospital patients. The students were asked to study the patient identification cards presented to them and suggest reasons why each patient might be at risk from CVD. Focus was again on hypertension and atherosclerosis but also introduced ethnic background, sex, age, and type II diabetes as contributors. Case studies were used as they

facilitated the discussion of CVD and were used in one of the studies judged to be successful in the component analysis in Chapter 7.[10]

The researchers then described how the doctors of the two case studies might calculate their risk of developing CVD using a risk score calculator. The students were shown the SCORE risk chart[11] and the tutor then went to an interactive risk calculator on the website of the New Zealand Heart Foundation.[12] Volunteers from the class were asked to put the details of the case studies into the online tool to calculate their current risk, and using suggestions from the class, the risk factors were varied to show how the score was affected.

The lesson then addressed the behaviours that help to reduce the risk of CVD. The students were told about SMART goal setting and how changing their behaviours in small, achievable ways they are more likely to succeed and improve their health. The researchers asked the students if anyone had a health behaviour from their own life that they would like to change. If no students volunteered the researcher used the examples of the case studies again. The class was asked to pretend that they were the doctors of either the student volunteer or the case study and to write a SMART goal for the person to improve their health. Teaching children how to set and achieve goals is an area of importance highlighted by the National Curriculum.[1]

Finally the researchers spoke to the class about healthy eating and how using the nutrition labels printed onto food packaging can help with this. The class was shown different types of food nutrition labels including the traffic light system.

The final activity was another quiz using the game show buzzers. This time the teams had to match food to a nutrition label and buzz in when they thought they knew the answer. A short discussion then followed around what nutrients the students would expect to find in the foodstuffs that help to reveal which label they went with. Points were again awarded for each correct answer and added to the points from the previous week. By discussing goal setting and

showing the students how to use nutrition information the objective was to provide them with the tools to make healthy changes and decisions.

At the end of the lesson the students were asked to complete a second KAB questionnaire, which included questions about their enjoyment of the lessons. The students were told that they were allowed to keep the workbooks and directed to the organisations listed in the book if they wanted any more information.

The components in Lessons One and Two met the recommendations of at least two of the previous studies in this thesis. Table 8.1 sets out in detail the components of the two lessons and the component requirements from previous chapters they fulfil.

Table 8.1 Components of intervention and recommendations from previous studies met

Lesson component	Recommendations from Systematic Review met	Recommendations from Student Focus Groups met	Recommendations from Parent Focus Group met	Recommendations from Component Analysis met
		Lesson 1		
British Heart Foundation video		Enjoyment of multimedia formats, detail on how the body functions, relevant to now	Concrete examples, visual aids	
Blood pressure discussion	Most significantly affected risk factors	Real examples, detail on how the body functions, discussion	Concrete examples, visual aids	Interactive, focus on fitness, focus on knowledge change
Blood pressure monitor activity	Most significantly affected risk factors	Hands on activities, interactive, detail on how the body functions, relevant to now	Concrete examples, interactive	Interactive, focus on fitness, hands on
Picture reveal quiz	Most significantly affected risk factors	Interactive, detail on how the body works, relevant to now and future	Interactive, concrete examples	Interactive, focus on knowledge change
Medical examples of CVD	Most significantly affected risk factors	Real examples, detail on how the body works	Concrete examples, visual aids	Focus on knowledge change
		Lesson 2		
Case studies	Most significantly affected risk factors	Interactive, discussion	Concrete examples, interactive, focus away from weight	Interactive, focus away from weight
Risk score calculator	Most significantly affected risk factors	Enjoyment of multimedia formats, information on future risk, interactive, hands-on	Concrete examples, interactive, focus away from weight	Interactive, focus on knowledge, focus away from weight
SMART goals		Interactive, hands on, relevant to now, discussion	Provide life skills	Goal setting, self-efficacy, problem solving, practical skills, life compatible activities
Nutrition labels		Relevant to now	Provide life skills	Self-efficacy, practical skills, focus on knowledge, diet
Food-label match quiz		Interactive, relevant to now	Interactive, provide life skills	Practical skills, focus on knowledge change, focus on attitude change, familiarity with foods, self-efficacy

Follow-up

Six weeks after the intervention the year groups were asked to fill in the KAB questionnaire for the third time. This was to give an indication of how well any changes that were seen from weeks one to two were maintained.

8.3.5 Data analysis

The change in the distribution of responses to the KAB questions was assessed through the proportions of students correctly answering the CVD knowledge questions and those selecting each of the different levels on the Likert scale. The significance of any change in distribution was assessed using the Wilcoxon Signed Rank Test. This was chosen over, for example, a related samples t-test because the data was non-parametric. A paper comparing the t-test and the Mann-Whitney Wilcoxon test found that both tests performed equally well when considering their α and β error rates.[13] The Mann-Whitney Wilcoxon test however performed better than the t-test when the data was skewed or peaked.[13] These conclusions were also supported by an earlier paper that compared the t-test to the Wilcoxon Signed Rank test.[14] As the data from the KAB questionnaires was found to be significantly skewed and peaked a Wilcoxon test was chosen as the most appropriate test.

The decision was taken following advice from a statistician to not adjust the significance levels of the tests because of the large number of analyses. This was because common tests such as the Bonferroni correction assume that the tests are statistically independent. This was not the case for the analyses herein as the same baseline statistics were used for all. Furthermore, if the significance level had been adjusted, many of the unfavourable results that are discussed below would have no longer been significant. This could have falsely inflated the success of the intervention and masked some areas to improve.

The results of the Wilcoxon tests for the attitude and behaviour scores are reported with their median and mean values as well as the change in proportion of students selecting each scale point at each time period. Although the use of mean values with Likert scale data has a long history of controversy due to it being an ordinal rather than continuous scale, they are presented here to help in the interpretation of the results.[15] [16] On a number of occasions where a significant change in the distribution was found in the Wilcoxon tests, there was no apparent change in the median scores. Upon closer inspection it was found that although the median did not change, the mean and the proportions of students at each point did. As such all three statistics, median, mean and proportions, are reported to illustrate the direction of any changes.

The KAB questionnaire was analysed so that a low score reflected an unhealthy attitude or behaviour and a high score reflected a healthy attitude or behaviour. Any items that were not worded in this way in the questionnaire were transformed to comply. If the intervention was a success, it was expected that the rankings of the items would increase at the post-intervention time points.

8.4 Results

Although all of the children in the lessons filled in the questionnaires, not all were completed in full and so the total responses vary.

8.4.1 Description of participants

Table 8.2 Description of participants

	Number (percent)
Year 7 Age 11-12	
Boys baseline	80 (47.6)
Girls baseline	88 (52.4)
Total	168
Boys post intervention	78 (46.4)
Girls post intervention	90 (53.6)
Total	168
Boys follow-up	79 (46.7)
Girls follow-up	90 (53.3)
Total	169
Year 11 Age 15-16	
Boys baseline	87 (59.6)
Girls baseline	59 (40.4)
Total	146
Boys post intervention	89 (60.5)
Girls post intervention	58 (39.5)
Total	147
Boys follow-up	67 (57.8)
Girls follow-up	49 (42.2)
Total	116
Baseline Total	314
Post intervention total	315
Follow-up total	285

Table 8.2 shows the characteristics of the students taking part in the intervention. The numbers of boys and girls varied between lessons, most likely due to absence, however the variation in numbers was small. In the Year 7 classes the number of boys was slightly less than the number of girls and in Year 11 this was reversed.

The students were asked at the end of the Lesson Two whether they enjoyed the cardiovascular health lessons and whether they would like more, similar lessons (Table 8.3). The majority of the students in both year groups enjoyed the lessons and said they would like more similar lessons, although the number was smaller in year 11.

Table 8.3 Enjoyment of the intervention

	Number (percent)
Year 7	
Enjoyed	154 (91.7)
Did not enjoy	13 (7.7)
Missing	1 (0.6)
Total	168
Year 11	
Enjoyed	133 (90.5)
Did not enjoy	13 (8.8)
Missing	1 (0.7)
Total	147
Year 7	
Want more similar	129 (76.8)
No more	37 (22.0)
Missing	2 (1.2)
Total	168
Year 11	
Want more similar	96 (65.3)
No more	50 (34)
Missing	1 (0.7)
Total	147

8.4.2 Change in questionnaire scores

Change in heart health knowledge

Tables 8.4 and 8.5 show the results of the change in knowledge assessment immediately before (baseline) and after (T1) the intervention and following the 6 week follow-up period (T2) in the Year 7s and Year 11s respectively. The increase in the number of correct responses from baseline to immediately following the intervention (T1) was significant in both the Year 7s ($p=0.01$) and in the Year 11s ($p=0.003$). Furthermore six weeks after the intervention the increase in the number of correct responses was still significant ($p=0.009$) in the Year 7 group. The same was not true however for the Year 11s despite many of the items having an increase in the number of correct responses ($p=0.541$).

Table 8.4 Heart health knowledge Year 7

Question	Number (%) correct baseline	Number (%) correct post intervention*	% change baseline-T1	Number (%) correct follow-up^	% change baseline-T2
The heart is a pump	161 (97.6)	165 (98.2)	+0.6	170 (98.8)	+1.2
Many vegetables are high in cholesterol	45 (27.1)	47 (28)	+0.9	88 (51.5)	+24.4
All cholesterol is bad for your heart	73 (44)	98 (58.7)	+14.7	112 (65.9)	+21.9
High blood pressure is 110/80 mmHg or higher	13 (7.8)	64 (38.3)	+30.5	27 (15.7)	+7.9
People who have diabetes are at higher risk of getting heart disease	45 (27.1)	157 (94)	+66.9	150 (87.7)	+60.6
The heart is made up of 2 chambers	39 (23.6)	47 (28)	+4.4	30 (17.4)	-6.2
Blood pressure is the force that blood puts on the walls of the blood vessels	69 (42.3)	117 (70.1)	+27.8	111 (64.9)	+22.6
Cardiovascular disease is the name for disease that affects the heart and it's blood vessels	67 (40.4)	134 (79.8)	+39.4	125 (73.1)	+32.7
Atherosclerosis is when fatty plaque collects on the walls of the blood vessels	38 (23.3)	120 (73.2)	+49.9	98 (57.3)	+34
Smoking increases the amount of oxygen your blood can carry	118 (71.1)	104 (61.9)	-9.2	114 (66.3)	-4.8
Physical activity can lower LDL cholesterol and raise HDL cholesterol	52 (31.5)	106 (63.9)	+32.4	81 (47.4)	+15.9

**Change in number correct baseline to T1 significant p=0.01*

^ Change in number correct baseline to T2 significant p=0.009 (Wilcoxon Signed Rank Tests)

Table 8.5 Heart health knowledge Year 11

Question	Number (%) correct baseline	Number (%) correct post intervention	% change baseline-T1*	Number (%) correct follow-up	% change baseline-T1#
The heart is a pump	136 (95)	140 (95.2)	+0.2	107 (92.2)	-2.8
Many vegetables are high in cholesterol	116 (79.5)	121 (82.9)	+3.4	88 (76.5)	-3
All cholesterol is bad for your heart	101 (69.7)	119 (81)	+11.3	94 (81)	+11.3
High blood pressure is 110/80 mmHg or higher	30 (21.1)	75 (51.4)	+30.3	30 (25.7)	+4.6
People who have diabetes are at higher risk of getting heart disease	87 (60)	133 (90.5)	+30.5	89 (76.7)	+16.7
The heart is made up of 2 chambers	65 (44.5)	88 (60.7)	+16.2	56 (48.3)	+3.8
Blood pressure is the force that blood puts on the walls of the blood vessels	88 (62)	117 (80.1)	+18.1	95 (81.9)	+19.9
Cardiovascular disease is the name for disease that affects the heart and it's blood vessels	94 (65.7)	117 (79.6)	+13.9	88 (75.9)	+10.2
Atherosclerosis is when fatty plaque collects on the walls of the blood vessels	42 (30)	88 (60.3)	+30.3	57 (49.1)	+19.1
Smoking increases the amount of oxygen your blood can carry	19 (13.1)	116 (79.5)	+66.4	90 (77.6)	+64.5
Physical activity can lower LDL cholesterol and raise HDL cholesterol	49 (34)	59 (40.7)	+6.7	41 (35.3)	+1.3

**Change in number correct baseline to T1 significant p=0.003*

#Change in number correct baseline to T2 not significant p=0.541 (Wilcoxon Signed Rank Tests)

Change in attitudes Year 7

A change in the attitude scores of the Year 7s was seen for a number of items although not always in the direction it was thought. Specifically, the attitude to future health. When baseline scores were compared to T1 scores it was found that immediately following the intervention more students agreed with the items "Cardiovascular disease doesn't affect many people" ($p<0.000$) and "It doesn't matter what I do now, I could still get cardiovascular disease when I'm older" ($p=0.022$). Finally a change towards more students agreeing with the statement "If someone smokes the damage they have done to their heart is permanent" ($p=0.025$) was found.

However, some changes were seen in the expected direction. When baseline and T1 scores were compared it was found that three of the five self-efficacy items had significant increases in the number of children agreeing with them. These three statements were "I can influence how much cholesterol is in my blood" ($p<0.000$), "I think I understand what cardiovascular disease is" ($p<0.000$), and "I know enough about heart disease to make decisions that are healthy for my heart" ($p<0.000$).

At the six week follow-up (T2) a significant decrease in ranking was still seen in the "Cardiovascular disease doesn't affect many people" item ($p=0.038$) when compared to baseline ranks.

At T2 two items in the self-efficacy subgroup relating to the children's perception of their own knowledge and understanding were still significant. The children's perceived ability to influence their cholesterol levels was no longer significant but had been replaced with "There are simple ways to stay healthy" ($p=0.012$) from the self-efficacy subgroup.

Change in behaviours Year 7

Immediately following the intervention no significant changes in behaviour were reported by the children.

At T2 there was a significant decrease in the rankings, more students disagreed with the statements, “I think about the health of my heart” ($p=0.043$), “I think about the health of my friends’ and family’s hearts” ($p=0.015$), and “If I had a question about my heart I would try to find out more” ($p<0.000$).

Change in attitudes Year 11

At T1 there were significant changes to the distribution of responses in the self-efficacy subgroup. In this subgroup there was less agreement with the statement “There are simple ways to stay healthy” ($p=0.045$). There was also more agreement with the statements “I think I understand what cardiovascular disease is” ($p<0.000$) and “I know enough about heart disease to make decisions that are healthy for my heart” ($p<0.000$).

At T2 the self-efficacy subgroup again had the most significant changes in distribution of responses. Compared to baseline, there was a reduction in the number of students agreeing with the statements “I can influence how much cholesterol is in my blood” ($p=0.001$) and “There are simple ways to stay healthy” ($p=0.005$). However for the other two self-efficacy statements “I think I understand what cardiovascular disease is” and “I know enough about heart disease to make decisions that are healthy for my heart” there was an increase in the number of students agreeing or strongly agreeing with them ($p=0.033$ and $p<0.000$ respectively).

Two further statements had shifts in the distribution of responses on the attitude scale with more students supporting the statements “I only need to worry about my heart when I get older” ($p=0.024$) and “If someone is overweight it is unhealthy for their heart” ($p=0.038$).

Change in behaviours Year 11

At T1 and T2 there were no significant changes to the distribution of responses given to the behaviour measure when compared to baseline distributions.

The full set of these results are available in Appendices 8.3 to 8.8.

8.4.3 Post-hoc analysis of attitude subgroups

Table 8.6 shows the post-hoc analyses run of the subgroups that made up the attitude section of the Year 7 KAB questionnaires. There was a significant change in the distribution of responses to the items in some of the subgroups. Compared to baseline, at T1 and T2 there were a shifts towards the healthy attitudes for health risk ($p<0.000$) and self-efficacy (T1 $p<0.000$, T2 $p=0.011$). There was no significant change in the attitudes to future health subgroup.

Table 8.6 Year 7 attitude subgroup analyses

Attitude subgroup		Median	Mean (S.E.)	Change baseline to T1	Change baseline to T2
Future health	Baseline	3	2.826 (0.066)	p=0.190	P=0.260
	T1	3	2.938 (0.063)		
	T2	3	2.854 (0.052)		
Health risk	Baseline	2.75	2.725 (0.041)	P<0.000	P<0.000
	T1	3	3.107 (0.042)		
	T2	3	3.014 (0.042)		
Self-efficacy	Baseline	2.8	2.825 (0.040)	P<0.000	P=0.011
	T1	3.2	3.160 (0.041)		
	T2	3	2.921 (0.045)		

Table 8.7 shows the results of the subgroup analysis of the attitudes of the Year 11s. A significant decrease was seen in the healthy attitudes to health risk subgroup ($p=0.015$) at T2 and a significant increase was seen in the self-efficacy attitudes at T1 ($p=0.014$). There was no significant change found in the attitudes to future health subgroup at either time point.

Table 8.7 Year 11 attitude subgroup analyses

Attitude subgroup		Median	Mean (S.E.)	Change baseline to T1	Change baseline to T2
Future health	Baseline	3	2.841 (0.053)	P=0.876	P=0.394
	T1	3	2.806 (0.055)		
	T2	2.5	2.712 (0.061)		
Health risk	Baseline	3	2.985 (0.036)	p=0.620	P=0.015
	T1	3	2.903 (0.042)		
	T2	2.75	2.856 (0.039)		

Self-efficacy	Baseline	3	2.920 (0.038)	P=0.014	P=0.851
	T1	3	2.998 (0.042)		
	T2	3	2.897 (0.045)		

8.4.5 Research team feedback

At the end of each lesson the ten researchers were required to fill in a feedback form giving their opinion on how the lesson was received, how easy it was to teach and if any adverse events occurred. As this intervention was piloted in order to assess the feasibility of a full size trial, any difficulties in its delivery were important to resolve. In general, the feedback was positive for both groups.

For the Year 7 the researchers stated that the students enjoyed the video and the interactive elements of the lessons. There were however frequent comments that the time in which to deliver the lesson was short given the amount that needed to be covered. There were also comments that the blood pressure monitors frequently gave error messages and that this slowed down the progress of the lessons. Finally when asked to comment on the elements that worked best and worst, the quiz and the blood pressure monitor activity were said to be enjoyed the most by the students and the SMART goals activity least.

The researchers gave suggestions as to how the lesson could be improved and these frequently included smaller groups for the blood pressure monitor and quiz components.

Lastly, one adverse event was reported in the Year 7 classes and that was that one of the students said that they were now afraid of getting CVD. The researchers present reassured the student, reiterated the healthy living message of the lessons and reminded the student of the people they could speak to if they had any more questions or concerns.

For the Year 11 lessons, the researchers stated that the Year 11s enjoyed the blood pressure monitor and online risk calculator activities. For the older students the time available to deliver

the lessons was not an issue and some groups even had a few minutes at the end of the lessons for discussion.

There were some concerns that if the student was taking biology, PE, or a similar subject the material may have been too easy for them. As with the Year 7s, the researchers mentioned faulty blood pressure monitors and a lack of enthusiasm from the students when going through the SMART goal technique.

No adverse events were reported for this age group.

8.5 Discussion

8.5.1 Main findings

The main finding of this study was that the WE ♥ Health intervention could feasibly be trialled in a full-scale RCT. In addition, although not powered to do so, a significant increase in knowledge compared to baseline scores was seen immediately post and six weeks post intervention in the Year 7s and immediately following the intervention for the Year 11s.

Changes in both Year 7 and Year 11 attitude towards heart health scales were characterised by improvements in some items counter balanced by worsening attitudes in other items. Despite this, in both year groups and at both follow-up points the students' self-efficacy scores improved.

For both the knowledge and the attitude sections, significant changes were fewer at six weeks follow-up. Where there were significant changes, these were less significant. This is a common finding of intervention studies and was expected as some of the information from the lessons gets forgotten over time.

There were no significant changes found in how the students responded to the behaviour section of the KAB questionnaires with the exception of a few items at T2 in the Year 7s. These items were the health of their own or their loved ones' hearts and whether they would seek more

information if they had questions about their heart. A significant reduction was found in the number of students agreeing with these statements.

8.5.2 Links to previous research

As was shown again in this study, education interventions are consistently able to improve the knowledge of the children they include, even if that result is not accompanied by a similar improvement in their behaviours.[17 18] However, in light of the results of previous studies a significant change in the behaviours of the students was not expected here either. A report published in 1985 that evaluated school health education concluded that 10 hours are needed to improve students' knowledge and 50 hours are needed to change their behaviour.[4] This, however, could be an over estimate as the WE ♥ Health intervention achieved knowledge improvements in 80 minutes total lesson time, although the students were found to already have some knowledge at baseline.

There is, however, evidence that behaviour and attitudes can be influenced by education under the right circumstances. Studies that have aimed to improve the health of children by focusing on improving their attitudes towards and participation in physical activity, promoting cardiovascular health, and promoting healthy nutrition have been able to improve the knowledge, attitudes, and behaviours of their participants. [19-21] What differentiates these studies from the pilot intervention under discussion here, is the duration of their delivery. While the WE ♥ Health intervention only had a total of 80 minutes in which to deliver its material, these other studies either had a longer, more intense lesson[20] or much more of the school year in which to be delivered.[19 21] The Get Fit with the Grizzlies study, which used local sportsmen to deliver diet and physical activity information, was also short in comparison to many other studies, and like the WE ♥ Health intervention it was found that while an improvement in the children's knowledge was achieved, behaviour change was not.[5] Additionally the short follow-up period of the pilot intervention described herein of six weeks may not have been long enough for the

knowledge and initial attitude improvements to be translated into measureable behaviour changes, although this too was expected.[17 22]

Changing the behaviour of an individual is most effectively done through changing the attitudes associated with that behaviour.[20] Therefore, although this intervention was not expected to bring about significant improvement in the behaviours of the children, it is possible that the improvements in some of their attitudes could be translated into behavioural changes given more time and continuation of the education and behaviour change process.

In addition to the agreements about the time knowledge, attitude and behaviour change take between this and previous research, there were also agreements about how lesson material should be delivered. Through the use of the researcher feedback forms it was established that repetition is needed in order to fully relay health information to the students. This has been recommended specifically when seeking to improve the cardiovascular health of children in that frequent and targeted messages delivered through their school are best.[23] Although this intervention met two of those three recommendations, if the material could be delivered on a more regular basis its outcomes might be better achieved.

8.6 Strengths and limitations

There are a number of strengths of this study. Firstly, a large number of students received the lessons and completed the KAB questionnaires. In total 316 students were present for at least one of the lessons, making this feasibility study bigger than some full intervention studies.[10 19 20] Furthermore from these 316 students, almost 1000 KAB questionnaires across the three measurement points were returned.

