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Preventing obesity in children : developing a school-based intervention

Preventing obesity in children: developing a school-based intervention

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A dissertation submitted to the University of Bristol in accordance with the requirements of the degree of Doctor of Philosophy (PhD) in the Faculty of Medicine, Department of Social Medicine.

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Abstract

The prevalence of childhood obesity has increased to epidemic proportions in Western Europe and North America. School-based interventions to prevent obesity have shown evidence of a reduction in the odds of obesity and weight, but most studies are from the US. The aims of this thesis are to examine the feasibility of transferring a US school based obesity prevention intervention for 9 to 10 year olds in England and to complete a feasibility study and pilot cluster randomised controlled trial of this intervention. The intervention is called 'Active for life year 5' (AFLY5).

Using data from nationally representative surveys I found that obesity was at least 8% higher in US children aged 9-10 than English children. I found it is feasible and acceptable to adapt a US obesity prevention intervention to England. The intervention may lead to improvements in sedentary behaviour, physical activity, active travel to school, and eating healthy portions of fruit/vegetables, snacks and high energy drinks in English children. However, my pilot studies were too small to provide precise estimates that exclude the null. Homeworks engage some parents and may support behaviour change in a proportion of children. A sample size of 1300 children and 52 schools would be required for a full scale trial.

A full-scale RCT of the intervention will provide robust evidence of the effectiveness of the intervention to decrease sedentary behaviour, increase physical activity and healthy eating. There are opportunities to integrate the intervention into existing public health initiatives.

Author's Declaration

I declare that the work in this dissertation was carried out in accordance with the Regulations of the University of Bristol. The work is original, except where indicated by special reference in the text.

I managed the two phases of data collection in schools and undertook all the measurements in the second phase of the work. I analysed the data from the two phases of work under the supervision of Professor Debbie Lawlor and Dr Russ Jago. The analysis of body mass index data from the Health Survey for England and the National Health and Nutrition Examination Study (US survey) was in collaboration with Dr Iain Lang. No part of the dissertation has been submitted for any other academic award. Any views expressed in the dissertation are mine.

Four papers have been published from this work and one has been accepted for publication (following revisions). I am first author on the five papers. All papers are listed on the next page.

SIGNED: [signature]　　　　DATE: 24·11·2010

Publications and presentations from thesis

Four journal papers have been published from the thesis and one paper has been accepted for publication following revisions.

Publications

Kipping RR, Jago R, Lawlor DA. Obesity in children. Part 1: Epidemiology, measurement, risk factors, and screening. *BMJ* 2008. 337: a1824.

Kipping RR, Jago R, Lawlor DA. Obesity in children. Part 2: Prevention and management. *BMJ* 2008. 337: a1848.

Kipping RR, Payne C, Lawlor DA. Randomised controlled trial adapting US school obesity prevention to England. *Arch Dis Child* 2008. 93: 469-473.

Kipping RR, Jago R, Lawlor DA. Diet outcomes of a pilot school-based randomised controlled obesity prevention study with 9-10 year olds in England. *Preventive Medicine* 2010. doi: DOI: 10.1016/j.ypmed.2010.04.011

Kipping RR, Lang, I, Jago R, Lawlor DA. Variation in childhood and adolescent obesity prevalence defined by international and country-specific criteria in England and the US. (accepted for publication 30/06/10 by *Eur J Clin Nutr*)

Presentations

Kipping R.R., Lang I, Jago R, Lawlor DA. Are US children and adolescentes more obese than their counterparts in England? Comparison of BMI trends using cuntry-specific and international cut-points. Annual Conference of the ISBNPA. 2009. P2 T2.2(Abstract).

Kipping RR. Using an American school-based obesity prevention project in England: findings from a pilot cluster randomised controlled trial and feasibility study. Oral presentation at Faculty of Public Health Annual Conference. 27/6/07.

Kipping RR, Lawlor DA. Using an American school-based obesity prevention project in England: findings from a pilot cluster randomised controlled trial and feasibility study. Oral presentation at Royal Society of Medicine Childhood Obesity Meeting. 23/3/07.

Dedication

To my parents - for their love and support

Acknowledgements

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Finally, many thanks to my husband James, for his unstinting love, support, patience and encouragement.

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Abbreviations

AFLY5	Active for Life Year 5
ALSPAC	Avon Longitudinal Study of Children and Parents (a cohort study of children born in Avon in 1990/1)
BMI	Body mass index
2000 CDC	Center for Disease Control 2000 (a US standard for classifying body mass index in children)
CI	Confidence interval (usually presented at the 95% level)
CONSORT	Consolidated Standards of Reporting Trials
CRB	Criminal Record Bureau
DEXA	Dual-energy X-ray Absorptiometry
ID	Identification
IOTF	International Obesity Taskforce
IQR	Inter quartile range
HSE	Health Survey for England
LDL	Low-density lipoprotein
MRC	Medical Research Council
MVPA	Moderate and vigorous physical activity
NHANES	National Health and Nutrition Examination Study (US survey)
NICE	National Institute for Health and Clinical Excellence
3Ps	Parents, peers and physical activity (Bristol research study)
PA	Physical activity
PCT	Primary Care Trust
PE	Physical education
PEACH	Personal and Environmental Associations with Children's Health (Bristol research study)

PSHE	Personal social health and economic
PTA	Parent Teacher Association
QCA	Qualifications and Curriculum Authority
RR	Relative risk
SATS	Standard Assessment Tests
SD	Standard deviation
SEP	Social economic position
UK 1990	Growth charts used in the UK which are based on children's height and weight in the UK in 1990
US	United States of America
WHO	World Health Organisation

Glossary

Accelerometers	Accelerometers are small match-boxed sized activity monitors worn unobtrusively on a belt around the hips that have provide accurate measures of physical activity by measuring acceleration
Active for life year 5	School-based intervention to prevent obesity in 9-10 year olds, adapted from Eat Well Keep Moving which was developed in the US
Adiposity rebound	The period when a child's BMI is at its lowest, usually at age 5-6, before it starts to increase monotonically
Combined sensors	Measurement of physical activity using a sensor which combines a movement sensor e.g accelerometer and a physiological measure e.g. heart rate or temperature monitor.
Inclinometers	Monitors which quantify time spent lying, sitting or standing
Intention-to-treat	All participants are analysed according to their group allocation, regardless of the treatment actually received
Nvivo	Qualitative data analysis software
Self-efficacy	The perceived confidence in the ability to engage in a particular behaviour.
Stata	Data analysis and statistical software
VO_2 max	The maximum capacity of an individual's body to transport and utilize oxygen during incremental exercise, which reflects the physical fitness of the individual
z-scores	The distance from the mean in units of standard deviations. A positive z-score indicates that the value is above the mean and a negative z-score indicates that the value is below the mean. Z-scores are commonly standardised by age (sometimes additionally by gender).

CHAPTER 1. INTRODUCTION

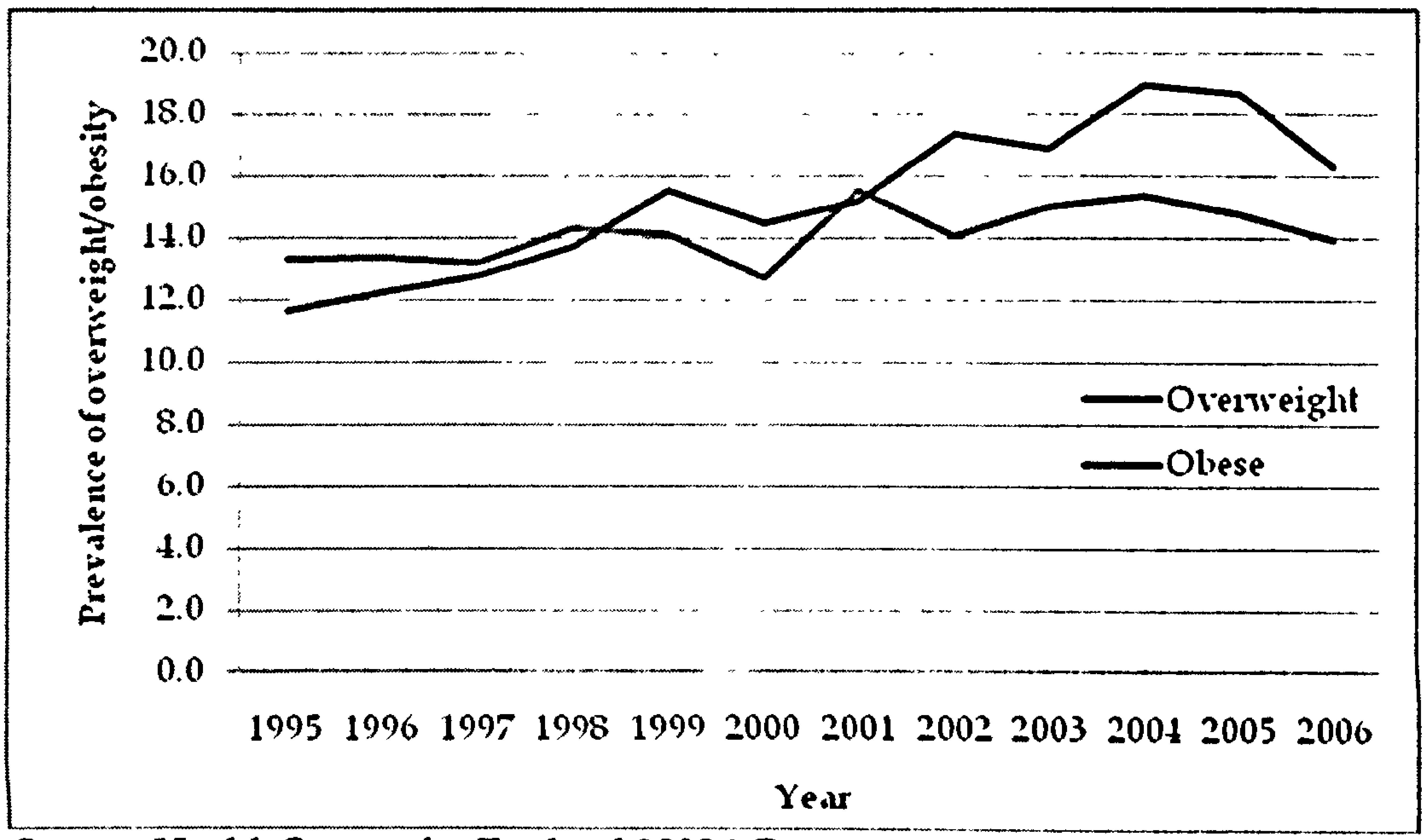
This chapter places the thesis within the wider context of the field and identifies the challenge of childhood obesity, the specific problems associated with obesity prevention. It goes on to present the aims, objectives and structure of the thesis.

1.1. Childhood obesity

Globally 22 million children under 5 years of age were overweight in 2007, with more than 75% of overweight and obese children living in low and middle income countries.[1] It is not only the scale of childhood obesity that presents a major public health challenge, but also the speed at which the prevalence has increased and the paucity of knowledge about how to prevent and manage obesity.

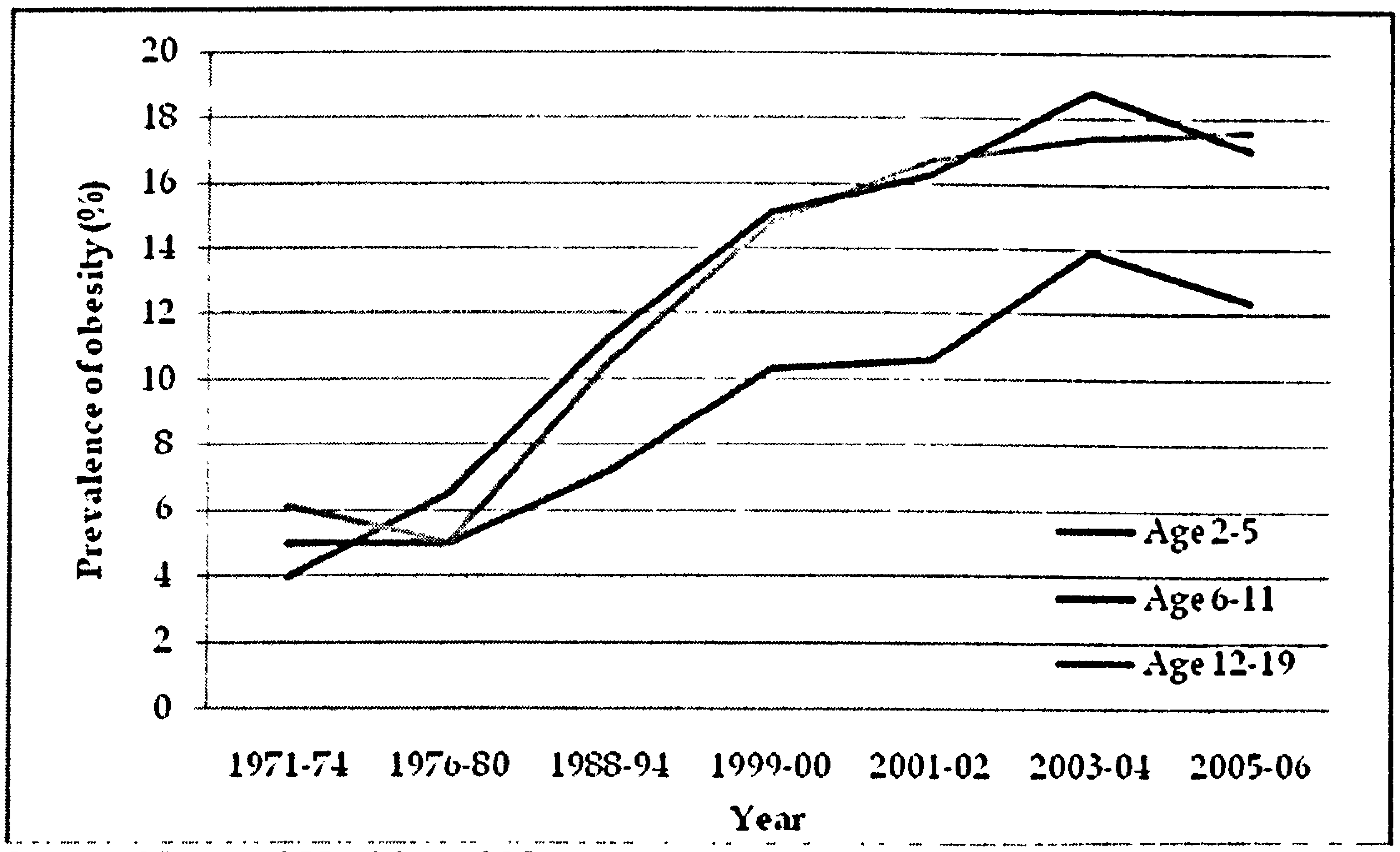
Internationally, the greatest increases in annual change in obesity since 1970 in school children have been in Western Europe and North America.[2] Trends in the prevalence of obesity in England and the US are shown in Figure 1.1 and Figure 1.2. The data in these figures are from cross-sectional surveys and use country specific growth charts (UK 1990 reference charts and 2000 CDC growth charts from the Centre for Disease Control in the US, with overweight defined as ≥ 85th < 95^{th} percentiles and obese defined as ≥ 95th percentiles of gender specific body mass index (BMI) for age). For both countries, the latest published survey data is presented and it suggests that the increase in prevalence of obesity may be levelling off, but it is too early to know whether the peak in prevalence has been reached or if this apparent levelling is general variation around an on-going increase.[3,4,5]

Figure 1.1 Prevalence of overweight and obesity in England among 2 to 15 year olds (1995-2006)



Source: Health Survey for England 2008.[3] Categories are independent: overweight does not include those who are obese. Overweight defined as ≥ 85th < 95th UK gender specific BMI for age percentiles; obese defined as ≥ 95th UK gender specific BMI for age percentiles (1990 reference charts).

Figure 1.2 Prevalence of obesity in United States of America for 2 to 19 year olds (1971-2006) using CDC 95th percentile cut-point



Source: National Health and Nutrition Examination Survey (NHANES) 2006.[4,5] Obese defined as ≥95th centile based on the USA 2000 gender specific BMI for age growth charts from the Centre for Disease Control.

1.2. Risk factors for obesity in children

Obesity is caused by an imbalance in energy intake and expenditure. The relative contribution of physical activity, sedentary behaviour and diet to the development of obesity in children is not clear. This is in part because of the difficulties in measuring these variables and the complexity of energy balance.[6,7]

The evidence for a wide range of risk factors associated with childhood obesity are summarised in Appendix 1. Genetic variants, ethnicity, parental fatness, higher birth weight, timing or rate of maturation, low levels of physical activity, high levels of sedentary activities and energy dense food are all associated with childhood obesity.[8-10] Some risk factors are common (prevalence >10%) but not modifiable, such as the combined effect of multiple genetic variants. Other risk factors are both common and modifiable: these include high birth weight (which is modifiable in cases of maternal diabetes mellitus), high levels of television viewing, low levels of physical activity, parents' inactivity, and consumption of dietary fat, carbohydrate and sweetened beverages. Clearly these need to be the focus of prevention programmes.

1.3. Consequences of childhood obesity

Obesity in children and adolescents is associated with a range of adverse metabolic and cardiovascular conditions,[11] exacerbation of asthma,[12] poor self-esteem[13] and obese children are more likely to be obese as adults.[14-16] The evidence for the consequences of childhood obesity is based on observational, often cross-sectional, studies and these associations do not necessarily mean causation. Furthermore, associations have often been examined in clinically obese populations and these may not reflect associations in the general population even at the same level of adiposity. Higher BMI in children aged seven to seventeen has been shown in a meta-analysis to be associated with increased risk of coronary heart disease (RR of coronary heart disease outcome for a 1kg/m^2 higher body mass index (BMI) = 1.05, 95% CI 1.02 to 1.09).[17] Increases in adiposity at ages 8.5 to 10 in the Avon Longitudinal Study of Parents and Children (ALSPAC) have been shown to be associated with fat mass and a range of cardiovascular disease risk factors at age 15.[18]

1.4. Prevention of childhood obesity

Whilst at a simplistic level obesity is caused by an imbalance in energy expenditure, the underlying mechanisms are complex and inter-related.[19] Therefore, it is not surprising that interventions designed to prevent obesity have rarely been successful. A meta-analysis[20] and Cochrane systematic review[21] of controlled interventions to prevent childhood obesity published up to 2005 identified 61 and 22 studies respectively. The majority of studies did not demonstrate strong evidence for an effect of preventing weight gain or obesity and many studies were limited in design, duration or analysis.

The Cochrane review concluded that comprehensive strategies which address diet and physical activity, interventions with psycho-social support and those that involved environmental change may help to prevent obesity.[21] The meta-analysis concluded that, despite a very large number of childhood obesity prevention trials, the vast majority (79%) did not find an effect on the prevention of weight gain.[20] The investigators pooled all studies (despite the varied intervention types and populations across the studies) in one large meta-analysis and found a 'trivial' beneficial effect on average but with very marked heterogeneity between studies.

In contrast to these broad reviews of all interventions, a systematic review of controlled studies with interventions to reduce sedentary activities found that they consistently demonstrated reductions in weight in children.[22] A systematic review of controlled trials to promote physical activity found some evidence of effect on activity levels for environmental interventions and those targeted at children from low socioeconomic backgrounds.[23] Multi-component interventions (school/educational and family, environmental or policy interventions) were effective at increasing physical activity for adolescents.[20,24] The modest effectiveness of programmes aimed at individual change to prevent obesity is similar to those found for other health behaviours.[20] Less research has evaluated the effect of interventions at the societal and political levels to prevent obesity.

Eleven systematic reviews of randomised controlled trials of school-based childhood obesity prevention programmes have been published (see section 2.6 for a detailed discussion of the reviews). Earlier reviews noted a lack of evidence of effectiveness and the poor quality of studies; whereas more recent reviews suggest that school based interventions may be effective. Two meta-analyses have shown evidence for a reduction in the odds of obesity and weight.[25,26] The majority of school obesity prevention studies were conducted in the US. Thus, there is a need to determine what the key effective characteristics are of such programmes and whether they are effective outside the US.

1.5. Research question

1.5.1. Aims

The aim of the thesis is to evaluate the feasibility of transferring a US school-based obesity prevention intervention to England.

1.5.2. Objectives

The objectives of the thesis are:

1. to compare the prevalence of childhood and adolescent obesity in England and the US from 1999 to 2006. This was in order to set the scene for further feasibility and pilot work. In particular I was interested in whether levels of obesity in English children aged 9-10 (the target group for my intervention) were markedly different to levels in US children of the same age. This is because absolute effects of any intervention will vary by the underlying prevalence of the condition in the population.
2. to evaluate the feasibility of transferring a US school based obesity prevention intervention to 9-10 year olds in England and to examine the effect of the intervention on screen viewing, BMI, obesity, active travel to school and diet (specifically fruit and vegetables, snacks, high fat foods and high energy drinks).
3. to develop and pilot methods to involve parents in the school based intervention; and to compare the effect of the intervention with and without parental involvement on sedentary behaviours, BMI, waist circumference, obesity, diet and physical activity; and finally to investigate parent, teacher and children's views of methods to involve parents.

1.6. Structure of thesis

The thesis is structured with a review of the relevant literature in chapter 2 followed by four areas of work (see Figure 1.3). The first of these areas of work (chapter 3) is a comparison of the prevalence of childhood obesity in England and the US from 1999 to 2006, which is used to set the scene for transferring a school based intervention from the US to England. This is followed by three chapters which report the progression of adapting a US school-based obesity prevention intervention to England: chapter 4 outlines the AFLY5 phase I study, chapter 5 covers the work to develop methods to involve parents in the AFLY5 phase II study, and chapter 6 outlines the AFLY5 phase II study to pilot the parent involvement work. Within each of these chapters the aims, methods and results are presented followed by a summary. The thesis concludes with a discussion of the main conclusions and implications of my research. Followed by a broad discussion of the implications for research and policy (chapter 7).

Figure 1.3 Outline of thesis

Chapter 1
Introduction

Chapter 2
Literature review

Chapter 3
Comparison of prevalence of child obesity in England and US

Chapter 4
AFLY5 phase I: *pilot study*

Chapter 5
AFLY5 phase II: *developing methods to involve parents*

Chapter 6
AFLY5 phase II: *parent involvement study*

Chapter 7
Discussion

1.7. Summary

The increased prevalence and significant consequences of obesity in children necessitates effective prevention efforts. There is some evidence that school based interventions may be effective, but studies of these have been largely conducted in the US. It is important to test the feasibility and effectiveness of transferring interventions from the US to other countries. My thesis aims to address these gaps in current knowledge of childhood obesity prevention by examining the feasibility of transferring a school based intervention from the US to the UK, piloting this intervention and further developing parent involvement in this intervention and piloting its effectiveness.

CHAPTER 2. REVIEW OF LITERATURE

2.1. Background

In this chapter the literature relevant to the thesis is reviewed. The key questions addressed in this thesis are:

- How does the prevalence of childhood and adolescent obesity in England compare to those in the US?
- Is it feasible and effective to transfer a US school-based obesity prevention intervention to 9-10 year olds in England?
- How can parents be involved in a school-based intervention and does this involvement change the effectiveness of the intervention?

The chapter begins by outlining how the key outcomes - adiposity, diet, physical activity and sedentary behaviours - can be measured. This is followed by a description of the search strategy used to identify literature relevant to the three key questions of the thesis. The literature comparing obesity prevalence in the US and England is discussed. The design of interventions including theories of behaviour change are outlined before examining the literature on child obesity prevention; by setting (school and family); and by type (single or multi-component). Finally the gaps in knowledge will be identified.

2.2. Measuring outcomes

This section presents an overview of the measurement of the key outcomes: adiposity, diet, physical activity and sedentary behaviours in children.

2.2.1. Measuring adiposity

Childhood adiposity (fatness or obesity) is measured using direct or indirect methods. Direct measurements are more expensive than indirect measurements and as a consequence indirect measurements are more commonly used in research, particularly in studies with relatively large sample sizes. Direct measures for children include densitometry and scanning using Dual-energy X-ray Absorptiometry (DEXA)[27] and air-displacement plethysmography (for example BodPod® and PeaPod®).[28] Indirect methods include anthropometric measures of adiposity such as BMI (kg/m^2), waist circumference, skin fold thickness and bioelectrical impedance.[29] BMI and skin fold thickness have been associated with cardiovascular disease risk factors during adolescence, such as hypertension, raised total cholesterol and low density lipoprotein cholesterol, insulin resistance and type II diabetes.[30-34] BMI is as accurate as skin fold thickness in identifying children and adolescents who are at risk from metabolic changes such as triglycerides, low-density lipoprotein (LDL) cholesterol, fasting insulin and hypertension.[34] BMI is the only measure of adiposity in childhood that has been shown to be associated with future risk of cardiovascular mortality in adulthood.[17]

BMI is the standard method of assessing the prevalence of overweight and obesity. There are internationally agreed thresholds for BMI to define under-weight ($\leq$18.5), normal weight (18.5 to 24.9), overweight (25 to 29.9), obesity I (30 to 34.9), obesity II (35 to 39.9) and obesity III (>40) in adults[35] but in children the marked effects of age, gender and pubertal status make simple classification difficult. The assessment of obesity among children relies on plotting BMI on a standard growth chart and then defining a cut-point for increased BMI relative to age and gender. International comparisons are difficult, as countries tend to use standard growth charts based on their own country and different cut-points. Commonly used cut-points for overweight and obesity include: 110% or 120% of ideal weight for height; weight-for-height Z-scores of >1 and >2, and BMI at the

85th, 91th, 95th and 98th percentiles (based on international or country-specific reference populations).[2,35] To address this issue the International Obesity Taskforce (IOTF) have developed international cut-points for BMI for overweight and obesity by gender between 2 and 18 years. The cut-points are defined to pass through BMI of 25 and 30 kg/m^2 at age 18, based on BMI data from six countries which enables comparison of prevalence globally.[36] In the UK the 1990 UK reference chart for boys and girls are used to measure BMI from age four onwards.[37] In 2009 new charts from birth to age four were published which combine the UK 1990 and World Health Organisation (WHO) growth standards for healthy breast fed children with optimal growth.[38,39] Differences between the growth standards are explored further in chapter 3.

The National Institute for Health and Clinical Excellence (NICE) recommends tailored clinical intervention if a child's BMI (adjusted for age and gender) is $\geq$91st percentile and consider assessing for co-morbidities if their BMI is $\geq$98th percentile, using UK 1990 reference charts. The 85th and 95th percentiles are used for defining overweight and obesity for surveillance purposes in the UK and US.[40,41]

It has been suggested that abdominal adiposity may be a more important risk factor for cardiovascular risk than obesity in adults, although recent evidence suggests that indirect measurements of abdominal adiposity (waist circumference and waist-hip-ratio) have similar magnitudes of association to cardiovascular risk in adults as does BMI.[42] Recent evidence from the ALSPAC cohort suggests that the same may be true in children.[43] Measurement of waist circumference may be useful for identifying children at risk of excess centrally located weight although, as with BMI, there is debate about the correct cut-point for defining central obesity in children. Gender specific waist percentile curves for British children aged 5-16 years have been published.[44] The International Diabetes Federation have suggested criteria for defining the metabolic syndrome in children and they recommend a cut-point of $\geq 90^{th}$ percentile of waist circumference for age, gender and ethnic origin in children aged six and above for defining central adiposity.[45] However, to date no studies have demonstrated an association of central adiposity, or metabolic syndrome, in children with future risk of cardiovascular disease.

2.2.2. Measuring diet

Food intake can be measured at national, household or individual levels. Food intake is difficult to measure accurately because it requires data to be collected on many food items, the consumption of which varies by time of day, day of the week and season. Assessment is also complicated by the reliance on self-report methods, with under-reporting typically being 10-20% for normal weight adults and 20-50% for obese adults.[46] In children food frequency questionnaires can lead to an overestimation of calorie intake by approximately 50%, whilst 24 hour recalls and diet records are more accurate as mean values for a group.[29] In this section the methods that are used to measure food intake in intervention and epidemiology research studies will be described.