Secondly this intervention was designed following input from and approved by professionals such as a general practioner and teachers working with the target children in subjects that are most likely to include some health information. Through this process it was ensured that the messages were appropriate for the students and any potential adverse events could be discussed and planned for. For example, during the discussion with the teachers the issue of frightening

children who had a family history of heart disease or undermining the self-esteem of overweight children was discussed. The teachers however believed the possible benefits of the intervention outweighed the risk of any adverse event. Rather than diluting the seriousness of the message, they suggested that the children be reminded of the health and counselling service that the school offered. As such the researchers were able to enter into the lessons confident in the material they were to present.

Furthermore, not only was feedback on the acceptability of the intervention collected from the students but also from the researchers delivering it. If this intervention is to be implemented in the long term it has to not only be engaging to its audience but also acceptable to its deliverers. Through gathering researcher feedback, future versions of the WE ♥ Health programme can be improved so that its effectiveness is maximised.

Fourthly, this intervention was designed with teacher materials that allow any teacher regardless of their academic background to be able to deliver it. The researchers who delivered this pilot, although all researchers in primary health care, did not all have experience in or extensive knowledge of cardiovascular health and disease. Despite this no difficulties with the content were reported.

Finally, the response from the students to the intervention was very positive with the vast majority stating that they found it enjoyable and would like more similar health lessons in the future. During a discussion with the head of Year 11 it was mentioned that she was impressed with the reaction of the students to the intervention and that it generated a lot of discussion amongst them.

As well as its strengths this study also had a number of limitations. Firstly, there was no control group. This was to avoid reducing the number of children in the intervention group thereby making the effect of the intervention harder to detect. The assistant head teacher also requested that the students not be separated into intervention and control groups as she felt the control students would be deprived of useful information. Due to time pressures it was also not possible

to deliver the intervention to the control students at a later date. It was suggested that any students who declined to take part in the lessons formed a small control group, however no students declined. Additionally as the control group would be students at the same school there would have been no way to prevent them discussing the lessons with their peers and so contaminating the results. As this is a feasibility study and not a full trial of the intervention, however, it was felt that this would not be a serious problem when assessing the acceptability and initial outcomes of the intervention.

Secondly the intervention was carried out in only one school. This was due to a lack of local schools volunteering to take part. However, this was not of significant concern as this was not a full trial. It was felt that a large amount of good quality data from one enthusiastic school would compensate for the lack of multiple sites.

Thirdly, although the majority of the KAB questionnaires were completed correctly by the students there were a number of students, particularly in Year 11, who did not. A common example of this was for the student to circle the same response for all statements or to respond in a pattern. This is possibly because the second and third questionnaires placed too great a burden on the students. These spoiled questionnaires were still included in the analysis to avoid biasing the data but it is possible that they masked some of the effects of the intervention.

In addition, although the KAB questionnaire was made up of three previously validated questionnaires it had not been validated in the combined form in which it was used. Furthermore, the small number of additional questions that were added had also not been validated. While this is a limitation of the questionnaire, its purpose was only to give an indication of whether the lessons could potentially bring about a change in the knowledge, attitudes and behaviours of the student. Care was taken in the additional questions to follow the format and wording of the original items. If this intervention were ever to be carried out on a larger scale, a custom written questionnaire would be written and validated in the appropriate age groups.

The above limitations may have contributed to the unanticipated result following the analysis of the KAB questionnaires. It was found that the Year 11 students' attitudes towards their future health risk of CVD worsened from baseline to T2. No previous studies were found by the author that could offer an explanation as to why this may have occurred. As such, it must be assumed that numbers of spoilt questionnaires, high participant burden of the repeated measuring, and a questionnaire that was not validated in the state in which it was used, played a role in this outcome. In addition, the lack of a control group prevents any conclusions being made as to whether this is a result of the intervention or an unrelated consequence of an unknown factor.

Finally, this intervention was only allotted 80 minutes, two PSHE lessons, in which to be delivered and this is a short amount of time when compared to other education interventions. In future this can be dealt with by delivering a larger number of lessons and spreading the material out over them to ensure that the teacher does not feel they have to skim over or leave out information in order to complete the lesson in the allotted time.

8.7 Implications for future research

Although the wider implications that this pilot intervention has for future research will be discussed in Chapter 9, three implications have also been raised in the conducting of this feasibility study that are specific to any future versions of it.

Firstly, the feasibility study indicates that a full-scale randomised-controlled trial of the intervention is warranted. A sample size calculation was carried out based on the significant results achieved in the Healthy Buddies study.[24] The sample size calculation was based on an α error rate of 5% and β error rate of 20%, and the approximate sample size given in order to significantly increase knowledge, attitudes and behaviours was 228 children per study arm. This is, however, an approximation as the Healthy Buddies study cluster-analysed the results of the intervention. As such 228 children may be an underestimate due to clustering effects whereby similarities between the children in the clusters reduced the variability in their responses in the Healthy Buddies study. This results in a loss of power and 228 children would be too few to

detect an effect of the intervention, so the sample size would have to be increased to compensate for the clustering effect.[25]

Secondly, a more diverse sample should be recruited. Even if the schools in the more deprived areas of Oxfordshire had not withdrawn, the study would have still been limited by a lack of diversity. As such, participants should be recruited from different counties and regions so that a truly diverse sample can be achieved.

Thirdly, the length of time allowed for the intervention to deliver its materials should be greatly increased. The shortest study in the component analysis detailed in Chapter 7 ran for 30 minutes per week for six weeks and had some success.[5 26] It is therefore suggested that six weeks be the minimum length of time for any future trials of the WE ♥ Health intervention to be run.

8.8 Conclusion

There is evidence that education interventions are able to lower CVD risk parameters.[27] If the lessons learnt from this pilot study are incorporated into future versions of this intervention, the WE ♥ Health programme could also make a contribution towards improving the health outcomes of children.

Despite the limitations of this intervention and issues in its implementation raised by the feasibility study, the strengths in its design and the reaction it received from the students and their teachers indicate that there is potential for a full randomised controlled trial of the WE ♥ Health intervention. NICE guidelines suggest that behaviour change interventions be evaluated based on their effectiveness, acceptability, feasibility, equity and safety.[7] The WE ♥ Health intervention was found to be acceptable by the researchers and students, feasible, and safe with only one minor adverse effect reported. Additionally it was effective in one of its outcomes of interest and so should at this stage should be judged a success and worthy of further testing.

In summary, this study is a feasibility study for a full randomised controlled trial of the WE ♥ Health programme and provides some good indicators as to how the programme can be

improved and delivered more effectively. This education intervention was tailored to the national curriculum, designed in consultation with a medical professional, teachers, mothers and students and was informed by the successes of previous studies to improve the health of children. It was able to significantly increase the heart health knowledge and improve the self-efficacy of the students. If a randomised controlled trial of the WE ♥ Health programme were run then its effectiveness in changing the attitudes and behaviours of children could be more reliably assessed.

8.9 References

1. Department of Education. *Review of the National Curriculum*, 2011.

2. Bergman H, Reeve B, Moser R, Scholl S, Klein W. Development of a Comprehensive Heart Disease Knowledge Questionnaire. *Am J Health Educ.* 2011;42:74-87.

3. Smalley SE, Wittler RR, Oliverson RH. Adolescent assessment of cardiovascular heart disease risk factor attitudes and habits. *Journal of Adolescent Health* 2004;35(5):374-79.

4. Connell DB, Turner RR, Mason EF. Summary of findings of the School Health Education Evaluation: health promotion effectiveness, implementation, and costs. *J Sch Health* 1985;55(8):316-21.

5. Irwin CC, Irwin RL, Miller ME, Somes GW, Richey PA. Get Fit With the Grizzlies: A Community-School-Home Initiative to Fight Childhood Obesity. *Journal of School Health* 2010;80(7):333-39.

6. Roberts C, Freeman J, Samdal O, Schnohr C, de Looze M, Nic Gabhainn S, et al. The Health Behaviour in School-aged Children (HBSC) study: methodological developments and current tensions. *International Journal of Public Health* 2009;54(0):140-50.

7. National Institute for Health and Clinical Excellence. *Behaviour Change*: Department of Health, 2007.

8. Woods SE, Springett J, Porcellato L, Dugdill L. 'Stop it, it's bad for you and me': experiences of and views on passive smoking among primary-school children in Liverpool. *Health Education Research* 2005;20(6):645-55.

9. British Heart Foundation. Children with CHD- How does a healthy heart work?, 2009. Available:http://www.youtube.com/watch?feature=player_embedded&v=ep4cQrYFLOw, Accessed 2012.

10. Melnyk BM, Jacobson D, Kelly S, O'Haver J, Small L, Mays MZ. Improving the Mental Health, Healthy Lifestyle Choices, and Physical Health of Hispanic Adolescents: A Randomized Controlled Pilot Study. *Journal of School Health* 2009;79 (12):575-84.

11. Conroy RM, Pyörälä K, Fitzgerald AP, Sans S, Menotti A, De Backer G, et al. Estimation of ten-year risk of fatal cardiovascular disease in Europe: the SCORE project. *European Heart Journal* 2003;24(11):987-1003.

12. New Zealand Heart Foundation. Your Heart Forecast. Auckland, 2012. Available: http://www.knowyournumbers.co.nz/heart-age-forecast.aspx. Accessed 2012.

13. de Winter JCF, Dodou D. Five-Point Likert Items: t test versus Mann-Whitney-Wilcoxon. *Practical Assessment, Research and Evaluation* 2010;15(11).

14. Blair RC, Higgins, J.J. Comparison of the Power of the Paired Samples t Test to That of Wilcoxon's Signed-Ranks Test Under Various Population Shapes. *Psychological Bulletin* 1985;97(1):119-28.

15. Knapp TRE. Treating Ordinal Scales as Interval Scales: An Attempt To Resolve the Controversy. *Nursing Research* 1990;39(2):121-23.

16. Jamieson S. Likert scales: how to (ab)use them. *Medical Education* 2004;38:1212-18.

17. Wagner N, Meusel D, Kirch W. Nutrition education for children - Results and perspectives. *Journal of Public Health* 2005;13 (2):102-10.

18. Szczech R, Chrostowska M, Zdrojewski T, Makarewicz-Wujec M, Kozlowska-Wojciechowska M, Naruszewicz M, et al. When to Start Education About

Hypertension? Chance for the Young Heart. Education Program for 14 000 Pupils in 546 Polish Primary Schools. *Public Health, Education and Guidelines*, 2010:e327.

19. Christodoulos AD, Douda HT, Polykratis M, Tokmakidis SP. Attitudes towards exercise and physical activity behaviours in Greek schoolchildren after a year long health education intervention. *BJSM online* 2006;40 (4):367-71.

20. Fleming TL, Green JL, Martin JC, Wicks MN. Effectiveness of a cardiovascular health promotion education intervention on the attitudes of urban African American school-age children. *Journal of Community Health Nursing* 2000;17 (1):49-60.

21. Fahlman MM, Dake JA, McCaughtry N, Martin J. A Pilot Study to Examine the Effects of a Nutrition Intervention on Nutrition Knowledge, Behaviors, and Efficacy Expectations in Middle School Children. *Journal of School Health* 2008;78(4):216-22.

22. Black MM, Hager ER, Le K, Anliker J, Arteaga SS, Diclemente C, et al. Challenge! Health promotion/obesity prevention mentorship model among urban, black adolescents. *Pediatrics* 2010;126(2):280-8.

23. Purath J, Lansinger T, Ragheb C. Cardiac Risk Evaluation for Elementary School Children. *Public Health Nurs* 1995;12(3):189-95.

24. Stock S, Miranda C, Evans S, Plessis S, Ridley J, Yeh S, et al. Healthy buddies: A novel, peer-led health promotion program for the prevention of obesity and eating disorders in children in elementary school. *Pediatrics* 2007;120 (4):e1059-e68.

25. Public Health Action Support Team. *Health Knowledge: Education, CPD and Revalidation from PHAST*. Gerrards Cross, Buckinghamshire: Department of Health, 2011.

26. Schofield L, Mummery WK, Schofield G. Effects of a controlled pedometer-intervention trial for low-active adolescent girls. *Medicine and Science in Sports and Exercise* 2005;37 (8):1414-20.

27. Cotts TB, Goldberg CS, Palma Davis LM, DuRussel-Weston JE, Aaronson SM, Lin K, et al. A School-Based Health Education Program Can Improve Cholesterol Values for Middle School Students. *Pediatric Cardiology* 2008;29(5):940-45.

Chapter 9. WE ♥ Health study discussion and conclusions

9.1 Overview of the thesis

This thesis aimed to address three questions:

- *What is the link between body mass index and the risk factors for cardiovascular disease in childhood?*
- *Could educating children specifically about their hearts lead to improvements in their attitudes to health?*
- *Can an intervention be designed to improve children's health behaviours in relation to cardiovascular disease?*

In order to address these questions the WE ♥ Health study, which is an original, evidence-based set of projects that culminated in a heart health education intervention, was carried out. Through the completion of the WE ♥ Health study the author performed a systematic review of 63 papers, involving nearly 50,000 children across 23 countries, two qualitative studies with 46 students and six mothers, and finally a feasibility study of the WE ♥ Health educational intervention with 314 secondary school students over four weeks. Additionally, a consultation was held with teachers and a component analysis was carried out to guide the design of the education intervention and ensure its acceptability to students.

The literature review in Chapter 2 showed that CVD risk factors can begin to develop in childhood and are linked to excess weight. This can lead to an increased risk of premature morbidity and mortality from CVD when the child reaches adulthood.[1-4] The substantial effect that childhood health can have on adulthood health has made improving the lifestyles of children a priority in both research and government policy. Intervening to improve children's health-related knowledge and attitudes in order to positively influence their behaviours has had some success and is an approach taken by a number of studies. Despite these attempts, the rates

of obesity worldwide continue to rise and as such, the author concluded that there remains a need for new interventions that make use of the existing evidence base to address the problem.[5]

This chapter will discuss the gaps filled by the WE ♥ Health study, the methods used to fill those gaps and the results of the individual projects, as well as the strengths and limitations of these methodologies and findings.

9.2 Literature gaps fulfilled by the WE ♥ Health projects, conclusions and lessons learnt

As a result of the literature review, four gaps were identified: 1) the link between BMI categories and CVD risk factors in children had not been quantified systematically; 2) children were rarely asked about their knowledge and attitudes towards their own health and how this affects their behaviours; 3) Parents' knowledge and attitudes towards childhood health and how this affects their child care is rarely investigated; and 4) new interventions are not informed by the successes and failures of previous ones. Each of these was addressed by this thesis and contributed to the design and delivery of the WE ♥ Health pilot intervention.

9.2.1 The link between body mass index categories and CVD risk factors in children

Although it is widely accepted that increasing weight adversely affects CVD risk factors, the link between BMI categories and these factors had not been previously quantified in a systematic review. As BMI categories are widely used by government, general practitioners and so on to define whether a child is overweight or obese and are used as a proxy indicator for health, it was important to establish the actual relationship between BMI categories and CVD risk factors. This was achieved through the systematic review and meta-analysis described in Chapter 3. In the meta-analysis, comparisons were reported for the mean difference of the risk factors between normal weight and overweight, and normal weight and obese children. The results were that adverse levels of every CVD risk factor investigated were present in both the overweight and obese BMI categories but that the factors were significantly worse in the obese category. To the author's knowledge this had not been previously systematically demonstrated.

The non-linear relationship between the BMI categories and the CVD risk factors was particularly evident for systolic blood pressure, total cholesterol, and LDL-cholesterol. For systolic blood pressure, the difference between normal weight and obese children was 40% greater than the difference between normal weight and overweight children. Similarly when compared to normal weight children, the mean difference in total cholesterol was seven and a half times higher and LDL-cholesterol nine times higher in the obese than the overweight children.

The systematic review concluded that projections of the future burden of coronary heart disease in children could also be underestimates because they are based on historical data from when the prevalence of obesity was much lower, and they did not incorporate the effect that overweight as well as obesity was shown to have. Furthermore, weight was shown to have such a profound effect on the risk factors investigated that the author suggested that children will start to experience damage to their cardiovascular systems at earlier ages in the near future. It was recommended that the long-term implications need to be followed in longitudinal studies.

It is the belief of the author that an over-focus on weight has led to a neglect of the co-morbid conditions that it has great influence on. Furthermore, excess weight, especially in childhood, is viewed by many as an aesthetic issue that can be easily resolved without long-term health consequences. This opinion was supported by the responses of the participants who took part in the focus group studies of Chapters 4 to 6.

It is the opinion of the author that the findings of this systematic review suggest that categorising children by their BMI, as is done currently under the National Child Measurement Programme (NCMP), is a waste of resources if no positive steps are taken towards addressing the health consequences associated with these categories. Although perhaps more costly in the short term than simply supplying health promotion materials, the NCMP provides a unique

opportunity to identify children with unhealthy weight and address CVD risk factors in their early stages.

The findings of this systematic review and meta-analysis highlighted why CVD should not be dismissed as a disease of middle to late adulthood, but should be a priority when monitoring and promoting the health of individuals of all ages, and provided impetus for the studies detailed in Chapters 4 to 8. In particular, the risk factors that were found to be most greatly affected by excess weight- blood pressure, cholesterol, and atherosclerosis- were taken forward as the priorities to discuss in the focus group studies of Chapters 4 to 6 and to teach in the pilot intervention of Chapter 8.

9.2.2 Children's knowledge and attitudes towards their own health and how this affects their behaviour

Although it is recommended that behaviour change is approached by improving the knowledge and attitudes of the individual, children are rarely consulted in the design of interventions. As such these interventions often do not incorporate the preferences of their target audience. Chapters 4 and 5 detail the focus groups that were held with school students to establish their knowledge, attitudes and behaviours towards health and health risk factors and their opinions on health education. The focus groups found that attitudes held and behaviours adopted in relation to a CVD risk factor was highly dependent on the students' depth of knowledge about the risk factor. Where knowledge was deep, for example as with cigarette smoking, the students were more likely to express strong negative attitudes towards the risk factor, actions to avoid it, and a willingness to discourage the behaviour in others. Where knowledge was poor, such as with blood pressure, the reverse was true. Other findings included the students' use of technology as a form of exercise, the ways in which they seek and gain information, and their perceptions of a healthy weight range, which was heavier than what medically defined as healthy. Finally, the students discussed their views on health education, which included the improvements that could be made to the system. These focus groups highlighted how important information about risk

factors for CVD in the context of obesity could be delivered, and they added to the base of evidence from which the WE ♥ Health intervention was designed.

In the author's opinion, the findings that are important are those that highlight the differences in the ways different health risk behaviours are addressed both in school and generally. It is perhaps telling that the risk behaviour students had the deepest knowledge about- smoking- was the one that seems to have the greatest amount of media coverage, classroom time, and discussion around the diseases that it contributes to. While it is true that diet and exercise are not as simple as smoking- smoking is always damaging, but healthy and unhealthy diet and physical activity exist on continuums- efforts to tackle the risk factors for Non-Communicable diseases, like CVD, should learn from the way smoking is being tackled. It is clear from the focus groups in Chapters 4 and 5 that the multi-faceted approach to the anti-smoking campaign has resulted in children knowing substantially more about smoking than other CVD risk factors.

9.2.3 Parents' knowledge and attitudes towards childhood health and how this affects their child care

Interventions that take into account parents' concepts of health in childhood and opinions on how their children should be taught are rare, despite their substantial impact on the health-related knowledge, attitudes and behaviours of their children. These interventions risk failing if they go against the parents' beliefs and so a focus group study was conducted to inform the WE ♥ Health intervention.

The mothers in this focus group were more likely to change their parenting behaviours when a health issue is less of a societal norm and so perhaps less familiar to them. It was suggested by the author that because excess weight is so common, it no longer causes concern in the way that the mothers said a child being underweight would. Similarly, an underweight but not an overweight result from the NCMP feedback would concern the mothers and prompt behaviour change.

In general the mothers thought that a child would grow out of their excess weight, especially if they were young, and disliked using the terms ‘obese’ and ‘overweight’ to describe a child. They also disliked the use of weight as a proxy for health. The mothers agreed that the potential images and activities that could be incorporated into a healthy living lesson using CVD as an example of ill health rather than weight made it a preferable method for teaching health.

In the opinion of the author, the dismissal of the mothers of the health risks posed by excess weight is the most important finding of these focus groups. To date, attempts to communicate the health risk associated with excess weight have been too moderate and so have failed to relay the seriousness of the risks. While healthy eating and activity messages are a feature of daily life, they lack some of the gravity that can be seen in anti-smoking and mental health campaigns. As such it is suggested that parents have a sense of being well-informed about weight-related health issues but not of the importance of those issues.

The contribution of this study to the thesis was in the support it gained from the mothers for the shift in the focus of health education away from weight. Their assertions that the risk factors for CVD would provide more opportunity for visual aids, activities, and active learning contributed to the rationale for the design of the WE ♥ Health intervention in Chapter 8. Furthermore, the mothers supported the finding of Chapters 3 and 5 that CVD risk factors should be taught to children. Finally, the mothers in this study confirmed the findings of previous studies described in Chapter 2 that parents dislike labelling children according to their weight and are often reluctant to share the results of child BMI measuring programmes with them.

9.2.4 Lessons learnt from the successes and failures of previous interventions

A component analysis was conducted to ensure that the intervention that was to form the final study in this thesis would be evidence-based and draw on the successes and avoid the shortcomings of similar interventions. The author saw little evidence to suggest that interventions designed to improve child health outcomes were informed by previous studies.

This component analysis allowed elements of successful studies to be incorporated into the WE ♥ Health intervention.

The components that were common to studies that brought about an improvement in both biological and non-biological outcomes were: instruction in healthy eating and physical activity, improving self-esteem and self-efficacy, and practical tools such as goal setting and interpreting nutrition labels. Furthermore a strong interactive element with take home materials for children and teachers was included.

9.2.5 WE ♥ Health intervention feasibility study

The WE ♥ Health intervention addressed the literature gaps and used the findings from the previous chapters. As a feasibility study it was successful because even in the short amount of time allowed, the intervention brought about significant improvements in the health knowledge of both the year 7 and year 11 groups. In addition, although underpowered to detect such differences, the intervention significantly improved the self-efficacy and attitudes to health of the year 7 students and the self-efficacy of the year 11 students. The feasibility study was also well-received by the researchers, students and teachers at the school in which it was delivered.

The finding of this study that adds most to the literature is that highly-interactive lessons that make use of technology are an effective and feasible way to teach health topics. Additionally, this lesson was highly engaging for the students and the author had reports that they continued to discuss it even after the intervention was complete.