There are five steps involved in measuring food intake and converting this to nutrient intake:[46]

1) Obtain a report or direct observation of all the foods (type and amount) an individual consumes in a given period of time
2) Match the foods consumed to an appropriate item in a food table that provides information on amounts of nutrients in each food
3) Quantify the portion sizes for each food
4) Measure or estimate the frequency with which each food is eaten
5) Calculate the nutrient intake from food tables (portion size (g) x frequency x nutrient content per g).

In Table 2.1 five methods to measure food intake are summarised. These include retrospective methods (24 hour recall, food frequency questionnaires and diaries), prospective methods (food record/diary) and eating behaviour questionnaires. The methods which are cheapest and with lowest respondent burden are the retrospective methods, but the prospective food record provides more detailed information. 24 hour recall, repeated on three occasions is accepted as a reliable method, as is a three to seven day food record.[47] For all methods there are practical problems with using them with children, most notably problems with literacy, numeracy, estimation and memory. The literacy and numeracy problems with children can be overcome by using an interviewer, but this increases the cost and time required. With all the methods the parent can complete the measures on behalf of the child, however, for school age children parental recall may be inaccurate for daytime consumption.

Table 2.1 Summary of methods to measure food intake[29,46-48]

Measurement method	Description	Administered	Time period	Prospective/ retrospective	Food items preselected	Portion size	Food weighed	Strengths & weaknesses	Issues for use with children aged 9-10
Multiple pass dietary recall	Recall all food consumed the previous day in detail	Usually with a trained interviewer but can be computer administered	24 hours (repeat at least 3 times)	Retrospective	No. A script is used to probe.	Can be estimated from photos or house-hold measures	No	Low respondent burden. Expensive and time consuming if using a trained interviewed. Needs to be repeated to be representative because not typical intake. May influence food choices. Relies on memory. Does not give dietary patterns.	Literacy is not an issue. Can use pictures. Relies on memory which may be poor in children. Multiple pass method compares well with total energy expenditure.
Food frequency questionnaire	Structured dietary questionnaire about frequency of consumption; can be for specific foods e.g. fat.	Self-administered or by interviewer	Typical week	Retrospective	Yes	Can be included	No	Low respondent burden. Cheap, easily scanned and good for large studies. Relies on memory, estimation, literacy and numeracy. Enables ranking of individuals but not quantifying intake.	Memory and estimation may be poor. Children need to be literate and numerate. Tend to overestimate energy intake in children.

Table 2.1 continued

Measurement	Description	Administered	Time period	Prospective/ retrospective	Food items preselected	Portion size	Weigh	Strengths & weaknesses	Issues for use with children
Food histories	Information gathered through questionnaire or interview including diet and eating patterns	Self-administered or by interviewer	Month or year	Retrospective	Yes	Can be included	No	Low respondent burden. Relies on memory and estimation. Provides a picture of dietary habits and intakes.	Memory and estimation may be a problem. Tends to overestimate energy intake in children.
Food record (diary)	Food and drink recorded daily	Self-administered following training	Daily for 3-7 days	Prospective	No	Yes using house-hold measures, photos or 3D models	Yes	High respondent burden Requires compliance, numeracy, literacy and cognitive skills, and memory if completed at end of day. Time consuming to complete and code. May lead to under-eating or under-reporting. Provides a detailed record of all foods consumed and a better picture of dietary habits and intakes than other methods.	Not practical with children unless completed by parent.
Eating behaviour questionnaires	Questionnaire about eating behaviours	Yes	No specific time period	Retrospective	No	No	No	Low respondent burden and can be self-administered. Does not assess intake.	Requires parent proxy report.

Dietary recall has the advantage that the food consumed is not usually influenced by the data collection method, in the way that a food record may. The 24 hour recall is probably the most common method of collecting information on food intake.[46] Estimates of quantities are made in a similar way to non-weighed diet records. A technique of interviewing called 'the multiple-pass 24 hour recall' is used by interviewers to assist recall by giving several 'passes' or stages of questioning with different levels of detail. For example a five step multiple pass comprises of 1) quick list, 2) forgotten foods list, 3) time and occasion, 4) detail and 5) review. The multiple pass method compares well with total energy expenditure in children.[29] Although dietary recall has high compliance, data are only collected on one day and does not take into account the usual variation in daily intake. Therefore multiple days of 24 hour recall are usually needed to increase reliability. Electronic methods of 24 using computer based self-administered 24 hour dietary recall have been developed, such as FIRSSt, which has been validated for use with children. It has reasonable reliability and reduces the expense of dieticians administering the recall.[49]

Food frequency questionnaires (FFQs) measure frequency of consumption by asking respondents to indicate how frequently they eat or drink an item (e.g. more than once a day, daily, 3 to 4 times per week, 1 to 2 times per week, 1 to 2 times per month, occasionally, never). The study design will determine the number of items to include, which can be up to 200 items. FFQs are useful in epidemiological studies of association between food intake and disease or disease risk. FFQs however tend to overestimate energy intake in children, partly due to a lack of information on children's portion sizes.[29]

Diet histories aim to provide detailed information about habitual food intake over a month or year by using an interview with a cross-check of a list of commonly consumed foods. The intakes are usually classified as high, medium or low rather than quantifying energy intake.

The dietary record, typically measured in a diet diary, is demanding and requires the participant to be literate.[48] For children this method requires completion by parents.

A different form of dietary assessment is questionnaires about eating behaviour. For children these are usually completed by the parent. For example, the Children's Eating Behaviour Questionnaire is a 35 item instrument which measures responsiveness to food, enjoyment of food, satiety responsiveness, slowness in eating, fussiness, emotional overeating, emotional under eating, and desire for drinks.[50] While eating behaviour questionnaires are useful they only provide information on limited aspects of diet.

The errors associated with measuring dietary intake include: sampling bias, response bias, inappropriate coding of foods and use of food composition tables, estimation of portion size, recall or memory error, day-to-day variation in intake, and effect of survey method on food intake. With children 24 hour recall and food records tend to under-estimate energy intake, whilst food frequency questionnaires tend to over-estimate energy intake.[51]

The assessment of reproducibility and validity of dietary measures is difficult. With regard to reproducibility, this is in part because there is real day to day variation in what individuals eat and how much they eat, as well as measurement error. In terms of validity, it is difficult to observe real dietary intake to compare it with measured intake. Therefore, validity has relied on comparison of one method of measurement with another (typically the reference being a seven day weighed dietary record).[46] An alternative approach is to assess the validity of a dietary method with an objective measure, such as biochemical or physiological measures of energy and nutrient intake, for example, urinary nitrogen to assess protein intake, doubly labelled water to assess energy expenditure and the ratio of energy intake to basal metabolic rate.[46]

If the purpose of a study is to examine differences in intakes of specific foods (for example fruit and vegetable consumption), rather than nutrient intake, an alternative approach is to measure means, medians and frequency distributions of intake of these specific foods. As with the assessment of nutrients this requires information (either collected or assumed, e.g. from standard sizes) on portion size and frequency of consumption.

In summary, the method of reporting dietary intake varies depending on whether habitual intake is to be measured or a detailed measure of recent intake, the capabilities and motivation of the respondents, the funding available, and for children, the potential limitations of memory, literacy and numeracy levels. Methods range in accuracy and the time period over which data is collected. Reports of diet can be converted into nutrients and energy content or categorised into food types.

2.2.3. Measuring physical activity

Physical activity is a complex and multi-dimensional behaviour[7,52] which can be defined as:

> *"Any bodily movement produced by skeletal muscles that results in caloric expenditure."*[53]

It has the dimensions of intensity, frequency and duration (which combined make up the total volume of activity) and type or mode (e.g. walking or cycling).[54] Physical activity in children is influenced by a range of physiological, psychological, socio-cultural and ecological factors[55] and examples of these are summarised in Table 2.2.

Table 2.2 Summary of determinants of physical activity in children[55,56]

Determinants of physical activity in children	
Physiological	Age, developmental stage, gender, ethnicity, aerobic fitness, obesity, genetics, feeling tired
Psychological	Self-efficacy, perception of physical or sport competence, attitude toward physical activity, perceived benefits, time
Socio-cultural	Socioeconomic status, parental inactivity, parental activity, prompts to be active
Ecological	Access to play spaces, facilities, availability of equipment and transportation to activities or programmes.

The intensity of physical activity is usually classified as light, moderate or vigorous), which combined together make up the dose. The Metabolic Equivalent (MET) is the absolute measurement of intensity and is defined as the ratio of the metabolic rate of a particular activity to the resting metabolic rate. For a person weighing 60kg, one MET is approximately 3.5ml/kg/minute of oxygen consumed or about 1 kcal/kg/hour of energy expenditure.[57]

Children's physical activity is measured using either subjective methods (questionnaires, interviews, proxy report from carers and activity diaries) or objective methods (pedometers, accelerometers, heart rate monitors, combined sensors, direct observation and doubly labelled water).[54,56,58] The attributes of the different measurement methods for children and adolescents are summarised in Table 2.3. The choice of method will be informed by the aims of the study, level of validity required, cost, ease of administration, whether information is required about the type of activity, the impact of measurement on behaviour change, size of study and age of the children.[58] Each method will be considered below.

Table 2.3 Attributes of methods to measure physical activity in children and adolescents (reproduced from Trost[1])[58]

Method	Valid	Affordability	Objective	Ease of administration	Ease to complete/ compliance	Measure patterns, modes & dimensions of physical activity	Non-reactive[2]	Feasible in large studies	Suitable for ages <10 years	Suitable for ages >10 years
Questionnaire	✓	✓✓✓	x	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	x	✓✓
Interview	✓✓✓	✓✓	x	✓✓	✓✓	✓✓	✓✓✓	✓✓	✓	✓✓
Proxy report	✓	✓✓✓	x	✓✓✓	✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓
Diary	✓	✓✓✓	x	✓✓	x	✓✓✓	✓	✓	x	✓
Heart rate monitoring	✓✓	✓✓	✓✓✓	✓	✓	✓✓	✓	✓	✓✓✓	✓✓✓
Accelerometer	✓✓	✓	✓✓✓	✓✓	✓✓	✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Pedometer	✓✓	✓✓✓	✓✓✓	✓✓	✓✓	x	✓	✓✓	✓✓✓	✓✓✓
Observation	✓✓✓	x	✓✓	✓	✓✓✓	✓✓	✓	✓	✓✓✓	✓✓
Doubly labelled water	✓✓✓	x	✓✓✓	✓✓	✓✓	x	✓✓	x	✓✓✓	✓✓✓
Calorimetry[1]	✓✓✓	x	✓✓✓	✓	✓	x	✓✓	x	✓✓✓	✓✓✓

Key: x Poor or inappropriate ✓ Acceptable ✓✓ Good ✓✓✓ Excellent

[1] The table is exactly as in the Trost paper with the exception that I have added information about calorimetry

[2] Does not induce changes in physical activity behaviour as a result of the measurement process

Subjective

Questionnaires and interviews are widely used in epidemiology studies because they are easy to administer, relatively cheap, can provide qualitative and quantitative information and they can also be self-administered in children aged at least 10 years.[58] Questionnaires range from global (one to four items which classify individuals according to their level of vigorous intensity activity), short recall (5 to 15 items about recent physical activity patterns which can allow classification according to categories of activity e.g. inactive, sufficiently active or regularly active); and quantitative history questionnaires (detailed instruments with 15 to 60 items which provide information about intensity, frequency and duration of activities).[58] Self-report can also be measured by a diary in children aged at least ten years or proxy report from a carer.[58] All methods of self-report are limited by reliability and validity problems associated with recall of activity and potential problems with content validity when interpreting physical activity in different populations.[59]

Objective

The most precise measure of energy expenditure is doubly labelled water. This is a procedure whereby energy expenditure is estimated through biological markers which reflect the rate of metabolism. Two stable isotopes of water ($H_2{}^{18}O$ and ^2H_2O) are ingested and the rate of loss of the two isotopes from urine, sweat and evaporation are assessed over one to two weeks. This assessment provides a direct measure of carbon dioxide production and therefore an accurate measure of energy expenditure in physical activity. However, it is invasive and the $H_2{}^{18}O$ isotope is expensive.[59] Calorimetry uses respiratory gas analysis to measure energy expenditure by measuring oxygen consumption and carbon dioxide production, either using a facemask for short durations or within a metabolic chamber. Whilst this is a precise measure of energy expenditure it is invasive, expensive and generally not suitable for large research studies, but it can be used in small subgroups (including in children[60]) to validate other methods.[59]

Heart rate monitors have good association with energy expenditure and provide information about intensity, frequency and duration. However, they are only useful for measuring aerobic activities, they are more expensive than self-report methods and there is some discomfort when worn for extended periods.[59]

Electronic pedometers measure walking motion by movement of a horizontal spring-suspended lever arm that moves with the vertical acceleration of the hips. Pedometers provide the total number of steps taken each day and they can provide distance and energy-expenditure.[61] Some pedometers are able to store information for longer than 24 hours, thereby reducing potential bias if participants are required to log daily step counts. Whilst pedometers are cheaper than heart rate monitors and activity monitors, they are limited to measuring ambulatory activities and they do not provide information about intensity, frequency or duration of activity. In a 400m track walking test, eight of ten different types of pedometer were accurate at measuring recorded steps, however three of the pedometers were assessed to be superior to other pedometers with respect to their accuracy in quantifying steps to a level of +/- 3% steps (Kenz-Lifecorder, New Lifestyles NL-2000 and Yamaz Digiwalker SW-701).[62] The intramodel reliability (testing four pedometers of the same model) was good (at least 0.80) for all ten models tested. The accuracy of pedometers is reduced at slow walking speeds (below 3km/hour) and at fast running speeds (>16km/hour).[64]

In adults and adolescents pedometer measurement is required for at least five consecutive days to achieve a valid and reliable estimate of annual average number of steps (ICC $\geq$0.80).[63,64] For adults it has been estimated that 3,000 to

4,000 steps per day is equivalent to the recommended $\geq$30 minutes of physical activity a day and 10,000 steps are associated with a healthy level of physical activity.[65] For adolescents 8,000 steps (if undertaken in an hour) have been estimated to be equivalent to the UK recommendation of 60 minutes of moderate to vigorous physical activity per day.[66,67]

Direct observation has the advantage of measuring the behavioural aspects of physical activity and can provide both qualitative and quantitative information. However, the disadvantages are the time and expense involved during observation and coding. Therefore this approach is limited to studies with small numbers of participants.

Accelerometers

Accelerometers are the most commonly used objective method to assess physical activity in children.[54] Accelerometers are small match-boxed sized activity monitors worn unobtrusively on a belt around the hips that have been shown to provide accurate measures of physical activity among children.[68] Electric transducers and microprocessors convert acceleration into a digital signal.[69] Data collected by accelerometers is recorded in the monitor and can be downloaded as a dat file using software provided by the manufacturer. In the case of the Actigraph GT1M accelerometer, the monitor records activity counts, which are simply the summation of the absolute values of the sampled change in acceleration measured during the cycle period. One count is equal to 16.6 milli G's per second at 0.75 Hertz.[70] The activity counts represent a quantitative measure of activity over time. The dat file contains the serial number, start time, start date, epoch period, download time, download date, current memory address pointer, current battery voltage, mode and first start time.

There are a number of issues regarding the comparability of data collection and interpretation of accelerometry data. The issues that relate to children are: how many days should accelerometers be worn to provide an accurate measure of activity; what is the minimum wear time per day for the data to be an accurate measure of daily activity; should data be excluded from the analysis if the accelerometer records periods of continuous zeros (suggesting that the accelerometer was not worn or the child was extremely still); what spurious values should be excluded; and what cut-points should be used to categorise activity as light, moderate and vigorous. These issues will be discussed below. It should also be noted that accelerometers are not able to measure all activity, such as cycling and they are removed for any activities involving water, like swimming.

Estimates of the number of days of wear required for a reliable estimate of physical activity have been published with reliability coefficients. A summary is provided in Table 2.4. A study of accelerometers worn by English children aged 11 considered data to be valid if a child provides at least 600 minutes per day recorded for three days.[71] This combination gave reasonable reliability (R= 0.7 for 3 days and 0.8 for 4 days), and ensured a sufficient sample size (N = 5,601 for three days), with power estimated to be >90% for most planned analyses. A study with five year olds by Penpraze et al found the most reliable measure of physical activity was a monitoring period of seven days and 600 minutes per day (R = 0.8; 95% CI 0.7 to 0.86).[72] Trost estimated that between 4 and 5 days of monitoring would be necessary to achieve reliability of 0.80 in children (aged six to ten) and depending on age, between three and five days of monitoring are required to achieve a reliability of 0.70.[73] Comparison of intraclass correlation coefficients for the number of days wearing an accelerometer by Janz et al with seven to fifteen year olds concluded that four day averages for accelerometry produced acceptable correlations (R = 0.75 to 0.78) and 95% CI (0.60 to 0.88) that can be considered stable and highly reflective of usual physical activity.[74] Three studies (SPEEDY,[75] PEACH[76] and The European Youth Heart study[77]) with similar aged children (eight to fifteen years) used accelerometers to measure physical activity with at least three days as the criterion to determine inclusion. Therefore, although measurement of six or seven days increases reliability, many researchers have accepted three or four days because the reliability is reasonable and this more lenient criteria increases the sample size of eligible participants.[71]

Table 2.4 Reliability coefficients for number of days accelerometer worn

Study	Age	Minutes/day included	Number of days included	Reliability Coefficient R (95% CI)
Mattocks[71] ALSPAC study	11	600 minutes, however little difference in power with 540, 480 and 420 minutes	3 days	0.7
			4 days	0.8
Penpraze[72]	5	600 minutes	7 days	0.8 (0.70 to 0.86)
Trost[73]	10	Not given	4 and 5 days	0.8
Janz[74]	7 to 15	600 minutes	1 day	0.42 to 0.47
			4 days	0.75 to 0.78 (0.60 to 0.88)
			6 days	0.81 to 0.84

In addition to deciding how many days are required to produce a reliable measure of activity, the length of wear time needs to be assessed. It is common for a minimum of ten hours per day (600 minutes) to be used (see Table 2.4).[61] The ALSPAC study of accelerometers worn by children aged 11 found the combinations of days and minutes per day (540, 480 and 420 minutes) revealed little difference in power.[71]

In the absence of movement, accelerometers provide zero count readings. As such many researchers have interpreted periods of consecutive zeros as non-wear time. To determine non-worn time it is common to exclude ten or twenty minutes of continuous zeros.[71,75] For adults this may indicate genuine periods of sedentary behaviour since adults in sedentary jobs may genuinely be sedentary for long periods. However, it is unusual for children to be sedentary for long periods of time. The ALSPAC study with 11 year olds excluded data if there were continuous zeros for 10 or more minutes.[71] Reilly reported that:

> *"definitions of non-wear time vary in the literature, from bouts of 10 minutes of motionless data (10 consecutive '0' counts using 1 minute epochs) up to 180 minutes. Esliger and colleagues' analysis of data from 115 children aged 8-13 indicated that the average time for the longest recorded bout of motionless data was approximately 17 minutes, reinforcing the use of a 20 minute bout to identify behaviourally implausible data in school-aged children."*[78]

In contrast, the NHANES survey, determined non-wear time as at least 60 consecutive minutes of zero activity, with allowance for 1 to 2 minutes of counts between 0 and 100. This demonstrates there is no consensus.[79]

Another consideration is what values should be excluded as implausible; for example where children may have 'tampered' with the sensor (there are reports of children putting the accelerometers on their pet dogs or moving them up and down very rapidly in their hand). Esliger et al identified an upper range of biological plausibility as no more than 15,000 counts per minute therefore recommending that data with counts per minute greater than this should be excluded.[80] The ALSPAC analysis of data from 11 year olds excluded data if on any one day the average counts per minute were less than 150 or the average counts per minute was more than three standard deviations above the mean because it was considered to be behaviourally implausible.[71]

One of the greatest debates in research using accelerometer data is the use of thresholds or cut-points to determine levels of activity.[61] Calibration studies have been undertaken whereby energy expenditure from room respiratory calorimetry, activity counts from a microwave detector and heart rate telemetry have been compared with energy expenditure from activity monitors to determine cut-points for counts per minute. The cut-points for three calibration studies including primary school aged children up to age 12 are show in Table 2.5. Each study will be summarised below.

Table 2.5 Accelerometer cut-points from calibration studies with children aged 12 and under

Study (age of children)	**n**	**Sedentary**	**Light**	**Moderate**	**Vigorous**
ALSPAC[60] (12)	246	-	-	3581	6130
Puyau[81] (6 to 16)	26	0-800	801-3200	3201-8200	>8200
Trost[82] (10 to 14)	30	-	-	>1267	>4057

The ALSPAC calibration study used portable calorimetry as the gold standard with children aged 12.[60] In the calibration study 246 children performed six activities of graded increase in activity (e.g. lying, walking, hopscotch). Random intercepts models were used to develop a prediction equation in 163 children. The equation was assessed in another 83 children (the validation group) by calculating limits of agreement of their actual energy expenditure minus predicted expenditure. Thresholds for moderate and vigorous activity were derived by using VO_2 as the outcome in the energy expenditure model.

The Puyau calibration study used whole room calorimetry for six hours with 26 children aged 6 to 16 as the gold standard.[81] The children were given a structured protocol of varying intensity physical activities during which time energy expenditure by respiration calorimetrey was measured, followed by outdoor measurements to test the accelerometers in field conditions (without calorimetery). Energy expenditure was calculated using the Weir equation. The cut-points for moderate activity were similar to ALSPAC but the cut-points for vigorous activity had a higher cut-point at 6130 counts per minute.

The Trost calibration study was based on a sample of 30 children aged 10 to 14. Energy expenditure was calculated by measuring VO_2 during three five minute treadmill measures at 3, 4 and 5mph. An energy expenditure prediction equation was developed from 20 of the children and validated on the remaining 10 children. The cut-points for moderate and vigorous activity are both lower than the ALSPAC and Puyau cut-points.

A correction factor of 0.91 needs to be applied to the cut points, as recommended by Corder et al, because the GT1M accelerometer records fewer counts per minute compared to the model 7164 which was used to calculate the cut points.[83]

Although not a calibration studies, the European Youth Heart study [77] with 9-15 year olds and the SPEEDY study with 10 year olds[75] have used a cut-point of 2000 counts per minute for moderate activity, as being equivalent to walking about 4 km/hour, but without providing a reference for this choice of cut-point.

In summary self-report methods can be used with children and adolescents to measure physical activity, but the lower reliability with children makes objective methods such as accelerometers or heart rate monitors a preferable additional option. Pedometers have limited use because they only measure walking activity. High precision objective measures such as doubly labelled water are not practical for large scale studies.

2.2.4. Measuring sedentary behaviours

Sedentary behaviour is a cluster of behaviours where the posture is lying or sitting (excluding sleeping) and energy expenditure is very low.[84] Behaviours include screen-time (TV or computer), motorised transport, and sitting to read, talk, work or listen to music.

Self-report, in the form of questionnaires or diaries, or direct observation are used to provide information about frequency and duration of time spent in different sedentary behaviours. Bryant et al's systematic review of studies published between 1985 and 2005 measuring television viewing in children and adolescents included 88 studies using methods of self-report to assess TV watching, eight studies using self-reporting diaries and five studies using observation of TV viewing (direct observation or video-taping).[85] The minority of studies had been assessed for test-retest reliability or validity. Of the self-report studies, 70% asked the children to respond to questions and the remainder asked parents to respond, which was related to the children being younger. Eleven studies asked both children and parents to respond, with correlations ranging between r=0.31 to 0.92 and parents tending to underestimate viewing time compared with child report. Therefore caution is needed in the choice of measurement method and in interpreting evidence from studies using self-report of sedentary behaviours.

Sedentary behaviours are measured objectively using accelerometers or inclinometers (which quantify time spent lying, sitting or standing). These measuring devices are useful in minimising reporting error from self-report but they do not give information about the type of behaviour. Accelerometers do however provide practical, accurate and reliable information about the amount of sedentary behaviour in children.[86] The use of accelerometers to assess sedentary behaviours requires all the issues of measurement and cut-points discussed above to be considered. A range of cut-points for sedentary behaviour counts per minute have been defined from three calibration studies: children (1,100[87]), adolescents (100[88]) and adults (<800[89]).

2.3. Method of searching the literature

This section outlines the search strategy used to identify literature relating to the three key questions noted at the start of this chapter. The search strategy for this section took part in stages. The first search was a broad search to identify reviews of obesity to inform two overviews of childhood obesity published in the British Medical Journal[90,91]: for these the search of Medline was undertaken on 6/5/08. 1005 titles and abstracts articles were identified. The second search was to update the earlier review and to add evidence to address the key questions in relation to my thesis. The search terms were informed by the search strategy in the Cochrane review of obesity prevention in children.[21] Medline was searched from 1950 to 01/12/09 and Embase from 1980 to 03/12/09). The search strategies and results are shown in Appendix 2 (Table 2.1 and Table 2.2). 1189 articles were identified in Medline and 1348 articles in Embase and the titles and abstracts were all reviewed. A total of 75 articles were retrieved in full from the two searches.

This literature review aims to answer the following specific questions that relate to the three broad questions outlined at the start of this section:

1. Is the prevalence of childhood and adolescent obesity in England less than that in the US?
2. What settings (school and family) are effective and practical to prevent obesity in children?
3. Are single or multi-faceted interventions more effective at preventing childhood obesity?

4. What are the gaps in the knowledge of preventing childhood obesity and how could these be addressed?

Where the results from studies are reported, the strength of evidence will be based on the hierarchy of evidence taken from the Oxford Centre for Evidence-based Medicine.[92]

2.4. Comparing the prevalence of obesity in the US and England

International comparisons are important for documenting global epidemics of obesity that will require international prevention policies, and for identifying country-level differences that might be used to suggest causal mechanisms.[93] However, direct international comparisons are currently difficult because existing studies use different methods to define childhood obesity.[94] As outlined in section 2.2.1 above on measuring adiposity, classification of obesity in children difficult.

Given the differences between reference criteria for obesity, it is not uncommon for comparisons to be made between two or more criteria to estimate the prevalence of overweight and obesity in children in a country. Such studies have been undertaken in Chile, Ireland, Israel, Italy, Northern Quebec, Saudi, Switzerland and the US.[95-102] These studies almost universally compared the IOTF and 2000 CDC reference criteria and some also compared country-specific criteria. All the studies found the prevalence of obesity varied substantially using the different methods, with lower estimates of obesity using the IOTF criteria for most ages. Authors of these studies noted the inherent problems in adopting a BMI reference for children, particularly given that none of the criteria for children classify obesity based on prospectively validated health consequences.[100] All the criteria have inherent assumptions, such as the 95th centile indicating that exactly 5% of children are expected to be obese in each age group[102], and therefore differences in estimates of obesity need to be interpreted with caution.

I only identified one study that has made comparisons of childhood obesity between countries using different BMI reference criteria. In that study childhood obesity prevalence was compared between China, Russia and the US using IOTF, WHO weight for height z scores for <10 year olds and WHO BMI percentiles for >10 year olds, and the US percentiles based on NHANESI calculated by Must et al.[103,104] Obesity prevalence and between country comparisons varied depending upon which criteria were used.[105]

No studies were identified that have made direct comparisons between BMI/overweight/obesity of children and adolescents in the US and England. Therefore, the current literature only allows me to make indirect comparisons between national surveys in each country.

Childhood obesity in England

In England the Health Survey for England provides a reliable, annual cross-sectional survey of BMI. The latest published data in 2008 shows that 14% of two to fifteen year olds were overweight and 16% were obese (16.8% for boys and 15.2% for girls). Analysis of the Health Survey for England data from 1995 to 2007, using IOTF standards for obesity, reported that the prevalence during this period increased from 3.1% to 6.9% in boys and from 5.2% to 7.4% in girls.[106] Since 2004/5 there is evidence that the prevalence of childhood obesity may be levelling off. This analysis demonstrated that prevalence differed by social class, and was higher in manual than non-manual children by 0.6% in boys and 1.5% in girls aged 2 to 10 years. The differences in social class were greater in adolescents. The analysis also projected the prevalence forward to 2015 using a linear or power extrapolation (based on acceleration or slowing down). Estimates of future obesity risk based on these data suggested prevalence in children aged 2 to 10 will increase to 13.5% for boys, and to 9.3% for girls by year 2015 if an exponential (multiplicative) rate of increase were assumed and to 10.1% for boys and 8.9% for girls if a linear (additive) rate of increase were assumed.

Childhood obesity in the US

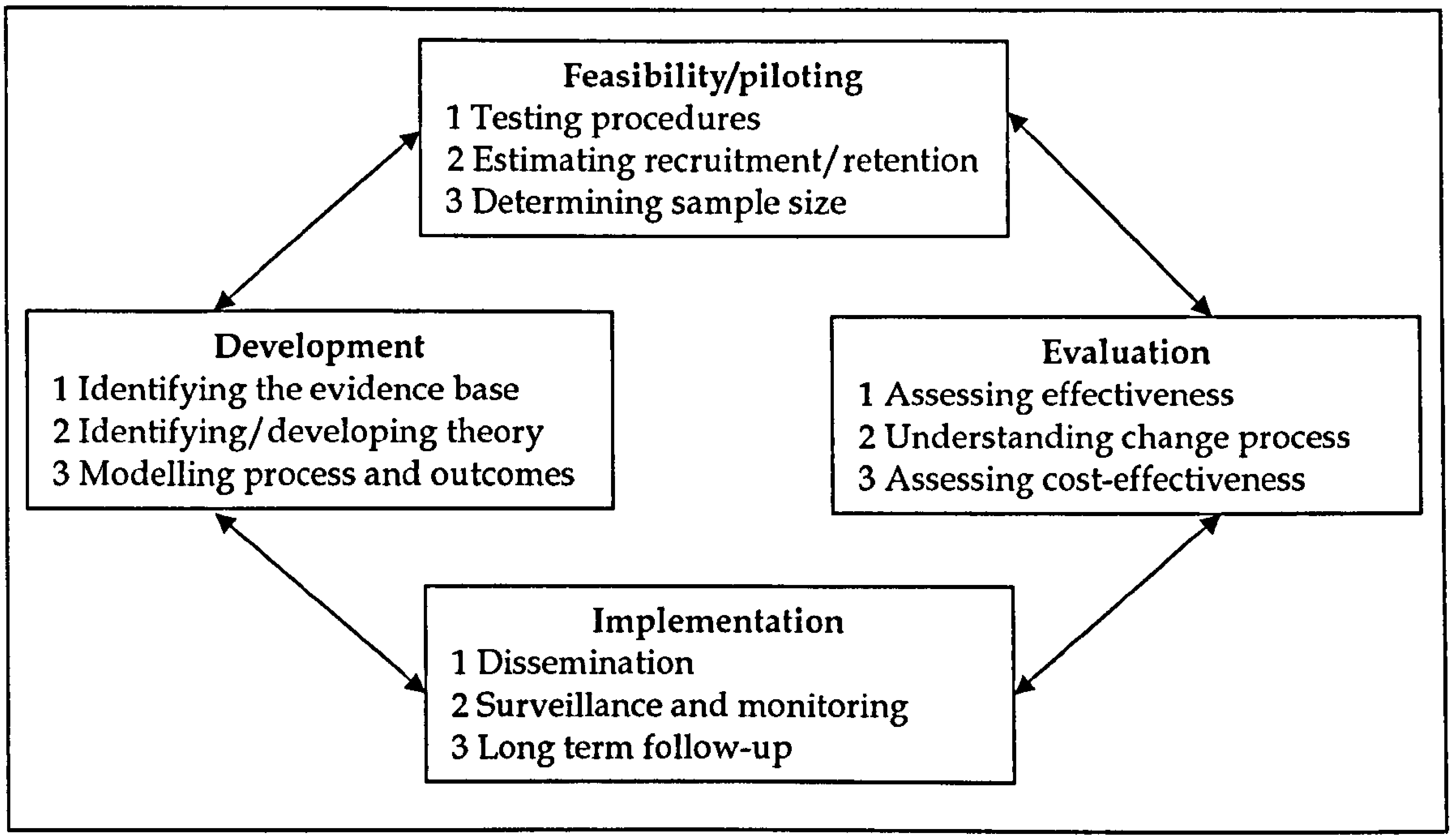
Analysis of cross-sectional data in the US uses The National Health and Nutrition Examination Survey, which is a representative sample of the US population with measured heights and weights on children and adolescents (2 to 19 years of age).[107] The analysis of the 2007 to 2008 data compared the prevalence of overweight and obesity at the 85th, 95th and 97th centiles using the 2000 CDC criteria and compared them to the estimates since 1999 using logistic regression models. No statistically significant linear trends in overweight or obesity were found over the time periods between 1999-2000 to 2007-2008 among girls and boys except among the very heaviest ($\geq 97^{th}$ percentile) 6 to 19 year old boys (OR 1.52, 95%CI: 1.22 to 2.94, p=<0.004). The prevalence of obesity in 2007-2008 in this survey was 21.2% for boys and 18.0% for girls. This compares to values of 16.5% for boys and 14.6% for girls in the Health Survey for England in 2007 using the UK 1990 criteria. However, the age groups are not the same (ages 2 to 10 for the English data and ages 6 to 11 for the US data and the English data covers the year 2007, whereas the US data covers the period 2007 to 2008. Also, as noted above, when different criteria are used for defining childhood obesity within the same population markedly differing prevalences are reported. Thus, it is not possible to interpret these apparent differences in obesity between English and US children as they may be completely explained by the use of different criteria for defining obesity.

My thesis is concerned with examining the feasibility and effectiveness of transferring an obesity prevention initiative from the US to England; therefore it was important for me to know whether there were marked differences in childhood obesity prevalence between the two countries. If the prevalence was much greater in the US than England then the absolute effect of any intervention would be likely to be lower in England even if the relative effect were similar in the two countries. Furthermore, since it is often assumed that US is leading the childhood obesity epidemic, with the UK following, I felt there was value in knowing whether in contemporary children obesity was as prevalent in the UK as it is in the US. This lack of available comparisons was therefore an important gap in the literature that I have now addressed in my thesis. Analysis of the differences in prevalence of obesity in the two countries, using country-specific and IOTF growth standards are presented in chapter 3.

2.5. Obesity prevention interventions: design and theory

The determinants of obesity are biologically and socially complex.[19] Therefore, the design of interventions to prevent obesity fits the definition of 'complex interventions', that is, they are interventions with several interacting components, numerous or difficult behaviours, targeting several groups or organisations, with variability of outcomes and flexibility in delivering the intervention.[108] The Medical Research Council has provided guidance for evaluating complex interventions. This guidance encourages the use of a framework that includes phases of development, piloting, evaluation and implementation (see Figure 2.1). The aim is for studies to be designed which are based on existing evidence and which determine how the intervention works, as well as whether it works in everyday practice in the setting/with the population for which it is designed.

Figure 2.1 Medical Research Council stages in the development through to implementation of a complex intervention



Baranowski et al use a similar framework to propose the steps in the design, development and evaluation of obesity prevention interventions.[109] They propose four sequential types of studies are used to maximise the potential for identifying interventions that achieve effective behaviour change. The four steps are: 1) targeted behaviour validation; 2) targeted mediator validation; 3) intervention procedure validation; and 4) pilot feasibility interventions. They recommend that sample sizes of at least 400 or 500 participants are required even when doing validation and pilot feasibility studies, to allow results that will be valuable to take effective interventions forward to full scale randomised controlled trials, whilst rejecting those that are unlikely to be effective.

The MRC guidance on development of complex interventions recommends that interventions are based on relevant theory to enhance effectiveness.[108] The theoretical understanding of the likely process of change helps to inform a complex intervention by suggesting possible determinants of behaviour, particularly when it is unknown what changes are expected.[108,110] Baranowski et al provide an overview of the main behaviour change theories/models in relation to preventing weight gain, which outlines the concepts, the motivational mechanisms, the resources needed for change, the processes by which change is likely to occur and the procedures required to promote behaviour change.[111] A summary is given in **Error! Reference source not found.** with additional information from Epstein on Behavioural Choice Theory.[112]

The majority of theories have common factors influencing behaviour change, such as, attitudes, social influence, self-efficacy and intervention or stage of change.[113] Whilst the models and theories are useful in providing possible explanations for behaviour, the extent to which most predict diet or physical activity behaviour is modest (r^2 <0.3).[114] Baranowski argues that there is no clear dominance of one model in its ability to predict behaviour, however the Theory of Planned Behaviour consistently exceeds this level of prediction by a small amount in adults.[111] However, there is limited demonstration of the impact of Theory of Planned Behaviour based interventions in changing behaviour in children.

The theories have usually been applied to studies which aim to change a single behaviour. However, Noar et al argue that studies of single behaviours essentially remove the behaviours from the context of multiple behaviours in which they take place.[113] This raises the question about how individuals change multiple health behaviours, and whether the changes occur sequentially or simultaneously. This is of particular relevance to obesity prevention work which may target physical activity, sedentary behaviours and diet.

Table 2.6 Summary of theories of behaviour change[111,112]

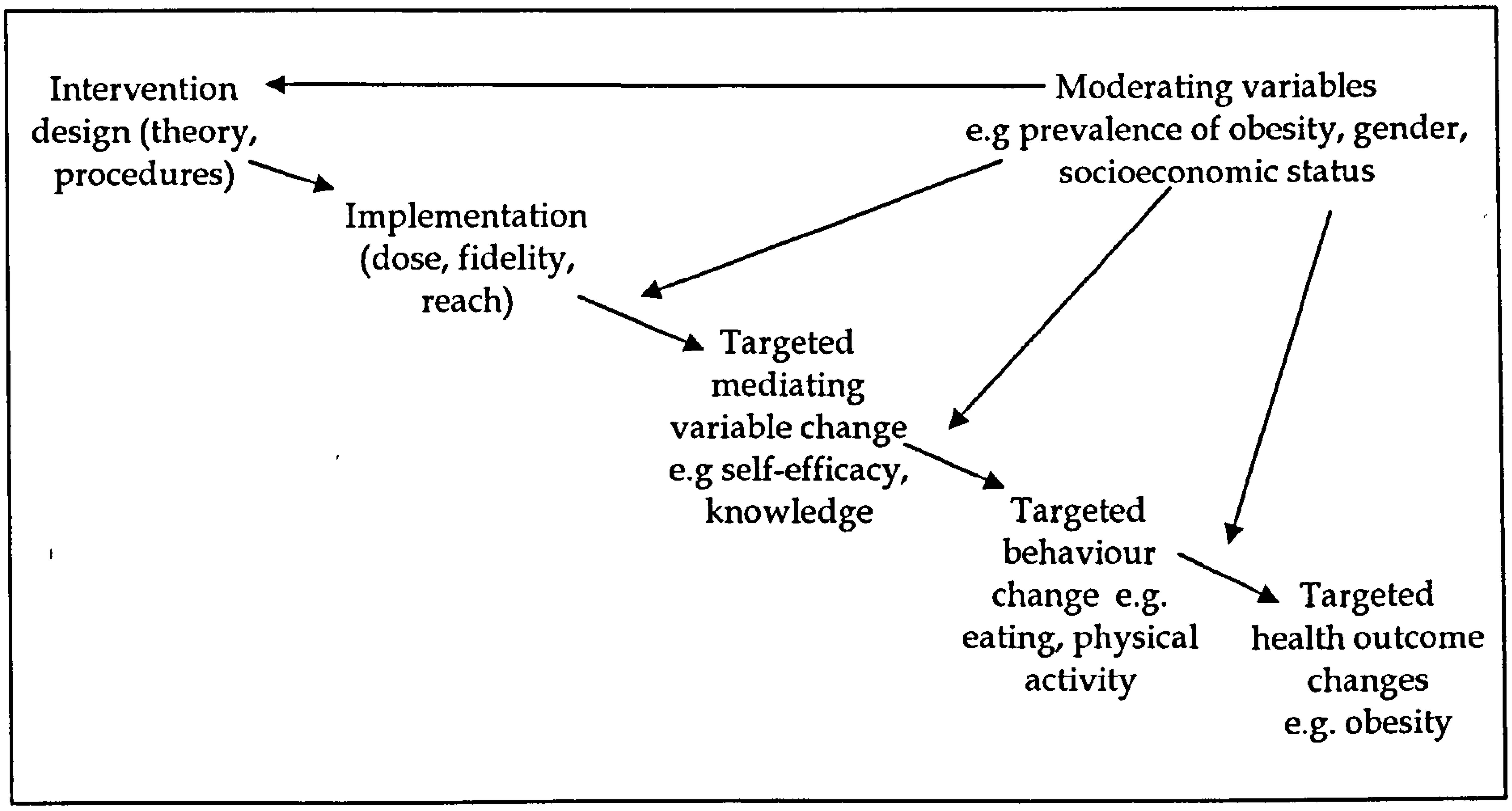
Name of theory	Key features
Knowledge-Attitude-Behaviour Model	Accumulation of knowledge leads to changes in attitude, which overtime lead to behavioural change. Attitude is the motivational force. The model assumes rational behaviour, which is often not the case. The processes between knowledge, attitude and behaviour are not specified. There is weak evidence to support the role of knowledge in behaviour change and it can be difficult to distinguish knowledge from skills.
Behavioural Learning Theory	Operant conditioning is the most common version of this theory; whereby behaviours are in response to stimuli and frequency of stimuli act to reinforce behaviour. This theory has been adapted and applied to obesity in the form of a 'Behavioural Economics model', where benefits act as reinforcers; obese people obtain more reinforcing value from food and less from physical activity than non-obese people.
Health Belief Model	The primary constructs are: susceptibility, severity, benefits, barriers cues to action, bodily events, stories in the media and self-efficacy. The level of perceived threat or risk is the primary motivation to change and the resource to change is self-efficacy. Many of the predictions of this model have not been confirmed. Children commonly perceive themselves to be immortal which means that this model is unlikely to be useful.
Social Cognitive Theory	This model is the most common model in nutrition education interventions. Behaviour is a function of the environment and the person, in constant reciprocal interaction. The personal concepts are skills, self-efficacy and outcome expectations and the environmental concepts are modelling and availability. The primary concept for behaviour change is self-control; by setting behavioural change goals, monitoring, reward and problem solving and decision making when goals are not attained.
Theory of Reasoned Action or Theory of Planned Behaviour	This model is based on the relationship between attitudes and behaviours; a behaviour is more likely when it is intended. The individual's attitude and subjective norm cause intention. The motivating factors are the values of the outcomes of the behaviour. The theory of planned behaviour (TPB) is an expansion, including that intention is influenced by perceived behavioural control. TPB accounts for 41% variance in intentions and 34% of variance in behaviour in a variety of health behaviours.
Transtheoretical Model and Stages of Change	The Transtheoretical Model focuses on promoting change in behaviour using pros, cons and self-efficacy and considers the change in stages: precontemplation, contemplation, planning, action and maintenance. With regard to dietary behaviours, physical activity or weight loss it can be difficult to assign people to stages.
Ecological and Social Ecological Models	Environments are composed of physical aspects (ecological) and people (social). The environment can affect health through behaviour. These models do not include cognitive variables and therefore lack motivational variables. Possible cues to prompt behaviours are availability. The models have been used to include physical, economic, political and sociocultural influences.
Behavioural Choice Theory	This theory is focused on decision-making and how time and responses are allocated on the basis of options available. The principles are: the cost of the behaviour; the choice and reinforcing value depend on available alternatives; choice is important to motivate people to obtain a reinforcer; and choice depends in part on the delay between choosing and receiving.

Multiple behaviours have been defined by Prochaska et al as "efforts to promote two or more health behaviours" (page 183).[115] They can take place within populations (targeting an entire population with interventions matched to individuals' needs e.g. smoking or diet) or within individuals (focusing on high-risk individuals). Population level interventions have shown little success in the area of coronary heart disease. A Cochrane review of 39 population level interventions targeting multiple risk behaviours for cardiovascular disease (high cholesterol, excessive salt intake, high blood pressure, excess weight, a high-fat diet, smoking, diabetes, and a sedentary lifestyle) found these programmes result in small reductions in risk behaviours, but the changes had little or no impact on the risk of heart attack or death.[116] In contrast, Prochaska et al cite greater success in individual studies targeting a range of different health behaviours such as smoking, high fat diet and high risk sun exposure or weight, smoking and stress.[115] Some health behaviours may benefit from sequential rather than simultaneous change, such as smoking cessation followed by weight management.[117]

There is only limited evidence of a causal relationship between obesity and physical activity,[118] sedentary behaviours,[22] and aspects of diet such as drinking sweetened beverages.[119,120] In part this lack of evidence may reflect the difficulty of measuring these behaviours accurately (see above) and the difficulty of identifying interventions that really do change the behaviour and hence can be used in RCTs to determine the causal influence of the behaviour. A further difficulty with respect to obesity is that the plausible causal behaviours (diet, physical activity and sedentary behaviours) cannot be completely abolished from any individual's life. Thus, messages about behaviour change are complex, referring to desired levels for health benefit rather than more simple messages of 'do' or 'don't'. Furthermore, moderators and mediators are features that may need to be considered in the design of interventions to prevent obesity (see

Figure 2.2).[109] In practice, few studies studying behavioural change assess mediators.[121,122]

Figure 2.2 Model of mediating and moderating factors in interventions studies (taken from Baranowski et al[109] and adapted)



A final component of the design of obesity interventions is process evaluation. Process evaluation helps to explain why interventions succeed or fail.[123] Process evaluation provides insight into resources, reach, dose and content of the intervention.[122] Process evaluations frequently use qualitative methods to investigate why the intervention does/does not work and how it could be changed. Quantitative methods, such as questionnaires, document analysis and direct observation can also be used.[123,124] Process evaluations can be used in three ways:

- in a pilot study to refine the content of the intervention
- in an RCT to assess at the end of the study how well the intervention was delivered

- in an RCT to refine the intervention during the delivery phase (through formative implementation monitoring) to increase fidelity, dose and reach.[125]

Process evaluations can be formative (using data to provide on-going monitoring and quality assessment in order to maximise the fidelity of an intervention) or summative (analyse data at the end of the intervention to check whether the intervention was implemented as intended).[125] A challenge to formative research is the need to collect and analyse data in a timely manner. There may also be a risk that the increased presence of the researcher during the delivery of an intervention and with subsequent changes to increase the effectiveness may influence how the intervention is given and the response of the participants. Therefore additional research may be required to test the effectiveness as opposed to the efficacy of the intervention through a pragmatic trial.

Process evaluation can help to understand the role of mediating factors, for example, if it is found that a school-based intervention works because it the children increase their levels of physical activity but there is no change in diet, then it is possible to say that the intervention is mediated by exercise but not diet. The process evaluation can be useful in identifying why the intervention had an effect on physical activity not on diet; for example, is it that physical activity is easier to change in children than diet, is it that schools can have more influence on physical activity than they can on diet (which needs more parental input), is it that the intervention actually had clearer messages about physical activity that the children found easier to understand than it did about diet, and so forth.

Process evaluations offer the potential to greatly enhance the analysis of outcomes from an intervention. However, a systematic review of school-based obesity prevention interventions found that process evaluations were either not reported or little detail was provided.[126]

2.6. Obesity prevention interventions: setting

2.6.1. School

Schools are popular settings for obesity prevention interventions because they provide continuous, intensive and almost universal contact with children for approximately half their waking hours over six to twelve years of their lives.[126,127] However, drawbacks of schools as settings for promoting any health behaviour are that they are primarily centres for learning and there are competing priorities and therefore they may be unsupportive environments for some behaviour changes or in some children who do not enjoy the learning/school environment.[127]

Interventions to prevent obesity in schools usually focus on one of these four areas individually or combined:

- Changing diet
- Decreasing sedentary behaviour
- Increasing physical activity.[26]

The methods used for interventions fall broadly into the areas of educational (changing knowledge, attitudes and motivation); environmental (changing the physical environment, policies or practices); or multi-component approaches (comprehensive whole school approaches covering the classroom, playground, parents, policy, food provision in school, physical activity support in school etc).[127]

The evidence for school-base interventions changing diet, physical activity and sedentary behaviours will be reviewed followed by a summary of systematic reviews of school-based obesity preventions.

School-based diet interventions include changes to policies, the environment, the curriculum, involving parents or any combination of these. A systematic review of interventions to increase fruit and vegetable intake with children and adolescents (ages five to eighteen) included fifteen studies.[128] Of the eleven studies with primary school children, nine had statistical evidence of a positive effect on fruit and vegetable intake and two did not. Seven of the nine studies had higher intake in the intervention than the control group at follow-up ranging from +0.3 to +0.99 servings per day. Features of interventions associated with successful results were:

- Attention to fruit and vegetables rather than to nutrition in general
- Hands-on exposure to fruit and vegetables
- Special training of teachers
- Peer leaders
- Active participation and encouragement by school food staff
- Active involvement of parents at school and home
- School nutrition policy
- Community involvement (producers, markets)
- Longer length of follow-up.

This review concluded that school settings provide many opportunities to improve nutrition, ranging from formal learning, gardening, cooking and feeding. Further they concluded that schools are settings where such interventions are practical and can be implemented at low cost. However, barriers to effective change were noted, including competition with other school priorities and that some interventions will be perceived as too demanding and may gain insufficient support.

A different review of interventions to increase fruit and vegetable consumption with six to twelve year old children found seven multi-component interventions (with combinations of curriculum, parental activities, school meal modification, marketing and community interventions).[129] All seven interventions led to positive increases in fruit and vegetable intake (portions per day ranging from 0.2 to 1.68 (no confidence intervals or p values given).

An RCT (called CHOPPS) to reduce the consumption of carbonated drinks was undertaken in schools with children aged 7 to 11 in England with two year post-intervention follow-up.[130] The intervention comprised of four sessions on healthy eating and reducing carbonated drinks. After 12 months there was a reduction in the consumption of carbonated drinks in the intervention group compared to the control group (mean difference 0.7, 95% CI: 0.1 to 1.3) and a reduction in the prevalence of overweight and obese children (risk difference 9.8%, 1.8% to 17.8%, p=0.01). The initial reductions in the prevalence of overweight at one year were not sustained at the two year post intervention assessment (risk difference 4.6%, -4.3% to 13.5%, p=0.28).[131] The consumption of carbonated drinks at two years was not measured.

Beyond fruit and vegetable consumption and sweetened beverages my literature search did not identify randomised controlled trials or systematic reviews of school-based interventions aimed at changing other dietary behaviours in children.

A Cochrane systematic review of school-based physical activity programmes to promote physical activity and health in children and adolescents aged six to eighteen was published in 2009.[55] The review found that of nine outcome measures school-based physical activity interventions showed a positive effect on four: duration of physical activity, television viewing, fitness (either measured or predicted VO_2 max) and blood cholesterol. However, there was generally no effect on: leisure time physical activity rates, systolic and diastolic blood pressure, BMI and pulse rate. Effect sizes were not reported and no meta-analysis was undertaken. The review also found that a combination of printed educational materials and changes to the school curriculum which promote physical activity resulted in the four positive outcomes. A review of non-curricular approaches to increasing physical activity in young people found evidence that physical activity can be increased during school break periods by 17 to 60% using simple, low-cost interventions such as painting areas of playgrounds or providing game equipment.[132]

A systematic review of controlled studies with interventions to reduce sedentary activities in population-based prevention studies included six prevention studies in school settings. The results for four of these studies reported the mean difference of TV/video use comparing intervention to control was -0.55 to -5.37 hours per week and improvements in BMI ranged from -0.21 to -0.36 kg/m^2.[22] There were no prevention studies in non-school settings.

Reviews of school based obesity interventions

Eleven systematic reviews and one review of reviews of school-based obesity prevention interventions are summarised in Table 2.7, listed by publication date. Differences in the reviews include the time periods, the inclusion and exclusion criteria (e.g. age range, countries, study design), whether meta-analysis was undertaken, the measures of obesity used (e.g. BMI, overweight/obesity prevalence, obesity prevalence, fat mass). The review of reviews had included 12

Table 2.7 Summary of reviews of school-based obesity prevention interventions

Author (date)	Dates of search	N[a]	Inclusion/exclusions[b]	Conclusions	Comment
De Boudeaudhuij (2010)	1990 to Dec 2007	53	School-based studies (any design) to prevent obesity in Europe with outcomes on behaviour or obesity; ages 6 to 18.	Combining educational and environmental components that focus on both sides of the energy balance give better and more relevant effects. Computer-tailored education in the class show better results than generic classroom curriculum.	Restricted to European studies, which is useful because the majority of studies are in the US but this review does not allow comparison with the US.
Brown and Summerbell[126] (2009)	Jan 2006 to Sept 2007 (to add to NICE obesity guidance search)	38	Only studies with a weight outcome for controlled studies of a lifestyle intervention in schools for children aged 5-18 with at least 12 weeks duration.	1/3 diet studies, 5/15 physical activity (PA) studies and 9/20 combined diet and physical activity studies showed significant and positive differences between intervention and control for BMI. Findings suggest that combined diet and PA school-based interventions may help prevent children becoming overweight in the long term. School-based PA interventions may help children, particularly girls in primary schools, maintain a healthy weight.	This review found 15 new studies which were combined with 23 studies identified in the search for the NICE obesity guidelines.
Gonzalex-Suarez[26] (2009)	1995 to 2007	12[c]	Ages 11+: (pre-adolescent and adolescent). Interventions on obesity (includes management of obesity). Excluded studies without control groups; studies without OR or standardised mean difference & 95% CIs; studies with <60% score on assessment of quality.	It provided sound evidence to support schools as settings for obesity prevention in children. The odds of participants being overweight and obese in school-based interventions compared to control arm showed there was a significant protective effect in the short term with an OR of 0.74 (95% CI: 0.60, 0.92), but no evidence of effectiveness to decrease BMI (weighted mean difference of -0.62; 95% CI: -1.39, 0.14), except for interventions lasting >1 year but the difference was very small (weighted mean difference -0.1; 95% CI: -0.14, -0.06). Interventions conducted >2 years had greater OR of 0.59 in decreasing overweight and obesity (95% CI: 0.37, 0.94).	This review was restricted to high quality studies (those scoring <60% were excluded even if they met the other inclusion criteria). It was also limited to studies with children aged ≥11. It included studies which were not primary prevention. This review found physical activity and lessons to be effective.

Table 2.7 continued

Author (date)	Dates of search	N[a]	Inclusion/exclusions[b]	Conclusions	Comment
Van Wijnen[133] (2009)	1990 to 2008	7	Studies which measured psychosocial wellbeing.	7 interventions measured psychosocial well-being; all but one in children aged 5 to 12. Two studies reported a statistically significant net intervention effect (decrease in use of purging or diet pills, peer ratings of aggression) and the others found no evidence of an effect.	One of the two studies which reported a positive effect on psychosocial well-being was Planet Health.
Katz[134] (2008)	1966 to October 2004	19	English studies targeting children aged 3 to 18 in a school setting, with a weight related outcome and a control measurement with 6 months follow-up.	Nutrition and physical activities interventions combined led to significant reductions in body weight compared with control (standardised mean difference= -0.29; 95% CI: -0.45 to -0.14). Parent or family involvement in these interventions also led to weight reduction (standardised mean difference= -0.20; 95% CI: -0.41 to 0.00). Too few studies allowed adequate evaluation of diet, PA and TV reduction interventions individually, however the results suggest that the nutrition component may be the successful factor.	8/19 studies were included in the meta-analysis; however it does not appear that authors were contacted to provide additional information to allow their inclusion in the meta-analysis.
Kropski[135] (2008)	1990 to 2005	14	Studies including the whole population for at least 6 months in an intervention affecting the school curriculum.	3 studies reported statistical evidence of an impact on BMI or overweight in boys, girls or both. 12 reported statistical evidence of an impact on diet, physical activity or sedentary behaviour. There were limitations in drawing conclusions because of the small number of studies.	
Shaya (2008)	1986 to June 2006	51	Obesity-related intervention in a school setting with children aged 7 to 19, with pre and post anthropometric measures. *No restriction to controlled studies.*	40/51 studies were reported to have results at the $p<0.05$ level for some or all the quantitative measures, however these included a range of non-anthropometric measures such as blood lipids, insulin, glucose, blood pressure, fitness and diet. *No information was given about the size of effect or any analysis of which type of measurements showed evidence of change.*	This review included studies with no control group; it had an unusual and unexplained age range (7 to 19); and it combined all quantitative measurements together and merely *assessed results at $p<0.05$.*

Table 2.7 continued

Author (date)	Dates of search	N[a]	Inclusion/exclusions[b]	Conclusions	Comment
Gittlesohn[136] (2007)	1985 to 2007	12	Review articles of prevention of obesity or diabetes	Interventions are often successful in improving psychosocial factors, diet and physical activity, but the clinical/public health significance of the size of change is not great. Reviews range in the proportion of studies that show statistical evidence for an impact on obesity from 20% to 75%, which relates to inclusion and exclusion criteria. When there is an effect it is quite modest. There has been a focus on individual behavioural change and little emphasis on factors outside schools. There is a lack of obesity prevention at community level.	This is a review of reviews.
Zenzen[137] (2007)	2000 to 2007	16	English language studies of obesity prevention programmes in schools with children aged 4 to 18.	56% of studies evaluated the effect on BMI and only 1 reported a 'significant' difference in BMI between intervention and control schools. 50% of studies applied theoretical frameworks, 25% used constructs from Social Cognitive Theory and 25% used the transtheoretical model. Individual studies used other theories such as the health promotion model and theory of planned behaviour.	This review called itself an 'integrative review' and was focused on the variability of approaches more than the outcomes.
Sharma[138] (2006)	1999 to 2005	21	Ages 3 to 18. Excluded studies in the US.	14/21 studies led to some aspect of behaviour change e.g. eating fruit and veg or switching off the TV. All interventions (n=3) with parent involvement positively influenced obesity indices. Only 5 studies based on explicit behavioural theory. The majority of studies were in primary schools. 9 studies focused on nutrition changes , 7 on physical activity and nutrition and only minority on policy or environmental changes. 16 used teachers to deliver the intervention.	This review was not systematic. Little information was given about the selection of papers and there was very little synthesis of the findings.