9.3 Implications for health policy

The findings of this thesis have raised four implications for health policy:

1) Health education should be prioritised, made compulsory throughout the child's school career and what is taught expanded beyond simple diet and exercise advice. It has, however, found that health education is a low priority, mainly available in optional subjects, and with an over-focus on weight control as the reason for a healthy lifestyle. This thesis has demonstrated

repeatedly the importance of equipping children with the information to live heart healthy lifestyles.

2) The National Curriculum, while containing some requirements for health education, has very little requirements for the provision of practical skills that would allow children to make healthy decisions.[6] As such the way in which health is taught should be modified so that it focuses on practical skills and includes much more of the immediate effects of unhealthy behaviour, rather than just the disease end points. In doing this, health education will provide children with the reason why the behaviours being advocated are important, recognise their agency in their own health, and through that agency help them to make informed healthy decisions.

3) Opportunities for relaying a heart health message should be taken outside of the classroom environment. Health professionals such as family doctors and school nurses are well-placed to spread the message that excess weight is not an issue of aesthetics but rather has serious health consequences that could affect the child throughout their adult years. Although the amount of contact that the 5 to 14 years age group has with their primary care practice is the lowest out of all age groups a discussion about cardiovascular health should be built into the consultation whenever possible.[7] Additionally, a multifaceted approach should be taken making use of other outlets of information, for example, the media.

4) The NCMP has the potential to provide a wealth of data on the health of children and the author would recommend broadening its scope to include a greater range of ages and health indicators. As has been discussed throughout this thesis, the risk factors of CVD appear to be more amenable to healthy changes than weight reduction. As such, if unhealthy levels of these factors were identified early, they could be addressed before they are able to worsen. Furthermore, by gathering more data, the NCMP could be a valuable resource for informing parents, monitoring, and equipping researchers with data on the state of the health of English children, rather than just be a proxy measure of their health.

9.4 Implications for future research

This thesis has highlighted thirteen directions for future research.

1) It was demonstrated that overweight and obese children have raised CVD risk factors in comparison to normal weight children; however, the exact ages at which changes in individual CVD risk factors begin need to be established. CVD risk factors could then be more effectively targeted before abnormal levels were reached and treatment could be preventative.

2) The effect that being underweight has on CVD risk also needs to be examined more closely. Study in this area would be greatly advanced if the continuous association between the full range BMI categories and CVD factors was established, in particular the change in risk factors per unit increase of BMI.

3) The non-linear relationship between BMI and blood pressure and cholesterol levels warrants further investigation, not least for the therapeutic implications it may have. The non-linearity of these two relationships suggests that an obese child who loses a small amount of weight may still greatly improve their CVD risk. This could lead to the important conclusion that the complete removal of excess weight is not necessary for substantial improvements to health and future health risk. In turn, recommendations for smaller and more achievable weight loss goals that are directly related to the child's weight could be developed, thereby reducing the onerous task of weight loss in a population where it has often proved difficult to achieve.

4) Studies in this area are limited by the lack of consensus on cut-off points and standardisation in measurement methods. It is important, therefore, that the most appropriate cut-offs and methods be established to improve the quality and comparability of studies being carried out. For example, when conducting the systematic review, it was noted that 11 different sets of cut-offs ranging in publication date from 1986 to 2006 were used by the included studies. The differences in the 90^{th}, 95^{th} and 97^{th} centile cut-off points in the three most frequently cited papers were examined and found that they differed by as much as five points at some weight

thresholds (Appendix 9.1).[8-10] Moreover, differences in cut-off points used to identify children at risk for CVD has significant implications for the numbers categorised as at higher risk, and subsequent therapeutic decisions such as medications or lifestyle changes.

5) Existing definitions of the 'normal' levels of CVD risk factors should be re-examined and should take into account the weight of the child as well as their age and height. For example, BP and lipid tables, such as those published by the National Heart, Lung and Blood Institute (NHLBI), while claiming to provide a more precise definition of childhood BP centiles by incorporating height and/or age into their calculations, fail to take into account the weight of the child.[11 12] For instance, an increase of 7·49mmHg, as was found in the obese children in the systematic review, would result in all children being diagnosed as hypertensive, unless their BP based on their age and height was lower than the 25th centile. Likewise, the obese children had an overall mean triglyceride level of 1.1mmol/L, which would place them in the borderline/high category according to screening recommendations from the NHLBI.

6) Long term studies are needed to clarify the link between childhood BMI, CVD risk factors, and CVD-related morbidity and mortality in adulthood. Although a link has been found between excess weight and adverse health outcomes in adults, a recent review reported little evidence to suggest childhood BMI was an independent risk factor for these outcomes.[13 14] It could be that the interaction between BMI and risk factors could contribute to adult disease rather than the individual effects of each factor.

7) The link between the depth of knowledge and healthier attitudes and behaviours was, to the author's knowledge, a new finding and as such it warrants further investigation. If this were proven the curriculum could be tailored to provide the depth of knowledge most likely to result in attitude and behaviour change in the health issues most affecting children and adolescents.

8) The best method to translate significant increases in knowledge into similar improvements to behaviour is in need of investigation. To date, studies that have attempted behaviour change

through increasing knowledge are often successful in increasing knowledge, but fall short of making meaningful changes to behaviour. Behaviour is complex and influenced by personal, societal, financial and time factors, to name only a small number.[15] As such it is likely that only interventions that are able to address the range of behaviour complexity will succeed.

9) With the growth in popularity of active video games there is an opportunity to take advantage of a new technology in child intervention studies. Although active video games have only been found to be equivalent to moderate physical activity, they are a physical activity that children find enjoyable and so future research should make use of them.[16] [17] Furthermore, children's use of the media should be utilised. The children in the focus groups spoke of watching many lifestyle programmes that featured and are primarily aimed at adults, and stated that no such programmes were aimed at them. Future studies should look at how tailored media can be used to bring about positive health behaviour changes.

10) The way in which different societal norms affect what children believe to be healthy should be investigated. It has been found that in the UK over a period of eight years the rates of being overweight or obese increased, but the rates of those people carrying excess weight who perceived themselves to be overweight decreased.[18] Similarly, the children in Chapter 5 were unable to correctly identify the healthy range of BMI, skewing their ranges to include most of the obese and overweight categories. This may be true of other health issues such as sedentary behaviour, and so by exploring the link between the norms of a child's society and their perceptions of health behaviours new directions for intervening in unhealthy behaviour could be found.

11) Parents have been frequently found to hold the attitude that children will grow out of any excess weight they may have, and this was confirmed in the Chapter 6 focus group.[19] Future investigation could identify the age at which the "they will grow out of it" defence of an overweight child stops being seen as a valid argument by parents. If this age were found to be

late into childhood or in adolescence there would be cause for education programmes targeting parents to discuss the long term implications of poor health in childhood.

12) The contribution of fathers should be sought in future health research. The comparatively low participation of fathers in health care research is a long standing and known issue in research involving parents.[20] The parent focus group detailed in Chapter 6 experienced this difficulty, with only one father volunteering and then failing to attend the discussion. While this may not have been a problem in earlier studies when the mother still assumed the traditional role of primary caregiver, today this role is more likely to be shared and so it is important that the views of fathers are taken into account as well.[20]

13) Finally, the successful WE ♥ Health intervention feasibility study should be improved according to the feedback and delivered to a larger student group, over a longer period of time, as a randomised controlled trial. The Medical Research Council's Framework for Evaluating Complex Interventions recommends that once interventions are designed and piloted the lessons learnt should be used to improve the intervention so that it can be run as a full scale trial.[21] For example, a randomised controlled trial would allow for the inclusion of a control group while the greater number of participants would allow for group sizes to still be sufficiently large for an effect to be found. In addition to a greater number of children overall, further research could test the intervention on a greater number of age groups, and an intervention tailored to these age groups with evidence to support its effectiveness could be produced.

9.5 Reflections on the methodology

In designing the WE ♥ Health studies, several methodological decisions had to be made and they are detailed now below.

9.5.1 Systematic review and meta-analysis

Despite the high levels of heterogeneity present in some of the analyses in Chapter 3, the decision was taken to include a meta-analysis with the systematic review. The advantage of a

meta-analysis over a descriptive analysis is that it allows the effects of studies to be viewed in the context of other similar studies, so that an overall picture of the effects can be gained. It is for this reason that the meta-analysis was carried out where there was high heterogeneity; it allowed both the author and the reader to have an overview of the effect of BMI on the CVD risk factors. It was, however, ensured that the reader was made aware of the I^2 results in both the text and the tables so that they could take them into account when viewing the results of the meta-analysis.

The systematic review resulted in a number of recommendations for both research and health policy that would be added to greatly if, where possible, a life course epidemiological approach was taken to studying the origins of CVD in adulthood. While the systematic review provides a picture of the children's health at the time they were measured, life course epidemiology could shed light on the earlier beginnings of the risk factors found in Chapter 3, and follow how those risk factors may develop and influence adulthood disease. Life course epidemiology advocates the investigation of the beginnings of disease through the study of the effects of biological, behavioural and psychosocial exposures on disease risk from before birth, through childhood, adolescence, adulthood and old age.[22 23] Crucially, this approach to the study of the origins of disease takes into account the timing of various exposures and incorporates them through the critical period model.[22] The model states that exposures during specific periods of development can have a particularly significant effect on future health risk. This approach to health research could be hugely beneficial as it could be used to define the risk exposures, for example excess weight, the timing of when those exposures occur, and how the interaction of these two influence later disease.[23] This could add to previous studies that have established that CVD begins in childhood and is related to measures of weight but do not explain how risk develops and progresses- such as this systematic review. Additionally, studies that have reported that childhood risk for CVD continues into adulthood but do not report information on how the timing of the various exposures influence the development of risk and later disease would be

added to. Furthermore, a life course epidemiological approach to this area of research would provide information on both protective and confounding factors which has frequently been absent in research to date.[23]

9.5.2 Focus group studies

In the focus group studies of Chapters 4 to 6, three major methodological decisions were made. First, whether the data would be gathered via a quantitative or qualitative method. A qualitative method was chosen because the author wished to understand the participants' experiences of health, health measurement and health education.[24] As such a quantitative method, for example questionnaires, could have restricted the participants and gained answers only to questions that the author of the questionnaire thought to be important.

Secondly, a decision was taken between one-on-one interviews or focus groups. It was decided that as the topic of heart health may not be familiar to all of the students, a focus group method would stimulate discussion even if the question was difficult to answer.[25] It is possible that by holding one-on-one discussions the author would have been able to explore more thoroughly the children's reasoning and motivations for the perceptions they expressed. In spite of this, it was thought that the added pressure of interviews would not allow the child to freely express themselves, and make a social desirability response bias more likely.[26]

Thirdly, Framework Analysis was chosen as the method by which the data would be analysed. This approach was chosen because the studies had specific questions to answer but were also interested in any relevant themes that may arise. Framework Analysis allows for this and because it has a well-defined process, it is a comprehensive but efficient method.[27 28] Another method that was available to analyse the data was Grounded Theory.[29 30] This approach, however, requires the researcher to approach the data without pre-conceived notions of the topic under investigation. Even in its modified form, where it is accepted that researchers are unlikely to have no pre-conceptions, the approach does not allow for answers to questions to be sought. A second method that was considered but deemed unsuitable was Interpretive

Phenomenological Analysis (IPA).[31] IPA was not suitable for the purpose of these focus groups because it allows the researcher to explore a phenomenon from the view point of the participant and interpret their cognitions. As such IPA is a useful tool for exploring, for example, participants' experiences of illness, but not the more concrete group experiences and behaviours that were of interest to the WE ♥ Health focus groups.[31]

9.5.3 Pilot intervention feasibility study

The two main methodological decisions that were taken during the development of the pilot intervention were how its success was to be measured and how the data collected was to be analysed. The WE ♥ Health intervention was assessed using the Knowledge, Attitudes and Behaviours (KAB) questionnaire. The KAB questionnaire is made up of the relevant parts of three previously validated questionnaires, with some extra items added to meet the needs of the study.[32-34] While the possibility of developing and validating a new questionnaire that met all of the requirements of the study was considered by the author, it was decided that, given the time and resources available, it was more practical to use previously validated instruments. As this was a feasibility study its main aim was to test how deliverable the intervention would be, with the questionnaire only intended to give an indication of whether the knowledge, attitudes and behaviours of the children would be affected. Therefore, if the intervention were to be tested in a randomised controlled trial, a tailored questionnaire could be developed.

Secondly, following data collection a decision had to be taken on which statistical test should be applied to the data. It was decided by the author that the average group responses for the items should be compared so that whether the intervention was leading to shifts in response patterns could be deduced. As such the choice was between a dependent t-test, because the same children completed the questionnaires on all three occasions, or the Wilcoxon Signed Rank Test if the data was non-parametric. The Wilcoxon Signed Rank Test was selected when it was concluded that the data was not normally distributed following the skewness and kurtosis calculations.[35] Friedman's ANOVA was not considered because the author wished to analyse

the post-intervention and follow-up data in relation to the baseline responses and so only two conditions would be compared per analysis, whereas Friedman's ANOVA compares multiple conditions.[36] Furthermore, the author decided not to apply a Bonferroni correction as it assumes that the datasets are independent which, was not the case here.

9.5.4 The effect of the socio-economic status of the participants

Considerations about the impact of the participants' characteristics on the outcomes of the studies that made up Chapters 5, 6 and 8 cannot be over looked. While efforts were made to recruit participants from a range of social backgrounds, difficulties with recruiting participants of low socio-economic status meant that only high status participants took part in these studies. It is possible that the background of the participants could therefore have affected the findings of those studies. For example, a 2003 study questioned nearly 1700 British adults about their attitudes and beliefs about healthy lifestyles and analysed the responses by social class based on occupation. This study found that lower social class was associated with strong beliefs that health was due to chance and seldom thinking about future health. Additionally, the odds of seldom thinking about ways to stay healthy were greater in lower social classes after adjustment for age, sex and self-rated health.[37] As such, if the student focus group study had been carried out with a more socially deprived group of children the responses gathered may have reflected the more fatalistic, short term health attitudes and beliefs that were found by Wardle and Steptoe.[37] Furthermore, it has been found previously that higher socio-economic status was associated with greater engagement with health messages about CVD risk factors,[38] and was negatively associated with passive coping, and positively associated with adaptive coping strategies in response to messages about health risk.[39 40]In light of these findings, it maybe that the attitudes and responses to the health messages detailed throughout this thesis were more positive than would have been found if the study were carried out in a more diverse sample.

In addition, the socio-economic status of the participants in this study could have an effect on the interaction between the knowledge, attitudes and behaviours, as links between unhealthy

aspects of these and low socio-economic status have been reported. Potvin, Richard and Edwards (2000) found that an individual's socio-economic status was positively associated with their ability to name CVD risk factors.[41] Furthermore, similar findings have been reported where socio-economic status and health related attitudes and behaviours have been investigated. Statistically significant associations have been found between low socio-economic status and beliefs that good health was due to chance, a failure to consider the link between healthy lifestyle and physical health, and not expecting to live beyond 80 years of age.[37] Additionally, high socio-economic status was associated with decreased odds ratios of not spending any time in vigorous activity and less than 1portion of fruit or vegetables consumed daily.[37]

As well as the above individual factors, studies have shown how areas of high deprivation are adding to the issue. A 2007 study examined the concentration of the four largest fast food chains in England and Scotland and reported that outlets were more concentrated in deprived areas.[42] Furthermore, statistically significant associations have also been found between low socio-economic status measured on a neighbourhood level and poor health, even when individual status was controlled for.[43] The authors of this study suggest that the lack of availability of health services, recreational grounds, healthy foods, social support, and the general normative attitudes towards health in areas of high deprivation all contribute to this association.[43]

The associations in the studies described above highlight how the high socio-economic status of the participants taking part in the studies of this thesis could have influenced the results reported herein. The children who took part in the focus groups and pilot intervention had access to facilities and support that could have improved their health related knowledge and attitudes, and made them more likely to engage in healthy behaviours than may have been found if these studies were conducted elsewhere. Highlighted also is the importance and appropriateness of creating an education intervention that is carried out in school and fits into the curriculum, as was done here. Schools are one of the few community structures that can be found across all levels of deprivation and so this intervention would be accessible to all.

9.5.5 The role of the author

While reflections were made in Chapters 5 and 6 on the role that the background of the author could have had in the interpretation of the results, it is also important to consider the influence that the author's background could have had on shaping this thesis as a whole. Firstly, coming from a Health Psychology background, rather than clinical background, the outcomes of this project were always more likely to be predominantly cognitive and behavioural as opposed to clinical. It is the belief of the author that this background aided in conducting the focus group studies as the author is familiar with techniques such as active listening, and this background also aided in the design of the materials for the pilot intervention. The author has experience in designing accessible health promotion and information material, and this could have contributed to the significant increase of knowledge following the intervention. As such, it is believed that this thesis and the projects contained within it contribute a fresh perspective and approach to a research area that is frequently dominated by clinically motivated and assessed studies.

9.6 Conclusion

The question that this thesis aimed to answer was what the link was between BMI categories and a pre-specified set of important CVD risk factors, and whether an intervention designed to educate children about CVD and their hearts would be feasible and potentially result in improvements in their health behaviours in relation to CVD.

New knowledge was contributed to this field by revealing the extent to which CVD factors are affected by BMI categories and highlighting the methodological failings of research in this area. Furthermore it revealed a strong relationship between depth of knowledge and attitudes and behaviours in both students and mothers that has not been described previously in this area.

This thesis was conducted at a time when weight issues were especially topical and heart health was becoming increasingly so. The solution to the global obesity crisis and its co-morbid conditions is unlikely to be solved by a 'silver bullet', but through a number of different

approaches, as has been learnt both from this thesis and from the success, for example, of various anti-smoking campaigns. This thesis has contributed a number of new theories and findings to the literature and has brought us a few steps closer to solving the problem of global obesity and its co-morbid conditions.

9.7 References

1. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The Relation of Overweight to Cardiovascular Risk Factors Among Children and Adolescents: The Bogalusa Heart Study. *Pediatrics* 1999;103(6):1175-82.

2. Gunnell D, Frankel S, Nanchahal K, Peters T, Davey Smith G. Childhood obesity and adult cardiovascular mortality: a 57-y follow-up study based on the Boyd Orr cohort. *Am J Clin Nutr* 1998;67(6):1111-18.

3. Allebeck P, Bergh C. Height, body mass index and mortality: Do social factors explain the association? *Public Health* 1992;106(5):375-82.

4. Hoffmans MDAF, Kromhout D, de Lezenne Coulander C. The impact of Body Mass Index of 78,612 18-year old dutch men on 32-year mortality from all causes. *Journal of Clinical Epidemiology* 1988;41(8):749-56.

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

6. Department of Education. *Review of the National Curriculum*, 2011.

7. RCGP Research and Surveillance Centre. *Weekly Returns Service Annual Report 2009*. London: Royal College of General Practitioners, 2009.

8. 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.

9. Kuczmarski RJ, Ogden CL, Grummer-Strawn, LM ea. CDC growth charts: United States. Advance data from vital and health statistics; no. 314. . Hyattsville, Maryland: National Center for Health Statistics, 2000.

10. Kromeyer-Hauschild K, Wabitsch M, Kunze D, Geller F, Geiß HC, Hesse V, et al. Perzentile für den Body-mass-Index für das Kindes- und Jugendalter unter Heranziehung verschiedener deutscher Stichproben. *Monatsschrift Kinderheilkunde* 2001;149(8):807-18.

11. National High Blood Pressure Education Program Working Group. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics* 2004;114(2):555-77.

12. Daniels SR, Benuck I, Christakis DA, Dennison BA, Gidding SS, Gillman MW. *Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents*: National Heart, Lung, and Blood Institute, 2011.

13. Juhola J, Magnussen CG, Viikari JSA, Kähönen M, Hutri-Kähönen N, Jula A, et al. Tracking of Serum Lipid Levels, Blood Pressure, and Body Mass Index from Childhood to Adulthood: The Cardiovascular Risk in Young Finns Study. *The Journal of pediatrics* 2011;159(4):584-90.

14. Lloyd LJ, Langley-Evans SC, McMullen S. Childhood obesity and adult cardiovascular disease risk: a systematic review. *International Journal of Obesity* 2010;34(1):18-28.

15. National Institute for Health and Clinical Excellence. Promoting physical activity for children and young people. *NICE public health guidance 17*. Manchester, 2009.

16. Biddiss E IJ. Active video games to promote physical activity in children and youth: A systematic review. *Archives of Pediatrics & Adolescent Medicine* 2010;164(7):664-72.

17. Graf DL, Pratt LV, Hester CN, Short KR. Playing Active Video Games Increases Energy Expenditure in Children. *Pediatrics* 2009;124(2):534-40.

18. Johnson F, Cooke L, Croker H, Wardle J. Changing perceptions of weight in Great Britain: comparison of two population surveys. *BMJ* 2008;337:a494.

19. 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. *Journal of School Health* 2006;76 (10):496-501.

20. Phares V. Conducting Nonsexist Research, Prevention, and Treatment with Fathers and Mothers. *Psychology of Women Quarterly* 1996;20(1):55-77.

21. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. *Developing and evaluating complex interventions: new guidance*. Medical Research Council, 2008.

22. Ben-Shlomo, Y and Kuh, D. Alifecourse approach to chronic disease epidemiology: conceptual models, empirical challenges and interdiciplinary perspectives. *International Journal of Epidemiology* 2002; 31: 285-293.

23. Kuh, D, Ben-Shlomo, Y, Lynch, J, Hallqvist, J and Power, C. Life course epidemiology. *Journal of Epidemiology and Community Health* 2003; 57:778-783.

24. Pope C, Mays N. Reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *BMJ* 1995;311(6996):42-5.

25. Holloway I, Wheeler S. *Qualitative Research in Nursing and Health Care*. 3rd Edition ed. Chichester: Wiley-Blackwell, 2010.

26. Furnham A. Response bias, social desirability and dissimulation. *Personality and Individual Differences* 1986;7(3):385-400.

27. Srivastava A, Thomson SB. Framework Analysis: A Qualitative Methodology for Applied Policy Research. *Journal of Administration and Governance* 2009;4(2):72-79.

28. Ritchie J, Lewis J, editors. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London: Sage Publications Ltd., 2003.

29. Glaser B, Strauss A. *The Discovery of Grounded Theory: Strategies for qualitative research*. New Brunswick: Aldine Transaction, 1967.

30. Strauss A, Corbin J. *Basics of qualitative research: Techniques and procedures for developing grounded theory*. 2nd ed. London: Sage Pulications, 1998.