Table 2.7 continued

Author (date)	Dates of search	N[a]	Inclusion/exclusions[b]	Conclusions	Comment
Sharma[139] (2006)	1999 to 2004	11	Population approaches to preventing child obesity in schools from pre-school to secondary school age in the US or UK.	Interventions resulted in modest changes in behaviours and mixed results with indicators of obesity. TV watching seems to be the most modifiable behaviour, followed by physical activity and nutrition behaviours. Single and multi-component interventions.	This review was limited to US and UK studies and a similar review by Sharma was limited to countries outside the US. Little synthesis of the findings.
Budd[140] (2006)	1985-2004	12	RCTs with BMI as an outcome conducted in US school during the school day. Restricted to studies with significant findings or novel interventions.	Several large multi-component RCTs did not demonstrate a reduction in the percent of overweight children. Those which did, several targeted older children. The authors concluded that classroom instruction and physical education can promote MVPA in teenagers, particularly girls. Younger children may benefit from behaviour change to reduce sedentary behaviour.	This review provided little information given about the selection of papers and unconventional inclusion criteria e.g. studies with statistically significant findings. There was little synthesis of the findings.
Doak[141] (2006)	Search in 2003 updated in August 2005. Not clear if from beginning of Medline.	25	Studies of children aged 6 to 19 years with anthropometric measurements and intervention on diet or physical activity behaviour. Abstract says 'school-based studies' but this is not mentioned in the inclusion criteria.	Effectiveness was determined on the basis of the intervention group showing a statistically significant improvement in comparison to a control group. 56% (17/25) of the studies were effective in reducing overweight, obesity ore adiposity measures for at least one subgroup.	This review also looked at the impact of the intervention on underweight and found only 3 studies; only one found an increase in underweight prevalence.

[a] N= number of studies included. [b] The inclusion and exclusion criteria listed are not exhaustive but highlight the areas where the reviews differ.
[c] 19 papers selected for inclusion but 7 not included because of quality or lacking data for meta-analysis.

articles, however only three of these reviews are included in Table 2.7 because nine reviews were not systematic reviews of school-based interventions; one was a commentary on another review, two were not reviews, one was restricted to physical activity in children, one was restricted to sedentary behaviours in children, two combined school and community interventions and did not report on school interventions separately and two were broad prevention reviews which were not restricted to schools.

Two of the systematic reviews included a meta-analysis (Gonzalex-Suarez[26] and Katz[134]). The other reviews provided a descriptive overview of the studies, which were not combined into a meta-analysis because of the heterogeneity of studies and measurements.

The two meta-analyses showed a protective effect of school-based interventions: OR of overweight or obesity of 0.74; 95% CI: 0.60 to 0.92[26] and a standardised mean difference in weight of -0.29; 95% CI: -0.45 to -0.14.[134] These two meta-analyses suggest that the length of the intervention increases the effectiveness however. The Gonzalex-Surez review was restricted to studies with children aged 11 and the meta-analysis was restricted to high quality studies (scoring >60% on the Joanna Briggs Institute Critical Appraisal of Evidence Effectiveness tool after removing a question about blinding participants which was not relevant). A further three studies were excluded because the odds ratio, standard mean difference or confidence intervals were not reported. Therefore 19 of 22 high quality studies were included. The Katz review included 8/19 articles in the meta-analyses and no attempt appears to have been made to contact the authors from the 11 other studies to obtain the original data for the meta-analysis. The reviews which did not undertake meta-analyses drew mixed conclusions, however, overall there is evidence that school based interventions aimed at preventing obesity by changing diet and physical activity behaviours can have a beneficial effect on these mediators possibly some beneficial effect on BMI or obesity risk though this seemed less robust than evidence for effects on behaviours. Studies have rarely assessed psychological well-being or unintended effects on prevalence of eating disorders.

In summary schools are popular settings for obesity prevention interventions and studies have been undertaken to change diet, sedentary behaviour, increase physical activity and behaviour modification. There is evidence from systematic reviews that interventions in schools can effectively increase fruit and vegetable intake, duration of physical activity, television viewing, fitness and blood cholesterol. Eleven systematic reviews of obesity prevention interventions in schools showed mixed conclusions, with evidence of changes in behaviour but possibly limited effect on BMI. Most work has been undertaken in the US and therefore it would be appropriate to take what has been developed and is known from the US and test whether it works in the UK. The rationale for the choice of school-based intervention is given later in section 4.1.1.

2.6.2. Family

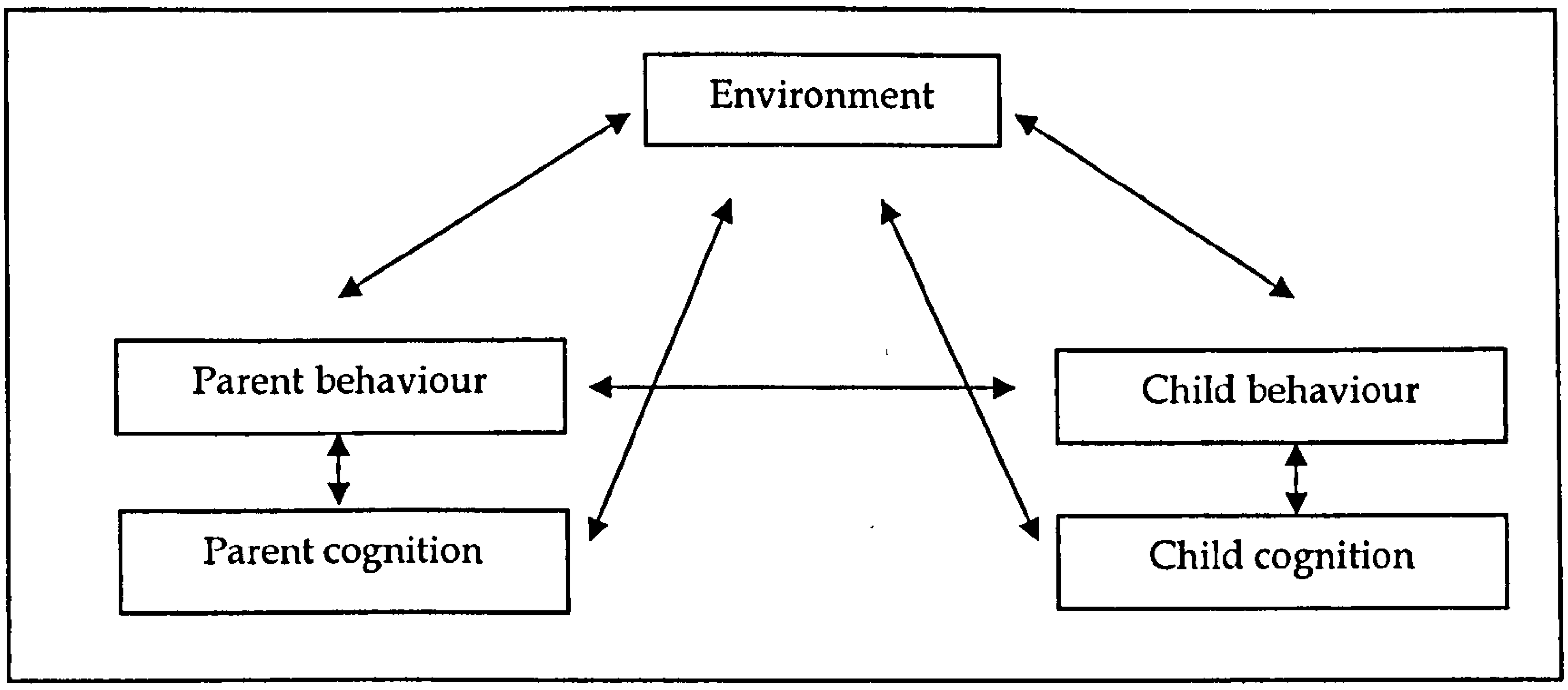
Parents, families and the home environment are major influences in shaping children's eating and physical activity behaviours.[142] Families have been defined as:

> *"Two or more individuals who live in the same household, who have some common emotional bond, and who are interrelated by performing some social tasks in common. This definition includes the nuclear family (Father, mother and children), single parents, adoptive parents, and multigenerational arrangements".*
> (page 319)[143]

The role of parents/families in obesity prevention is important because children under 10 years of age with obese parents have double the risk of adult obesity and 80% of children with two obese parents become obese.[16] In addition, parents are role models and support the development of behaviours.[144] The influence of parents may start during pregnancy, in terms of the intrauterine environment (although there is only limited evidence that high maternal dietary intake in pregnancy leads to increased growth of the foetus and programming of appetite and energy intake[145]). Parental influence continues through childhood and weakens through adolecence.[144]

Research into family and social determinants of children's eating and diet has found that both the physical and social environment have a strong influence.[146] Taylor et al have adapted the social-cognitive theory to include the family perspective, by incorporating the reciprocal interactions of the home environment, parent and child cognitions and behaviour (see Figure 2.3).[143]

Figure 2.3 Social-cognitive theory - a socialisation model of child behaviour (taken from Taylor et al)[143]



Children are more likely to eat food that is easily accessible and eat more food if larger portions are provided.[146] Parent's education, time constraints and ethnicity influence the types of food children eat.[146] For example, higher education is related with health conscious food choices; African-American children consume more fat and carbohydrates than Euro-Americans.[146] A review of family correlates of fruit and vegetable consumption identified 33 correlates of child fruit and vegetable consumption.[147] The correlates related to families were parental modelling and intake, home availability, family rules and parental encouragement.

A review of correlates of physical activity in children and adolescents found family related correlates are parental modelling and parental support.[148] An ALSPAC study found that parent's physical activity during pregnancy and early in a child's life (up to age 5) showed a modest association with physical activity of the child at age 11-12 years, which suggests that active parents tend to raise active children.[149]

Parenting styles and practices have been found to be important influences on children's development.[150] Parenting styles are a description of the emotional context of interactions between parents and children and specifically the parent's communication with their child and response to the child's demands.[151,152] Four parenting styles based on level of demand and response have been described: authoritarian (demanding obedience), authoritative (using reasoning), permissive (compliance with a child's demands), and uninvolved or neglectful.[151] Parenting practices are a description of parental behaviours to socialise with their children, for example facilitating participation in swimming by taking the child to the leisure centre.[150,152]

A literature review of childrens' eating and parenting found mainly cross-sectional studies and some experimental studies.[152] Therefore, it is possible that some papers were not identified by the search strategy. The majority of studies were cross-sectional and those which were experimental focused on parental practices, with the exception of one which looked at parental styles. The review concluded:

- There is inconsistent evidence from cross-sectional studies for the association between general parenting style and child weight

- There is strong evidence that specific parent feeding practices (such as pressure to eat, restriction and modelling) can influence child eating, and evidence that suggests that parenting practices affect child weight.[152]

The authors helpfully drew attention to the bi-directionality of parenting style/practice and child weight/eating and the caution in interpreting studies.

We know less about the relationships between parenting and physical activity. Davison has developed a questionnaire (activity-related parenting practices) to measure parental support and modelling to support their daughter's physical activity.[153] A sample of 180 girls aged nine in the US completed two questionnaires about physical activity and a progressive aerobic cardiovascular endurance run test. Their parents completed the activity-related parenting practices questionnaire to assess how they promote physical activity in their child. There was statistical evidence that mothers reported higher levels of logistic support than fathers (e.g. driving the child to an activity) and fathers higher levels of explicit modelling than others. Both methods were associated with higher physical activity in girls.[153] Further, there was strong evidence that girls who were highly active had at least one parent providing a high level of support. However, the authors notes that parental support for physical activity in girls only explain 12% of variance in girls' activity, which reflects the numerous additional factors such as child characteristics, peers, the school environment and community factors such as access and safety.[153] A further study with the same group of girls and parents from ages nine to fifteen, compared parental and peer support with the girls' moderate to vigorous physical activity (MVPA) using accelerometry. The study found that from ages eleven to fifteen there was a decline in parental logistic support, which was more pronounced for girls who did not maintain levels of physical activity of at least 30 minutes of MVPA, and a steady decline in parental modelling. Peer support increased between ages nine to thirteen.[154]

These studies provide useful insights into the role of direct support and modelling from parents with girls when aged nine and the increasing role of peers in adolescence but they provide no insights for boys. A study in England (3Ps - Parents, Peers and Physical activity) with 792 boys and girls aged 10 to 11 used accelerometers to assess physical activity.[155] Parenting style and physical activity parenting practices were measured by self-report. Permissive parenting was associated with higher levels of physical activity among both boys and girls. Maternal logistic support was associated with higher levels of physical activity in girls (as found in the US study above) and the same was true for paternal logistic support for boys. This study demonstrates that both parenting style and parenting support influence children's physical activity.

This section looks at the evidence of the effect of parental/family involvement in obesity prevention interventions. The 2005 Cochrane Review of interventions to prevent obesity in children identified two studies of family-based interventions that met its inclusion criteria, although a family component was an integral part of some of the school-based interventions.[21] The first study targeted non-obese 8 to 10 year old African-American girls and their parents through four pilots called GEMS (the Girls health Enrichment Multi-site Study) which were not intended to be combined, but to test different interventions. The four pilot studies had similar study design and populations but differed in the interventions they provided. The intervention was evaluated as four pilot RCTs with the intervention and measurements being over 12 weeks with a focus on changing eating and physical activity behaviours (however the interventions were very different e.g. a summer camp in one and TV reduction combined with dance sessions in another). The control group were given a self-esteem and cultural awareness programme. The studies all had small numbers and were underpowered to compare changes in BMI. No statistical evidence of change was reported, but all studies showed positive trends in BMI reduction.[156] Whilst these studies had a similar methodology, they differed in the interventions delivered; therefore it is surprising that the studies should be considered as one study. However, the results suggest that family based interventions may be useful in this population for preventing obesity, although further larger studies are required to demonstrate this.

The second study was an American pilot RCT with 40 children aged nine months to three years with mothers who had a BMI >25.[157] The intervention was a 16 week home visit by a peer educator which focused on parenting skills for diet and activities to prevent obesity. Controls received the usual parenting programme (Active parenting curriculum). There were no significant differences in weight-for-height z-score between intervention and control groups, however this was a small study of short duration. The Cochrane review of interventions to prevent obesity commented that:

> *"The interventions identified in this review rarely considered the impact of parents' and family's increasingly complex working and living arrangements, yet the potential for change at the family level in the absence of addressing supportive strategies is likely to be diminished." (page 43)*[21]

A systematic review by O'Connor et al included 35 studies of parental engagement in physical activity interventions with young people.[158] Five methods of involving parents were identified: 1) face to face education or training; 2) family participation in exercise programmes; 3) telephone communication; 4) organized activities; 5) sending education materials home. The review concluded that it could currently find little evidence for the effectiveness of involving parents. However, this was because of the heterogeneity between studies with respect to their design, quality and outcomes assessed, rather than clear evidence that parental involvement was ineffective. They found education or training programmes, or communication via telephone with parents offered some promise.

Although a review by Zenzen reported in the school section above, found 9/16 school-based intervention studies also involved families (using methods such as family fun nights, workshops, newsletters, interactive meetings, a family field guide and assessment of nutrition knowledge) the involvement of families had not been separately assessed from the main school-based intervention and therefore it was not possible to determine whether it provided added value.[137] Brown et al's systematic review of school based interventions on diet and physical activity to prevent obesity found that:

> *"Overall, authors reported that parents responded positively to diet and PA changes but this did not necessarily lead to behaviour change or change in BMI. However, it is of course the level of engagement with the intervention that has an impact on involvement, and this was not reported in any meaningful way in any of the papers included in this review."* (page 137)[126]

Lindsay et al also observe that few high quality studies have been conducted on the effectiveness of obesity prevention interventions for children that focus on parental involvement.[144]

In summary, whilst interventions to change physical activity, dietary and sedentary behaviours have been undertaken with parent or family involvement, there has been little research to understand the impact of this part of the intervention.

2.7. Obesity prevention interventions: type

In this section the evidence for single versus multiple interventions will be assessed. There is obviously overlap between type and setting (covered in the previous section). Since most of the studies were conducted in schools the discussion in this section relates to a comparison of studies aimed at single or multiple behaviours in school settings and if other settings were used this will be given.

2.7.1. Single interventions

The 2005 Cochrane Review of interventions to prevent obesity in children included two studies that evaluated diet as a single intervention and six studies that evaluated physical activity as a single intervention. The review presented the results by length of the study: long-term was at least 12 months and short-term was 12 weeks to 12 months (the length of study refers to the intervention itself or to a combination of the intervention with a follow-up phase). There were two long-term studies evaluating a physical activity intervention and two long-term studies evaluating a dietary intervention. There were four short-term physical activity studies and two showed evidence of minor reductions in overweight in the intervention group. One evaluated an intervention to reduce TV viewing, which resulted in a reduction in BMI (-0.45kg/m^2, 95% CI: -0.73 to -0.17, p=0.02).[159] The second evaluated a dance and health education intervention with African American and Hispanic adolescents, which resulted in a reduction in BMI in girls (-1.10kg/m^2, 95% CI not given, p value reported as <0.05) but no evidence of a change in boys.[160]

2.7.2. Multiple interventions

The 2005 Cochrane Review of evaluations of interventions to prevent obesity in children included fourteen studies which combined dietary and physical activity interventions. The review presented the results by length of the study: long-term was at least 12 months and short-term was 12 weeks to 12 months (see note in previous paragraph). Six were long-term combined studies: five showed no evidence of a difference in overweight status. One study, Planet Health, a school based intervention, reported a reduced odds of improved overweight status in girls but not boys. The adjusted odds ratio for reduction in prevalence of obesity in girls was 0.47 (95% CI 0.24 to 0.93; p = 0.03) and in boys it was 0.85 (95% CI 0.52 to 1.39; p= 0.48).[161] Eight were short-term combined studies and none showed evidence of a change in overweight status.

The Cochrane review authors concluded that whilst nearly all the studies resulted in some improvement in diet or physical activity, only a few interventions which focused on diet or physical activity showed a small impact on BMI. The authors suggested that interventions which combined changes to systems, environment and organisational issues as well as addressing individual and group behaviour change may be required.[21]

A systematic review and meta-analysis of RCTs to prevent childhood obesity through changing lifestyle behaviours (diet, physical activity or sedentary behaviours) pooled the effects of the interventions on mean BMI from 34 studies with relevant data.[162] The pooled effect suggested a small reduction in BMI (-0.02 standardised mean difference (SMD); 95% CI -0.06 to 0.02; I^2=17%), but with 95% confidence intervals that included the null value. Subgroup analysis compared single interventions (dietary or physical activity) with combined lifestyle interventions and found similar trivial effects on BMI but with 95% confidence intervals that included the null value: the effect of dietary interventions on BMI SMD = -0.04; 95% CI -0.16 to 0.08; physical activity interventions on BMI SMD = 0.01; 95% CI -0.06 to 0.08; combined lifestyle interventions pooled BMI SMD = -0.03; 95% CI -0.07 to 0.01.

In summary, the majority of both single interventions and multiple interventions show no impact on changing BMI or the prevalence of obesity, although they frequently show changes in diet or physical activity. The small number of studies demonstrating changes in BMI mean it is not possible to say with confidence that single or multiple interventions differ in effectiveness to prevent obesity.

2.8. Summary

Child obesity is most commonly measured using BMI adjusted for age and sex. A range of methods are used to measure diet, which vary in accuracy and the time period over which data is collected. Reports of diet can be converted into nutrients and energy content or categorised into food types. Physical activity can be measured using self-report methods, but the lower reliability with children makes objective methods such as accelerometers or heart rate monitors a preferable option. There are variations in how accelerometery data is collected, analysed and interpreted, which make comparisons between studies difficult. At least three days of measurement. Sedentary activities can be measured using self-report or accelerometers.

This literature review aimed to answer four questions; a summary answer for each question is given below:

1. *Is the prevalence of childhood and adolescent obesity in the US greater than the prevalence in England?*

The published literature does not directly compare the prevalence of childhood obesity between the two countries, even though comparable BMI data is routinely collected. Therefore there is a lack of knowledge about whether the prevalence of childhood obesity in England is lower than in the US.

2. *What settings (school or family) are effective and practical to prevent obesity in children?*

There is evidence that diet and physical activity interventions in schools can have a positive effect on behaviour change and overweight/obesity. Whilst interventions to change physical activity, dietary and sedentary behaviours have been undertaken with parent or family involvement, there has been little research to understand the impact of this part of the intervention.

3. *Are single or multi-faceted interventions more effective at preventing childhood obesity?*

Whilst nearly all studies to prevent obesity resulted in some improvement in diet or physical activity and possibly a small impact on BMI, it is not clear if single or multi-faceted interventions are preferable.

4. *What are the gaps in the knowledge of preventing obesity?*

- Currently it is unknown how the prevalence of childhood overweight/obesity differ between England and the US
- Whilst there is evidence that school based interventions can effectively improve behaviours and possibly reduce overweight/obesity, most studies are undertaken in the US. It is unknown whether these can be used in the UK and if so whether they would be effective
- It is unknown whether adding a parental component to a school based intervention would improve its effectiveness
- It is unclear whether multi-faceted or single component interventions are more effective at reducing obesity in children.

It would be impossible to tackle all of these gaps in one PhD thesis study. In my thesis I will address the first three of the four listed gaps.

CHAPTER 3. PREVALANCE OF CHILD AND ADOLESCENT OBESITY IN ENGLAND AND THE US

The US is commonly regarded as leading the global epidemic of obesity, however it is difficult to ascertain how the patterns of obesity vary by age and gender for children because country-specific definitions of obesity are used in the US and England. This chapter compares the prevalence of obesity in England and US children aged 2 to 17 from pooled cross-sectional surveys in 1990 to 2006. The rationale for this work, in relation to the overall aim of examining the feasibility of transferring a US school based intervention to England, is that absolute effects of any obesity intervention will vary depending upon the underlying prevalence. Thus, I felt it relevant to determine whether there were marked differences between the two countries in terms of obesity prevalence, particularly with respect to children in the target population for my intervention study (ages 9 to 10 years). Three sources were used to provide cut-off points for obesity; UK and US country-specific growth charts and internationally determined cut-off points.

3.1. Background

I outlined the issues relating to the measurement of obesity in children in section 2.2.1. Direct international comparisons are currently difficult because studies use different methods to define childhood obesity.[94] Analyses of trends in obesity prevalence in children in England and the US commonly use country specific growth charts[163,164] even though international criteria (IOTF) have been developed.[93]

As outlined in section 2.4 above, where studies do compare childhood obesity using different criteria they almost universally compare the IOTF and 2000 CDC reference criteria; some also compare their own country-specific criteria.[95-102] Prevalence of obesity varies substantially with the different criteria, with lower estimates of obesity using the IOTF criteria for most ages. Only one study has made comparisons of childhood obesity between countries using different BMI reference criteria.[103,104]

3.2. Aims

In this chapter I compare mean BMI data and prevalence of overweight and obesity for children and adolescents (aged 2 to 17) from large cross-sectional surveys in England and the US using three criteria: (1) UK 1990 reference charts for BMI from the Child Growth Foundation; (2) the US 2000 Centre for Disease Control and Prevention (CDC) BMI-for-age charts; and (3) IOTF. The analysis had two aims:

(i) To compare the prevalence of overweight and obesity in England and the US by age and gender. This is important because even if the US based intervention that I am piloting here has a similar relative effect in England as that seen in the US, if population prevalence of childhood obesity here is markedly lower then in absolute terms it will have less impact. Thus, I am particularly interested in differences in obesity prevalence at age 9 to 10 years (the age group for whom the intervention is aimed).

(ii) To examine the effect on childhood obesity prevalence of using different criteria for defining this. Specifically, I have compared the two country-specific growth chart criteria and the IOTF criteria. This aim is important since I need to consider what the effect will be on my pilot work of choosing a specific criterion for the outcome of childhood obesity.

The work outlined in this chapter was undertaken in collaboration with Iain Lang, Lecturer in Epidemiology at the Peninsula Medical School and my two supervisors. Iain and I contributed to the study conception and design and to interpretation of data, conducted statistical analysis and drafted the paper we have had accepted for publication with revisions (see page iii). My supervisors contributed to interpretation of data and drafting of the manuscript, and provided supervision.

3.3. Methods

3.3.1. Data sources

Data for these analyses came from two nationally representative cross-sectional surveys. For England, data were from repeated waves of the Health Survey for England (HSE).[165] Across the years included here, the number of participants aged 2 to 17 varied from 2,160 (in 2000) to 8,114 (in 2002). Weighting was applied to take account of the under-representation of children in households with more than two children and the clustered, stratified multistage sample design.[166-168] US data were from repeated waves of the National Health and Nutrition Examination Study (NHANES). To account for the clustered, stratified multistage sample design, complex sampling, weighted estimates of population parameters were computed.[169]

From each study data were used for participants aged 2 to 17 for whom complete height and weight data were available from years 1999 to 2006. In HSE, 38,936 participants were eligible for inclusion in this age range and of these 33,563 (86.2%) had usable heights and weights. In NHANES, 15,500 participants were eligible for inclusion and of these 14,540 (93.8%) had usable heights and weights. Characteristics of the participants from the two surveys are shown in Table 3.1.

Table 3.1 Characteristics of participants in English and US surveys

	England (n=33,563)		US (n=14,540)	
Characteristics	Male	Female	Male	Female
Age 2-5		Mean (SD)		
Age	3.50 (1.12)	3.50 (1.11)	3.31 (1.14)	3.33 (1.16)
Weight	17.9 (3.8)	17.4 (3.8)	17.4 (4.5)	16.8 (4.0)
Height	103.2 (9.4)	102.1 (9.6)	102.1 (9.8)	101.1 (9.7)
BMI	16.7 (2.3)	16.6 (2.2)	16.5 (2.1)	16.3 (2.0)
Age 6-11				
Age	8.48 (1.70)	8.49 (1.71)	8.48 (1.70)	8.50 (1.72)
Weight	31.9 (9.4)	32.6 (10.3)	34.7 (12.6)	35.3 (13.5)
Height	133.5 (11.5)	133.4 (12.1)	134.8 (11.8)	134.9 (13.1)
BMI	17.6 (3.0)	17.9 (3.3)	18.6 (4.3)	18.8 (4.4)
Age 12-17				
Age	14.27 (1.67)	14.40 (1.68)	14.53 (1.73)	14.45 (1.70)
Weight	58.4 (15.3)	56.5 (12.7)	66.2 (20.4)	61.0 (16.8)
Height	165.8 (11.6)	160.1 (7.3)	168.1 (10.8)	160.0 (7.1)
BMI	21.0 (3.9)	22.0 (4.2)	23.1 (5.8)	23.7 (5.9)
	England (n=3,698)		US (n=753)	
Age 9-10				
Age	9.50 (0.50)	9.51 (0.50)	9.51 (0.50)	9.49 (0.50)
BMI	17.97 (2.98)	18.37 (3.25)	19.44 (4.49)	19.654.37)

3.3.2. Measurement of height and weight

Details of the methods to measure height and weight in the two surveys are provided in Appendix 3.