31. Smith JA. Beyond the divide between cognition and discourse: Using interpretative phenomenological analysis in health psychology. *Psychol. Health* 1996;11(2):261-71.

32. Bergman H, Reeve B, Moser R, Scholl S, Klein W. Development of a Comprehensive Heart Disease Knowledge Questionnaire. *Am J Health Educ.* 2011;42:74-87.

33. Smalley SE, Wittler RR, Oliverson RH. Adolescent assessment of cardiovascular heart disease risk factor attitudes and habits. *Journal of Adolescent Health* 2004;35(5):374-79.

34. Roberts C, Freeman J, Samdal O, Schnohr C, de Looze M, Nic Gabhainn S, et al. The Health Behaviour in School-aged Children (HBSC) study: methodological developments and current tensions. *International Journal of Public Health* 2009;54(0):140-50.

35. Blair RC, Higgins, J.J. Comparison of the Power of the Paired Samples t Test to That of Wilcoxon's Signed-Ranks Test Under Various Population Shapes. *Psychological Bulletin* 1985;97(1):119-28.

36. Field A. *Discovering Statistics Using SPSS*. 3rd ed. London: SAGE Publications Ltd, 2009.

37. Wardle, J. and Steptoe, A. Socioeconomic Defferences in Health Attitudes and Beliefs about Healthy Lifestyles. *Journal of Epidemiology and Community Health* 2003; 57:440-443.

38. Ribisl KM, Winkleby MA, Fortmann SP, Flora JA et al. The interplay of socioeconomic status and ethnicity on Hispanic and White men's cardiovascular disease risk and health communication patterns. *Health Education Research* 1998; 13 (3):407-417.

39. Adler NE, Epel ES, Castellazzo G et al. Relationship of subjective and objective social status with psychological and physiological functioning: preliminary data in healthy white women. *Health Psychology* 2000; 19:586–92.

40. Iversen, AC, and Kraft, P. Does socio-economic status and health consciousness influence how women respond to health related messages in media? *Health Education Research* 2006; 21(5):601-610.

41. Potvin, L, Richard, L, and Edwards, AC. Knowledge of cardiovascular disease risk factors among the Canadian population: relationships with indicators of socioeconomic status. Canadian Medical Association Journal 2000;169 (Suppl 9):S5-S11.

42. Macdonald, L, Cummins, S, Macintyre, S. Neighbourhood fast food environment and area deprivation- substitution or concentration? Appetite 2007;49(1):251-254.

43. Pickett, KE, and Pearl, M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: A critical review. Journal of Epidemiology and Community Health 2001; 55:111-122.

Appendices

Chapter 3 Appendices

The following appendices support the study detailed in chapter 3 and some were taken from the paper that resulted from this study that was published in the British Medical Journal.

Friedemann, C., Heneghan C., Mahtani, K., Thompson, M., Perera, R., Ward, A. (2012). Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. BMJ;345:4759 . DOI: 10.1136/bmj.e4759

Appendix 3.1 Search terms and limits

Population	Intervention (measured item)	Outcomes	Exclude
Terms: Children aged 5-16 years	Terms: Overweight Underweight Obes* Body Mass Index Waist circumference Neck circumference % body fat Adipos* Waist hip ratio Skinfold thickness	Terms: Cardiovascular disease Coronary heart disease Blood pressure Hyperlipidaemia Cholesterol Diabetes Pulse rate VO_2Max Fit* Atherosclerosis Arterial stiff* Arterial wall thick*	Prader Willi Syndrome Polycystic Ovary Syndrome AIDS Cerebral Palsy All disabilities All mental illness All eating disorders Cancer Pilot studies Study protocols Non-developed world Studies including the parents Studies taking place in an inpatient setting Pharmacological treatments
Synonyms: School age* children, schoolchild*, adolescen*, teenage*, pubescent, pre-pubescent, pre-teen*	Synonyms: Body weight disorder Over nutrition Under nutrition Thinness Leanness Morbid obesity Abdominal obesity BMI	Synonyms: Hypercholesterolemia Hypertriglyceridemia Impaired glucose tolerance Glucose intoleran* Atherosclerotic plaque Hypertension Heart rate Exercise tolerance Heart disease Vascular disease Coronary artery atherosclerosis Arterial pressure Diastolic blood pressure DBP Systolic blood pressure SBP Ischemic heart disease Aerobic capacity Aerobic exercise	
Limits: **Publication date January 2000 to December 2011** **Human participants** **Children aged 5-16 years** **Articles published in peer reviewed journals**			

Appendix 3.2 Conversion factors used for conventional to standard international units

Risk parameter for cardiovascular disease	Conventional unit	Conversion factor	SI unit
Total, HDL, and LDL cholesterol	mg/dL	0.0259	mmol/L
Glucose	mg/dL	0.0555	mmol/L
Insulin	μIU/mL	6.945	pmol/L
Triglyceride	mg/dL	0.0113	mmol/L

Appendix 3.3 Studies included in the descriptive analysis

Paper	Country of Origin	Number of Participants	Age of participants	Type of study	Parameters measured	Reason for exclusion from meta-analysis
Alhassan 2008[34]	USA	208	8-10	Cross-sectional	Weight, height, resting BP, cholesterol, triglycerides, fasting insulin, fasting glucose	No weight comparison group
Andersen 2003[27]	Denmark	1020	9-16	Cross-sectional	Weight, height, BMI, cholesterol, triglycerides, fasting glucose, fasting insulin, resting BP	No weight comparison group
Andersen 2006[35]	Denmark, Estonia, Portugal	1732	9 and 15	Cross-sectional	Weight, height, resting BP, HOMA-IR, cholesterol, triglycerides	No weight comparison group
Bouziotas 2004[36]	Greece	210	11-14	Cross-sectional	Weight, height, cholesterol, triglycerides, resting BP	No weight comparison group
Brage 2004[37]	Denmark	589	8-10	Cross-sectional	Weight, height, resting BP, cholesterol, fasting insulin, fasting glucose, triglycerides	No weight comparison group
Carrel 2005[38]	USA	50	12 (0.5)	RCT	Weight, height, fasting insulin, fasting glucose	No weight comparison group
Du Bose 2006[39]	USA	375	7-9	Cross-sectional	Weight, height, BMI, triglycerides, cholesterol, resting BP, fasting glucose	No weight comparison group
Ekelund 2007[40]	Denmark, Estonia, Portugal	1746	9 and 15	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglycerides, fasting glucose, fasting insulin	No weight comparison group
Evans 2009[18]	USA	168	13.4 (1.8)	RCT	Weight, height, BMI, cholesterol, triglycerides, fasting glucose	No weight comparison group
Flouris 2007[41]	Canada	3293	14-15	Cross-sectional	Weight, height, resting BP, cholesterol	No weight comparison group
Graf 2005[19]	Germany	1677	5.4-12	Cross-sectional	Weight, height, BMI, resting blood pressure	No weight comparison group
Hansen 2005[42]	Denmark	696	6-7	RCT	Weight, height, BMI, fasting glucose, fasting insulin, cholesterol, triglyceride, resting BP	No weight comparison group
Jago 2006[28]	USA	1717	13.6 (0.6)	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglycerides	No weight comparison group
Johnston 2010[43]	USA	54	10-14	RCT	Weight, height, BMI, cholesterol, triglycerides, resting BP	No weight comparison group
Kalarchian 2009[44]	USA	192	8-12	RCT	Weight, height, BMI, resting blood pressure	No weight comparison group
Kim 2010[45]	South Korea	405	9-10	Cross-sectional	Weight, height, BMI, resting BP, fasting glucose, insulin, triglyceride, cholesterol, HOMA-IR,	No weight comparison group
Klasson-Heggebo 2006[46]	Denmark, Estonia, Portugal, Norway	4072	9 and 15	Cross-sectional	Weight, height, BMI, resting BP	No weight comparison group
Kovacs 2009[47]	Hungary	38	6.5-12.5	RCT	Weight, height, BMI, resting BP, fasting glucose, fasting insulin, cholesterol, HOMA-IR, triglycerides	No weight comparison group
Kriemler 2010[48]	Switzerland	502	6.9 (0.3) and 11.1 (0.5)	RCT	Weight, height, BMI, resting BP, fasting glucose, cholesterol, triglyceride, fasting insulin, HOMA-IR	No weight comparison group
McMurray 2002[49]	USA	1140	11-14	RCT	Weight, height, BMI, resting BP	No weight comparison group
Mirzaei 2007[21]	Australia	1230	8-10	Longitudinal	Weight, height, BMI, resting BP	No weight comparison group
Raman 2010[31]	USA	121	9-13	Cross-sectional	Weight, height, BMI, cholesterol, triglycerides, resting blood pressure	No weight comparison group
Reed 2008[50]	Canada	268	9-11	RCT	Weight, height, BMI, resting BP, cholesterol	No weight comparison group

Reinehr 2010[20]	Germany	66	11.6 (1.6) and 11.4 (1.7)	RCT	Weight, height, BMI, resting BP	No weight comparison group
Resnicow 2005[51]	USA	123	13.6 (1.43)	RCT	Weight, height, BMI, resting BP, cholesterol, fasting glucose, fasting insulin	No weight comparison group
Ribeiro 2004[29]	Portugal	1461	8-15	Cross-sectional	Weight, height, BMI, resting BP, cholesterol	No weight comparison group
Ruiz 2007[52]	Sweden, Estonia	873	9-10	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, fasting glucose, fasting insulin, triglycerides	No weight comparison group
Sacher 2010[53]	UK	116	8-12	RCT	Weight, height, BMI, resting BP	No weight comparison group
Savva 2000[22]	Cyprus	1987	10-14	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglycerides	Weight groups described as ≥ or≤ a cut-off point, no weight data reported
Shalitin 2009[54]	Israel	162	6-11	RCT	Weight, height, BMI, resting BP, triglycerides, cholesterol, fasting glucose, fasting insulin, HOMA-IR	No weight comparison group
Simon 2008[55]	France	954	9.9-13.8	RCT	Weight, height, BMI, fasting glucose, fasting insulin, cholesterol, triglycerides, HOMA-IR, resting BP	No weight comparison group
Steene-Johannessen 2009[30]	Norway	2299	9 and 15	Cross-sectional	Weight, height, resting BP, cholesterol, fasting glucose, triglyceride, fasting insulin, HOMA-IR	No weight comparison group
Steinberger 2002[56]	USA	322	12-14	Cross-sectional	Weight, height, resting BP, triglyceride, fasting insulin, cholesterol, fasting glucose, LVM	No weight comparison group
Teixeira 2001[25]	Portugal	159	10-15	Cross-sectional	Weight, height, BMI, triglycerides, cholesterol	No weight comparison group
Thomas 2007[23]	UK	208	12.9 (0.3)	Cross-sectional	Weight, height, resting BP, cholesterol, triglycerides	No weight comparison group
Vizcaino 2007[24]	Spain	1280	8-11	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglycerides	No weight comparison group
Vizcaino 2008[57]	Spain	1119	9-11	RCT	Weight, height, BMI, resting BP, cholesterol, triglycerides	Number of children in groups not reported in sufficient detail for analysis
Woo 2004a[26]	Hong Kong	82	9-12	RCT	Weight, height, cholesterol, triglycerides, IMT	No weight comparison group
Yoshinaga 2008[58]	Japan	319	6-11	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglyceride, fasting glucose, fasting insulin, HOMA-IR	No weight comparison group
Total: 39		Total: 33,033				

Appendix 3.4 Studies included in the meta-analysis

Paper	Country of Origin	Number of Participants	Age of participants	Type of study	Parameters measured
Aggoun 2008[16]	Switzerland	71	6-11	Cross-sectional	Weight, height, BMI, resting BP, ambulatory BP, IMT, cholesterol, triglycerides, fasting insulin, HOMA-IR
Aguilar 2010[33]	Spain	921	10-12	RCT	Weight, height, BMI, resting BP, cholesterol, triglycerides
Banach 2010[59]	Canada	65	9-12	Cross-sectional	Weight, height, BMI, resting BP
Barba 2006[60]	Italy	3923	6-11	Cross-sectional	Weight, height, BMI, resting BP
Calcaterra 2008[61]	Italy	267	6-15	Cross-sectional	Weight, height, BMI, resting BP, fasting glucose, fasting insulin, cholesterol, triglycerides, HOMA-IR
Csabi 2000[62]	Hungary	419	9-15	Cross-sectional	Weight, height, BMI, resting BP, fasting glucose, fasting insulin, cholesterol, triglycerides
De Sousa 2009[63]	Germany	82	11 +-2	RCT	BMI, triglycerides., cholesterol, fasting insulin, resting BP
Di Bonito 2008[64]	Italy	141	7-14	Cross-sectional	Weight, height, BMI, fasting glucose, cholesterol, triglycerides, fasting insulin, HOMA-IR, resting BP, LVM
Di Salvo 2006[65]	Italy	300	6-15	Cross-sectional	Weight, height, BMI, resting BP, ambulatory BP, fasting insulin, fasting glucose, HOMA-IR, IMT, LVMi
Di Salvo 2008[66]	Italy	320	6-15	Cross-sectional	Weight, height, BMI, resting BP, ambulatory BP, fasting insulin, fasting glucose, HOMA-IR, LVMi
Falaschetti 2010[14]	UK	7589	9-12	Cross-sectional	Weight, height, BMI, resting BP, triglycerides, cholesterol
Farpour-Lambert 2009[67]	Switzerland	66	6-11	RCT	Weight, height, BMI, resting BP, ambulatory BP, IMT, cholesterol, triglycerides, insulin, HOMA-IR
Giannini 2009[32]	Italy	120	6-10	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglycerides, fasting glucose, fasting insulin, HOMA-IR, IMT
Hrafnkelsson 2009[68]	Iceland	267	7	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglycerides, fasting glucose, fasting insulin
Iannuzzi 2004a[69]	Italy	147	6-14	Cross-sectional	Weight, height, BMI, cholesterol, triglycerides, fasting glucose, HOMA-IR, IMT
Iannuzzi 2004b[70]	Italy	143	10 (2.6)	Cross-sectional	Weight, height, cholesterol, triglycerides, fasting glucose, HOMA-IR
Maggio 2008[71]	Switzerland	66	8.8 (1.5)	Cross-sectional	Weight, height, BMI, resting BP, ambulatory BP, LVM
Peralta-Huertas 2008[72]	Canada	63	9-12	Cross-sectional	Weight, height, BMI, resting BP, LVM
Platat 2006[15]	France	640	11.2-11.79	Cross-sectional	Weight, height, BMI, resting BP, fasting glucose, cholesterol triglycerides, fasting insulin
Roh 2007[17]	Korea	83	14-16	Cross-sectional	Weight, height, BMI, cholesterol, triglyceride, resting BP, IMT
Suriano 2010[73]	Australia	180	6-13	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglyceride, fasting insulin, fasting glucose, HOMA-IR
Van Putte-Katier 2008[74]	Belgium	94	8-14	Cross-sectional	Weight, height, BMI, resting BP, fasting glucose, fasting insulin, cholesterol, triglycerides, LVM
Watts 2008[75]	Australia	148	6-13	Cross-sectional	Weight, height, BMI, resting BP, cholesterol, triglyceride, fasting inulin, fasting glucose, HOMA-IR
Woo 2004b[76]	Hong Kong	72	7-12	Case-control	Weight, height, BMI, resting BP, cholesterol, triglyceride, insulin, IMT
Total in meta-analysis: 24		Total in meta-analysis: 16,187			

Chapter 4 Appendices

Appendix 4.1 Invitation letter to schools

Wellness Education for Heart Health Study

Department of Primary Care Health Sciences
23-38 Hythe Bridge Street, Oxford, OX1 2ET
Tel: 01865 289414
E-mail: WEHH@phc.ox.ac.uk

18 December 2013

Lead researcher: Claire Friedemann

Dear

I am writing to invite your school to take part in a new study being run by the University of Oxford's Department of Primary Care Health Sciences. The aim of the study is to discuss with [insert age] year old students what they know about heart health and how they might protect the health of their own hearts.

With your help we would like to send invitations and information sheets about this study to the year [insert] students and hold discussion groups in a classroom at a time that is most convenient for the school. Please see enclosed a copy of the invitation and participant information pack that we would send to the students and their parents.

I would be grateful if you would read through the enclosed participant information sheet, consider whether you would like your school to take part and let me know of your decision. You can let me know of your decision either by completing and returning the reply slip in the freepost envelope provided or by e-mail with the details above.

Heart disease is a leading cause of death in the UK but with simple healthy lifestyle choices the risk of developing it can be reduced. A benefit to your students of taking part in this study will be the education and activity session we would like to run on completion of the discussion groups to teach them about their hearts and encourage them to be interested in their heart health. If you have any questions please contact me on the details at the top of this letter. I look forward to hearing from you.

Yours sincerely,

Claire Friedemann

Lead Researcher

Wellness Education for Heart Health Study

Appendix 4.2 Participant Information Sheet and Consent Forms

WE Health
Weight and Wellness Education for Heart Health

Participant Information Sheet

UNIVERSITY OF OXFORD

Young people's understanding of heart health

You are being invited to take part in a research study. This information sheet explains why the study is being done and what will happen if you decide to take part. Please read it carefully and talk about it with your parents, guardians and friends.

Part 1 explains why we are doing the study and why you have been invited to take part. Part 2 explains what will happen if you decide to take part and what you can expect from us. Please telephone or e-mail us if you want to ask any questions. Please take your time to decide if you want to take part and talk about it with your parents and friends.

If you decide you want to take part please fill in the consent form and send it back to us in the paid envelope in two weeks of getting this information pack.

Part 1

1. Why is the study being done?

The study is being a done to find out what young people know about how their heart works, what makes it unhealthy and what they can do to keep it healthy. We want to find out what students in year 11 are taught about keeping healthy and if they even think about their hearts when they try to be healthy.

2. Why have I been invited?

You have been invited to take part because your school has agreed to be in our study and you are in year 11. We have chosen year 11 because you are finishing secondary school and so will be able to tell us about the things you have learnt at your school. This study is being run by the University of Oxford and we would like 60 students to take part.

3. Do I have to take part?

It is your choice whether you take part. If you decide that you want to take part now but change your mind later you may tell us that you do not want to be in the study anymore without giving a reason. Being in the study will not affect your school work in any way.

Part 2

4. What will happen to me if I take part?

Deciding whether to take part and giving consent

If when you have read this information sheet and spoken about it with your parents you decide to take part, you **and a parent** will need to fill in the consent form that came with this sheet and return it to the University of Oxford in the paid envelope provided. Please return the consent form in two weeks of getting this information pack. If you think you want to be in the study but would like to talk to one of the research team before you fill in the form we are happy to answer all your questions. Our e-mail address and telephone number is at the end of this information sheet. The consent form will also ask for you to say we may record the discussion group you are in and use anonymous quotes- there will be no way to tell who said the quote- in the reports we write.

Discussion groups

The discussion groups will last for an hour either during the school day or in the afternoon after school. The discussion group will be held at your school. Each discussion group will have 5 students in it as well as one researcher asking questions and one researcher taking notes. We will ask you to talk to the other students and the researcher about what you think about being healthy and what you know about keeping your heart healthy. We will be recording the discussion groups so that when we write up the report we know exactly what everyone said. Only the research team will be able to listen to the recordings.

5. Why should I take part?

If you decide to take part you will be helping us to learn what young people know about keeping healthy and what they still need to be taught so that they can look after the health of their hearts.

6. If I take part will people be able to find out who I am from what I say?

No one will be able to tell who you are from the information we collect. You will be given a number instead of your name so that we can follow what you say but no one will be able to find out who you are. We will keep the digital recordings of each discussion group in a safe and secure place for 10 years after the study has been published. All the information we collect will be kept securely according to the Data Protection Act 1998 which is a guide to protect the personal information people might give to businesses.

7. What will happen if I don't want to be in the study anymore?

If you decide you don't want to be in the study anymore you can phone, write to or e-mail the research team. You can leave the study at any time and you don't have to tell us why. We will delete or destroy any information you have given us already. If you decide to leave the study your school work will not be affected in any way.

8. What if I have any problems with the study?

We don't think that you should have any problems because you took part in the study but if you or your parents have any worries about how the study was run you should contact the lead researcher, Claire Friedemann (Tel: 01865 289414).

9. What will happen to the results of the study?

The results of the study will be published in a medical journal that is checked by people working in medicine and health care and will be available on the journal's website. We will write a newsletter describing the results of the study and if you or your parents would like to know what we found out please tick the box at the end of the consent form and we will send you a copy within two weeks of the study being published.

10. Who is running and funding the study?

The study is being run by the University of Oxford's Department of Primary Care Health Sciences and is funded by the University and the Medical Research Council.

11. Has anyone checked the study?

The study has been checked by the Oxford University Ethics Committee as well as a group of teachers from your school and they have agreed that it can be carried out.

12. More information and contact details

If you would like any more information or would like to ask us any questions about the study you can talk to one of the research team.

WEHH Study
Department of Primary Care Health Sciences
University of Oxford
2nd Floor Offices
23-38 Hythe Bridge Street
Oxford OX1 2ET

Tel: 01865 289414 (office hours)

Email: WEHH@phc.ox.ac.uk

Lead researcher: Claire Friedemann

Department of Primary Care Health Sciences
23-38 Hythe Bridge Street, Oxford, OX1 2ET
Tel: 01865 289414
E-mail: WEHH@phc.ox.ac.uk
Lead researcher: Claire Friedemann

Student Consent Form

Study ID Number

WE♥H: Young People's Understanding of Heart Health

If you would like to take part in this study, you need to complete this consent form, otherwise we cannot use the information you give us for the study.

Please initial each box

1. I have read and understand the information sheet for the above study. I have had a chance to think about the information and ask questions. All my questions have been answered and I have no more questions. ☐
2. I understand that it is my choice whether or not to take part in the study and I can decide that I do not want to take part anymore at anytime without giving a reason. ☐
3. I understand that the information collected by the study will be looked at by researchers at the University of Oxford and I give permission for these researchers to use the information I give in the study. ☐
4. I agree that my discussion group can be recorded so that the researchers can analyse what we say. ☐
5. I agree for quotes without names from my discussion group to be used in papers published from this study in scientific journals. ☐
6. I agree to take part in this study. ☐

Name (please print) _____

Signature _____ Date _____

School _____

Tutor group _____

I would like a copy of the newsletter of the results of the study (please tick). ☐

Department of Primary Care Health Sciences
23-38 Hythe Bridge Street, Oxford, OX1 2ET
Tel: 01865 289414
E-mail: WEHH@phc.ox.ac.uk
Lead researcher: Claire Friedemann

Parent Consent Form

Study ID Number

WE♥H: Young People's Understanding of Heart Health

If you agree for your child to take part in this study, you need to complete this consent form, otherwise we cannot use the information they provide us for the study.