3.3.3. Growth charts and cut-off points

The UK 1990 age-related BMI reference curves cover the age range from birth to 23 years, and the curves are presented as nine centiles in the format of Cole (0.4th, 3rd, 10th, 25th, 50th, 75th, 90th, 97th and 99.6th centiles).[170] The reference sample of children was based on data from 11 surveys on gender, age, height, and weight collected between 1978 and 1990 for 15,636 boys and 14,899 girls, aged from 33 weeks to 23 years. Exact age was calculated from the dates of birth and the dates of the measurements for all participants. Summary centile curves were fitted to the data using Cole's LMS (lambda mu sigma) method and penalised likelihood.[170]

The US 2000 CDC BMI-for-age charts for ages 2 to 20 years were developed with data from five national health examination surveys between 1963 and 1994 and limited supplemental data. Smoothed percentile curves were developed in two stages: first, selected empirical percentiles were smoothed with a variety of parametric and nonparametric procedures; in the second stage, parameters were created to obtain the final curves, additional percentiles, and z-scores.[171]

The IOTF criteria for obesity were based on international survey data from six large nationally representative cross-sectional growth studies in Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States from birth to 25 years of age.[36] For each of the surveys, centile curves were drawn that at age 18 passed through the widely used criteria of 25 and 30 kg/m^2 for adult overweight and obesity. The resulting curves were averaged to provide age and gender specific criteria from 2 to 18 years.

3.3.4. Statistical analyses

The prevalence of overweight and obesity in children and adolescents was estimated according to the three sets of criteria from the growth curves described above. Using the UK1990 and 2000 CDC BMI-for-age reference charts for BMI those who had an age-gender-specific BMI above the 85^{th} percentile were classified as overweight/obese, and those who had a BMI above the 95^{th} percentile were classified as obese. Using the IOTF classification, age-gender specific overweight and obesity criteria were used for each participant. This meant that for each of the three methods, each participant was graded as being of recommended weight, overweight/obese, or obese. Where growth charts referred to months rather than years of age the nearest mid-year figures were used. Using the appropriate weighting for each study, as described above, the proportion of participants in each country who were above the overweight and obesity criteria from the three growth charts were estimated. All analyses were conducted using Stata version 10.1.

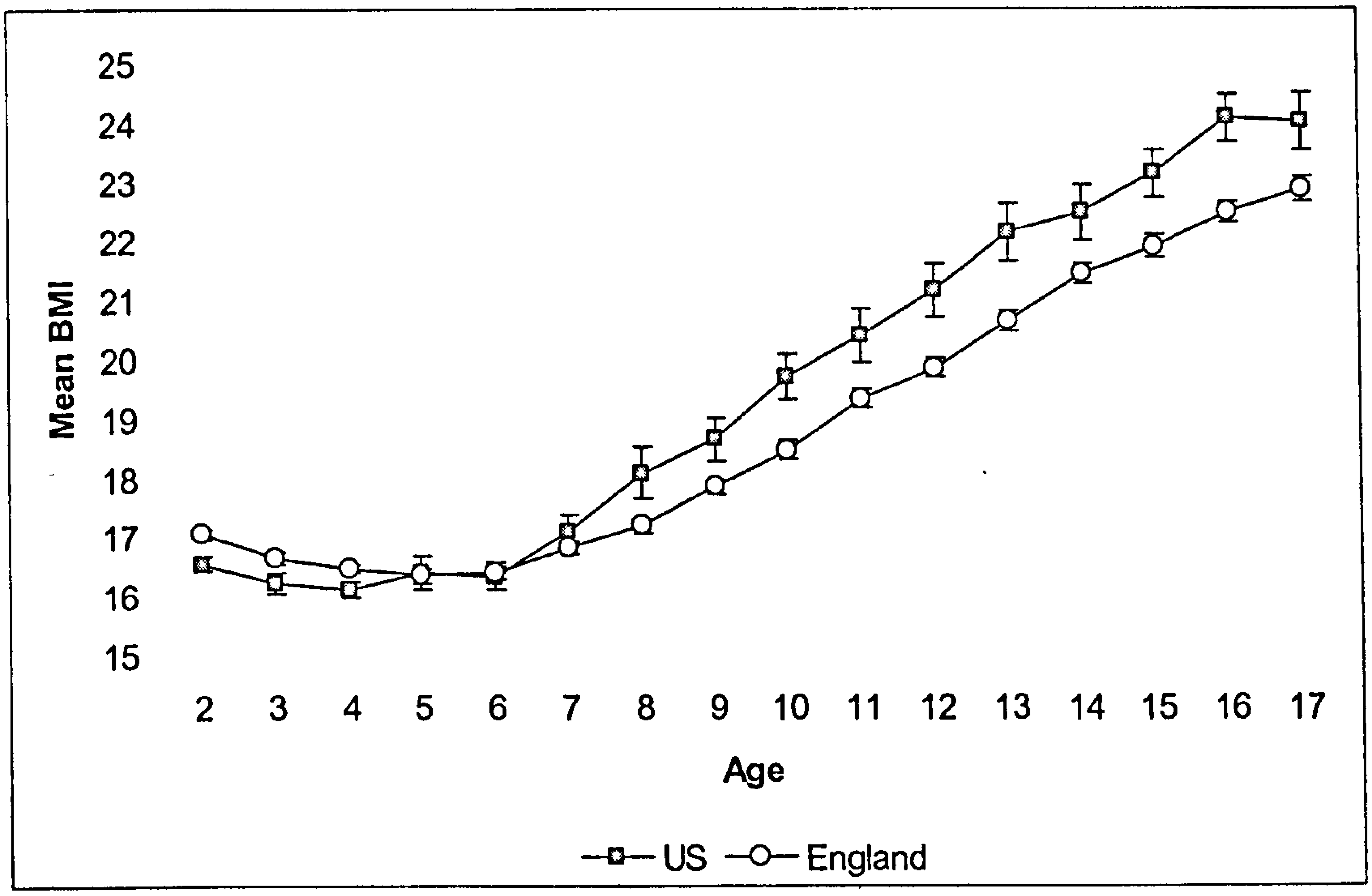
3.4. Results

3.4.1. Mean BMI

Mean BMI for children and adolescents in England and the US, by age in years, are shown in Table 3.1 and Graph 3.1. For children aged 9 to 10, mean BMI was lower in England compared to US children: mean difference = -1.39kg/m^2 (95% CI -1.19 to -1.58). At younger ages English children had higher mean BMI than their peers in the US but this pattern was reversed in older children. Specifically, higher mean BMI was found in English compared to US children at ages 2 to 4 (mean difference England minus US =0.41kg/m^2, 95% CI 0.31 to 0.52) but lower mean BMI in English compared to US children/adolescents from ages 8 to 17: at ages 8 to 11 the mean difference was -1.00kg/m^2 (95% CI -1.26 to -0.75) and at ages 12 to 17 the mean difference was -1.37kg/m^2 (95% CI -1.59 to -1.14). At ages 5 to 7 the mean BMI was similar in the two countries (mean difference = 0.09kg/m^2, 95% CI -0.07 to 0.25).

There were gender differences in the ages at which there were the greatest differences in BMI between English and US children. At age 9 to 10, boys had a slightly higher mean BMI than girls in both countries, but the 95% confidence intervals included the null. In girls the biggest differences in BMI were at age four, when English girls had a mean BMI 0.42kg/m² (95% CI 0.25 to 0.60) higher than US girls, and at age 13, when English girls had a mean BMI -1.62kg/m² (95% CI -1.88 to -1.36) lower than US girls. In boys, the biggest differences were at age two, when English boys had a mean BMI 0.64kg/m² (95% CI 0.43 to 0.84) higher than US boys, and at age 16, when English boys had a mean BMI -2.40kg/m² (95% CI -2.69 to -2.12) lower than US boys.

Graph 3.1 Mean BMI in English and US children and adolescents from 1999 to 2006 by age, boys and girls combined, with 95% confidence intervals



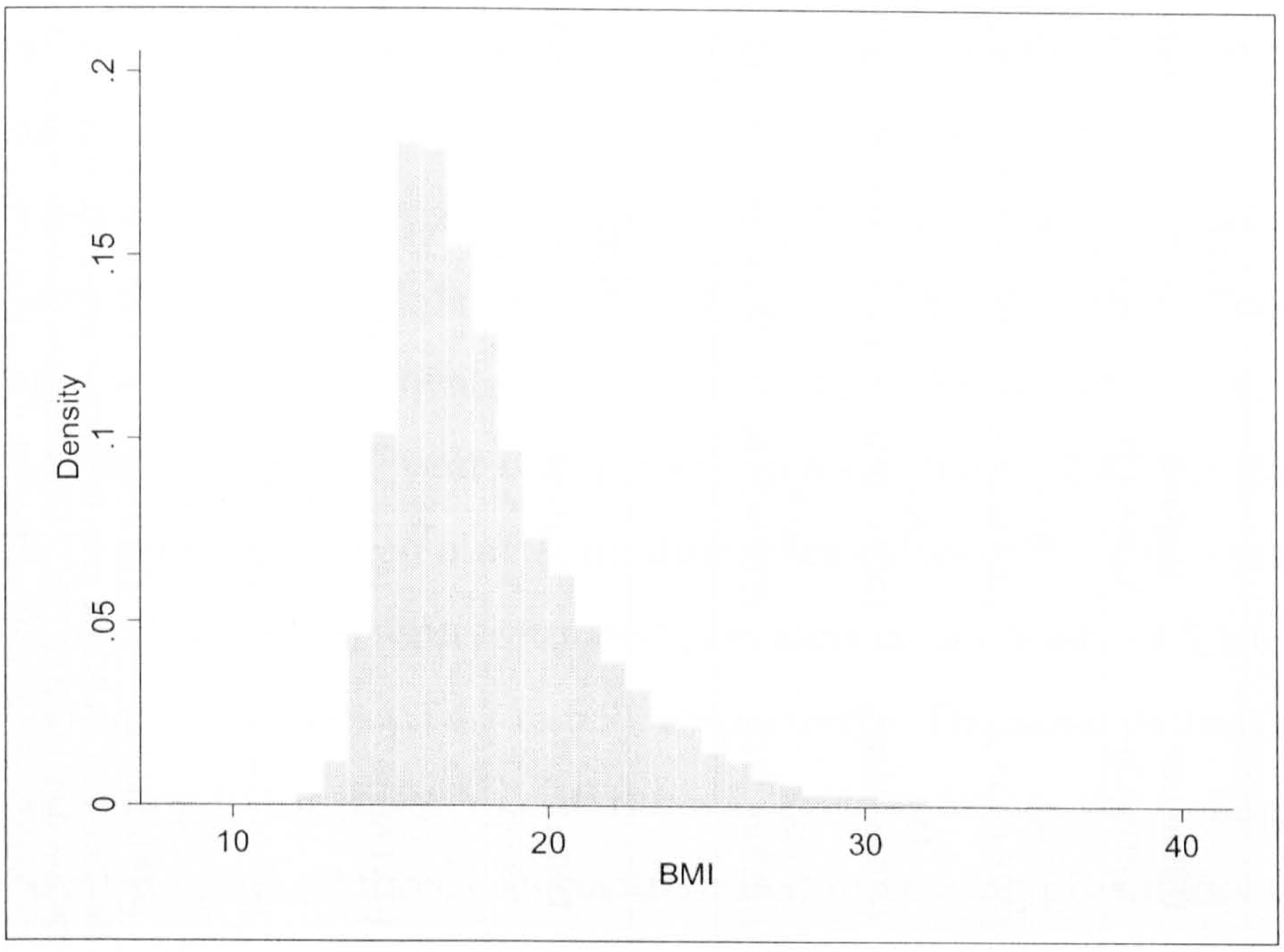
3.4.2. Prevalence of overweight and obesity

Graph 3.2 and Graph 3.3 show the distribution of BMI for English and US children aged 9 to 10, with more US children at the higher range of BMI. Table 3.2 shows the prevalence of overweight/obesity and obesity for England and US children aged 9 to 10 by gender for the three criteria. The prevalence of overweight/obesity was consistently lower in English children across the three criteria by at least -12.4% (and up to -14.2% for boys by the IOTF criteria). For obesity there was a difference of at least -8.3% across the three criteria (and as great as -13.9% in boys for the UK 1990 criteria). The UK 1990 and 2000 CDC criteria give similar estimates of obesity but the IOTF estimates are almost half that of the other two criteria for children aged 9 to 10.

The prevalence of overweight/obesity and obesity for England and the US in all age and gender specific groups according to each of the three criteria is shown in Tables 3.1 and 3.2 in Appendix 3. Using the 2000 CDC criteria, the prevalence of obesity in 2 to 5 year olds (girls and boys combined) reflected the pattern for mean BMI: prevalence of obesity in English children was 13.5% (95% CI 12.7 to 14.5) and in US children in this age group was 11.9 (95% CI 10.2 to 13.6; mean difference = 1.7%, 95% CI -0.2 to 3.6). There was little between-country difference in the prevalence of obesity in this age group in either gender using the UK 1990 or IOTF criteria.

Estimates of obesity for older children were consistent with patterns of mean BMI. Whilst the actual estimates of obesity prevalence varied considerably by the criteria used in both countries, the mean difference in prevalence was similar for each criteria. For example, at ages 12 to 17 the prevalence of obesity was markedly lower in English than US adolescents using the 2000 CDC criteria for obesity (difference = -8.0%, 95% CI -9.6 to -6.4), using the IOTF criteria (difference = -7.9%, 95% CI -9.3 to -6.5) and using the UK 1990 criteria (difference = -8.3%, 95% CI -10.0 to -6.5). US adolescents (aged 12 to 17) had the highest prevalence of obesity by age group and by country using each of the three criteria.

Graph 3.2 BMI distribution of English children aged 9 to 10 (1999-2006)



Graph 3.3 BMI distribution of US children aged 9 to 10 (1999-2006)

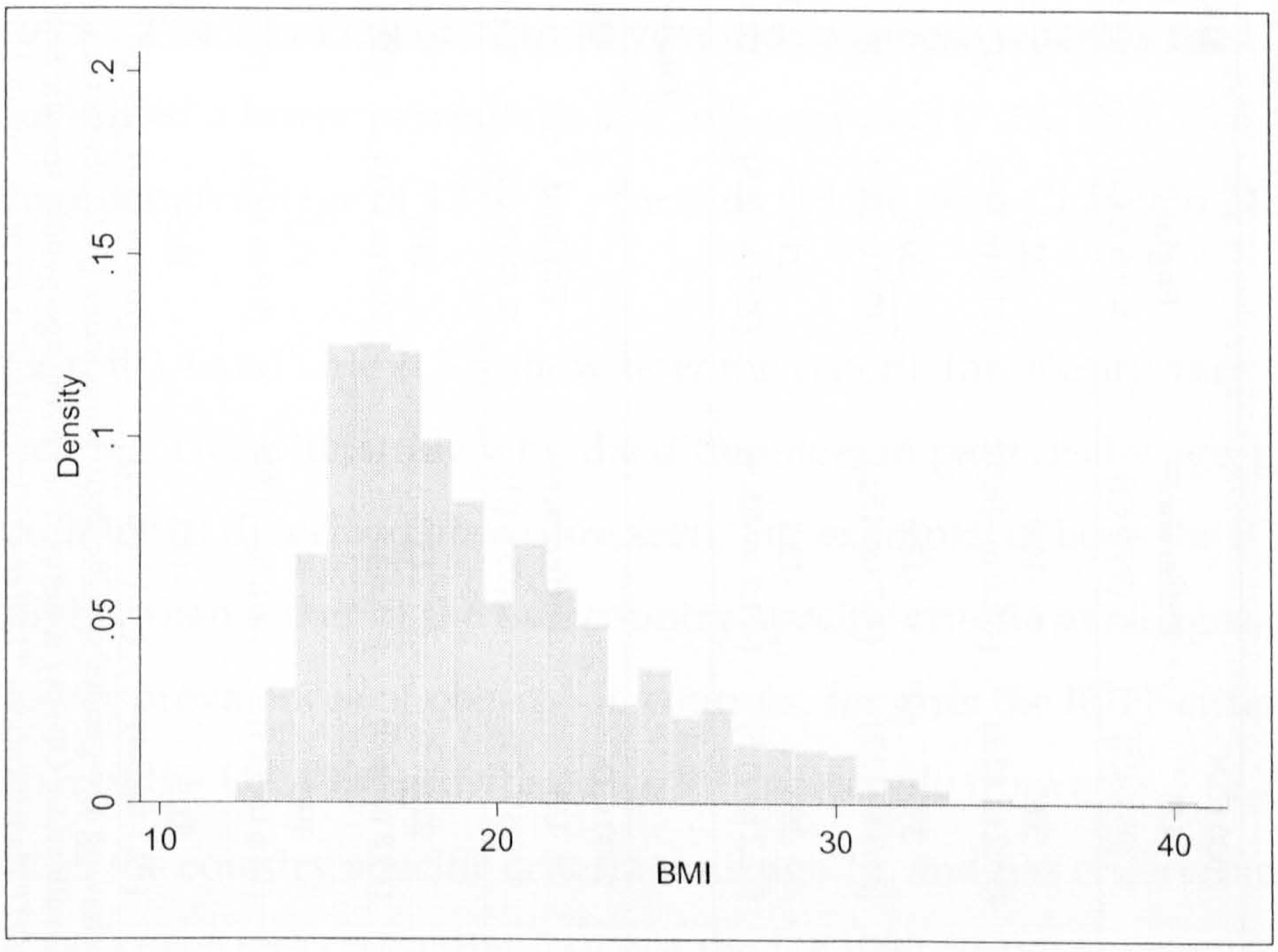


Table 3.2 Percentage of children aged 9 to 10 overweight/obese and obese[1] by age group and study from 1999 to 2006

Overweight and obese[1]

	2000 CDC			UK 1990			IOTF		
	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)
Boys									
9-10	25.2 (24.0 to 26.4)	39.2 (36.2 to 42.1)	-14.0 (-11.0 to -16.9)	22.4 (21.0 to 23.7)	36.5 (33.0 to 40.0)	-14.1 (-10.6 to -17.5)	21.9 (20.5 to 23.2)	36.0 (32.5 to39.6)	-14.2 (-10.8 to -17.6)
Girls									
9-10	26.7 (25.4 to 28.0)	39.4 (36.5 to 42.2)	-12.6 (-9.7 to -15.6)	20.5 (19.0 to 22.0)	32.9 (29.4 to 36.4)	-12.4 (-9.0 to -15.8)	26.5 (24.9 to 28.1)	39.9 (36.3 to 43.6)	-13.4 (-9.7 to -17.1)
All									
9-10	25.9 (25.0 to 26.8)	39.3 (37.2 to 41.3)	-13.4 (-11.3 to -15.5)	21.5 (20.5 to 22.5)	34.7 (32.2 to 37.2)	-13.2 (-10.7 to -15.6)	23.9 (22.9 to 25.0)	38.0 (35.5 to 40.5)	-14.0 (-11.5 to -16.5)

Obese[1]

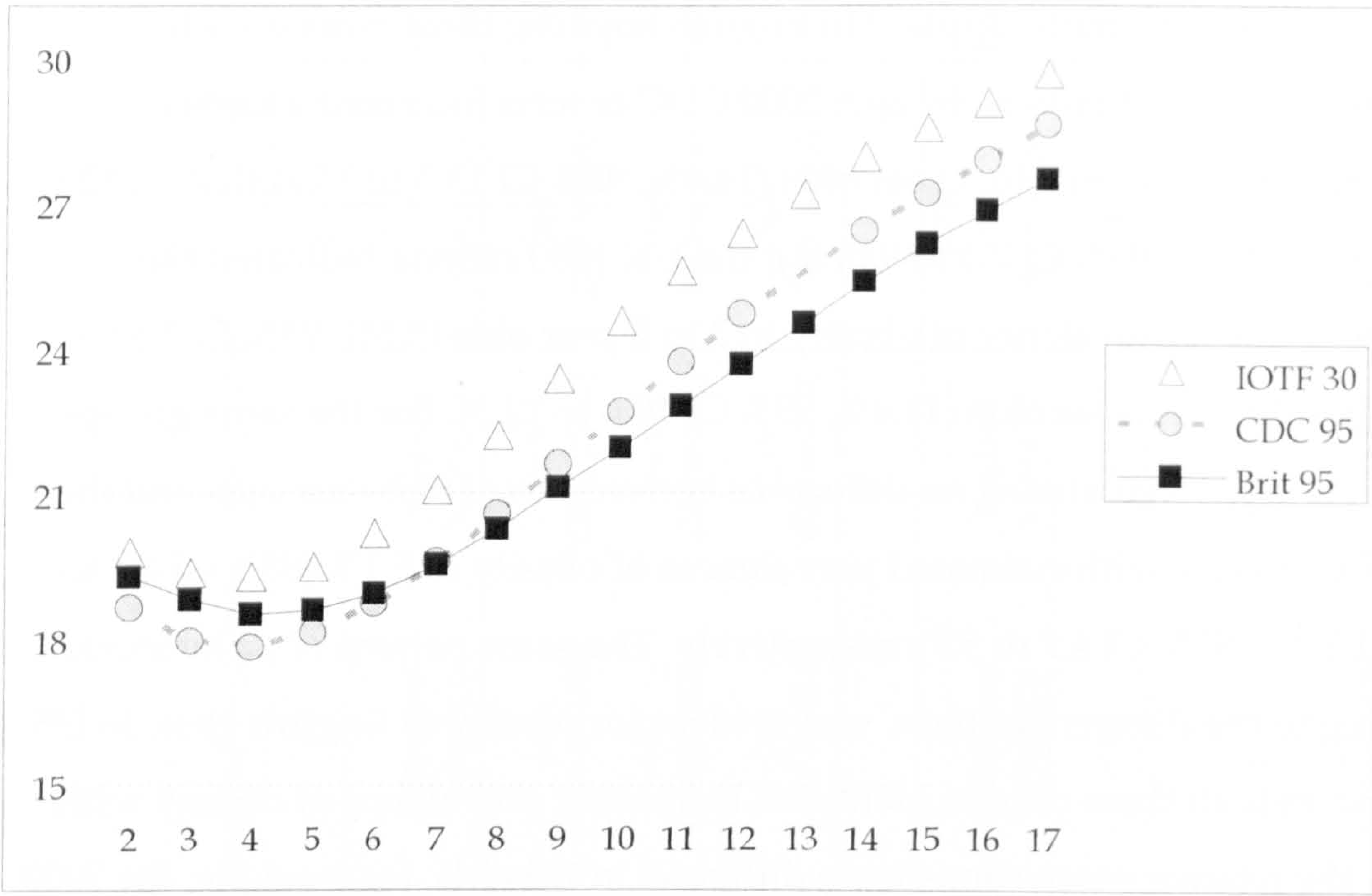
	2000 CDC			UK 1990			IOTF		
	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)
Boys									
9-10	9.7 (8.7 to 10.7)	22.9 (19.8 to 26.0)	-13.2 (-10.6 to -15.8)	11.9 (10.9 to 13.0)	25.8 (22.6 to 29.1)	-13.9 (-11.1 to -16.7)	4.8 (4.1 to 5.5)	14.2 (11.7 to 16.8)	-9.4 (-7.5 to -11.4)
Girls									
9-10	10.3 (9.2 to 11.4)	19.5 (16.6 to 22.5)	-9.2 (-6.6 to -11.9)	11.1 (9.9 to 12.2)	20.7 (17.7 to 23.7)	-9.6 (-6.9 to -12.3)	6.7 (5.8 to 7.6)	15.0 (12.4 to 17.7)	-8.3 (-6.1 to -10.6)
All									
9-10	10.0 (9.2 to 10.7)	21.2 (19.1 to23.4)	-11.3 (-9.4 to -13.1)	11.5 (10.8 to 12.3)	23.3 (21.1 to 25.5)	-11.7 (-9.8 to -13.7)	5.7 (5.1 to 6.2)	14.6 (12.8 to 16.5)	-9.0 (-7.5 to -10.5)

[1] Overweight is defined as having age-gender specific Body Mass Index (BMI) above the 85th centile in the 2000 CDC/ UK1990 growth charts or above the criteria for overweight in the IOTF classification. Obesity is defined as having age-gender specific BMI above the 95th centile in the 2000 CDC/ UK 1990 growth charts or above the criteria for obesity in the IOTF classification. [2] Difference is England percentage minus US percentage, i.e. positive values indicate English figure higher than US

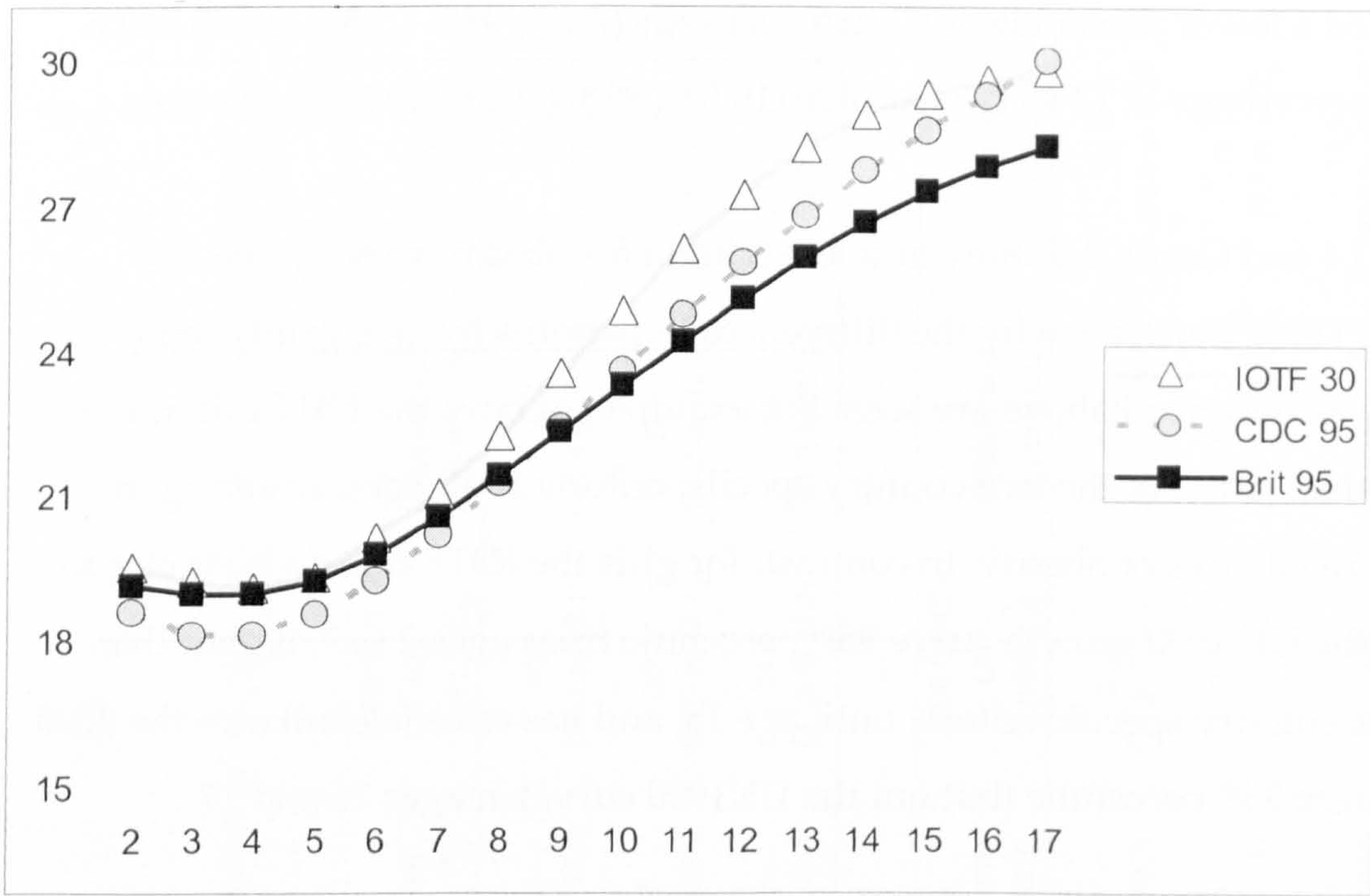
Within country and gender groups, patterns by age differed according to the criteria used. For example, applied to English boys the three criteria each suggested a different pattern by age: 2000 CDC criteria indicated a higher prevalence of obesity in 2 to 5 year olds (14.4%, 95% CI 13.3 to 15.7) than in 12 to 17 year olds (8.3%, 95% CI 7.5 to 9.0) but the UK 1990 criteria indicated the opposite: a lower prevalence of obesity in 2 to 5 year olds (8.5%, 95% CI 7.5 to 9.4) than in 12 to 17 year olds (11.4%, 95% CI 10.6 to 12.3). For the same groups, IOTF criteria showed almost no difference between the 2 to 5 year olds and the 12 to 17 year olds, with estimated prevalences of obesity of 5.1% (95% CI 4.4 to 5.9) and 5.3% (95% CI 4.7 to 5.9), respectively. The same pattern of differences, according to the different criteria, was evident for obesity in English girls. In US boys and girls all three criteria identified increasing prevalence of obesity with age but the relative proportions were different: in US girls, for example, the 2000 CDC criteria identified 11.7% (95% CI 9.5 to 13.8) of 2 to 5 year olds and 16.0% (95% CI 14.1 to 17.9) of 12 to 17 year olds as obese whereas the UK1990 criteria identified a lower percentage of 2 to 5 year olds (7.2%, 95% CI 5.6 to 8.8) but a higher percentage of 12 to 17 year olds (19.0%, 95% CI 16.9 to 21.1) as obese.

Graph 3.4 and Graph 3.5 show how the criteria for obesity vary by age and gender. These illustrate why the differences in patterns by age, gender and country as described above are seen. For example, in boys the IOTF criteria are higher than either of the two country specific criteria at all ages, resulting in lower prevalences of obesity. In contrast, for girls the IOTF criteria is similar to that of the UK 1990 growth curve 95th percentile from ages 2 to 7, higher than both the country specific criteria until age 15, and has criteria similar to the 2000 CDC curve 95th percentile (but not the UK1990 curve) at ages 16 and 17.

Graph 3.4 Criteria for obesity by gender and age, boys aged 2 to 17



Graph 3.5 Criteria for obesity by gender and age, girls aged 2 to 17



3.5. Discussion

Mean BMI, prevalence of overweight/obesity and obesity were all lower in English children at ages 9 to 10 compared with US children between 1999 to 2006. The difference in prevalence of obesity by each of the three criteria was at least -8.3%.

Mean BMI differed between the countries by age, with English children having a higher mean BMI than their US peers at ages 2 to 4 but lower mean BMI at ages 8 and above. This could in part be explained by US children having an earlier adiposity rebound. For public health the prevalence of obesity is particularly important but because population distributions of BMI are positively skewed, the patterns of mean BMI do not necessarily reflect patterns of obesity. US adolescents (ages 12 to 17) had the highest prevalence of obesity of all age groups and in either country by all three criteria (UK 1990, 2000 CDC, and IOTF).

A key finding of the analyses is that there were marked differences in obesity prevalence in each country and by age and gender when applying each of the three different criteria. However, general differences in the prevalence between England and the US were consistent irrespective of which criteria were used, except at younger ages where using 2000 CDC criteria where English children aged 2-4 have a higher prevalence than US children.

These findings have important implications for public health surveillance, clinical practice, and research into childhood obesity. For example, the higher prevalence of obesity in young children in England compared to the US found using the 2000 CDC criteria might suggest efforts to prevent childhood obesity in England should focus on surveillance and intervention research in pre-school children. However, there was no strong evidence of an age effect when obesity was defined using the other two criteria. Furthermore, using IOTF criteria the overall prevalence of childhood obesity in both England and the US in all age groups was considerably lower than using either of the country-specific criteria, which is in keeping with studies which have found that the IOTF criteria have poor sensitivity for obesity.[95,172] Using the IOTF criteria one would be likely to estimate the magnitude of the childhood obesity epidemic as far smaller than when using the country-specific analyses.

3.5.1. Strengths and weaknesses of the study

A key strength of this analysis is the use of data collected as part of nationally representative surveys with standardized methods. Three established methods of classifying children and adolescents as overweight/obese and obese were used. International comparisons of the prevalence of obesity have relied on published studies from single countries using whatever classification system and years of coverage were used in the initial publication.[2] These findings suggest relying on country-specific classifications is likely to present problems in terms of making meaningful comparisons between as well as within countries.

A limitation of this study is that the prevalence estimates by age and gender are pooled over an eight year period, during which time the prevalence of obesity increased and more recently has appeared to plateau (though longer term trends are required before it can be concluded that the epidemic has reached its peak in these countries).[5,164] The relatively small numbers of obese children/adolescents in each age group by year make it impossible to draw conclusions about annual differences between countries. I have not attempted to distinguish how the prevalence of obesity differs between the two countries in relation to these ethnicity and socioeconomic profiles because the two surveys assess these factors differently.

3.5.2. Implications for further research

Two studies suggest all three criteria for defining childhood obesity used here have similar and high specificity but that the IOTF criteria may have lower sensitivity when compared to a gold standard of high body fat.[95,172] It could be argued that the best method for defining childhood obesity should be that which best predicts adverse obesity related short and long term outcomes. Therefore I recommend that the IOTF and one or more country-specific criteria are used and compared in research studies until it is clear which provides the best method for identifying children at greatest adverse consequences from obesity.

US adolescents aged 12 to 17 had the highest prevalence of obesity by age group compared to England using each of the three criteria assessed. In contrast, English children aged 2 to 4 had higher mean BMI and higher prevalence of obesity using the 2000 CDC criteria compared to the US. It is unclear what factors drive these between country differences as there is currently a lack of high-quality studies exploring country level differences in risk factors for obesity and examining how these explain the observed differences.

The research implications of the higher prevalence of obesity in US children aged 9 to 10 year olds by the three criteria, is that obesity prevention interventions in countries such as England with lower prevalence may show less absolute effect on obesity and may therefore be less cost effective, whilst still contributing to important lifestyle changes to prevent obesity. The difference in prevalence by the three criteria for assessing obesity, particularly the much lower estimates from the IOTF suggest that it is important to present results by the three criteria to allow easy comparison with studies from the US, UK and other countries.

3.6. Summary

US children aged 9 to 10 had a higher prevalence of overweight/obesity and obesity compared to English children by all three criteria. US adolescents (aged 12 to 17) had the highest prevalence of obesity by age group compared to England using each of the three criteria. In contrast English children aged 2 to 4 had higher mean BMI and higher prevalence of obesity using the 2000 CDC criteria compared to the US. The results demonstrate very marked differences in the prevalence of childhood obesity by age, gender and country when different, established methods for defining childhood obesity are applied to the data. These different results could have profound implications for how public health surveillance and research data are interpreted. Until there is clear evidence for adopting one method to apply to all data all three approaches should be reported in future country level surveillance systems and research. With respect to this thesis, all three criteria should be used to assess overweight and obesity.

CHAPTER 4. AFLY5 PHASE 1: PILOT STUDY

This chapter presents the background, methods and results from Active for Life Year 5 (AFLY5) Phase I; a pilot cluster RCT of a school-based obesity prevention intervention. The strengths and weakness of the methods and results are discussed, followed by the main implications of the study.

4.1. Background

4.1.1. Choice of obesity prevention intervention

The choice of intervention was influenced by three factors: i) the target population; ii) a review of interventions that to date had shown some effect; iii) pragmatic considerations. Each will be considered in turn.

i) children of primary school age seemed most appropriate since there is a legal requirement for all children to attend school. Schools therefore provide the opportunity to work with all children which fits with the need to reduce population level BMI downwards to prevent obesity.

ii) the choice of intervention was informed by a review of childhood obesity prevention published in 2002[173] which recommended multi-faceted school-based interventions. This recommendation was based on Harvard School of Public Health's success in reducing obesity rates in girls in the US to Planet Health, a health promotion programme.[161] A cluster randomised controlled trial of 11-12 year olds in 10 schools (5 intervention; 5 control) examining the effect of the Planet Health programme of lessons found that girls in the intervention schools were less likely than those in the control schools to be obese at follow-up (OR 0.47; 95%CI 0.24 to 0.93; p=0.03). The study also reported that the effect of the intervention on girls was mediated by a reduction in TV viewing. There was no effect on obesity in boys.[161] A similar intervention from the same research group with younger children (aged 8-9), called Eat Well Keep Moving, was examined in a quasi-experimental non-randomised controlled trial with 12 schools.[174] The intervention saw an increase in fruit and vegetable intake (0.36 servings/4184kJ; 95% CI -1.2 to -0.01; p=0.05). There was also weak evidence that television viewing was reduced (-0.55 hours per day; 95%CI -1.04 to 0.04; p=0.06). BMI was not measured. No gender differences were found in this study.

iii) persistent obesity is established before the age of 11; therefore, obesity prevention needs to be targeted at children aged under 11.[175] A focus on preventing obesity in children under 11 was established in England in 2004 when the Government Departments of Health, Education and Skills and Culture, Media and Sport were given the joint Public Service Agreement 'to halt the year-on-year rise in obesity in children under 11 by 2010, in the context of a broader strategy to tackle obesity in the population as a whole' (page 13).[176] Therefore, I recommended to the Director of Public Health at South Gloucestershire Primary Care Trust (PCT) that we should seek funding to explore the feasibility of transferring the US Eat Well Keep Moving intervention for use in UK primary schools and to locally pilot this intervention.

The academics at Harvard School of Public Health confirmed that the lessons had not been adapted for use in the UK. With support from the academics at Harvard University and publisher of the lessons (Human Kinetics), funding was obtained from the Department of Health to pilot the feasibility of transferring the intervention to 9-10 year olds in England. My role was to obtain funding, design the study, recruit schools and coordinate the research, in collaboration with Professor Debbie Lawlor at the University of Bristol and with health promotion staff at the PCT and Local Authority.

The next section outlines the methods for the study including the design, intervention, theory underpinning the intervention and ethics. This is followed by the methods of data collection and analysis of sedentary activity, diet, BMI, physical activity, active transport and process evaluation. Details of the statistical analysis and data analysis are provided. The results section begins by providing summary statistics that describe the study sample and the baseline distribution of key outcomes. I then go on to examine associations of gender and deprivation with each outcome using the baseline data only. The rationale for these initial analyses are to provide contextual information that can be used in interpretation of the main pilot randomised controlled trial results. It allowed me to see whether the school children in South Gloucestershire included in this study were similar to the same aged school children in the rest of England and if not how they differed. Lastly, I present results for the comparison of outcomes by randomised group (taking account of clustering by school). The discussion of methods and results concludes the chapter.

4.2. Methods: general

4.2.1. Study design

This AFLY5 Phase I study aimed to evaluate the feasibility of adapting the lessons from the US intervention for use in the UK and to examine the short-term effect of the lessons on children's screen-time, BMI, diet, physical activity and mode of transport to and from school. The study was designed as a pilot cluster randomised controlled trial of UK children aged 9–10 years, with the primary aim of informing the design of a larger trial. It included both quantitative and qualitative analysis.

An RCT design was chosen because it is considered to be the most reliable method of determining effectiveness, as allocation to intervention or control is left to chance and the characteristics of individuals that are related to the exposure and that influence the outcome (confounders) are equally distributed between the two groups.[177,178] Although this was a feasibility/pilot study I felt that it was appropriate to use the RCT design as this would enable me to determine (a) the feasibility of randomising schools to the intervention; (b) any problems with this approach; (c) the ICC (necessary for sample size calculation) and (d) the likely magnitude of effects for a full scale RCT (though acknowledging that the short-term follow-up would mitigate against this).

It is common for public health research focused on primary prevention or behaviour change, such as smoking[179] or eating breakfast[180], to use a cluster RCT design where randomising individuals to an intervention would either be impossible or could lead to contamination of intervention and control arms. In a clustered design, groups (e.g. schools) are randomised and allocated to intervention or control, as opposed to individuals within the groups.[181] The drawback of such a design is that a larger sample size is required because within groups (clusters) the observations are not independent of each other.[182] If this clustering (non-independence) of the data is not taken into account in analyses then standard errors for regression coefficients are inappropriately small and hence p-values for associations are smaller than they should be and confidence intervals narrower.[182]

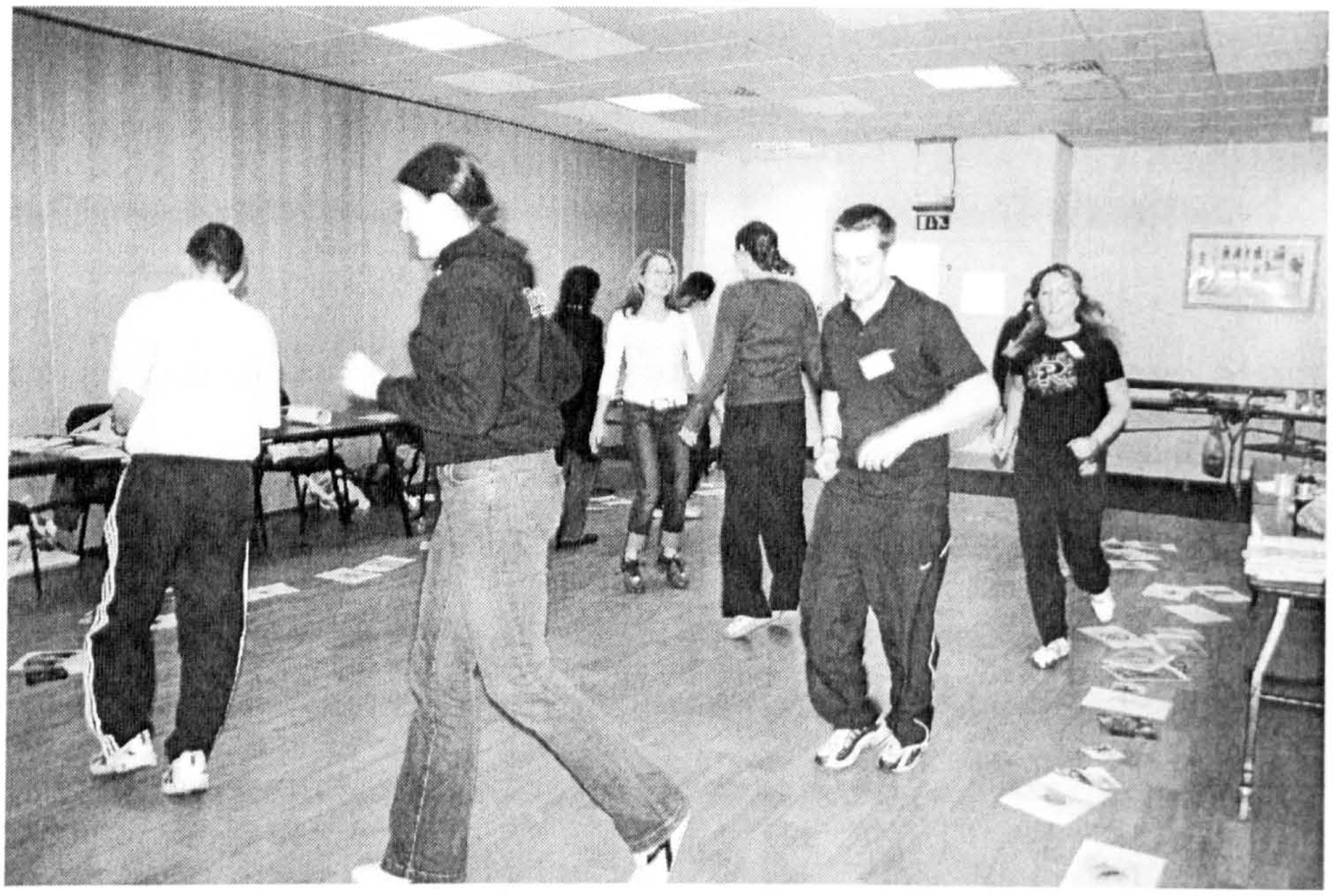
The inclusion criteria for the AFLY5 Phase I study were state primary and junior schools with year 5 children (aged 9-10) in the urban area of South Gloucestershire. All schools had a rural and urban area classification 2004 classification of 'urban> 10k – less sparse'.[183,184] Special schools (e.g. learning disabilities), private schools and schools with infants only were excluded. Since this was a pilot study, the aim was to recruit as many schools and their pupils as possible and use the results, including the ICCs to calculate the necessary sample size for a full-scale study.

All eligible schools that fulfilled the inclusion criteria in South Gloucestershire (n=27) were invited by letter to take part in the study. The letters were sent jointly from the PCT's Director of Public Health and the Local Authority's Deputy Director of Children's Services to the Headteacher, copied to the Chair of Governors (see Letter 4.1 in Appendix 4). The schools were informed they would be randomly allocated to intervention or control groups. Nineteen schools (70.4%) agreed to be in the study.

Random allocation to intervention or control school was concealed and performed by Professor Debbie Lawlor using a random-number generator to establish the group allocation of each school. Ideally an RCT has a double blind design, in which neither participants nor researchers know what intervention has been received during the trial and analysis, however in this study it was impossible for the schools to be blinded. Debbie Lawlor was blinded when she undertook the initial statistical analysis of screen-time, BMI and transport to school; however I was not blinded when I did the subsequent analysis, including the diet data for the first time. An intention to treat analysis was undertaken, where the individuals were analysed in the intervention and control groups they were allocated to by the random allocation, regardless of the number of lessons taught in intervention schools. A more conservative intention to treat analysis was undertaken, by bringing forward the baseline measurements for children missing follow-up measurements and this made no difference to the results and therefore is not presented here. The more conservative analysis for the diet data has been published.[185]

Training for teachers was provided in January 2006 (see Figure 4.1). All measurements were taken in January/February 2006 before the lessons were taught (from February to June 2006) and five months later (July 2006) after the lessons had been completed. The US study was evaluated over a two-year period. However, it was not possible to undertake a long-term trial as part of this feasibility and pilot work. The programme was implemented over two terms with teacher training taking place in January 2006, the intervention taking place between February to June 2006 and the final outcome assessment in July 2006.

Figure 4.1 Photograph of teacher training day



4.2.2. Intervention

The intervention was an adapted and abbreviated form of the 'Eat Well Keep Moving' programme developed in the United States.[174] I recruited two primary school teachers to work with me to adapt the US intervention, which consisted of sixteen lessons on healthy eating, increasing physical activity and reducing TV viewing for use in the English school setting. The main changes were to shorten the lesson plans, change American phrasing or references and change the US based pyramid structure of food groups to the UK 'balance of good health' plate[33] (which has more recently been updated to the 'eat well plate'[186]). The UK revised lessons were tested in one school in Bristol by the two teachers, who adapted the lessons. The lessons were well received by the children who recommended small changes to the slides, such as making the font larger.

The lessons included nine physical activity lessons, six nutrition lessons and one lesson about screen viewing (see Table 4.1 in Appendix 4). An example if a lesson plan is shown in Figure 4.1 in Appendix 4. The nutrition lessons focused on learning the content of the food groups, as outlined in the balance of good health, the importance of eating at least five fruit and vegetables a day and the importance of eating breakfast.[187] In the physical activity lessons the children played games based on the food groups using photographs of food, which reinforced the theory taught in the nutrition lessons. In addition, the children were given two journals. In the Fit Check journal the children kept a record of their time spent being physically active or sedentary and set goals to achieve an hour of physical activity and no more than two hours of sedentary time per day. In the Freeze My TV journal the children identified TV programmes to stop watching and replace with physical activity and a reflective diary on how it felt to freeze their TV. The two teachers and I provided a one day training session to the ten teachers who were teaching the lessons in the intervention schools. Materials were provided including a folder with the lesson plans, two journals per child, photographs of food and a CD with the lesson plans.

4.2.3. Theory

In this section the two behaviour change theories underlying the Eat Well Keep Moving and Planet Health programmes are outlined; social cognitive theory and behavioural choice theory. Social cognitive theory is the most common model in nutrition education interventions.[109] In this theory behaviour is a function of a 'reciprocal determinism', the interaction between the environment and the person. The personal concepts are skills, self-efficacy and outcome expectations and the environmental concepts are modelling and availability. The primary concept for behaviour change is self-control; by setting behavioural change goals, monitoring, reward and problem solving, followed by decision making when goals are not attained. Behavioural choice theories are focused on decision-making and how time and responses are allocated on the basis of options available.[112] The principles are: the cost of the behaviour; the choice and reinforcing value depend on available alternatives; choice is important to motivate people to obtain a reinforcer; and choice depends in part on the delay between choosing and receiving. See section 2.5 for more detail about theories of behaviour change.

4.2.4. Ethical approval and consent

In 2006 the University of Bristol did not have an ethics committee in the Faculty of Medicine. Therefore ethical approval was sought from the NHS local research ethics committee. However, the chairman of the committee said that since this was research that did not involve patients or NHS staff, NHS ethical approval was not required. However, the chairman was asked to give his ethical view of the study and said that he did not see any ethical issues. Parents were sent a letter by the school and were asked to give opt-in written consent for each of the outcome measures.

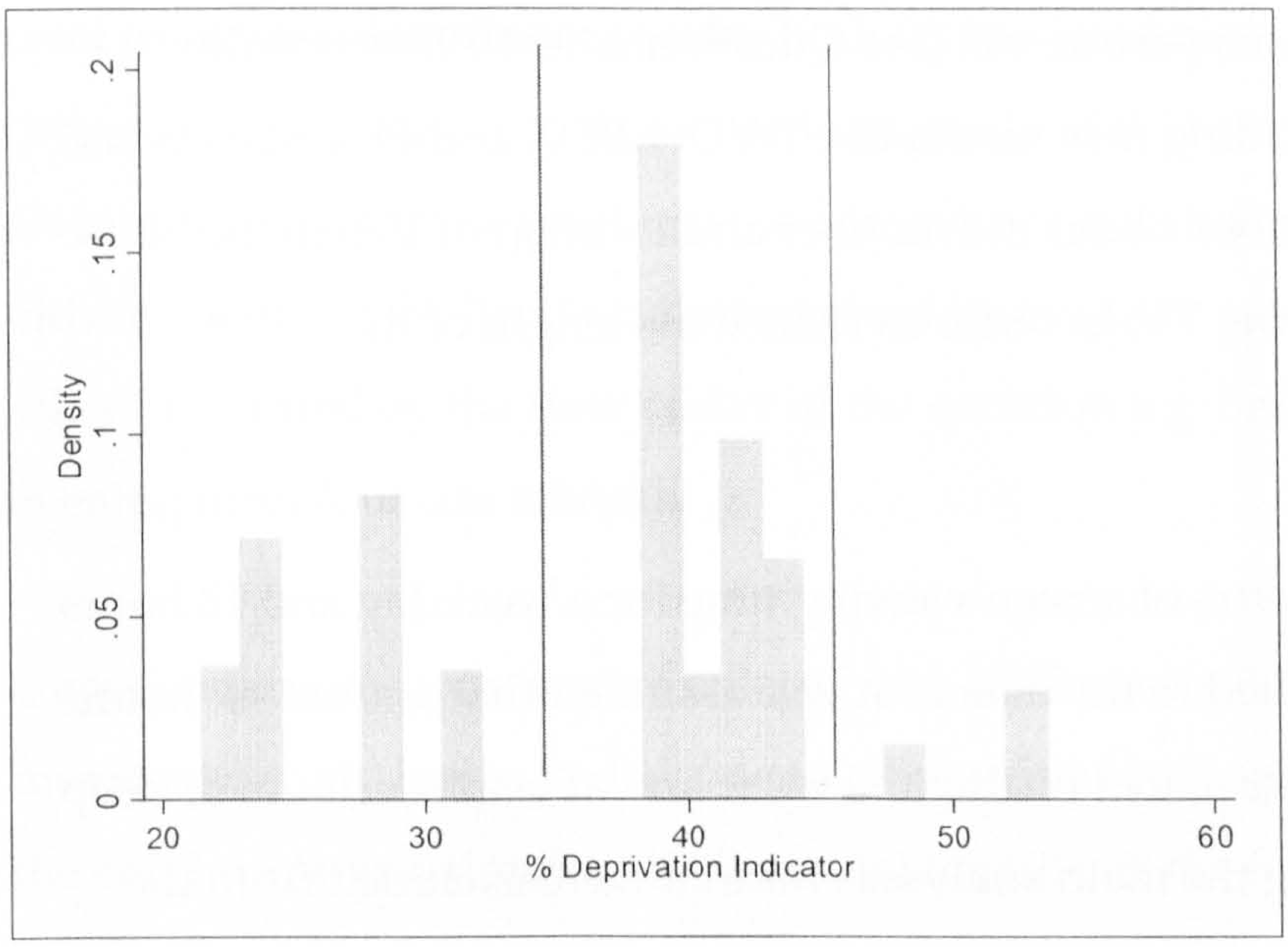
4.3. Methods: measurements

4.3.1. Deprivation

It is common for deprivation in schools to be measured using the percentage of pupils receiving free school meals.[188] A weakness of using percentage of free school meals is that it is only a measure of children who take up the free meal entitlement, not a measure of the percentage of children who are entitled to it. The Statistics and Research Officer at South Gloucestershire Council recommended using the English Government's new school deprivation indicator. This is a measure of income deprivation using the income characteristics of the area of residence for each child on the school roll. The percentage of families with children getting Child Tax Credits and/or Working Tax Credits informs the deprivation indicator.[189] A score of 100% represents the most deprived schools in

England. The scores for schools in this study ranged from 21% to 54%. The 19 schools were grouped into low (<=35%), medium (>35 < 45%) and high (>=45%) deprivation after initial inspection of the distribution of deprivation scores to give three roughly even groups. The high deprivation group is smaller than the other two, but it was felt that this was a distinct group (see Graph 4.1).

Graph 4.1 Distribution of schools by School deprivation indicator



4.3.2. Gender

Gender was collected by child self-report on the diet questionnaire. Where children were missing gender data the child's name was checked and if it clearly indicated the gender of the child this was imputed.

4.3.3. Screen viewing

The primary outcome for this pilot study was determined *a priori* as a reduction in screen viewing (watching television, videos, DVDs or computer games). I chose this as the primary outcome because it was the obesity related behaviour that had been shown to be affected by both Planet Health and Eat Well Keep Moving and because in Planet Health there was some evidence that this mediated the effect of the intervention on obesity prevention in girls. I felt that with just five months follow-up it would be extremely unlikely that differences in mean BMI or obesity would be detected.

The children completed a questionnaire about the length of time spent doing screen based activities on the previous weekday and Saturday. The questionnaire was an abbreviated and updated version of a questionnaire designed by Robinson, with the authors permission (see Questionnaire 4.1 in Appendix 4).[159] The changes included adding new media like DVD, XBOX and Play Station and removing detailed questions about the number and location of TVs in the house and eating whilst watching TV, in order to reduce the length of the questionnaire.

Maximum limits of 12 hours of screen viewing time for a weekday and 18 hours for a Saturday were applied to the data as it was assumed that at least six hours per day would be spent at school during the week and at least six hours of sleep on all days. Before doing the main analyses children were excluded from the analyses with a sum of 720 minutes or greater of screen-based activities for the weekdays and a sum of 1080 minutes of such activities for Saturday. At baseline this resulted in one child being excluded from the intervention schools and six from the control schools, and at follow-up this resulted in 34 children being excluded from the intervention schools and 55 from the control schools prior to analyses.

4.3.4. Diet

Dietary behaviours were assessed using the 'A Day in the Life Questionnaire'[190] (DILQ). The DILQ provides information about the children's entire food and drink intake the previous day (see Questionnaire 4.2 in Appendix 4). To improve recall the questionnaire is structured with sequential questions in a 24 hour segmented school day. The questionnaire was chosen because it has been shown to be reliable for assessing fruit and vegetable, and sweet and savoury snack consumption among children.[190,191] Teachers were asked to supervise the children completing the questionnaire. Completed questionnaires were returned by post.