Please initial each box

1. I have read and understand the information sheet for the above study. I have had the chance to think about the information, talk about it with my child and ask questions. I have had my questions answered and I have no more questions. ☐
2. I understand that it is my child's choice, with my permission, whether or not to take part in the study and both my child or myself can decide to withdraw from the study at anytime without giving a reason. ☐
3. I understand that the information collected by the study will be looked at by researchers at the University of Oxford and I give permission for these researchers to use the information that my child provides in the study. ☐
4. I agree to the audio recording of the discussion group that my child takes part in for the purpose of analysing the discussion for the study. ☐
5. I agree for anonymous quotations from my child to be used in papers published from this study in scientific journals. ☐
6. I give my permission for my child to take part in this study. ☐

Name (please print) _____

Signature _____ Date _____

Name of child _____

Preferred contact number _____

I would like a copy of the newsletter of the results of the study (please tick). ☐

Appendix 4.3 Focus group schedule

Young People's Understanding of Heart Health: Focus group schedule

Date:	School:	Number present and sex:
Researchers present		

Welcome and introduce researchers. Describe the purpose of the study and ask that all views expressed are treated with respect and not discussed outside the focus group. Questions?

Knowledge	Attitudes/beliefs	Behaviours	Prompts
Brainstorm: What kinds of things make your heart go wrong?			
Quiz.			
Quiz: Establish how the children answered in Q1			
1. Does anyone know what happens in your body when smoking, alcohol, exercise, being overweight, inactivity and salt affect your blood pressure? *Discuss each individually*	a) When discussing smoking ask if children think smoking is bad (if not already mentioned) and if and by how much smoking can shorten a person's life.		Notes
	b) How does high blood pressure damage the heart?		
	c) For all that are harmful ask if they think the harm can be reversed		
2. Do you think that the things that you do now can affect how healthy your heart is in the future?	a) When do you think people should start thinking about the health of their hearts?		
3. What kinds of things do you do in your spare time? For how long? How did you get into it?	a) Why do you do (things mentioned in 3)		
	b) If sports would they ever do because it is good for their heart?		
4. If you saw someone you knew doing something you thought was bad for them would you tell them?	a) What might you say?		

Quiz: Establish how the children answered in Q2 and Q3.		
5. Does anyone know what the different types of cholesterol are?		Notes
6. Is cholesterol helpful or harmful to your heart?	a) What are the good/bad types?	
7. Does anyone know what the different types of cholesterol do that makes them good/bad for your heart?		
8. Do you think that knowing how the different things you eat could affect your heart health is useful?	a) Why?	
9. What makes you choose the things you like to eat?		
10. What do you like to eat?		

Quiz: Establish how the children answered Q4.		
9. What kinds of things might affect a person's heart rate?		Notes
10. Is it good to do things that raise your heart rate for short amounts of time?	a) Why?	
11. Can anyone tell me how much time you should spend doing things that raise your heart rate every day?		
12. Do you think you do the right amount of exercise?		

Quiz: Establish how the children answered Q5.		
13. Does anyone know how you would use this machine?		Notes
14. What do the numbers mean?		
15. Is there a difference between blood pressure and heart rate?	a) What is it? b) Can one affect the other?	
16. Would you like it if when you were taught about health you were given the chance to use things like BP monitors?	a) Why?	
17. Whose responsibility do you think it is to teach you about heart health?		
18. Can you think of a lesson about a health topic that you enjoyed or didn't enjoy?	a) What did you like/dislike about it?	
19. Do you ever talk about heart health with your friends or family?		
20. If you had a question about your heart health who would you ask?	a) Why would you ask this person?	

Quiz: Establish how the children answered Q6.		
21. Why do you think (the response given to Q6) is bad for your heart?		Notes
22. Do you think these people can improve their heart health?		
23. If you knew someone who was like this would you talk to them about their health?	a) What would you say?	
Notes		
Did any adverse events occur during the focus group? Y/N		
IF YES, DESCRIBE:		

Appendix 4.4 Feedback letter to head teachers

WE Health
Height and Wellness Education for Heart Health

Department of Primary Care Health Sciences
Radcliffe Observatory Quarter, Woodstock Road, Oxford, OX2 6GG
Tel: 01865 289414
E-mail: WEHH@phc.ox.ac.uk
Lead researcher: Claire Friedemann

UNIVERSITY OF OXFORD

March 2013

Dear sir/madam,

Thank you for taking part in our focus group study last year. The results have now been analysed and we would like to share them with you. We have summarised them below as they would be in a scientific journal and we hope you find them of interest.

Background: The risk factors for cardiovascular disease can begin to appear in childhood, however through healthy lifestyle choices these are modifiable. It has been recommended that children are targeted early so that lifelong healthy lifestyle habits can be formed. Despite this, children's health and heart knowledge has been frequently found to be poor.

Methods: Focus groups were used to elicit the knowledge and views of 10-11 year olds and 15-16 year olds on heart health, general health and the delivery of health education in schools. Eight focus groups were conducted and analysed using Framework Analysis. Framework analysis allowed the research team to answer specific questions from the text while allowing new, unexpected theories to emerge from the students.

Results: Whilst the students had some heart health and general health knowledge, it was limited and frequently inaccurate. This was especially true of the younger children and in the 15-16 year olds was influenced by the choice of optional school subjects studied, for example those taking PE or Health and Social Studies were more knowledgeable. The participants spoke of influences to their own lifestyles that included family members, teachers, doctors and the media. When asked about how they would like to see health taught at school, both age groups expressed preferences for detailed and interactive lessons that they could apply to themselves now.

Conclusion: There is a need for effective health education and in particular heart health education. This study was able to elicit a number of recommendations for the format of lessons that could influence the health attitudes and behaviours of children.

We hope that you and your students enjoyed taking part in the study and would like to take this opportunity to that you again for your participation.

Yours sincerely,

Claire Friedemann

Chapter 5 Appendices

Appendix 5.1 Year 6 knowledge levels and links to attitudes and behaviours

Risk Factor	Knowledge	Attitude	Behaviour
Smoking	– "Because your putting unneeded toxins into your body and that starts to harm and […] they go in your lungs and it doesn't get oxygen into the blood" [year 6 boy] – "Because they go in your lungs and it doesn't get oxygen into the blood. Um like they [cigarettes] have tar…They got nicotine" [year 6 boy] – "and it [cigarette] has all of that black stuff" "tar" "tar" "tar" "and nicotine" [year 6 girls] – "I thought it could um, cigarettes have like things in them. Don't really, don't really know. It makes your heart work harder" [year 6 boy] – "[…] it goes down because it clogs up your arteries and blood can't get round your body" [year 6 girl] – "it would slow it down in a way because um the lungs give the oxygen to the heart; it might like have smoke in it and then damage the heart" [year 6 girl] – "Because you inhale bad stuff […] and so it makes your blood pressure go faster" [year 6 girl] – "If you like smoke it's […] like drugs so you continue and continue and continue" "Because you become addicted to it" "Unless you have like the strength to stop there's still a bit of smoke in your lungs so I think you can't" [year 6 girls] – "My mom smokes and she's trying to stop she has those other […]" "Nicorette, Nicorette patches" "It's like a cigarette but it doesn't have the really bad stuff […]" [year 6 girls] – "Even if you stop, even if you've already stopped and like put out the cigarette [there is] still smoke everywhere" "Yeah because apparently like 80% of it is invisible" [year 6 girls] – "It's like it's like this small tube and you put it at the end of the cigarette and it like takes all the tar out so it's not addictive, well it's not as addictive" [year 6 girl]	– "Her dad has started again and her two, her brother and her sister smoke because they live in London and she gets really upset" [year 6 girl] – "Why doesn't she throw the cigarettes in the bin?" "It takes time" "[…] because then you'd probably just you'd go mad because of the addiction and you'd just go and get them out the bin so you slowly decrease the amount, it's easier" [year 6 girls] – "It's on the packet anyway. Don't smoke. Smoking kills so I don't know why people do it" [year 6 boy] – "Yeah there's a horrible, there's loads of disgusting people, pictures of people's teeth [on cigarette packets]" [year 6 boy] – "It should be illegal" [year 6 boy]	– Researcher: "Would you say something [about their smoking to a loved one] to them?" "It [smoking] upsets me, yeah" [year 6 girl] – "Loads of people get pressured [to smoke]" "Yeah when you go out and you're like one of your friends smokes they normally um like" "[…] they like will try and get you to smoke but you've got to be strong" [year 6 girls] – "I have four sisters all over 18 and they all smoke. Well they'll walk past and I'll say smoking kills!" [year 6 boy] – "I, I, I would just take it [cigarette] out their mouths" [year 6 girl] – "Whenever I catch [family member smoking] like sometimes it's my nan or whatever I go you shouldn't be doing that!" [year 6 girl] – "[…] I've almost convinced her to quit smoking" [year 6 girl] – "My dad smokes since I was a baby. But he doesn't smoke with us so I can't say anything to him because he smokes outside" [year 6 girl] – "I heard it on the radio they like will try and get you to smoke but you've got to be strong" "I would run away if they asked me" "I would be scared" "Be strong"

		[year 6 girls]
Blood pressure	–	"[…] the bad things make it go down" [year 6 girl]
	–	Researcher: "Works it harder and why is that bad for it do you think?" " I don't know" " Because it's unnecessary for it to do that and if it does it can just, blow up" "It can give you cardiac arrest" [year 6 boys]
	–	"What is your blood pressure?" "maybe it's how many beats your heart does" [year 6 girls]
	–	"Because it's unnecessary for it to do that and if it does it [heart] can just, blow up [as a result of hypertension]" [year 6 boy]
	–	"Ah heart rate is how many beats per minute I think" "And blood pressure is the pressure of your blood" [year 6 boys]
	–	"[…] when you exercise it makes your heart beat faster which means that your breath goes up which stops your heart so it goes down" [year 6 girl]
Cholesterol	–	"What is a cholesterol?" [year 6 boy]
	–	"What is there good cholesterol?" "Oh yeah yeah there's good choles- cholesterol […] but I don't really know the difference" [year 6 girls]
	–	"What is cho- oh I don't know" "Cholesterol" "What is cholesterol?" [year 6 girls]
	–	"Only that there's good types [of cholesterol] and bad types but I have no idea what they're called or what they do" [year 6 girls]
	–	"I've heard of it before but I didn't know what it was. I knew there was a good and a bad but I didn't know how they were good or bad" [year 6 boys]
	–	"Can you name 3 things that might raise cholesterol?" "Fat, fat, fat" "Meat" [year 6 girls]
	–	"It like builds fat on your heart […] the kind of like food you eat and that" "Yeah the fat blocks up uh the like arteries and um so the blood it makes it hard for the blood to go through" [year 6 girls]
	–	"Because the blood goes slow […]" "It [cholesterol] gets in the veins and all that and it just like clogs it all up" [year 6 boys]
	–	"[…]if you have a bit of cholesterol fat um it can like keep you warm but if you have too much" "it just is unhealthy" "you get too hot [laughter]" "yes you get, you do get sweaty" [year 6 girls]

Diet	– "Can I down a glass, like a bottle of orange juice and say I've eaten, drink, drunk my five a day?" [year 6 girl] – "A calories [sic] is a store of energy in your muscles" [year 6 girl] – "Salt's bad for your heart" "Yeah but guys, guys the bad things make it go down" "No it clogs up your" "I think it makes it go down" "Main artery, arteries" [year 6 girls] – "I know it's bad for you [salt] but I don't know what it does" [year 6 boy]	– "When you're a teenager everybody thinks you can't eat because you have to be skinny" [year 6 girl] – "Because they're [the things they choose to eat] tasty" "Our taste buds, tongues, if they like them they make you like eat them more" [year 6 girls]	– "Yeah tried to persuade my dad to go on a diet about eight times but he keeps doing it" [year 6 boy]
Alcohol	– " I don't think alcohol does anything" [year 6 boy] – "I said go up [BP] because um when you get drunk you get a bit crazy" "Everybody at a party was drinking that means it gets crazy" "And you get really manic and" "Then you throw bottles out windows and stuff" [year 6 girls] – "I did nothing because I thought it [alcohol] only does, kills brain cells" [year 6 boy] – "and alcohol doesn't it eventually, well I don't know what damage it does, but the actual effect of alcohol wears off after like you've had your hangover? […] it does, it does wear off after a while of after a while the actual being drunk but the effects of what it does on your heart might be there I don't know" [year 6 girl]	– "And like you can stop drinking alcohol or drink it little" [year 6 girl]	– "Um well dad was drinking too much […] so we asked him to stop and we kept on pestering him until he did" [year 6 boy] – "I love Baileys" "Baileys that's alcohol!" " I drink bucks fizz at Christmas" "I only have like half a glass" "I had wine but I put straws in it" [year 6 girls] – "[…] drinking too much alcohol I wouldn't really say anything" [year 6 girl]
Weight	– "Because they've got a tiny heart [underweight people]" [year 6 girl] – "They don't have um like fat on them so they can't like breathe" [year 6 girl] – "If someone really fat works hard they can have a heart attack or something" [year 6 boy] – "On I saw on the news that this lady cried for an hour and she lost two stone" [year 6 girl] – "Unhealthy is [BMI] 29 up" [year 6 boy] – "The third is too skinny [BMI 22] I think the fourth is the average size [BMI 24]" [year 6 girl] – "I put the three first and the three last, there's only three healthy ones [BMI 24-29]" [year 6 girl] – "Is it because you have like more weight to carry so it's like harder to walk around?" "Your your heart has to pump a bit more" "More weight" "You need more blood pumping round" [year 6 girls]	– "Too skinny is just wrong and it's not healthy" [year 6 boy] – "[Thin people should] Eat fatty things and don't do exercise" [year 6 boy] – "[Fat people should] Eat more proper food […]" "Go to a gym" [year 6 boys] – "The fatter people exercise more and eat less and the thinner people eat more" [year 6 girl] – "[Thin people should] Eat eat a lot more" [year 6 girl] – "[Fat people should] Don't eat as much" "And restrict fats" [year 6 girls] – "[Thin people should eat] Vegetables or something. Not fat stuff just to get them fat" [year 6 girl] – "If you're obese if you exercised to make it better" [year 6 boy] – "Being overweight can you just go run round you like do exercise, start eating healthily" [year 6 girl] – "You can change being fat" [year 6 boy] – "I don't know whether it's your fault or not if you're too fat or too	– "If they were scarily overweight I would say something" [year 6 girl] – "Like a little bit or like a little bit underweight or a little bit overweight I wouldn't really say anything" "But there is a bit [sic] embarrassing that a fat person doesn't think they're fat so they keep eating" [year 6 girls]

		thin" "If you're young, if you're young it's really your parents" [year 6 girls] – "The fourth of third [BMI 22-24] are about average size because my mom's about that" "The third [BMI 22] is too skinny I think the fourth [BMI24] is the average size " [year 6 girls]

Appendix 5.2 Year 11 knowledge levels and links to attitudes and behaviours

Risk Factor	Knowledge	Attitude	Behaviour
Smoking	– "[…] smoking clogs up like blood vessels with tar and that causes cardiac arrests" [year 11 boy] – "[…] smoking as well reduces the amount of oxygen so the heart has to pump more blood round the body quicker" [year 11 boy] – "If you can only get a certain amount of oxygen in and you need so much oxygen, if your lungs aren't working to full efficiency then you're going to have to do, you're going to have to pump more blood round to get the same amount of oxygen, maybe? [as a result of smoking]" [year 11 girl] – "Because when you smoke you lose weight so when you stop you gain loads of weight so you've got something else to deal with so it's harder to get fit again" [year 11 girl] – "[Extent of smoking damage] depends how old you are when you quit smoking" "or how long you smoked for"[year 11 girls] – "if you smoked for like 2 years I've heard that then if you don't smoke for about a week your body starts kicking and gets back to its normal self" [year 11 girl] – "You've got to go through the dip though haven't you like nicotine debt or whatever it's called." [year 11 girl] – "Does it, does it like the nicotine or something make your heart beat faster? Meaning the blood goes round faster increasing the pressure maybe?" [year 11 girl] – Researcher: "And um how much does smoking, or how much do you think smoking can shorten a person's life, do you know?" "Isn't it something like, every one you have is like like 7 minutes, 6 minutes off your life or something?" [year 11 girl] – Researcher: "[…] do you know by how much smoking can shorten a person's life?" "Half an hour for every cigarette that you smoke" [year 11 boy] – "Every single time you smoke it's going to make it a little bit more [blocked arteries] isn't it?" [year 11 boy]	– "Um well if you can see people getting like overweight or if you start to smoke, it's quite young to what you think it would actually be but it does, like I say, have a knock on effect for later in life" [year 11 boy] – "I think you can reverse it a bit" "to a certain extent" "but not to like the full extent." [year 11 girls] – "Wouldn't want anyone to smoke, I want it banned" [year 11 girl] – "I really don't see the point in smoking, why someone would start" [year 11 girl] – "Disgusting" [year 11 girl]	– "I'm trying to get my mom to stop smoking but she tried a patch and she's allergic to it so straight back to square 1" [year 11 girl]
Blood pressure	– Researcher: "[…] how many times do you think a healthy person's heart beats in one minute?" "I thought it was 110-150, I don't know" [year 11 girl] – Researcher: "[…] and is it a good thing to do to raise your heart	– "So it's a lot less common [CVD] in young, as far as I'm aware, it's a lot less common in young people than it is in older people and I don't know if the stage we're at we might want to know more about it but we probably don't want to worry about it"	– Researcher: "[…] do you ever think about things like your heart health?" "Mmm not really you usually think

	rate for short amounts of time do you think?" "I don't know it could confuse your heart." [year 11 girl] – "I don't know what blood pressure is at all" "[…] they said you could measure your blood pressure by the number of times it goes through an artery or something." "[…] the number of time it goes round your body in a minute." [year 11 girls] – "Blood pressure isn't it how much pressure exists in the arteries." [year 11 boy] – "Blood pressure is the pressure that gets forced through your veins and the heart rate is how many times it beats per minute" [year 11 boy] – "Systolic's like your when your ah I think it's the when your hearts relaxed and then diastolic is when it's contracted, or the other way around […] it's something to do with ones, ones contracted and ones relaxed and how much blood you can pump out when its contracted and how much you can fill when its relaxed" [year 11 girl]	[year 11 boy] – "Yeah it's just something that happens later in life [CVD] when your body just stops doing things as efficiently" [year 11 boy] – "yeah I think of blood pressure because my dad has high blood pressure so if I like see bolognaise and it's really oily I go er [laughter] high blood pressure" [year 11 girl] – "yeah and if you've got health problems then I'm sure you'll have to think about it but if you don't you just it doesn't cross your mind really" [year 11 girl] – "Well personally I don't think about my heart that much […] "Same here I stay healthy but I don't particularly think about the heart itself and whether its ok or not" [year 11 boys] – "There's nothing like on TV unless you're like 80" [year 11 girl] – "Because we don't see the consequences like at our age" "no 16 year olds see consequences" [year 11 girls]	like outside" [year 11 boy]
Cholesterol	– Researcher: "[…] do you know that there are different types of cholesterol?" "No." [year 11 girl] – Researcher: "OK so cholesterol […] do you think that's helpful or harmful to your heart?" ALL: "harmful" [year 11 girls] – Researcher: "[…] foods that might raise your cholesterol, what did you put for these?" "salty foods" [year 11 boy] – "Yeah it's the cholesterol which clogs up the arteries" [year 11 boy] – Researcher: "[…] which of these food you think might raise cholesterol?" "High in saturated fat"[year 11 boy] – "[…] there's like a build-up of cholesterol so like it's harder for your blood to get round which increases pressure because it's all trying to get through." [year 11 girl] – "The fat gets stuck in er stuck in the veins and that forces the blood to go through at the same rate but it will have to go through faster through the veins because there isn't as much space for the blood to go through." [year 11 boy] – "[…] if the artery is all like blocked up and there's loads of pressure, isn't it like um if it blocks up the coronary artery then your heart can be cut off of oxygen or something. So you can have like a heart attack" [year 11 girl] – "Salty foods [raise cholesterol]" [year 11 boy]		

	– " Is it like the fat clogs their arteries and so increases their blood pressure which is important to heart disease" [year 11 boy]		
Diet	– "[…] [Salt makes] the blood gets thicker which means that it taxes the veins more as it goes through the veins." [year 11 boy] – "It's because your muscles need like nutrition to work and stuff and if they're not getting enough of it the um cardiovascular system won't work to its full capacity" [year 11 boy] – "The right diet, like a balanced diet" "giving your food the right, yup, giving your body the right stuff" "making sure everything is balanced" [year 11 girls]	– "When you're young like we are your parents, it depends what they give you in your lunch because some parents don't really care about their child's health like" [year 11 girl] – "I have parents for the things that I choose to eat. The sort of just go out and buy it and you have to make do with what they buy and just try to pick the healthy things from the list" [year 11 boy] – "I think people think as well because they're young then it's fine to eat lots of stuff and it doesn't really affect you" [year 11 girl] – "It's when they when they say completely cut it out everyone sort of like [goes] no why would I do that and then completely go against what they are saying" [year 11 girl]	– "I think the reason why I eat like rubbish food when I go out is she [mum] ain't going to give it me at home so I'm just going to buy it myself I think that's why. If I had no money then like I'd be like thin, I'd be good because my mum just gives me healthy food." [year 11 girl]
Alcohol	– "Does it [alcohol] get into your blood stream or something? I'm not sure." [year 11 girl]	– "[…] they don't tell you that it's OK to drink moderately like which I think they should" [year 11 girl]	– "We had an agreement in my in our family that now my parents are generally only allowed 1 glass of wine on a Saturday night because usually they would just have one like every night just because it's, after a long day it's just nice but we decided that we are going to start to be healthier" [year 11 girl]
Weight	– "[Excess weight] Putting pressure on your heart […] if you're just like slumped up it's going to be like pushing it all like onto your heart" Researcher: "So you mean the actual weight?" "Resting on your heart" [year 11 girls] – "Yeah in potential all of them could have an unhealthy heart. Yeah it all depends on other conditions not just BMI." [year 11 boy] – "[…] if you're skinny and you have like zero muscle then surely your heart is going to be really weak but there's part of me that says actually I don't know. […] would you get a really kind of weak heart in the same way that you'd get like weak body muscles? Like cardiac muscles? it just gets really weak" [year 11	– " I think the thinner people are going to have really bad hearts" "yeah both these sides, like the middle is going to be the normal" "I think the 33 to 22 is fine" [year 11 girls] – "I think on there 22 to 33 is sort of like not normal but like you know acceptable" [year 11 girl] – "I don't I might go to 29 actually I think 33 is a bit round-y" "24 to 29" "is the most normal" [year 11 girls] – "[Unhealthy BMI range] 37 to 40 and 17 to 19" [year 11 girl] – "[Unhealthy BMI] The first 2 [BMI17-19] and last 3 [BMI 33+]" – "Um well if you can see people getting like overweight or if you start to smoke, it's quite young to what you think it would	– "Probably not [discuss weight] because it's quite a touchy subject to go up to them and be like I-, I think you like diet or something" [year 11 girl] – "More like the aesthetics thing isn't it?" [year 11 boy] – "[exercise because] I'm going on holiday [laughter] and I need to look good [laughter]" [year 11 girl]

	girl] – "Because you're obviously under eating you're body's not getting the stuff it needs" [year 11 girl]	actually be but it does, like I say, have a knock on effect for later in life" [year 11 boy] – "I think you should start looking after your health around our age so that when you're older you can continue being healthy" "I bet if you told an obese person if you'd learnt this at 10 then you wouldn't have got yourself into this situation they go oh I wish I'd learnt that" [year 11 girls] – "They [overweight people] can make, do more exercise and then eat a better diet. I think they [underweight people] should also exercise but have a good diet as well […] they shouldn't just eat but they should make should make sure they eat more than they exercise but do exercise, because otherwise they've got to build muscles as well not just fat" [year 11 girl] – "Well for the bigger people you could suggest to do exercise and balance out your diet and gradually, for the skinny people you could say gradually build up your food intake, diversity and […] I'd say if they were lacking muscle and stuff wouldn't it be protein or something that you should advise them to have?" [year 11 boy]