Fruit and vegetable consumption was assessed using an established scoring scheme which is shown in Figure 4.2 in Appendix 4. The DILQ data were also used to create categories of snacks, high fat food and high energy drink. These categories were similar to those used in a study of 9-11 year olds in Wales[191] and also informed by those used in a food frequency questionnaire with 12-13 year olds in Australia.[192] Food was categorised by location; eaten at school or outside school informed by the time of day of the question e.g. break time (school) and evening meal (outside school).

Questionnaire responses were entered into a Microsoft Access database by one member of staff. I allocated a code to all possible spellings of words written by the children (approximately 1000 words) to indicate the food or drink category. This coding was used to generate automatic coding of the text in Access. I manually verified the automatic coding and made changes to the coding. I discussed with my two supervisors items that could be allocated to more than one of the outcome categories (e.g. croissant and waffle). The final allocation of all foods is given in Figure 4.2 in Appendix 4. Inaccurate spellings were also checked and agreed in discussion with my two supervisors. After these discussions (regarding spelling and allocating foods to categories) and initial complete coding by me, a second coder (my PhD supervisors) each coded 50% of the foods and any differences between the initial or second coders were agreed by discussion. Less than 3% of the original codes required changing after the second independent coding.

Binary outcomes that reflected healthy consumption were derived for each dietary outcome using the following to define healthy: fruit and vegetables (>=3 portions per day); sweet or savoury snacks (0 or 1 portion per day); high fat food (0 portion per day); high energy drink (0 or 1). These thresholds were defined after an initial inspection of the data and were based on both established knowledge of a healthy diet and recommendations for this, together with the distribution in this study sample (see Graphs 5.1 to 5.4 in Appendix 5). For example, healthy recommendations are for consumption of five or more portions of fruit and vegetables per day, but only 8.5% of children in the sample achieved this level and I felt that this was too few to form a category for meaningful analyses and therefore I used >= 3 portions per day.

4.3.5. Height and weight

Nine school health assistants, who were blinded to the allocation of schools, measured the children's height and weight. The school health assistants received training from their employer (North Bristol NHS Trust) to measure children for height and weight measurements and undertook these measurements annually with 4-5 year old children. Height (without shoes) was measured to the nearest 0.1 cm with a minimeter stadiometer. Weight (without heavy clothing) was measured to the nearest 0.1 kg on portable scales. Obesity was defined using BMI and the criteria for obesity from the IOTF,[36] 2000 CDC[171] and the UK 1990[170] reference populations. See section 3.1.2 for further information about how these three criteria differ. Conventionally in the UK the UK 1990 criteria are used, but because this study was testing an intervention from the US and given the differences in prevalence found using the three criteria reported in chapter 3, it was thought useful to present the results using the three criteria.

4.3.6. Physical activity

South Gloucestershire Council provided pedometers to objectively measure the children's physical activity levels. The children were asked to wear the pedometers attached to their belt for two consecutive school days in January and two schools days in July, with the teachers collecting a daily count from the children. I was concerned about these pedometers because there was evidence that such pedometers were not very accurate or reliable for research. However, I thought that if the same instrument was used pre-and post-intervention for each child they might be acceptable. However, the pupils and teachers reported a large number of problems with the pedometers re-setting and therefore these data were not analysed.

4.3.7. Active travel

The children's mode of transport to school was assessed by self-report of travel the previous day in the DILQ. The options given were walk, cycle, bus or car. Children were able to select more than one mode of transport.

4.3.8. Data management

The data collected from the schools was entered into an Access database by one data clerk at the University of Bristol. Each child was given a five digit ID, the first two digits of which identified the school. For all variables, rules were created to minimise errors in data entry, such as data entry being restricted to '0 or 1' where a binary answer was indicated. An error check was run on a sample of the data. The paper copies were retained and stored at the Department of Social Medicine in a locked, restricted access location.

4.3.9. Statistical analysis

The statistical analysis is summarised firstly by assessment of data quality, secondly by descriptive analysis and thirdly by intention to treat analysis of the effect of the intervention.

Firstly, the data quality was assessed. The individual height and weight measurements were assessed for digit preference (rounding up or down to whole or half numbers) for the third decimal place for height and the first decimal place for weight. For a random distribution of heights and weights, it would be expected that about 10% of height and weight measures would be to the nearest whole number, and 10% to the nearest half number. A further 10% of measures would be recorded for each of the other decimal places. BMI at baseline was plotted against BMI at follow-up to identify any outliers which could be transcribing errors at data collection or typing errors at data entry. The mean BMI for each pair of school health assistants who took measurements were compared at baseline and follow-up. The Kruskal-Wallis equality-of-populations rank test was used to test whether there was a difference by measurement pair.

The quality of the screen time data was assessed by determining maximum possible times for weekdays and weekends and removing outliers. The quality of the diet data was assessed by determining whether the data was incomplete if the child indicated they were not in school for part of the day or if more than half of the questions were incomplete or there was no text for the three main meals.

Secondly, data were described at baseline by mean (standard deviation) or median (interquartile range) for continuous measurements and numbers (%) for categorical variables. Previous evidence suggests that behaviours and adiposity are importantly influenced by deprivation and gender;[193] therefore data for the whole study sample is described by gender and area deprivation, using the baseline data for these descriptive statistics. The Kruskal-Wallis non-parametric test and the Pearson Chi Squared test were used to describe the patterns by gender and area deprivation.

For the diet data only, the percentage of portions consumed per day by location in school and outside school were assessed (because this is the only outcome measured by location). A t-test was used to compare the mean percentages of each food between the two locations. It was assumed *a priori* that the percentages for all food types would be expected to be higher for food/drink consumed outside school than in school, since two meals are consumed outside school during week days and in total more time is spent outside school than in school.

Consistent with the CONSORT guidelines,[194] all analyses were undertaken using an intention to treat protocol, regardless of the number of lessons taught in intervention schools. Only children with complete data at baseline and outcome were included in the analyses. Multivariable regression (linear or logistic) was used to determine the mean difference or odds ratio comparing intervention to control schools at follow-up. In these analyses, adjustment was made for age, gender and the baseline level of the outcome of interest to maximise precision. Robust standard errors were used to take account of clustering (non-independence between pupils from the same school) in the computation of 95% confidence intervals and p values. The results are also presented without this clustering being taken into account as a demonstration of how this affects the precision of the estimate and the p values. Lastly, intraclass correlation coefficients (ICC) and their 95%confidence intervals were estimated for each of the main outcomes. This assesses the extent of clustering within schools and is required to calculate the sample size required for a full-scale RCT.

All randomised comparisons of BMI, screen time and active travel were undertaken initially in Stata version 9.2 by Debbie Lawlor, who was blinded to which were the intervention and which the control group of schools. However, for this thesis I repeated these analyses and I undertook quality assessment and descriptive analyses for all measurements. I also undertook the diet randomisation analysis. All of the analyses that I conducted were done using Stata version 11.1.

4.4. Methods: process evaluation

4.4.1. Questionnaires

The ten teachers in the intervention arm were invited to complete a questionnaire about AFLY5 which included the training day, the measurements, the lessons, the resources and their future use of the materials (see Questionnaire 4.3 in Appendix 4).

4.4.2. Interviews

The ten teachers in the intervention arm were invited take part in a face to face semi-structured interview at their school which covered the same issues as the questionnaire (see Interview Schedule 4.1 in Appendix 4). I undertook all the interviews, they were recorded using a Dictaphone and I transcribed the tapes.

4.4.3. Analysis of interviews

The transcripts were read to aid familiarisation. Thematic analysis was used to identify the main themes (separately for the focus groups and the interviews).[195] Transcripts were coded electronically using main codes and sub-codes in Nvivo (version 9.0). The codes were derived from the data, informed by the research questions because of the emergent nature of the data and the limited literature in this area. The coded text was retrieved and further categories were assigned. Therefore, the hierarchy of coding was main code, sub-code and category. The framework method was used to chart the cateories.[196] The data were summarised for the purpose of charting. The categories were synthesised further into classes and summarised with illustrative quotes.[195]

4.5. Results: quantitative analysis

4.5.1. Assessment of data quality

The assessment of data quality is presented in Appendix 5.

4.5.2. Descriptive analyses at baseline

Baseline characteristics for those pupils included in the analysis were similar for those from the intervention and control schools, with the exception of the proportion walking or cycling to school (see Table 4.1). There were slight differences between intervention and control schools in the proportion of children in normal/overweight and obese categories; however, these differences were not consistent and differed by criteria (IOTF, 2000 CDC and UK 1990).

Significance tests for baseline differences are inappropriate as any such differences occur by chance and therefore have not been undertaken.[178,182,197] Despite concealed random allocation, pupils from those schools allocated to the control group were more likely at baseline to walk/cycle to school than those allocated to the intervention schools.

Table 4.1 Comparison of baseline characteristics between pupils at schools

	Intervention schools N = 10		Control schools N = 9	
	Pupils	Distribution	Pupils	Distribution
N (%) female	241	122 (50.6)	270	146 (54.1)
Mean (SD) age (years)	310	9.93 (0.30)	300	9.92 (0.31)
Mean (SD) school deprivation indicator	323	36.0 (10.42)	321	37.8 (6.48)
Median (IQR) screen time weekdays (minutes)	211	150 (75, 225)	209	135 (75, 210)
Median (IQR) screen time Saturdays (minutes)	213	150 (60, 285)	218	180 (90, 300)
N (%) with ≥2 hours screen time weekdays	211	124 (58.8)	209	129 (61.7)
N (%) with ≥2 hours screen time Saturdays	203	127 (62.6)	198	135 (68.2)
Mean (SD) BMI (kg/m^2)	273	17.80 (3.0)	253	17.82 (2.92)
N (%) normal (IOTF)	273	226 (82.8)	253	202 (79.8)
N (%) overweight (IOTF)	273	35 (12.8)	253	39 (15)
N (%) obese (IOTF)	273	12 (4.4)	253	12 (4.7)
N (%) normal (UK1990)	273	232 (85.0)	253	218 (86.2)
N (%) overweight (UK1990)	273	19 (7.0)	253	17 (6.7)
N (%) obese (UK1990)	273	22 (8.1)	253	18 (7.1)
N (%) normal (CDC2000)	273	219 (80.2)	253	200 (79.1)
N (%) overweight (CDC2000)	273	33 (12.1)	253	37 (14.6)
N (%) obese (CDC2000)	273	21 (7.7)	253	16 (6.3)
Median (IQR) fruit and veg portions per day	244	2 (1,3)	266	2 (1,3)
% consuming healthy amount of fruit and veg[a]	244	80 (32.8)	266	80 (30.5)
Median (IQR) snack portions per day	244	3 (2,4)	266	3 (2,4)
% consuming healthy amount of snacks[a]	244	48 (19.7)	266	57 (21.8%)
Median (IQR) high fat food portions per day	244	1 (0,2)	266	1 (0,2)
% consuming healthy amount of high fat food[a]	244	110 (45.1)	266	118 (45.1)
Median (IQR) high energy drink portions per day	244	2 (1,3)	266	2 (1,3)
% consuming healthy amount of high energy drink[a]	244	74 (30.3)	266	88 (33.6)
N (%) walking or cycling to school	235	123 (52.3)	266	156 (58.6)

N: number with this characteristic; %: percentage of the total with data who have this characteristic; SD: standard deviation; IQR: interquartile range; BMI: body mass index
[a] For these outcomes healthy were defined as: fruit and veg (≥3 versus <2); snacks (<1 vs ≥2); high fat food (0 vs ≥1); high energy drink (<1 vs ≥2)

Screen viewing

Boys spent more time screen viewing than girls on weekdays and Saturdays (see Table 4.2). Table 4.2 shows that there was no evidence of a difference in screen time on weekdays by deprivation, but there was strong evidence that children in less deprived areas spent more time in screen based activities on Saturdays than children in medium or high levels of deprivation.

Table 4.2 Screen time at baseline by whole cohort, by gender and deprivation (excluding outliers with >720 minutes on weekday and >1080 minutes on Saturday)

		Median (IQR) screen time on weekday (minutes)	Median (IQR) screen time on Saturday (minutes)
Total study sample	n = 414	150 (75,225)	180 (75,300)
By gender[a]	Male n = 196	172 (90, 247.5)	210 (90, 345)
	Female n = 218	120 (60, 210)	150 (60, 240)
	p-values	0.001	0.0004
By school based deprivation	Low n = 132	142.5 (75, 225)	210 (120, 330)
	Medium n = 223	135 (75, 225)	150 (60, 270)
	High n = 76	165 (82.5, 240)	150 (75, 300)
	p-values	0.77	0.009

[a]18 children missing gender data

Diet

Baseline assessments were completed for 506 (74.5%) children. The distributions of food and drink consumed per day were right skewed (see Graphs 4.2 and Graphs 5.1 to 5.4 in Appendix 5). At baseline, only 8.5% of the children reported consuming five or more portions of fruit and vegetables per day. Table 4.3 shows the median portions per day and the percentages of children meeting the set healthy eating amount for each of the four dietary outcomes by deprivation and gender: 'healthy' consumption of fruit and vegetable (>= 3 portions per day), sweet and savoury snacks (0 or 1 portions per day), high fat foods (0 per day) and high energy drinks (0 or 1 portions per day).

At baseline a minority of the whole sample consumed healthy amounts of fruit and vegetables (32%), sweet and savoury snacks (21%) and high energy drinks (32%). By contrast, nearly half (45%) of the children ate healthy (zero) amounts of high fat foods (see Table 4.3 and Graph 4.2).

Graph 4.2 Number of portions of fruit and vegetables, snacks, high fat food and high energy food eaten per day at baseline (n=506)

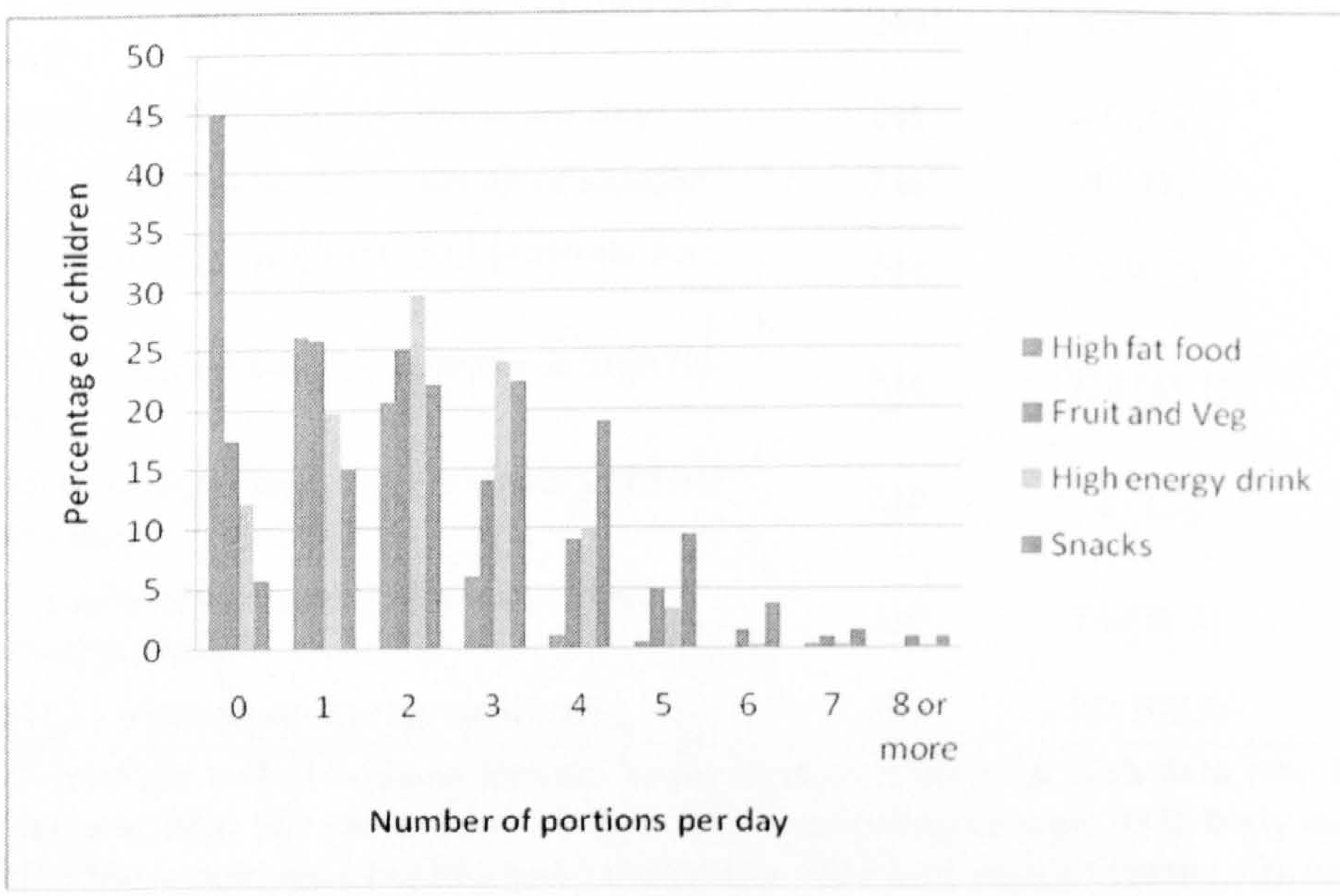


Table 4.3 Baseline dietary characteristics of 9-10 year old children in AFLY5 by gender, school deprivation and location of consumption (n= 506)

		Fruit & vegetable consumption		Sweet/savoury snack consumption		High fat food consumption		High energy drink consumption	
		Median (IQR) portions per day	N (%) consuming healthy amount[a]	Median (IQR) portions per day	N (%) consuming healthy amount[a]	Median (IQR) portions per day	N (%) consuming healthy amount[a]	Median (IQR) portions per day	N (%) consuming healthy amount[a]
Total study sample		2 (1,3)	160 (31.6)	3 (2,4)	105 (20.8)	1 (0,2)	228 (45.1)	2 (1,3)	162 (32.0)
By gender	Male N = 234	1 (1,2)	72 (30.8)	3 (2,4)	54 (23.1)	1 (0,2)	99 (42.3)	2 (1,3)	80 (34.2)
	Female N = 260	2 (1,3)	100 (38.5)	3 (2,4)	49 (18.8)	1 (0,1.5)	120 (46.2)	2 (1,3)	77 (29.6)
	p-values[b]	0.0001	0.001	0.102	0.32	0.15	0.44	0.05	0.15
By school based deprivation	Low N = 189	2(1,3)	59 (31.2)	3 (2,4)	38 (20.1)	1 (0,2)	92 (48.7)	2 (1,3)	20 (10.6)
	Medium N = 236	2 (1,3)	72 (30.5)	3 (2,4)	44 (18.6)	1 (0,2)	99 (41.9)	2 (1,3)	20 (8.5)
	High N = 81	2 (1,3)	29 (35.8)	2 (1,3)	33 (40.7)	1 (0,2)	37 (45.7)	2 (1,3)	13 (16.1)
	p-values[b]	0.10	0.001	0.02	0.08	0.34	0.52	0.10	0.77

[a] For these outcomes healthy were defined as: Fruit and veg ($\geq$3); Snacks ($\leq$1); High fat food (0); High energy drink ($\leq$1)

[b] p-values used the Kruskal-Wallis test for comparisons of medians and chi^2 for comparisons of proportions; for the associations with deprivation schools p-values were used to test a null hypothesis of no-linear trend across the three categories, for gender and location of consumption the p-values tested the null hypothesis of no differences between the exposure categories.

Table 4.4 shows the gender differences in portions of food and drink consumed per day. The multivariable linear regression analysis for effect of gender gave estimates for the difference in portion size. Girls were more likely to be consuming on average 0.7 more fruit and vegetables portions per day than boys. There is some evidence for an association of gender with high energy drink, with girls consuming on average 0.16 more portions a day more than boys. There is no evidence of gender differences for snacks or high energy food.

Table 4.4 Median portions consumed per day by gender with interquartile range and non-parametric log-rank test (n=494)

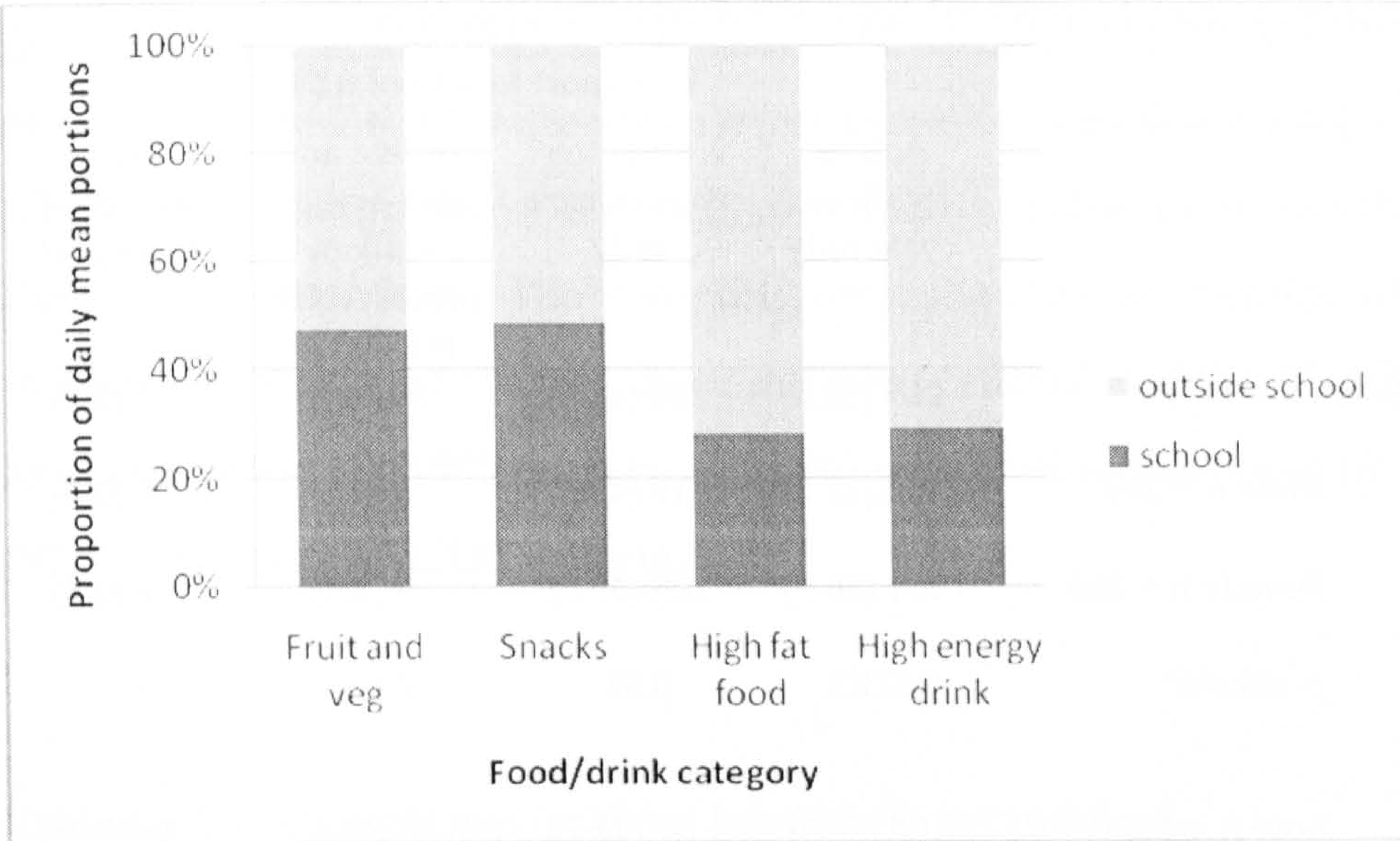
Portions eaten per day	**Median (Interquartile range)** **Boys (n=234)**	**Girls (n=260)**	**Kruskal-Wallis equality-of-populations rank test**
Fuit and vegetables	1 (1,2)	2 (1,3)	p=0.0001
Savoury and sweet snacks	3 (2,4)	3 (2,4)	p=0.102
High fat food	1 (0,2)	1 (0,1.5)	p=0.15
High energy drink	2 (1,3)	2 (1,3)	p=0.05

Children from the most deprived schools in the study population were more likely to consume healthy amounts of fruit and vegetables, sweet or savoury snacks and high energy drinks than those from the least deprived schools but there was no clear association of deprivation with consumption of high fat foods (see Table 4.3).

Location

Higher proportions of high fat food and high energy drinks were consumed outside school than inside school (p=<0.0001), but equal proportions were consumed in school and outside school for fruit and vegetables (p=0.14) and snacks (p=0.39) (see Graph 4.3).

Graph 4.3 Proportion of mean portions of food/drink consumed at school or outside school



Active travel

The mode of transport to school is presented by whole cohort, gender and deprivation at baseline. Data was available for 517 children, but there was only gender data available for 505 of these children. The children self-reported their mode of transport to school as walk, cycle, bus or car in the DILQ. Very few children cycled (1.9%) or took the bus (0.4%) and these children are combined with the children who walked or travelled by car, respectively. Just over half of the cohort travelled to school by active transport; (52.5%) walked or cycled to school (see Table 4.5). Most of the remainder (44.4%) travelled by non-active transport (bus or car) and a small number (3%) had a combination of active travel and non-active transport or some other means of transport (0.2%).

Table 4.5 Transport to school at baseline by whole cohort, by gender and deprivation (for children with answers to questions about both active travel and gender)

		Transport to school n (%)			
		Active: walk or cycle only	Non-active: bus or car only	Active and non-active: walk or cycle AND bus or car	Other means of transport
Total study sample[a] n=505		265 (52.5)	224 (44.4)	15 (3.0)	1 (0.2)
By gender	Male n = 239	114 (47.7)	119 (49.8)	6 (2.5)	0 (0.0)
	Female n = 266	151 (56.8)	105 (39.5)	9 (3.4)	1 (0.4)
	p-values[b]	0.03	0.03	0.6	-
By school based deprivation[c]	Low n = 192	108 (56.3)	82 (42.7)	2 (1.0)	0 (0.0)
	Medium n = 240	119 (49.6)	106 (44.2)	14 (5.8)	1 (0.4)
	High n = 85	44 (51.8)	40 (47.1)	1 (1.2)	0 (0.0)
	p-values[b]	0.79	0.43	0.01	-

[a] 12 missing gender data and these children are excluded from analysis by gender, but included in analysis by deprivation. [b] Kruskal-Wallis equality-of-populations rank test. [c] deprivation categories based on the school deprivation index: low <=35%; medium >35% <44%; high >=44%.

Approximately 10% more girls travelled to school by active transport compared to boys. There was no evidence of a difference by gender for the children engaged in both active and non-active travel. Table 4.5 also shows the mode of transport by school based deprivation. There was no evidence of a difference in mode of transport by deprivation.

Height and weight

The mean height, weight and BMI measurements at baseline are shown in Table 4.6. The distribution of BMI is right skewed (see Graph 5.10 in Appendix 5). Table 4.7 shows the proportion of children classified as normal, overweight and obese by the IOTF, UK 1990 and 2000 CDC criteria. More girls were obese than boys by all three criteria (difference of girls-boys: IOTF = 2.9%; 2000 CDC=2.1%;

UK 1990=1.7%), but there was no strong statistical evidence of a difference by gender for any of the criteria. The IOTF criteria gave the lowest prevalence of obesity and the UK 1990 the highest (for example at baseline 5.4% vs. 9.0% for the whole study sample (boys and girls combined)). Table 4.8 shows the cross-tab of the four obesity criteria. There are differences in the classification of normal, overweight and obesity using these different criteria. Of the 40 children defined as obese by the UK 1990 criteria, 24 (60%) were defined as obese by IOTF and 37 (92.5%) by the 2000 CDC criteria.