Appendix 5.3 Year 6 perceptions of health education

	What is provided	What is wanted
Heart function	– "60-100. 90 is healthy we learnt that" [year 6 boy] – "We did a heart we're in when we were in year 5 we did that thing in the hall kind of where we tested how our BPM changes reading, sitting, standing still and I think it was star jumps or running or something" [year 6 girl]	
Physical education	– "PE. We just don't do much [health education] in PE" "No we don't do much" [year 6 boys]	
PSHE	– Researcher: "What sort of things do you get taught in PSHE?" "A healthy diet" " Um being active, and sport" [year 6 boys]	
Health education	– "Um we sometimes have a school nurse to come in yeah" "To talk to like changes and stuff" "She tells us about, a few years ago she talked about health" "And like growing up" [year 6 girls] – Researcher: "What sort of things do you get taught about health in school?" "And eat healthy stuff like the five a day" "Eat healthily yeah" "Eat five a day" [year 6 girls] – Researcher: "What sort of things do you get taught about health in school?" "That you should exercise like every day" [year 6 girl] – "Yeah but she [school nurse] said you know exercise is good for you, especially when you're growing up" [year 6 girl] – "In year five we did like bones and the arteries and veins, veins get it round" [year 6 boy]	– "yeah I don't like ones where they just sit you down and just like tell you smoking is bad is bad for you" [year 6 girl] – "And then I don't like when they teach us a lesson yeah and like and like don't explain it they just say "this is a thing" and I'm like" "What's that?" "Yeah what is it? What is that? So they don't really explain it good so we don't get to learn anything except the word" [year 6 mixed] – "They sometimes write the answers on the board so we don't learn anything we just write it out a book" "So we just, so we just have to copy it all down" "Yeah so we don't really learn" [year 6 mixed] – "And you don't actually um you don't actually learn anything you just copy the words down" [year 6 boy] – "Well because we know what could happen if we eat it so maybe it will make us think before we do, I might get a bad, I might get you know some cholesterol if I eat this so I maybe won't eat it and switch to a carrot" [year 6 girl] – "Yeah sort of like, I know that some foods that I eat are bad for me but I don't entirely know why and stuff like that, it's bad for you, why?" [year 6 girl]
Interactive learning	– "Went to the Horton hospital" "Oh for Imps" "And ah I got a um got a machine attached to my wrists and neck and it tells if you're dead or alive" [year 6 boys] – "Laid in the ambulance and did CPR" [year 6 boy] – "A few years ago we had a trip to Imps to show us all about that stuff. Imps is at the John Radcliffe Hospital I think […} And then we went and did like learn about your heart thing and we used the machines and they put the things there and measured our pulse and they made us run on this machine it said […] how fast your hearts going or your pulse" [year 6 girl]	– "I like this sort of lesson because you have quizzes and you talk and you have stuff like that. You're not just, we're not just sitting down and you're not just telling us things" [year 6 girl]

Appendix 5.4 Year 11 perceptions of health education

	What is provided	What is wanted
Heart function	– "We did learn this [blood pressure] but I can't remember." [year 11 girl] – "We just talked about basically how cholesterol made your heart go faster." [year 11 boy]	
Physical education	– "I mean in PE taught like the circulatory system, everything aren't we really, we're taught heart rate being…like a balanced diet where you need to stay healthy that sort of stuff, we're taught that." [year 11 boy] – "Isn't it your stroke volume? How much blood you can pump out in one pump?" "Someone does PE for GCSE!" [year 11 girls] – Researcher: "Are you actually even taught about your heart? Your cardiovascular system?" "I only got taught it in PE, sort of GCSE PE." [year 11 boy] – "They do quite a lot in PE about exercise and diet." [year 11 girl]	
PSHE	– "In schools kind of that's what PSHE is for [health education]." [year 11 girl] – "Like some of the topics that are in PSHCE I don't think are very useful, I think we should use them more for health." [year 11 girl]	– "Yeah we should do more [health] in PSHE lessons to um…it's called health education for a reason!" [year 11 boy]
Biology	– "[…] they didn't really talk us through it or anything, they just sort of said cut up the heart." [year 11 boy] – "Well I liked the heart dissection but we weren't actually taught much based on what we were doing so like you're just dissecting a heart but you don't know what anything does with it or you're not, even if you do know how it works you're not learning about heart health." [year 11 boy] – "yeah when we do we don't look at the health factors we look at how […] what's made up inside it." [year 11 boy] – "Well we've learnt about our heart but not about healthiness just what it is." [year 11 girl] – "Open it up, look how it works" [year 11 girl] – "In some, like Biology we did a whole thing on, was it, what was it? Something heart disease." [year 11 girl] – "In Biology we did all about diseases […] and I think it was in Chemistry we looked at salt and some of our modules had questions about how salt can affect your heart." [year 11 boy] – "We cut up a heart." [year 11 boy]	– "We have done it in Science [dissected a heart] but I had to walk out of the room." "Yeah so did I." "it's horrible; I think this year was the first time I ever like agreed to do it, the rest of the time I just walk out." [year 11 girls] – MF6: "Oh that was hard, the smell of it was disgusting and I had to like walk out the Science block. I couldn't deal with it." [year 11 girl]

Health and social	– "No there is only like, about 15 people in my class" [year 11 girl] – "Health and social is just like everything to do with that like exercise and diet." [year 11 girl] – "No there are like, about 15 people in my class, all girls though, there's no boys that do it." [year 11 girl] – "yeah we learn about it a lot in Health and Social […] diets um BMI, your heart, your body the way it runs." "It's like Biology." [year 11 girls]	
Health education	– "It was basically saying don't smoke children it's bad for you" [year 11 boy] – "Yeah well firstly options, because we're in GCSE we have to pick our topics so I suppose if you don't pick […] subjects that include that sort of stuff you might not get taught as much as people who do." [year 11 boy] – "That's only about 40 kids that learn something […] out of how many? A hundred and something, 50? 60?" [year 11 boy] – "Well we get taught about like a balanced lifestyle and diet and stuff like that circle thing divided into sections." [year 11 girl] – "We do a bit on like don't smoke it's bad for you." "yeah we've done stuff on smoking and alcohol." "Don't drink alcohol it's bad for you." "Don't eat crisps." [year 11 girls] – "Like we don't learn about it [heart health] in school." [year 11 girl] – "You had to make your own leaflet." [year 11 girl] – "[…] you had to make a name of someone and you got passed around all these sort of different diseases, so like I was doing about like multiple sclerosis but people, other people were doing obesity and like heart disease." [year 11 girl] – "[…] we had an immersion day about like smoking and drugs, like a whole day on it." [year 11 girl]	– "What would be, what would be more useful is if they explained in more detail because um saying don't smoke it's bad for you is not as useful as saying don't smoke otherwise your lungs will fill up with black poison and you'll choke to death!" [year 11 boy] – "It's just the worst they don't tell you don't tell you the small effects they just say oh you'll die in the end." [year 11 girl] – "[…] It's good to know like what the severe effects are but it would be nice to know the small ones as well." [year 11 girl] – "You have to go into like how smoking affects people and then you learn about how it actually it affects your body which is better than just saying smoking is bad" [year 11 girl] – "What can, what knock on effects it can have because you sort of half-heartedly, you don't actually know what the actual risks are when you're younger." [year 11 boy] – "Yeah that [more health education] would be quite good […] that would make people more aware of like what they need to be doing, what they shouldn't be doing, that sort of stuff." [year 11 girl] – "It's got to explain it, give it more reason why more people might actually follow the advice." [year 11 boy] – "I don't think people realise that probably when you eat, because you don't know what's going on inside you." "And don't really know the effects." [year 11 girls] – "Yeah I think it might also scare people to think actually how much fat have I just sat here." [year 11 boy] – "[…] when you get to watch something it's a lot more interesting." [year 11 boy] – "Yeah I think they should do one lesson and then another refresher." [year 11 girl] – "If you think about like, you've got everything, all lessons going on like your whole school life, we're not just going to remember that lesson because we've got everything else to remember and that's why you need to do it more often sort of thing." [year 11 girl] – "I do think they with like especially with alcohol people like because they say the worst things that are going to happen, they said that, they say it as if it's going to happen like really soon […] they don't tell you that it's OK to drink moderately like

	which I think they should" [year 11 girl]
Interactive learning	– "[…] what actually happens like people who are like smokers in our room will kind of start getting worried like, like say you had an example of like a really tarnished lung or something like that." [year 11 boy] – "And like with smoking they've, they've had, I don't think it was actual tar but they were like this is what you're putting, um like in your lungs every year you're a heavy smoker and it's horrible." [year 11 girl] – "Anything practical is more interesting." [year 11 girl] – "Yeah that's what I enjoy." "Anything practical." [year 11 girl] – "Anything hands on is better […] something visual or something we can poke." [year 11 girl] – "So if we had, if we were allowed to use things like this [BP monitor] and dissect hearts and actually work through it and learn about health, I certainly would learn a lot more than I do." [year 11 boy] – "Also when there's activities that you can actually do, a lot more of the class will want to get involved instead of some slacking off and not doing the work." [year 11 boy] – "But sometimes that just doesn't have any affect unless you realise oh I am way over the normal average, this could have some consequences, you can apply it to yourself rather than just thinking oh some people have died because of this." [year 11 girl] – "I find things that are personal to me; I tend to learn more if they relate to me." [year 11 boy]

Appendix 5.5 Year 6 information seeking and behaviour

Source of information		Where information is sought		Resulting actions and (mis)perceptions of health	
Internet	– "Google is good for a lot of things" [year 6 boy]				
TV	– "No on the on the on this film I watched called Supersize vs. Superskinny there's this woman who weighs 55 stone" [year 6 girl] – "Do you watch the Biggest Loser? It's so funny" [year 6 girl] – "It's like The Biggest Loser isn't it?" [year 6 boy] – Researcher: "Where do you think you have heard that from?" "Um it was like I'm not sure but I think it was like on a advert or something" [year 6 boy] – "Is it true on the advert like even when you smoke there's an invisible smoke everywhere?" [year 6 girl] – "I knew there was a good and a bad but I didn't know how they were good or bad […] I think it was like on a advert or something" [year 6 boy]	–	"I would speak to that guy from embarrassing bodies" [year 6 boy]	– "On I saw on the news that this lady cried for an hour and she lost two stone […] I'm totally crying for an hour now" [year 6 girl] – "When you're a teenager everybody thinks you can't eat because you have to be skinny" [year 6 girl] – "And she used to think she had to be really thin to look pretty" [year 6 girl]	
Film	– "Oh because I watched Three Wedding and a Funeral and it was like "what is cholesterol?" [year 6 girl]	–		– "because they are unpredictable because you see films and like little in like documentaries and stuff about drunk people and how they get out of control sometimes" [year 6 girl]	
Other media	– "I heard it on the radio they like will try and get you to smoke but you've got to be strong" [year 6 girl] – "I read on this poster that um um like half an hour um swimming once a week is like the same in fitness as 45 minutes in the gym" [year 6 girl]	–			
Parents	– "They mention it, I don't mention it" [year 6	–	"I talk to my mum" [year 6 girl]		

	girl]	– "I would ask my dad because he's like really technical" [year 6 girl] – "No my dad, my dad tells me what to do about it, so my dad's better with like my health and everything" [year 6 girl]	
Other family members		– "Um I would speak to my aunt, she works at a hospital" [year 6 boy] – "I would ask my brother because he's a genius" [year 6 girl] – "I ask my nan" [year 6 girl] – "I ask my nan once because she used to be really skinny but now she's really fat" [year 6 girl] – "You speak to people you know" [year 6 boy]	
Doctor		– "I wouldn't go to a doctor just to ask a question" [year 6 girl] – "Yeah parents teachers or a doctor" [year 6 boy]	
Health messages	– "It's on the packet anyway. Don't smoke." [year 6 boy] – "Yeah there's a horrible, there's loads of disgusting people, pictures of people's teeth" [year 6 boy]		
Teachers		– "Or Mrs [X] because she's first aid" [year 6 boy] – "I speak to my dance teacher" year 6 girl] – "She's um she she's quite happy to talk to you even if we're in her lesson. If you're downstairs waiting and she's upstairs um teaching you could go up there and she'll talk to you" [year 6 girl]	
Video games			– "I play tennis on WII sport" [year 6 girl] – "[…]I go on the WII fit for like three hours a day" [year 6 girl] – "I'm a member so I go to the gym" "Yeah but if you go on the WII Fit that's also free

	and it's fun" [year 6 girls] – "Get up, go on the WII" [year 6 boy] – "What I do in my spare time is jog 3000 meters on my WII fit" [year 6 girl]

Appendix 5.6 Year 11 information seeking and behaviour

Source of information		Where information is sought	Resulting actions and (mis)perceptions of health	
Internet		– "Go on Supersize vs. Superskinny's website" "And that other programme" "Embarrassing Fat Bodies" [year 11 girls] – "Google it" [year 11 girl] – "The internet?" "that's where I'd go I'd Google it" "think most people would actually Google it" "I'd Google it first" [year 11 girls] – "If not I'll ask Google" [year 11 girl] – "I went on the NHS website once to find something out" [year 11 boy]		
TV	– "Your arteries will be clogged up with cholesterol" "like that advert" [year 11 girls] – Researcher: "Where did you hear about that, can you remember?" "On the TV" [year 11 girl] – "[…] If you eat porridge it's supposed to lower your cholesterol and stuff and like some margarines are said to lower your cholesterol […]" Researcher: "Where did you hear about that, can you remember?" " On the TV" [year 11 girl]		– "Yeah it's just something that happens later in life when your body just stops doing things as efficiently" [year 11 boy] – "There's nothing like on TV unless you're like 80" [year 11 girl] – "Because we don't see the consequences like at our age" "No 16 year olds see consequences" [year 11 girls] – "[…] you usually think like outside" "More like the aesthetics thing isn't it?" [year 11 boys] – Researcher: "Ok so would you say that healthy hearts is something more that older people need to worry about?" "That's the only time we hear about it so" [year 11 girl] – "When you're younger you sort of go out and do things more recklessly and don't think about your actions but when you're older […] it can lead to more like bigger health problems" [year 11 girl] – "We can eat like a billion pieces of cake it'll be fine, you can't do that when you're like 50 but we don't care about that at this	

					–	age it's just what we do." [year 11 girl] – "It [Embarrassing Bodies] scares me into doing exercise" [year 11 girl]
Film						
Other media	–	"We had an immersion day about like smoking and drugs, like a whole day on it. We had to watch a film […]I think it put off the majority of the people who watched it" [year 11 girl]			–	"Not that I'd ever thought of doing it [drugs] but I'd never ever do it after watching stuff like that" [year 11 girl]
Parents	–	"[…] my dad always says don't eat salt"[year 11 girl] – "My parents taught me about like stuff like exercise and stuff" [year 11 girl] – "I've talked about my dad cause he's got problems […] I'm kind of aware of what happens" [year 11 girl] – "Well my dad talks to me about it because it's his work but friends you might make a joke or something like if you do that you might but you wouldn't talk to them about it in detail seriously" [year 11 boy]	–	"I would probably talk to my mom, I wouldn't talk to my dad" [year 11 girl] – "I talk to my mom" [year 11 girl] – "I'd talk to my mom and then she'd decide GP" [year 11 girl] – "Oh well I would go to my dad because he is a heart cardiologist" [year 11 boy] – "[…] possibly my stepdad, he seems to know quite a lot about a lot of stuff" [year 11 boy]	–	"Don't expect we really think about it [heart health]" [year 11 boy]
Other family members	–	"Grandparents or something like that and they keep going 'oh my heart' it's something you don't really think about" [year 11 girl]				
Doctor			–	"I wouldn't go to a doctor" [year 11 girl] – "if you thought you had something wrong with you then I think I would go to a to a GP and but then ask them questions about it quite like in depth cause they they obviously know a lot more than what any well most other people will know […]" "They are probably used to explaining it in like a really simple way" [year 11 girls] – "Yeah speak to your GP about that. If it's something you're concerned about" [year 11 boy] – "I'd just turn up at the doctors" [year 11 girl]		

Health messages					
Teachers	–	"I do think they with like especially with alcohol people like cause they say the worst things that are going to happen they said that they they say it that as if it's going to happen like really soon […] they don't they don't tell you that its ok if you drink it moderately […]" [year 11 girl]	– ”I guess biology teacher maybe" "it depends if you like your biology teacher" [year 11 girls] – "Well I just normally ask my English teacher because her mom's a dietician I think" [year 11 boy] – "If it's a bit personal you wouldn't want to get ask your PE teacher" [year 11 boy] – "But I wouldn't go to the teachers because they tend to just take things off websites […] I'm not sure how much they actually know about certain bits" "[…] they will just talk to you about the stuff that will be on the module" "Or what you have to do for tests" "They wouldn't teach you any extra" [year 11 boys] – "You can't really talk to a PSHE teacher because they don't know anything they just read stuff out" [year 11 girl]	–	"[…] when they say completely cut it out everyone sort of like no why would I do that and then completely go against what they are saying" [year 11 girl]
Video games			– "Use the Wii" "Yeah its pretty good" "I've never done my BMI any other way" [year 11 girls]	–	"If you can check your BMI normally." "Use the Wii" "I've never done my BMI any other way" [year 11 girls]

Chapter 6 Appendices

Appendix 6.1 Letter to schools

Weight and Wellness Education for Heart Health Study

Department of Primary Care Health Sciences
23-38 Hythe Bridge Street, Oxford, OX1 2ET
Tel: 01865 289414
E-mail: WEHH@phc.ox.ac.uk

Lead researcher: Claire Friedemann

14 June 2013

Dear

I am writing to invite your school to take part in a new study being run by the University of Oxford's Department of Primary Care Health Sciences. The aim of the study is to assess how useful parents find the information they are sent following the routine height and weight screening of their child in year 1 and year 6, and how they might use the information to ensure the health of their child.

With your help we would like to send invitations and information sheets about this study to the relevant parents and hold the discussion groups in a classroom at a time that is most convenient for the school. Please see enclosed a copy of the invitation and participant information pack that we would like to send to the parents.

I would be grateful if you would read through the participant information sheet, consider whether you would like your school to take part and let me know of your decision. It is important that parents receive useful information on the health of their child and are able to act on that information as many of the leading causes of death in the UK can begin in childhood, but can be improved through simple healthy lifestyle choices. A benefit to your school of taking part in this study will be the education and activity session we would like to run on completion of the discussion groups to teach the students about their hearts and encourage them to be interested in their heart health. If you have any questions please contact the research team on the details at the top of this letter. I look forward to hearing from you.

Yours sincerely,

Claire Friedemann

Lead Researcher

Weight and Wellness Education for Heart Health Study

Appendix 6.2 Parent information pack and consent form

Weight and Wellness Education for Heart Health Study

Department of Primary Care Health Sciences
23-38 Hythe Bridge Street, Oxford, OX1 2ET
Tel: 01865 289414
E-mail: WEHH@phc.ox.ac.uk

Lead researcher: Claire Friedemann

Invitation to take part in WE♥Health: Parents' understanding and use of the BMI measure

The department of Primary Care Health Sciences at the University of Oxford is carrying out research on parents' understanding and use of the body mass index (BMI) measure. BMI takes into account the height of the child and so is thought to be a more reliable measure of whether they are a healthy weight. The measure is used in programs such as the National Child Measurement Program which measures the weight and height of children in Reception and in year 6 and produces a letter to parents detailing the measurements and weight status of their child.

We are looking for 60 parents or guardians of children who have had their BMI measured in the current or last academic year to take part in focus groups to discuss the BMI measure and whether they find it meaningful and useful. If you would like to take part please read the information sheet, complete the consent form and return it to us in the pre-paid envelope provided within two weeks of receiving this information pack.

If you would like to ask any questions before you decide, please e-mail or telephone the research team on the contact details at the top of this letter and on the information sheet.

Yours sincerely,

Claire Friedemann

Lead researcher
Weight and Wellness Education for Heart Health Study

Participant Information Sheet

Parents' understanding and use of the BMI measure

You are being invited to take part in a research study. This information sheet explains why the study is being conducted and what it will involve if you decide to take part. Please read it carefully and discuss it with others if you wish.

Part 1 explains the purpose of the study and why you have been invited to take part. Part 2 explains what will happen if you decide to take part and what you can expect from the research team. Please telephone or e-mail us if you have any questions. Please take your time to decide if you want to take part.

If you decide you want to take part please fill in the consent form and send it back to us in the paid envelope in two weeks of getting this information pack.

Part 1

1. What is the purpose of the study?

The purpose of this study is to establish how useful parents find the body mass index (BMI) measure. BMI is a measure of weight that takes into account the height of the person, making it a more reliable indication of whether they are a healthy or unhealthy weight. We would like to discuss whether the information parents receive about their child's BMI at the beginning of primary school and in year 6 is a useful guide to the weight status of a child and whether they feel they would be able to encourage a child to maintain a healthy lifestyle based on their BMI.

2. Why have I been invited?

You are being invited to take part because you have a child at a school taking part in the study. We would like to only include parents whose children have had their BMI calculated within this or the last academic year. This study is being run by the University of Oxford and we would like 60 parents to take part in our study.

3. Do I have to take part?

It is your decision whether you take part. If you decide that you want to take part but later decide to withdraw from the study you are free to do so at anytime without giving a reason. Any decision to take part or withdraw will not affect your child's school work in any way.

Part 2

4. What will happen to me if I take part?

Deciding whether to take part and giving consent

If when you have read this information sheet you decide to take part you will need to fill in the consent form accompanying this sheet and return it to the University of Oxford in the paid envelope provided. Please return the consent form in two weeks of getting this information pack. If you think you would like to participate in the study but would like to talk to one of the research team before you fill in the consent form we are happy to answer all your questions. Our e-mail address and telephone number is at the end of this information sheet. The consent form will also ask for your consent to audio record your discussion group and to use anonymous quotations in the reports and papers resulting from this study.

Discussion groups

The discussion groups will be held for an hour at your child's school. Each discussion group will have 6 parents in it as well as one researcher leading the discussion and one researcher taking notes. Before the discussion group we will ask you to provide us with some demographic information about yourself and your child, for example your age, education status and BMI of your child when they were measured. During the discussion we will ask you to talk about your understanding of the BMI measure and if or how you would use it as a guide when considering the health of a child. You do not have to discuss your own child if you do not wish to do so. The discussion groups will be recorded so that the information gathered during the discussion can be analysed accurately.

5. Why should I take part?

There is no direct benefit to you but if you decide to take part you will be helping to establish how useful the BMI feedback parents receive is to them and so whether it is a good use of resources.

6. Will my taking part in the study be kept confidential?

All of the information we collect will be kept anonymous. Your contribution to the discussion will be given a number rather than your name. The research team have a duty to you as a study participant to keep your contribution confidential. We will keep the information we collect and the digital recordings of each discussion group for 10 years after the study has been published in line with the University of Oxford's current research policy. All the information we collect will be kept securely according to the Data Protection Act 1998.

Any views you may express while taking part in the discussion groups will be treated with respect and we will ask that everyone who decides to take part does the same and keeps what is said during the discussion within the group.

7. What will happen if I don't want to carry on with the study?

If you decide you no longer wish to take part in the study you can phone, write to or e-mail the research team. You are free to leave the study at any time without giving a reason. Any information you have already provided will be deleted or destroyed.

8. What if I have any problems with the study?

Given the nature of the study it is unlikely that you will experience any problems resulting from your participation in it. If you have any concerns about this study or how it was run you should contact the lead researcher, Claire Friedemann (Tel: 01865 289414).

9. What will happen to the results of the study?

The results of the study will be published in a peer reviewed medical journal and will be available on the website of the journal. On completion of the study we will produce a newsletter of the results. If you would like a copy of the newsletter please tick the box at the end of the consent form and we will send it to you through your child's school within two weeks of the study being published.

10. Who is organising and funding the study?

The study is being organised by the University of Oxford's Department of Primary Care Health Sciences and is funded by the University and the Medical Research Council.

11. Who has reviewed the study?

The study has been reviewed and approved by both the Oxford University Ethics Committee and representatives from your child's school.

12. More information and contact details

If you would like any more information or would like to ask us any questions about the study please contact the research team.

WEHH Study
Department of Primary Care Health Sciences
University of Oxford
2nd Floor Offices
23-38 Hythe Bridge Street
Oxford OX1 2ET

Tel: 01865 289414 (office hours)

Email: WEHH@phc.ox.ac.uk

Lead researcher: Claire Friedemann

Department of Primary Care Health Sciences
23-38 Hythe Bridge Street, Oxford, OX1 2ET
Tel: 01865 289414
E-mail: WEHH@phc.ox.ac.uk
Lead researcher: Claire Friedemann

Consent Form

Study ID Number

Weight and Wellness Education for Heart Health: Parents' understanding and use of the BMI measure

If you agree to take part in this study, you need to complete this consent form, otherwise we cannot use the information you provide us with for the study.

Please initial each box

1. I have read and understand the information sheet for the above study. I have had the chance to think about the information, ask questions and they have been answered fully. ☐
2. I understand that participation in the study is voluntary and I am free to withdraw from the study at anytime without giving a reason. ☐
3. I understand that the information collected by the study will be analysed by researchers at the University of Oxford and I give permission for these researchers to use the information that I provide in the study. ☐
4. I agree to the audio recording of the discussion group that I take part in for the purpose of analysing the discussion for the study. ☐
5. I agree for anonymous quotations to be used in papers published from this study in scientific journals. ☐
6. I agree to take part in this study. ☐

Name (please print) _____

Signature _____ Date _____

Name of child's school _____

Preferred contact telephone number _____

I would like a copy of the newsletter of the results of the study (please tick). ☐

Appendix 6.3 Focus group schedule

WE Health

Parents' Perceptions of Childhood Heart Health and Screening

UNIVERSITY OF OXFORD

Date:	School:	Number present and sex:	
Researchers present			
Welcome and introduce researchers. Describe the purpose of the study and ask that all views expressed are treated with respect and not discussed outside the focus group. Remind that own child need not be discussed. Questions?			
Knowledge	**Attitudes/beliefs**	**Behaviours**	**Prompts**
Example of the NCMP letter			
1. Have you come across the BMI measure before?	a) What do you understand by BMI?		Notes
2. Have you ever been sent a letter like this?	a) What would be your reaction to a letter such as this?		
3. How understandable do you find the information in the letter when it is presented like this?	a) If a parent was told their child had a BMI of (e.g. 30) what would this mean?		
4. Do you think having a child's weight status described in this way is useful?			
5. Do you value being sent information about your child's weight status?			
6. Do you think that this letter gives you enough information to guide how you would care for a child?			
7. Would you change the way you cared for a child based in their BMI?			
8. What actions might you take?	a) For overweight? b) For underweight?		
8. Do you think you would discuss the results in this letter with the child?	a) How would you go about discussing it? b) What reasons might you have for discussing it?		
9. Is there anyone else whom you would discuss the results detailed in the letter with?			
10. Do you think that the BMI measure is a good indication of the general health of a child?	a) What are the benefits?		
	b) What are the risks?		
11. When thinking about the health of a child, what are the issues that concern you most?			
12. Would the health of a child's heart be a concern for you?	a) Now or in the future?		
	b) Why?		
13. To what extent do you think that the health behaviour of a child today will impact on their future heart health?	a) Ask about later childhood and adulthood		

14. Do you think that as parents you are given enough information about how weight impacts child health?		
15. Has your child ever discussed their heart health with you?	a) Did you feel able to answer their questions?	
16. To your knowledge is your child taught about heart health at school?	a) Do you think that the education they receive (if any) is effective?	
17. Do you see any barriers to looking after the health of your child?	a) Would you like to receive more information about the health of your child beyond their weight status?	
18. What would be your reaction if children had their weight screened more regularly than twice at primary school?		
19. What would be your reaction if children were screened for other heart disease risk factors e.g. BP, cholesterol?		
20. Do you think that having this extra information would affect how you would care for the health of a child?	a) Would they appreciate being given general cut point information with the letter (e.g. obesity is linked to a 7mmHg rise in BP)	
Thank the participants and collect the demographic questionnaires		
Notes		
Did any adverse events occur during the focus group? Y/N		
If yes describe:		

Appendix 6.4 Knowledge and attitudes to childhood health and the impact on parenting behaviours

Knowledge	Attitudes	Behaviours
	Knowledge and attitudes towards general health	
"I am unaware of the impact on her future heart health, although if she was overweight I know this would have an effect." Mother 6	"I nanny for a child that was told that she was obese who is now a ballerina, tiny, tall, skinny, […] so for me I think that it's a total waste of time" Mother 4	" if your child though came up and was underweight you would do something about it" Mother 4
	"But children I think are very different to adults too aren't they? Because their bodies aren't regulated you know, I'm guessing, I'm not worried about it too much with my son because I just thought well you know it's in his belly and he is a baby, he's, he's 4!" Mother 3	Researcher: "what sort of things might you do [if child was underweight]?" "Ah consult school probably and work out if they were having school dinners and lunches and what else you could pack in and […] I don't think they have enough time to eat their lunch, there is too much going on" Mother 4
	" […] in 5 years' time you will probably be eating just the same portions and have just stretched up and this is just a waste of time" Mother 4	" I just tell them if they eat biscuits they get fat I I just I'm very honest just if you have too many of those you'll get fat […]" Mother 4
	" […] I think their mental health's more important […] if you want a good physical health you need to have a good mental health […]" Mother 2	" I think I worry more about the bigger things that could happen rather than things like this [childhood weight]" Mother 3
	" she still runs around with a big squidgy bum but she cycles to school every day, she does dance 3 times a week and she does gymnastics" Mother 4	" I haven't considered the health of her heart" Mother 6
	"[…] at the age of 5 I believe it is down to the adult not to give the child too much unhealthy food and ensure enough exercise" Mother 6	"if you were told your child had high cholesterol you would look into it" Mother 4 "absolutely yes" Mother 3
	"I think I worry more about the bigger things that could happen rather than things like this you know I teach children that have got serious illnesses and I just think I'm so grateful" Mother 3	
	"[…] underweight is as much of a problem as overweight" Mother 2	
	"I think their mental health's more important" Mother 2	

Knowledge and attitudes towards the National Child Measurement Programme and Body Mass Index		
"I think more info overall on the effects of weight on health would be useful. […] Just being told they are overweight isn't as meaningful as being told what effect it will have on them now and in later life." Mother 6	" […] I think the school screening is raising the awareness to the child more which I think at that age is really critical secondary school is when girls especially get very you know" Mother 2 "body conscious" Mother 4	"it does pay to go to the GP, I didn't actually go and waste my GP's time […] it was by chance that we were there on the day that I got the letter" Mother 2
"It's very hard to gauge because everyone is so different and metabolism is so different" Mother 3	" this is surface screening isn't it really" Mother 3	"She had her little girl done, well they did it and when it came through and it said obese she was devastated and I just told her rip it up" Mother 4
"[…] we all got our um fat measured and she had the highest cholesterol of anyone in the office and she was a stick she was so thin but she was deeply unhealthy you know so in terms of this she would have passed mustard but in terms of her gen, her real health, her arteries, her heart you know she was a you know a stroke waiting to happen" Mother 5	"BMI it's a very abstract concept" Mother 5	Researcher: "[…] would you change the way you cared for a child based on their BMI?" "Nope! None what so ever" Mother 2 "Not knowing what my child is like" Mother 1
"when you children on the front of the newspaper they're really fat, I do look at them and think your life expectancy you're just not going to live" Mother 4	" think of [BMI] it as a good indication of a healthy weight range, to be used with other info" Mother 6	Researcher: "[…] would you change the way you cared for a child based on their BMI? Or would you take other factors into account?" "if he was underweight" Mother 4
"[…] it is a sense of playing off the weight against the height and coming up with a figure." Mother 5	"I valued being sent the letter as I think it's important to be aware and I don't think everyone is." Mother 6	" […] I explained that he isn't overweight [on receiving the NCMP letter], […]just because someone says one thing it doesn't always mean it's true and people can misunderstand something from what they know […] but yeah just because someone gives you a label it doesn't mean you have to wear it" Mother 2
"but when I got it I was a bit confused because I'm used to seeing the BMI as a figure but here on the letter it's written as a percentile" Mother 5	" would not be concerned if she was classed as being overweight" Mother 6	"[…] I wouldn't discuss the letter with the child […] trying to teach children healthy eating um but you know I, I do that at home" Mother 3
"[…] is BMI relevant to children?" Mother 5	"[…] it is a sense of playing off the weight against the height and coming up with a figure. And it is quite arbitrary I think" Mother 5	Researcher: "[…] is there anybody else that you might discuss this letter with?" "friends" Mother 4 "I would say a health visitor but I have to say general feedback you get from health visitors are not not found very helpful" Mother 1
"[…] I've heard of BMI um and I know that it's something to do with your body mass isn't it against, measured against bone?"	[reaction when receiving NCMP letter] "I don't know I think it's a waste of time" Mother 4 "I laughed" Mother 2 "yes I laughed" Mother 1	"I wouldn't mention the letter to a child unless they asked and to say she was healthy and that's a good way to be."

Mother 3		Mother 6
"Because I thought it's actually a measure on how much, not fat you've got but body mass there is in comparison to water and bone?" Mother 3	"I actually laughed out loud […] it was good timing when we got the letter, […] we went to the GP and his take on him being overweight was ignore, ignore, ignore and laughed too, so." Mother 2 "yes I have an obese daughter" Mother 1 "yeah I have an obese son" Mother 2 "I have an obese husband as well, who isn't obese?" Mother 1	
"Are they [BMI ranges] based on a scientific measure of what is healthy or just on average children's measurements?" Mother 6	"it's not an indicator of health if you like, that, so that worried me a bit" Mother 5	
	" it's upsetting" Mother 5	
	"Also I think the wording, when you see that word obese, I'm like gosh I mean it […] is that even necessary?" Mother 3	
	" because parents, if they are told their child is obese or even overweight they shut down, the shutters come down and they become very defensive, they are so unlikely to hear any of your healthy eating advice" Mother 5	
	"The letters are absolutely useless without support behind them." Mother 2	
	"and if you were off the 90th to start [when a baby] with well then you've only followed through. It's not like he's suddenly gone from the first up to the 95th [BMI percentile]." Mother 4	
	"but BMI is very skewed anyway isn't it? I mean I know for example like Matthew Pincent and Steve Redgrave, they're considered obese aren't they?" Mother 1	
	"it's not an exact science" Mother 4	
	" but there must be some children who come out on the obese scale who, who therefore are who need this support, who need the backup" Mother 1	
	" I think that's too broad for children, […] to have a borderline that is so thin […]" Mother 3	
	"…it's like oh you're all of a sudden overweight" Mother 3	
	"I think this [BMI] is probably a bit deceiving" Mother 3	

Appendix 6.5 Other sources of information

Theme	Supporting Quotation
Tone of information	"[…] doing the namby pamby side of it […] whereas some people actually need to be told you are fat […] is what's shocked them into then realising actually, and actually using medical sort of words rather than pussy footing around it almost." [Mother 1] "[…] When you see that word obese, I'm like gosh […] is that even necessary?" [Mother 3]
Change for life	"[…] I got a letter from them [Change for Life] saying a child should have one fish finger per five years of their life […] I got three other people to read this for me to check that I wasn't actually just really misreading it, my dad was really chuffed that he could have 32 fish fingers!" [Mother 2]
Who delivers the information	"I've never been able to take advice off of somebody who is very overweight, telling me how to keep my children slim." [Mother 2]

Appendix 6.6 Child behaviour

Theme	Supporting Quotation
Conscious unhealthy choices	"But they can make healthy choices." [Mother 5] "But they're not going to they're teenagers!" [Mother 1]
Deviant behaviour	"[…] if you hold back too much then I've come across children who will sneak it and they get pocket money and they'll buy their own." [Mother 4] "And they'll swap it at lunchtime, my son's already done that and he's four!" [Mother 3]

Appendix 6.7 Teaching health at home

Theme	Supporting Quotation
Influences on discussions	"You know not heart health but yeah they do talk about other things like we've had the period conversation and that's kind of lead into, for my oldest daughter, sexual thing […] um and yeah we talk about eating well and exercising." [Mother 5] "[…] my husband's family is Asian and there is quite a high incidence of diabetes in that population and in the family so that's another thing we've talked about." [Mother 5] "[…] you've got your obese family, well I've come into contact with you know families who, who've lost people through cancer and things so therefore you end up talking to them about things […] making sure that you address it at the time and in a way that's appropriate to age." [Mother 1]
Following parents' example	"I've been doing Slimming World and because we've been doing that I've been very open with her, she will talk about healthy food, unhealthy food that it's ok to eat crisps from time to time but not you know necessarily have them every day you know that there is a good weight to be and that if you eat too much this is going to happen you and if if you don't eat enough, so all tied in with that and she is very well aware and you know I'll sit and have a biscuit and mummy that's bad for you." [Mother 1]
Healthy palate	"[…] you need the foundations to have a healthy palate rather than a healthy choice and actually you want to eat these things because they're nice." [Mother 2]
Independence	"As long as you teach them what's right and what's wrong […] hopefully they'll manage it themselves." [Mother 3]

Appendix 6.8 Formal health education

Theme	Supporting Quotation
School failings	"[…] kids learn by doing […] not by being told so if you have a healthy lifestyles lesson and then you serve chips and burgers at lunch" [Mother 5] "it's pointless." [Mother 2] "The message is being totally undermined isn't it?" [Mother 5] "[…] I did very little teaching, I mean it was on the curriculum but it's, you know, it gets squeezed out doesn't it because you've got your maths, your literacy […] and that's the very first thing if you, you know have to miss a lesson for something else." [Mother 1]
Tone of information	"It's telling them without scaring them." [Mother 3]
Facilitating health education	"[…] they do respond better to visuals and being able to show them an illustration." [Mother 3] "I think it's about something really concrete and measureable […] a percentile of the BMI, it's a very abstract concept whereas if you talk about an artery where the bore is only that small and it's all furry then that's a very concrete image for people to visualise." [Mother 5]
Involve the child	"[…] because young people are making their own choices the conversation has to be with them." [Mother 5]
Independence	"As long as you teach them what's right and what's wrong […] hopefully they'll manage it themselves." [Mother 3]

Chapter 8 Appendices

Appendix 8.1 Requirements of the National Curriculum met by the WE ♥ Health intervention

Key Stage 3 (Years 7, 8, and 9)		
Subject	Curriculum section number	Requirement
Physical education	1.4a	Understand that physical activity contributes to the healthy functioning of the body and mind and is an essential component of a healthy lifestyle.
PSHE	1.2a	Recognising that healthy lifestyles, and the wellbeing of self and others, depend on information and making responsible choices.
	1.3a	Understanding risk in both positive and negative terms and understanding that individuals need to manage risk to themselves and others in a range of situations.
	2.1d	Identify and use strategies for setting and meeting personal targets in order to increase motivation.
	3f	How balanced diet and making choices for being healthy contribute to personal wellbeing and the importance of balance between work, leisure and exercise.
	4c	Use case studies, simulations, scenarios and drama to explore personal and social issues and have time to reflect on them in relation to their own lives and behaviour.
Science	3.3a	Life processes are supported the organisation of cells into tissues, organs and body systems.
	3.3c	Conception, growth, development, behaviour and health can be affected by diet, drugs and disease.
Key Stage 4 (Years 10 and 11)		
Physical education	1.4a	Understand that physical activity contributes to the healthy functioning of the body and mind and is an essential component of a healthy lifestyle.
	2.5	Making informed choices about healthy, active lifestyles.
PSHE	1.2a	Recognising that healthy lifestyles, and the wellbeing of self and others, depend on information and making responsible choices.
	2.1c	Identify and use strategies for setting and meeting personal targets and challenges in order to increase motivation, reflect on their effectiveness and implement and monitor strategies for achieving goals.
	2.2a	Use knowledge and understanding to make informed choices about safety, health and wellbeing, evaluating personal choices and making changes if necessary.
	3d	The benefits and risks of healthy lifestyle choices, including choices relating to sexual activity and substance use and misuse, and the short and long term consequences for the health and mental and emotional wellbeing of individuals, families and communities.
	4d	Use case studies, simulations, scenarios and drama to explore personal and social issues and have time to reflect on them in relation to their own lives and behaviour.

Taken from The Review of the National Curriculum (2011). Available: http://www.education.gov.uk/schools/teachingandlearning/curriculum/nationalcurriculum

Appendix 8.2 Knowledge, attitudes and behaviours questionnaire

We ♥ Health Questionnaire 1

The following questions are about cardiovascular disease and the things that can make a heart healthy or unhealthy.

This is **not a test** and no one will be able to tell who you are from the answers that you give.

Don't worry if you don't know the answer to a question just answer it with what you think is the right answer and as honestly as you can.

Please tell us:

Are you Male ☐ Female ☐

1. For each of the following questions please circle whether you think the sentences are true, false or you don't know:

The heart is a pump	True	False	I don't know
Many vegetables are high in cholesterol	True	False	I don't know
All cholesterol is bad for your heart	True	False	I don't know
High blood pressure is 110/80 mmHg or higher	True	False	I don't know
People who have diabetes are at higher risk of getting heart disease	True	False	I don't know
The heart is made up of 2 chambers	True	False	I don't know
Blood pressure is the force that blood puts on the walls of the blood vessels	True	False	I don't know
Cardiovascular disease is the name for disease that affects the heart and it's blood vessels	True	False	I don't know
Atherosclerosis is when fatty plaque collects on the walls of the blood vessels	True	False	I don't know
Smoking increases the amount of oxygen your blood can carry	True	False	I don't know
Physical activity can lower LDL cholesterol and raise HDL cholesterol	True	False	I don't know

2. For each of the following sentences please circle whether you agree or disagree with them:

I only need to worry about my heart when I am much older	Strongly disagree	Disagree	Agree	Strongly agree
Cardiovascular disease doesn't affect many people	Strongly disagree	Disagree	Agree	Strongly agree
It doesn't matter what I do now, I could still get cardiovascular disease when I'm older	Strongly disagree	Disagree	Agree	Strongly agree
I can influence how much cholesterol is in my blood	Strongly disagree	Disagree	Agree	Strongly agree
If someone smokes the damage they have done to their heart is permanent	Strongly disagree	Disagree	Agree	Strongly agree
Being active will take up lots of my time	Strongly disagree	Disagree	Agree	Strongly agree
There are simple ways to stay healthy	Strongly disagree	Disagree	Agree	Strongly agree
If someone is underweight it is healthy for their heart	Strongly disagree	Disagree	Agree	Strongly agree
I think I understand what cardiovascular disease is	Strongly disagree	Disagree	Agree	Strongly agree
If someone is overweight it is unhealthy for their heart	Strongly disagree	Disagree	Agree	Strongly agree
I know enough about heart disease to make decisions that are healthy for my heart	Strongly disagree	Disagree	Agree	Strongly agree

3. For each of the following sentences please circle how often you do the activity it describes:

I read labels on food packages	Never	Sometimes	Often	Always
I eat breakfast	Never	Sometimes	Often	Always
I am active (e.g. walking, cycling, playing sport) for at least 30 mins most days in the week	Never	Sometimes	Often	Always
I use the labels on food packages to decide what to eat	Never	Sometimes	Often	Always
I spend an hour or more in front of the TV or computer most days in the week	Never	Sometimes	Often	Always
I think about the health of my heart	Never	Sometimes	Often	Always
I think about the health of my friend's and family's hearts	Never	Sometimes	Often	Always
I talk about health with my friends or family	Never	Sometimes	Often	Always
I like to do active things in my spare time	Never	Sometimes	Often	Always
If I had a question about my heart I would try to find out more	Never	Sometimes	Often	Always

Thank you!

Appendix 8.3 Baseline to T1 Attitude and Behaviour Scores Year 7

Year 7 Attitude and Behaviour scores at Baseline and T1 measurement- Wilcoxon Signed Rank Test					
Question	Baseline median score	T1 median score	Baseline mean score	T1 mean score	Significance
I only need to worry about my heart when I get older	3	3	3.170	3.121	0.535
CVD doesn't affect many people	2	3	2.433	2.785	0.000
It doesn't matter what I do now, I could still get CVD when I'm older	2	3	2.371	2.600	0.022
I can influence how much cholesterol is in my blood	3	3	2.776	3.127	0.000
If someone smokes the damage they have done to their heart is permanent	1	2	1.745	2.000	0.025
Being active will take up lots of my time	3	3	2.893	3.000	0.135
There are simple ways to stay healthy	4	4	2.573	3.412	0.055
If someone is underweight it is healthy for their heart	3	3	3.273	3.162	0.081
I think I understand what CVD is	2	3	2.085	3.018	0.000
If someone is overweight it is unhealthy for their heart	4	3	3.363	3.295	0.433
I know enough about heart disease to make decisions that are healthy for my heart	3	3	2.673	3.068	0.000
I read labels on food packages	2	2	2.280	2.323	0.635
I eat breakfast	4	4	3.350	3.259	0.508
I am active for at least 30mins most days in the week	4	4	3.437	3.455	0.725
I use the labels on food packages to decide what to eat	2	2	2.050	2.115	0.48
I spend an hour or more in front of the TV or computer most days in the week	3	3	2.395	2.524	0.34
I think about the health of my heart	2	3	2.627	2.562	0.523
I think about the health of my friends' and family's hearts	2	2	2.506	2.368	0.154
I talk about health with my friends or family	2	2	1.943	1.847	0.425
I like to do active things in my spare time	3	3	3.167	3.217	0.447
If I had a question about my heart I would try to find out more	3	3	2.798	2.774	0.792

Appendix 8.4 Baseline to T2 Attitude and Behaviour Scores Year 7

Year 7 Attitude and Behaviour scores at Baseline and T2 measurement- Wilcoxon Signed Rank Test					
Question	Baseline median score	T2 median score	Baseline mean score	T2 mean score	Significance
I only need to worry about my heart when I get older	3	3	3.170	3.227	0.332
CVD doesn't affect many people	2	3	2.433	2.579	0.038
It doesn't matter what I do now, I could still get CVD when I'm older	2	2	2.371	2.500	0.361
I can influence how much cholesterol is in my blood	3	3	2.776	2.938	0.071
If someone smokes the damage they have done to their heart is permanent	1	2	1.745	1.892	0.101
Being active will take up lots of my time	3	3	2.893	3.066	0.113
There are simple ways to stay healthy	4	3	2.573	3.421	0.012
If someone is underweight it is healthy for their heart	3	3	3.273	3.118	0.076
I think I understand what CVD is	2	3	2.085	2.622	0.000
If someone is overweight it is unhealthy for their heart	4	3	3.363	3.361	0.957
I know enough about heart disease to make decisions that are healthy for my heart	3	3	2.673	2.833	0.046
I read labels on food packages	2	2	2.280	2.257	0.725
I eat breakfast	4	4	3.350	3.287	0.782
I am active for at least 30mins most days in the week	4	4	3.437	3.482	0.770
I use the labels on food packages to decide what to eat	2	2	2.050	2.047	0.937
I spend an hour or more in front of the TV or computer most days in the week	3	3	2.395	2.473	0.417
I think about the health of my heart	2	2	2.627	2.456	0.043
I think about the health of my friends' and family's hearts	2	2	2.506	2.271	0.015
I talk about health with my friends or family	2	2	1.943	1.852	0.280
I like to do active things in my spare time	3	3	3.167	3.149	0.557
If I had a question about my heart I would try to find out more	3	2	2.798	2.402	0.000

Appendix 8.5 Baseline to T1 Attitude and Behaviour Scores Year 11

Year 11 Attitude and Behaviour scores at baseline and T1 measurement- Wilcoxon Signed Rank Test					
Question	Baseline median score	T1 median score	Baseline mean score	T1 mean score	Significance
I only need to worry about my heart when I get older	3	3	3.196	3.110	0.37
CVD doesn't affect many people	3	3	2.965	3.027	0.314
It doesn't matter what I do now, I could still get CVD when I'm older	2	2	2.433	2.469	0.674
I can influence how much cholesterol is in my blood	3	3	3.130	3.113	0.668
If someone smokes the damage they have done to their heart is permanent	2	2	2.277	2.338	0.517
Being active will take up lots of my time	3	3	2.681	2.667	0.869
There are simple ways to stay healthy	3	3	3.376	3.264	0.045
If someone is underweight it is healthy for their heart	3	3	3.248	3.097	0.073
I think I understand what CVD is	2	3	2.453	2.979	0.000
If someone is overweight it is unhealthy for their heart	3	3	3.286	3.200	0.582
I know enough about heart disease to make decisions that are healthy for my heart	3	3	2.669	3.035	0.000
I read labels on food packages	2	2	2.158	2.178	0.063
I eat breakfast	4	4	3.166	3.151	0.7
I am active for at least 30mins most days in the week	3	3	3.079	2.965	0.236
I use the labels on food packages to decide what to eat	2	2	1.686	1.779	0.429
I spend an hour or more in front of the TV or computer most days in the week	2	2	2.014	2.139	0.353
I think about the health of my heart	2	2	2.144	2.257	0.243
I think about the health of my friends' and family's hearts	2	2	2.043	2.235	0.07
I talk about health with my friends or family	2	2	1.781	1.952	0.368
I like to do active things in my spare time	3	3	2.829	2.869	0.667
If I had a question about my heart I would try to find out more	3	3	2.676	2.688	0.923

Appendix 8.6 Baseline to T1 Attitude and Behaviour Scores Year 11

Year 11 Attitude and Behaviour scores at Baseline and T2 measurement- Wilcoxon Signed Rank Test					
Question	Baseline median score	T2 median score	Baseline mean score	T2 mean score	Significance
I only need to worry about my heart when I get older	3	3	3.196	3.000	0.024
CVD doesn't affect many people	3	3	2.965	2.938	0.57
It doesn't matter what I do now, I could still get CVD when I'm older	2	2	2.433	2.469	0.739
I can influence how much cholesterol is in my blood	3	3	3.130	2.955	0.001
If someone smokes the damage they have done to their heart is permanent	2	2	2.277	2.277	0.484
Being active will take up lots of my time	3	3	2.681	2.741	0.404
There are simple ways to stay healthy	3	3	3.376	3.081	0.005
If someone is underweight it is healthy for their heart	3	3	3.248	3.072	0.089
I think I understand what CVD is	2	3	2.453	1.871	0.033
If someone is overweight it is unhealthy for their heart	3	3	3.286	3.124	0.038
I know enough about heart disease to make decisions that are healthy for my heart	3	3	2.669	2.086	0.000
I read labels on food packages	2	2	2.158	2.088	0.798
I eat breakfast	4	4	3.166	3.133	0.458
I am active for at least 30mins most days in the week	3	3	3.079	2.965	0.465
I use the labels on food packages to decide what to eat	2	2	1.686	1.805	0.104
I spend an hour or more in front of the TV or computer most days in the week	2	2	2.014	2.079	0.839
I think about the health of my heart	2	2	2.144	2.135	0.932
I think about the health of my friends' and family's hearts	2	2	2.043	2.254	0.065
I talk about health with my friends or family	2	2	1.781	1.903	0.537
I like to do active things in my spare time	3	3	2.829	2.655	0.123
If I had a question about my heart I would try to find out more	3	3	2.676	2.579	0.705

Appendix 8.7 Change in proportions for Attitude and Behaviour measures Year 7

Year 7 Attitude and Behaviour scores changes in proportions voting for each ranking						
Question		**Strongly Disagree n (%)**	**Disagree n (%)**	**Agree n (%)**	**Strongly Agree n (%)**	**Significance (Wilcoxon Sign Rank Test)**
Attitudes						
I only need to worry about my heart when I get older	Baseline	5 (3)	20 (12.1)	82 (49.7)	58 (35.2)	
	T1	7 (4.2)	17 (10.3)	90 (54.5)	51 (30.9)	0.535
	T2	3 (1.7)	11 (6.4)	102 (59.3)	56 (32.6)	0.332
CVD doesn't affect many people	Baseline	4 (2.7)	83 (55.3)	57 (38)	6 (4)	
	T1	3 (1.8)	45 (27.6)	99 (60.7)	16 (9.8)	0.000
	T2	4 (2.4)	67 (40.9)	87 (53)	6 (3.7)	0.038
It doesn't matter what I do now, I could still get CVD when I'm older	Baseline	17 (10.7)	81 (50.9)	46 (28.9)	15 (9.4)	
	T1	18 (11.2)	56 (35.)	58 (36.2)	28 (17.5)	0.022
	T2	18 (11)	69 (42.1)	54 (32.9)	23 (14)	0.361
I can influence how much cholesterol is in my blood	Baseline	8 (5.3)	39 (25.7)	84 (55.3)	21 (13.8)	
	T1	4 (2.5)	14 (8.9)	98 (62)	42 (26.6)	0.000
	T2	5 (3.1)	26 (16)	105 (64.8)	26 (16)	0.071
If someone smokes the damage they have done to their heart is permanent	Baseline	76 (47.2)	57 (35.4)	21 (13)	7 (4.3)	
	T1	46 (28.4)	78 (48.1)	30 (18.5)	8 (4.9)	0.025
	T2	51 (30.5)	88 (52.7)	23 (13.8)	5 (3)	0.101
Being active will take up lots of my time	Baseline	11 (6.9)	29 (18.2)	85 (53.5)	34 (21.4)	
	T1	8 (4.8)	29 (17.6)	83 (50.3)	45 (27.3)	0.135
	T2	8 (4.8)	26 (15.5)	81 (48.2)	53 (31.5)	0.113
There are simple ways to stay healthy	Baseline	2 (1.3)	2 (1.3)	57 (36.3)	96 (61.1)	
	T1	5 (3)	5 (3)	72 (43.6)	83 (50.3)	0.055
	T2	2 (1.2)	5 (2.9)	83 (48.5)	81 (47.4)	0.012
If someone is underweight it is healthy for their heart	Baseline	5 (3.1)	11 (6.8)	80 (49.7)	65 (40.4)	
	T1	5 (3.1)	13 (8.1)	94 (58.4)	49 (30.4)	0.081
	T2	4 (2.4)	17 (10.1)	103 (60.9)	45 (26.6)	0.076
I think I understand what CVD is	Baseline	47 (30.7)	58 (37.9)	36 (23.5)	12 (7.8)	
	T1	4 (2.5)	23 (14.1)	102 (62.6)	34 (20.9)	0.000
	T2	11 (6.7)	52 (31.7)	89 (54.3)	12 (7.3)	0.000
If someone is overweight it is unhealthy for their heart	Baseline	4 (2.5)	10 (6.2)	70 (43.8)	76 (47.5)	
	T1	8 (4.9)	7 (4.3)	77 (47.2)	71 (43.6)	0.433
	T2	2 (1.2)	8 (4.7)	86 (50.9)	73 (43.2)	0.957
I know enough about heart disease to make decisions that are healthy for my heart	Baseline	8 (5)	50 (31.4)	87 (54.7)	14 (8.8)	
	T1	4 (2.5)	20 (12.3)	99 (61.1)	39 (24.1)	0.000
	T2	6 (3.6)	33 (19.6)	112 (66.7)	17 (10.1)	0.046

Behaviours						
I read labels on food packages	Baseline	23 (14.3)	86 (53.4)	36 (22.4)	16 (9.9)	
	T1	26 (15.6)	79 (47.3)	44 (26.3)	18 (10.8)	0.635
	T2	22 (12.9)	103 (60.2)	26 (15.2)	20 (11.7)	0.725
I eat breakfast	Baseline	8 (5.1)	25 (15.9)	28 (17.8)	96 (61.1	
	T1	13 (7.8)	28 (16.9)	28 (16.9)	97 (58.4)	0.508
	T2	10 (6)	28 (16.8)	33 (19.8)	96 (57.5)	0.782
I am active for at least 30mins most days in the week	Baseline	2 (1.3)	19 (12)	45 (28.5)	92 (58.2)	
	T1	-	19 (11.5)	52 (31.5)	94 (57)	0.725
	T2	1 (0.6)	20 (11.8)	45 (26.5)	104 (61.2)	0.770
I use the labels on food packages to decide what to eat	Baseline	52 (32.7)	64 (40.3)	26 (16.4)	17 (10.7)	
	T1	47 (28.3)	68 (41)	36 (21.7)	15 (9)	0.480
	T2	45 (26.6)	83 (49.1)	29 (17.2)	12 (7.1)	0.937
I spend an hour or more in front of the TV or computer most days in the week	Baseline	30 (19.1)	47 (29.9)	68 (43.3)	12 (7.6)	
	T1	20 (12)	57 (34.3)	71 (42.8)	18 (10.8)	0.340
	T2	31 (18.3)	46 (27.2)	73 (43.2)	19 (11.2)	0.417
I think about the health of my heart	Baseline	8 (5.1)	73 (46.2)	47 (29.7)	30 (19.0	
	T1	15 (9.3)	68 (42)	52 (32.1)	27 (16.7)	0.523
	T2	16 (9.5)	82 (48.5)	49 (29)	22 (13)	0.043
I think about the health of my friends' and family's hearts	Baseline	19 (12)	65 (41.1)	49 (31)	25 (15.8)	
	T1	26 (16)	73 (44.8)	42 (25.8)	22 (13.5)	0.154
	T2	32 (19.3)	79 (47.6)	33 (19.9)	22 (13.3)	0.015
I talk about health with my friends or family	Baseline	46 (29.1)	82 (51.9)	23 (14.6)	7 (4.4)	
	T1	54 (33.1)	86 (52.8)	17 (10.4)	6 (3.7)	0.425
	T2	60 (35.5)	79 (46.7)	25 (14.8)	5 (3)	0.280
I like to do active things in my spare time	Baseline	3 (1.9)	40 (25.6)	41 (26.3)	72 (46.2)	
	T1	3 (1.9)	31 (19.3)	55 (34.2)	72 (44.7)	0.447
	T2	4 (2.4)	35 (20.8)	61 (36.3)	68 (40.5)	0.557
If I had a question about my heart I would try to find out more	Baseline	12 (7.6)	47 (29.7)	60 (38)	39 (24.7)	
	T1	11 (6.7)	57 (34.8)	54 (32.9)	42 (25.6)	0.792
	T2	24 (14.2)	78 (46.2)	42 (24.9)	25 (14.8)	0.000

Appendix 8.8 Change in proportions for Attitude and Behaviour measures Year 11

Year 11 Attitude and Behaviour scores changes in proportions voting for each ranking						
Question		**Strongly Disagree n (%)**	**Disagree n (%)**	**Agree n (%)**	**Strongly Agree n (%)**	**Significance (Wilcoxon Sign Rank Test)**
Attitudes						
I only need to worry about my heart when I get older	Baseline	2 (1.4)	12 (8.4)	85 (59.4)	44 (30.8)	
	T1	5 (3.4)	13 (8.9)	89 (61)	39 (26.7)	0.37
	T2	6 (5.3)	15 (13.3)	65 (57.5)	27 (23.9)	0.024
CVD doesn't affect many people	Baseline	-	19 (13.5)	108 (76.6)	14 (9.9)	
	T1	-	21 (14.4)	100 (68.5)	25 (17.1)	0.314
	T2	5 (4.4)	11 (9.7)	83 (73.5)	14 (12.4)	0.57
It doesn't matter what I do now, I could still get CVD when I'm older	Baseline	4 (2.8)	79 (56)	51 (36.2)	7 (5)	
	T1	6 (4.1)	77 (53.1)	50 (34.5)	12 (8.3)	0.674
	T2	8 (7.1)	51 (45.1)	47 (41.6)	7 (6.2)	0.739
I can influence how much cholesterol is in my blood	Baseline	1 (0.7)	10 (7.2)	98 (70.5)	30 (21.6)	
	T1	4 (2.8)	9 (6.3)	96 (67.6)	33 (23.2)	0.668
	T2	7 (6.2)	7 (6.2)	82 (73.2)	16 (14.3)	0.001
If someone smokes the damage they have done to their heart is permanent	Baseline	18 (12.8)	68 (48.2)	53 (37.6)	2 (1.4)	
	T1	17 (11.7)	69 (47.6)	52 (35.9)	7 (4.8)	0.517
	T2	20 (17.9)	52 (46.4)	29 (25.9)	11 (9.8)	0.484
Being active will take up lots of my time	Baseline	9 (6.4)	41 (29.1)	77 (54.6)	14 (9.9)	
	T1	7 (4.9)	50 (34.7)	71 (49.3)	16 (11.1)	0.869
	T2	8 (7.1)	28 (25)	61 (54.5)	15 (13.4)	0.404
There are simple ways to stay healthy	Baseline	1 (0.7)	4 (2.8)	77 (54.6)	59 (41.8)	
	T1	-	5 (3.5)	96 (66.7)	43 (29.9)	0.045
	T2	6 (5.4)	4 (3.6)	76 (68.5)	25 (22.5)	0.005
If someone is underweight it is healthy for their heart	Baseline	2 (1.4)	13 (9.2)	74 (52.5)	52 (36.9)	
	T1	4 (2.8)	17 (11.7)	85 (58.6)	39 (26.9)	0.073
	T2	8 (7.2)	4 (3.6)	71 (64)	28 (25.2)	0.089
I think I understand what CVD is	Baseline	11 (8)	59 (43.1)	61 (44.5)	6 (4.4)	
	T1	2 (1.4)	15 (10.6)	108 (76.6)	16 (11.3)	0.000
	T2	7 (6.2)	23 (20.5)	74 (66.1)	8 (7.1)	0.033
If someone is overweight it is unhealthy for their heart	Baseline	6 (4.3)	8 (5.7)	66 (47.1)	60 (42.9)	
	T1	7 (4.8)	9 (6.2)	77 (53.1)	52 (35.9)	0.582
	T2	5 (4.4)	13 (11.5)	58 (51.3)	37 (32.7)	0.038
I know enough about heart disease to make decisions that are healthy for my heart	Baseline	4 (2.9)	46 (33.1)	81 (58.3)	8 (5.8)	
	T1	2 (1.4)	13 (9)	108 (74.5)	22 (15.2)	0.000
	T2	4 (3.5)	14 (12.4)	73 (64.6)	22 (19.5)	0.000

I read labels on food packages	Baseline	28 (20.1)	71 (51.1)	30 (21.6)	10 (7.2)	
	T1	35 (24)	66 (45.2)	29 (19.9)	16 (11)	0.063
	T2	34 (29.8)	48 (42.1)	20 (17.5)	12 (10.5)	0.798
I eat breakfast	Baseline	10 (7.2)	29 (20.9)	28 (20.1)	72 (51.8)	
	T1	9 (6.2)	37 (25.3)	23 (15.8)	77 (52.7)	0.7
	T2	8 (7.1)	27 (23.9)	20 (17.7)	58 (51.3)	0.458
I am active for at least 30mins most days in the week	Baseline	3 (2.2)	38 (27.3)	43 (30.9)	55 (39.6)	
	T1	6 (4.2)	47 (32.6)	37 (25.7)	54 (37.5)	0.236
	T2	10 (8.8)	28 (24.8)	31 (27.4)	44 (38.9)	0.465
I use the labels on food packages to decide what to eat	Baseline	67 (47.9)	54 (38.6)	15 (10.7)	4 (2.9)	
	T1	68 (47.2)	48 (33.3)	20 (13.9)	8 (5.6)	0.429
	T2	53 (46.9)	38 (33.6)	13 (11.5)	9 (8)	0.104
I spend an hour or more in front of the TV or computer most days in the week	Baseline	40 (28.6)	62 (44.3)	34 (24.3)	4 (2.9)	
	T1	39 (27.1)	57 (39.6)	37 (25.7)	11 (7.6)	0.353
	T2	34 (29.8)	45 (39.5)	27 (23.7)	8 (7)	0.839
I think about the health of my heart	Baseline	22 (15.8)	83 (59.7)	26 (18.7)	8 (5.8)	
	T1	22 (15.3)	75 (52.1)	35 (24.3)	12 (8.3)	0.243
	T2	17 (15.3)	68 (61.3)	20 (18)	6 (5.4)	0.932
I think about the health of my friends' and family's hearts	Baseline	36 (25.7)	70 (50)	26 (18.6)	8 (5.7)	
	T1	29 (20)	70 (48.3)	29 (20)	17 (11.7)	0.07
	T2	21 (18.4)	54 (47.4)	28 (24.6)	11 (9.6)	0.065
I talk about health with my friends or family	Baseline	43 (30.7)	74 (52.9)	21 (15)	2 (1.4)	
	T1	44 (30.3)	72 (49.7)	21 (14.5)	8 (5.5)	0.368
	T2	41 (36.3)	49 (43.4)	16 (14.2)	7 (6.2)	0.537
I like to do active things in my spare time	Baseline	5 (3.6)	53 (37.9)	43 (30.7)	39 (27.9)	
	T1	7 (4.8)	41 (28.3)	61 (42.1)	36 (24.8)	0.667
	T2	10 (8.8)	38 (33.6)	46 (40.7)	19 (16.8)	0.123
If I had a question about my heart I would try to find out more	Baseline	14 (10.1)	47 (33.8)	48 (34.5)	30 (21.6)	
	T1	13 (9)	50 (34.7)	50 (34.7)	31 (21.5)	0.923
	T2	17 (14.9)	37 (32.5)	37 (32.5)	23 (20.2)	0.705

Chapter 9 Appendices

Appendix 9.1 BMI cut-off points of the three most frequently cited definitions

BMI percentile	Cole et al 2000 (27)	CDC growth charts 2000 (79)	Kromeyer-Hauschild 2001 (80)
		Boys	
90th	25	26.8	25.91
95th	30	28.8	Not reported
97th	Not reported	30.5	28.78
		Girls	
90th	25	27.3	25.28
95th	30	30.3	Not reported
97th	Not reported	33	27.76