Table 4.6 Mean weight and height at baseline (for all children)

	Mean (SD)[a]
Weight (kg)	34.5 (7.73)
Height (m)	1.39 (0.06)
BMI	17.81 (2.96)

[a] At baseline: n= 530 for weight, n=531 for height, n=529 for BMI

Table 4.7 BMI indications of obesity at baseline for whole cohort and by gender (for children with baseline data)

		Baseline n (%)			
Criteria		All[c] n=444	Boys n=208	Girls n= 236	p value[d]
	Mean BMI (SD)	17.88 (2.99)	17.58 (2.79)	18.14 (3.14)	0.08
IOTF[a]	Normal[b]	346 (77.9)	169 (81.3)	177 (75.0)	
	Overweight[b]	74 (16.7)	31 (14.9)	43 (18.2)	
	Obese[b]	24 (5.4)	8 (3.9)	16 (6.8)	0.08
2000 CDC[a]	Normal[b]	337 (75.9)	158 (76.0)	179 (75.9)	
	Overweight[b]	70 (15.8)	35 (16.8)	35 (14.8)	
	Obese[b]	37 (8.3)	15 (7.2)	22(9.3)	0.88
UK 1990[a]	Normal[b]	368 (82.9)	167 (80.3)	201 (85.2)	
	Overweight[b]	36 (8.1)	24 (11.5)	12 (5.1)	
	Obese[b]	40 (9.0)	17 (8.2)	23 (9.8)	0.25

[a] Percentiles based on mid-point for each 6 month age group e.g. 9.25 years for children aged between 9.0 and 9.5 years. [b] Denominator is complete data. [c] 196 with missing gender data (31 boys missing BMI data, 32 girls missing BMI data; 50 missing gender and BMI data; 83 missing gender data) [d] Kruskal-Wallis equality-of-populations rank test testing the null-hypothesis that the proportions in each category (normal, overweight and obese) are the same in boys and girls

Table 4.8 Cross-tab obesity criteria at baseline

Criteria		UK 1990 n %)			
		Normal	Overweight	Obese	P value[b]
IOTF[a]	Normal	426 (81.0)	2 (0.4)	0 (0.0)	
	Overweight	24 (4.6)	34 (6.5)	16 (3.0)	
	Obese	0 (0.0)	0 (0.0)	24 (4.6)	<0.001
2000 CDC[a]	Normal	419 (79.7)	0 (0.0)	0 (0.0)	
	Overweight	31 (5.9)	36 (6.8)	3 (0.6)	
	Obese	0 (0.0)	0 (0.0)	37 (7.0)	<0.001
	Total	450 (85.6)	36 (6.8)	40 (7.6)	

[a] Percentiles based on mid-point for each 6 month age group e.g. 9.25 years for children aged between 9.0 and 9.5 years. [b] Pearson Chi Squared test

Table 4.9 shows there is strong evidence of differences in overweight/obesity by school deprivation, by all three criteria for defining overweight or obesity status, but interestingly the direction of association varied by the criteria used. When the 2000 CDC and UK 1990 criteria were used the prevalence of childhood obesity was lowest amongst those from the most deprived groups, whereas when the IOTF criteria were used the prevalence of childhood obesity was lowest amongst those from the least deprived group. For all three criteria overweight is more common in the lowest deprivation group.

Table 4.9 BMI indications of obesity at baseline by deprivation

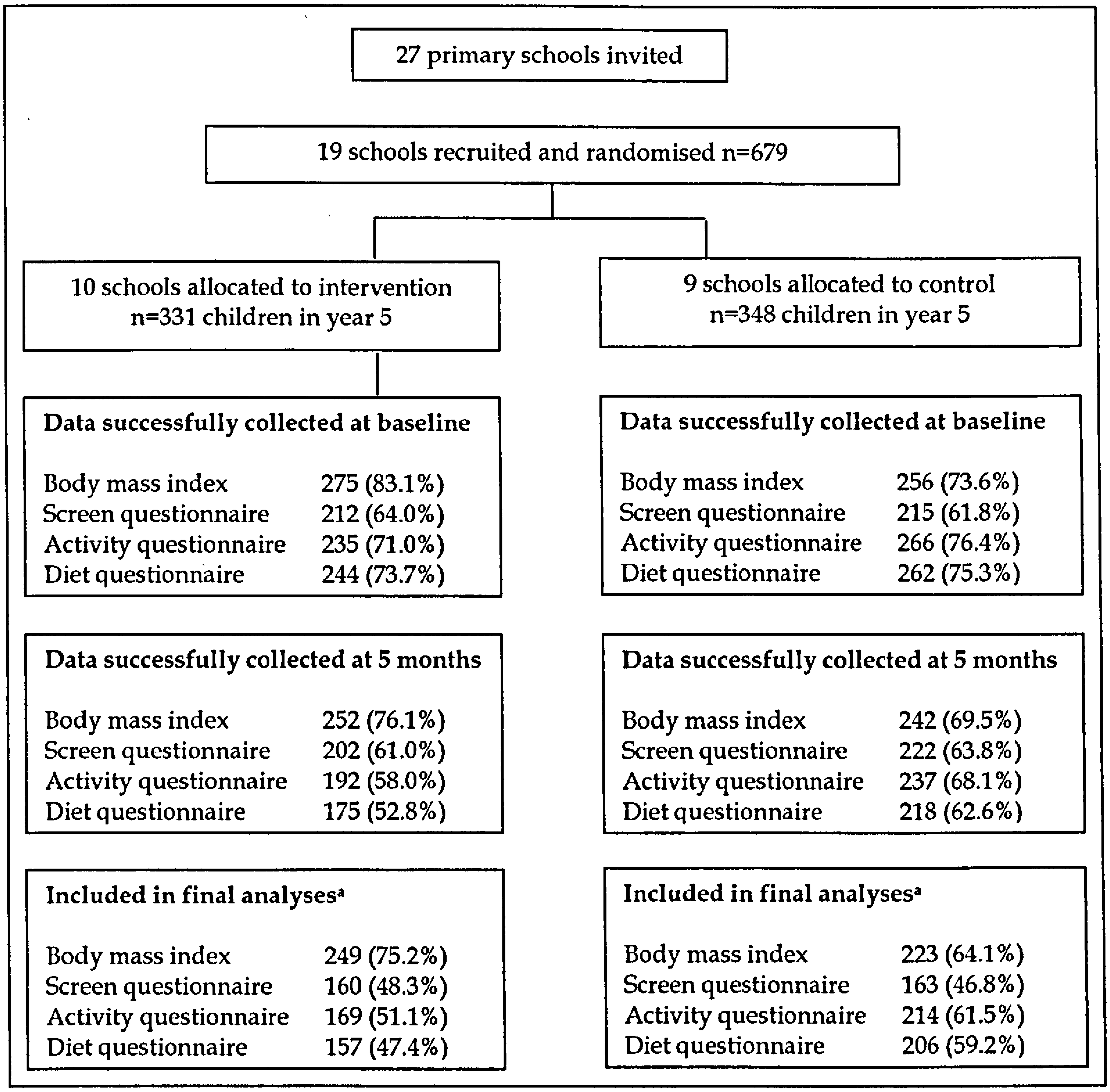
		Deprivation n (%)			
		Low[c] n=171	Medium[c] n=238	High[c] n=118	p value[d]
	Mean BMI (SD)	17.81 (2.99)	17.75 (2.96)	17.80 (2.92)	0.90
IOTF[a]	Normal[b]	133 (77.8)	197 (82.8)	98 (83.8)	
	Overweight[b]	32 (18.7)	28 (11.8)	14 (12.0)	
	Obese[b]	6 (3.5)	13 (5.5)	5 (4.3)	0.02
2000 CDC[a]	Normal[b]	130 (76.0)	192 (80.7)	97 (82.9)	
	Overweight[b]	28 (16.4)	28 (11.8)	14 (12.0)	
	Obese[b]	13 (7.6)	18 (7.6)	6 (5.1)	0.02
UK 1990[a]	Normal[b]	142 (83.0)	203 (85.3)	105 (89.7)	
	Overweight[b]	16 (9.4)	14 (5.9)	6 (5.1)	
	Obese[b]	13 (7.6)	21 (8.8)	6 (5.1)	0.003

[a] Percentiles based on mid-point for each 6 month age group e.g. 9.25 years for children aged between 9.0 and 9.5 years. [b] Denominator is complete data. [c] BMI data missing at baseline by deprivation: low=63 (26.9%); medium = 32 (11.9%); high = 23(16.4%) [d] Pearson Chi Squared test

4.5.3. Analysis by intervention

Figure 4.2 is a CONSORT style flowchart of pupils through the study. There were 679 pupils eligible for the study with between 62-83% (range varies by type of outcome) of pupils who provided baseline measures. Reasons for non-participation included parents not giving consent, children being absent and schools not returning the questionnaires. The greater missing data for the questionnaires occurred because a number were returned without the child's name or because of implausible levels of screen viewing.

Figure 4.2 Progress of schools and pupils through trial



[a] Those included in the final analyses include all pupils with baseline and follow-up measurements for the specific outcome and for screen questionnaires includes exclusion of those with implausible values (see results section of paper for details)

Screen viewing

Graph 4.4, Table 4.10 and Graph 4.4 show a decrease in screen-time from baseline to follow-up for all children on weekdays (-9.97%) and Saturdays (-9.64%). Table 4.10 compares the outcomes at follow-up between children in the intervention schools and those in the control schools. For the mean differences in screen time the null value is 0. A negative value indicates a beneficial effect for pupils in the intervention schools and a positive value indicates the mean level of the outcome is higher in the intervention group compared to the control group.

Table 4.10 Total screen time (TV and computer) at baseline and follow-up only for children with baseline and follow-up measurements n=311

	Weekday n (%)		Saturday n (%)	
Hours	Baseline	Follow-up	Baseline	Follow-up
0 hour	9 (2.89)	14 (4.50)	15 (4.82)	25 (8.04)
>0 <1 hour	37 (11.90)	56 (18.01)	33 (10.61)	54 (17.36)
>=1 <2 hours	76 (24.44)	83 (26.69)	60 (19.29)	59 (18.97)
2+ hours	189 (60.77)	158 (50.80)	203 (65.27)	173 (55.63)

Graph 4.4 Hours of screen time by all children at baseline and follow-up on previous weekday and Saturday (only for children with baseline and follow-up data n=314)

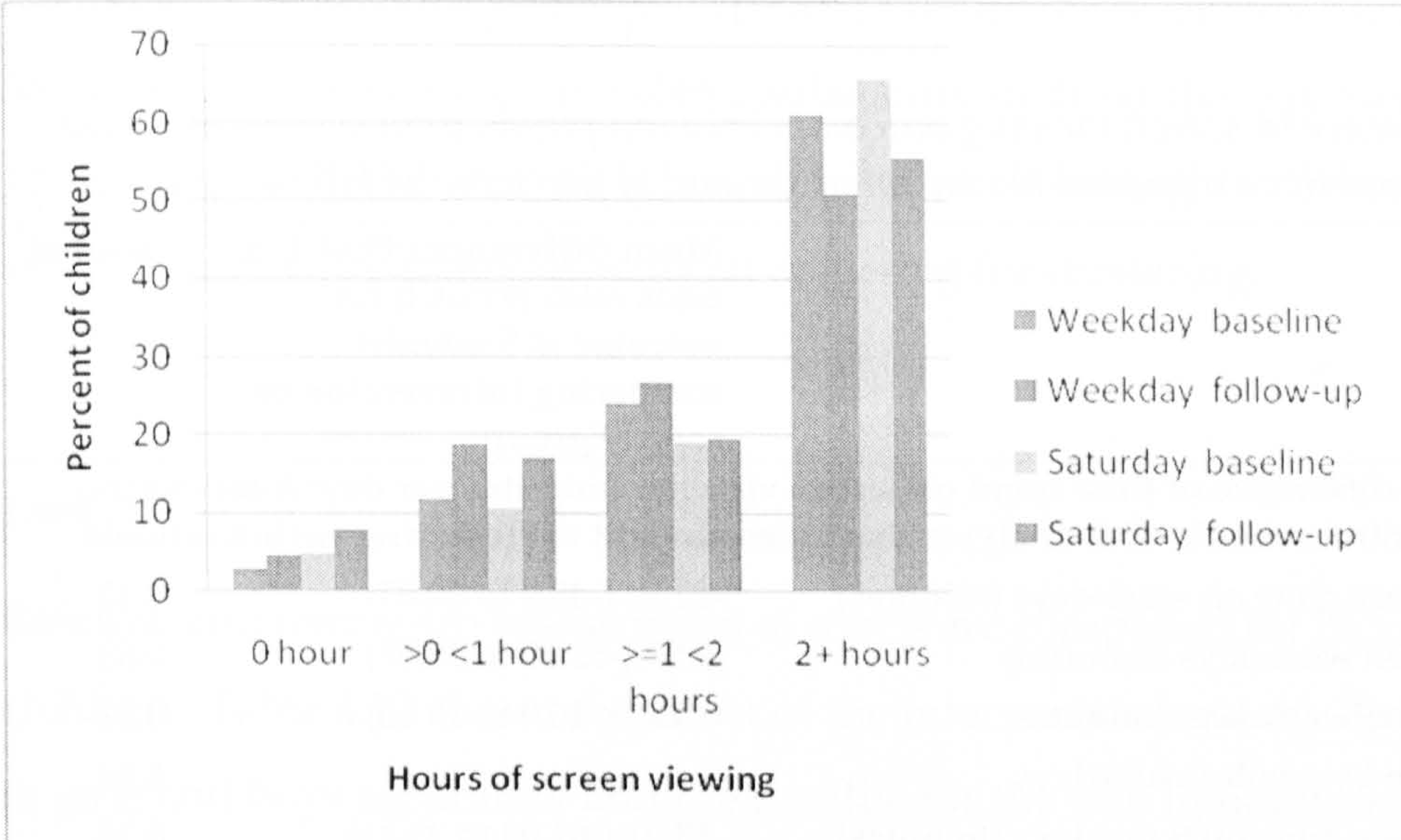


Table 4.11 shows there was weak evidence that children from intervention schools spent less time in screen viewing activities at the end of the intervention than children from control schools. Mean difference in minutes spent on screen viewing at the end of the intervention (intervention schools minus control schools) adjusted for baseline levels, age, gender and clustering within schools: -12.92 minutes (95% CI: -45.9 to 20.03) for weekday and -18.91 minutes (-61.03 to 23.41) for Saturday. There was no interaction by gender, however the largest decrease in screen-time in intervention compared to control schools at follow-up was for girls on a Saturday (-30.6 minutes).

Table 4.11 also shows the analysis of the binary variable of $\geq$ 2 hours of screen-time or <2 hours. There was weak evidence that children from intervention schools spent less than 2 hours on screen time compared with control schools at follow-up (OR = 0.84: 95%CI 0.44 to 1.81, p=0.59). There was no interaction by gender, however, there was evidence that the odds of screen-time of 2 hours or more reduced by 55% for girls on Saturdays (OR = 0.45: 95%CI 0.21 to 0.95, p=0.04).

Table 4.11 Difference in screen viewing outcomes between pupils from schools allocated to intervention and those allocated to control at the end of five months follow-up

Outcome	Mean difference (95%CI) or odds ratio (95%CI) for outcome at 5 months comparing intervention to control group[a]	p-value
Outcome = mean difference of time spent on screen viewing (minutes per day) intervention schools minus control schools with analyses that takes account of clustering within schools		
Boys and girls screen-time on weekdays (minutes)	-12.92 (-45.9 to 20.03)	0.42
Boys screen-time on weekdays (minutes)	-9.99 (-52.50 to 32.53)	0.63
Girls screen-time on weekdays (minutes)	-13.82 (-46.0 to 18.40)	0.38
Test for interaction by gender weekdays		0.84
Boys and girls screen-time on Saturdays (minutes)	-18.91 (-61.03 to 23.41)	0.36
Boys screen-time on Saturdays (minutes)	-5.56 (-71.94 to 60.82)	0.86
Girls screen-time on Saturdays (minutes)	-30.59 (-83.40 to 22.22)	0.24
Test for interaction by gender Saturdays		0.50
Outcome = odds ratio of spending more than 2 hours per day on screen viewing. Intervention school divided by control school.		
Boys and girls screen time on weekdays (>=2 hours)	0.84 (0.44 to 1.81)	0.59
Boys screen time on weekdays (>=2 hours)	0.93 (0.37 to 2.29)	0.86
Girls screen time on weekdays (>=2 hours)	0.75 (0.37 to 1.50)	0.41
Test for interaction by gender weekdays		0.64
Screen time on Saturdays (>=2 hours)	0.70 (0.37 to 1.35)	0.29
Boys screen time on Saturdays (minutes) (>=2 hours)	1.12 (0.40 to 3.16)	0.83
Girls screen time on Saturdays (minutes) (>=2 hours)	0.45 (0.21 to 0.95)	0.04
Test for interaction by gender Saturdays		0.12
Outcome = mean difference or odds ratio of time spent on screen viewing (minutes per day) intervention schools minus control schools with analyses that DOES NOT take account of clustering within schools		
Boys and girls screen time on weekdays (minutes)	-12.92 (-38.61 to 12.77)	0.32
Boys and girls screen time on Saturdays (minutes)	-18.81 (49.29 to 11.67)	0.23
Boys and girls screen time on weekdays (>=2 hours)	0.84 (0.53 to 1.34)	0.46
Boys and girls screen time on weekdays (>=2 hours)	0.70 (0.44 to 1.12)	0.14

[a] All results are adjusted for age, sex and baseline characteristic (e.g. screen-time on weekdays at follow-up is adjusted for screen-time on weekdays at baseline).

When all children were included, irrespective of their reported viewing times, and in a separate analyses that excluded a greater number of children by using the lower threshold for believable values (8 hours for week days and 14 hours for Saturdays), the results did not differ substantively from those presented here. Table 4.11 shows the analysis repeated without clustering, to demonstrate the smaller confidence intervals without adjusting for clustering.

Diet

Baseline and follow-up assessments of diet were completed for 363 (53.5%) children. Table 4.12 shows the effect of the intervention on each dietary outcome in girls and boys separately and the p-value for the null hypothesis that these effects are the same in each gender (gender*exposure interaction test). Both the stratified (by gender) associations and p-values show that the associations were essentially the same in boys and girls. There is no evidence for an interaction by gender for all the food and drink categories. Table 4.13 shows the follow-up differences in dietary outcomes by intervention and control arm for girls and boys combined. There was no strong or consistent evidence that the intervention affected dietary patterns in this short-term pilot.

Table 4.12 Effects of intervention on diet categories for males and females

	Odds Ratio of healthy levels for each dietary variable comparing children in intervention and control (95% CI)		**p value for interaction between trial arm and gender**
	Male	**Female**	
Fruit and veg[a]	0.90 (0.40 to 2.04)	0.63 (0.28 to 1.38)	0.49
Snacks	1.22 (0.58 to 2.56)	1.11 (0.46 to 2.69)	0.83
High fat food	0.75 (0.37 to 1.50)	0.78 (0.47 to 1.31)	0.95
High energy drink	1.22 (0.65 to 2.29)	0.73 (0.32 to 1.65)	0.40
Breakfast food	0.19 (0.04 to 0.92)	0.52 (0.15 to 1.86)	0.74

[a] $\geq$ 3 portions of fruit and vegetables

Table 4.13 Odds ratio of diet outcomes from children at schools allocated to intervention and those allocated to control at the end of five months follow-up taking account of clustering within schools

	Median portions consumed per day (IQR)			Proportion (%) consuming healthy amount		Odds ratio[a] of consuming healthy amount (95%CI)	
	Intervention schools N = 157 participants from N = 7 schools	Control schools N = 206 participants from N = 8 schools	p value[b]	Intervention schools N = 157 participants from N = 7 schools	Control schools N = 206 participants from N = 8 schools		p value[c]
Fruit and veg (≥5)	0 (0,0)	0 (0,0)	0.28	10.9	9.1	1.39 (0.69 to 2.80)	0.35
Fruit and veg (≥3)	2 (0,3)	2 (1,3)	0.20	30.6	39.3	0.73 (0.41 to 1.28)	0.27
Snacks (<1)	2 (1.5, 4)	3 (2,4)	0.18	25.0	24.8	1.22 (0.68 to 2.2)	0.50
High fat food (0)	1(0,2)	1(0,2)	0.50	33.8	43.6	0.76 (0.49 to 1.18)	0.22
High energy drink (<1)	2 (1,3)	2 (1,3)	0.43	33.0	36.7	0.92 (0.57 to 1.99)	0.73

[a] All results are adjusted for age, sex and baseline characteristic. The null value is 1; a value greater than 1 indicates increased odds of the outcome in the intervention group compared with the control group (ie, a beneficial effect for pupils in the intervention schools). The text in brackets indicates the number of portions per day that were considered 'healthy' for the binary analysis.

[b] Log rank test of null hypothesis of no difference in median portions by randomised group

[c] Wald test of null hypothesis that the odds ratio=1

4.5.4. Active travel

There was strong evidence of increased walking or cycling to school in the control compared to the intervention schools at outcome, controlling for baseline walking and cycling, age and sex (see Table 4.14). Table 4.15 presents the analysis without and without adjustment for clustering and testing for a gender interaction. As anticipated, the 95% confidence intervals were narrower and the p values were smaller for all outcomes when clustering within schools was (inappropriately) not taken into account in the analyses. There was no evidence of a gender interaction.

Table 4.14 Proportion of children walking or cycling to school by randomised group at baseline and follow-up (children with baseline and follow-up data)

	Baseline n(%)	Follow-up n(%)
Intervention n=169	88 (52.1)	88 (52.1)
Control n=214	125 (58.4)	157 (73.4)

Table 4.15 Odds Ratio of walking or cycling to school at five months comparing intervention to control group[a]

Outcome	Odds ratio (95%CI) for outcome	p-value
Taking account of clustering within schools	0.27 (0.11 to 0.69)	0.006
Without taking account of clustering within schools	0.27 (0.15 to 0.49)	<0.001
Boys, taking account of clustering	0.38 (0.12 to 1.22)	0.105
Girls, taking account of clustering	0.19 (0.05 to 0.71)	0.014
Test for interaction by gender	0.37 (0.07 to 1.85)	0.224

[a] All results are adjusted for age, sex and baseline characteristic

Height and weight

The prevalence of obesity for both boys and girls increased from baseline to follow-up, using the UK 1990 and 2000 CDC criteria, whilst for the IOTF criteria the prevalence of obesity did not change, although the prevalence of overweight did (see Graph 4.5 and Table 4.16). Table 4.17 shows the difference in BMI and obesity by intervention and control groups. For the odds ratios of obesity the null value is 1; a value below 1 indicates reduced odds of the outcome in the intervention group compared to the control group (i.e. for obesity a value below 1 indicates a beneficial effect for pupils in the intervention schools). There was no evidence of a difference in mean BMI or the odds of obesity between pupils allocated to intervention schools and those allocated to control schools. Interestingly, the odds of obesity were reversed for the IOTF criteria compared with the UK 1990 and 2000 CDC criteria; with the later showing a direction of change of increased risk of obesity and for IOTF a reduction in risk, although there was no strong statistical evidence that the prevalence of obesity by any criteria differed between intervention and control schools. Examination of the point estimates suggested no difference by gender for any of the outcomes.

Graph 4.5 Percentage of children obese at baseline and follow-up by trial arm (for children with baseline and follow-up data) n=430

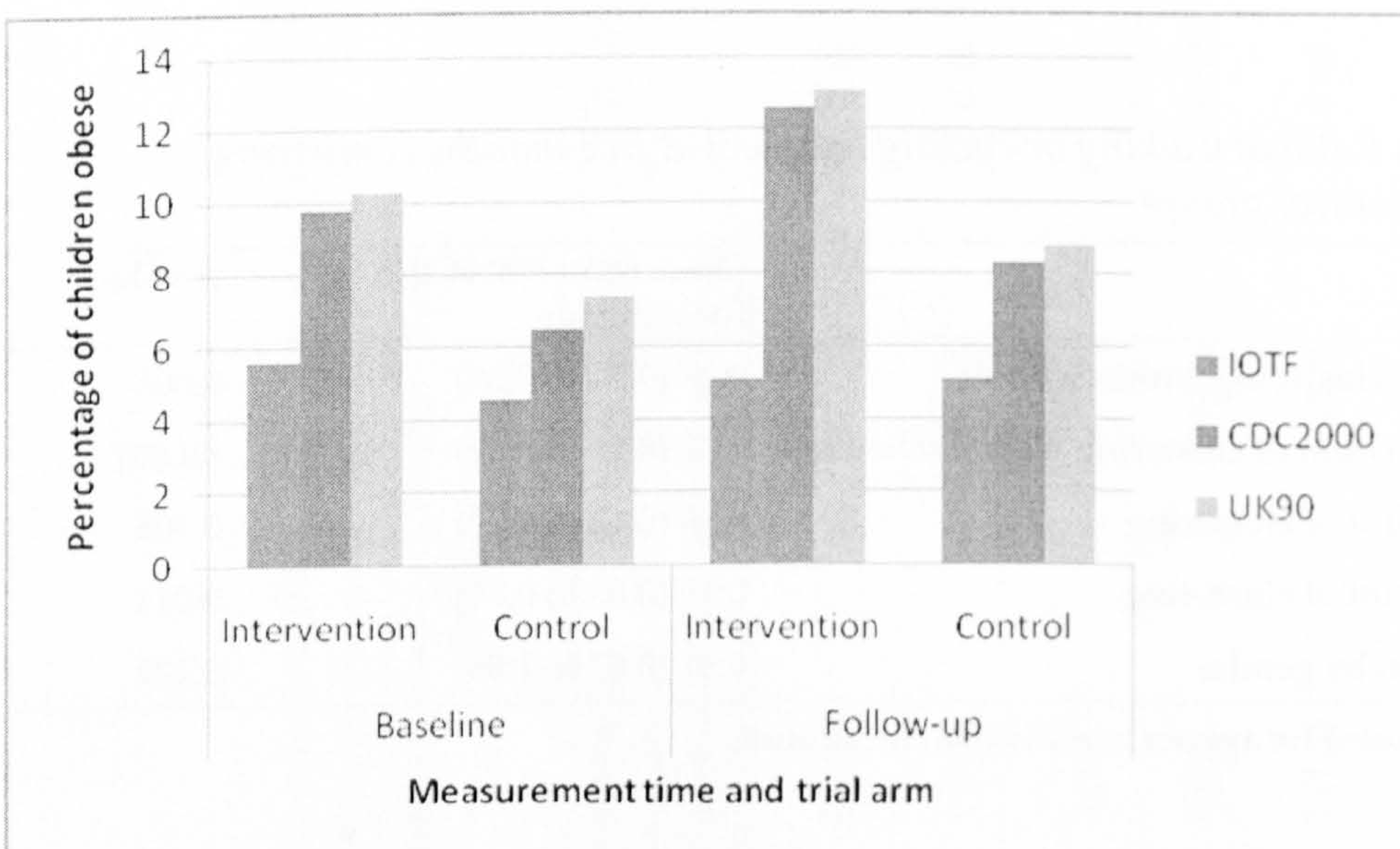


Table 4.16 BMI indications of obesity at baseline and follow-up

		Baseline n (%)			Follow-up n (%)		
		All[c] n=396	Boys n=189	Girls n= 207	All[c] n= 410	Boys n=192	Girls n=207
IOTF[a]	Normal[b]	308 (77.8)	155 (82.0)	153 (73.9)	297 (75.0)	150 (79.4)	147 (71.0)
	Overweight[b]	66 (16.7)	27 (14.3)	39 (18.8)	77 (19.4)	32 (16.9)	45 (21.7)
	Obese[b]	22 (5.6)	7 (3.7)	15 (7.3)	22 (5.6)	7 (3.7)	15 (7.3)
2000 CDC[a]	Normal[b]	299 (75.5)	144 (76.2)	155 (74.9)	286 (72.2)	141 (74.6)	145 (70.1)
	Overweight[b]	62 (15.7)	31 (16.4)	31 (15.0)	65 (16.4)	31 (16.4)	34 (16.4)
	Obese[b]	35 (8.8)	14 (7.4)	21 (10.1)	45 (11.4)	17 (9.0)	28 (13.5)
UK 1990[a]	Normal[b]	327 (82.6)	153 (81.0)	174 (84.1)	315 (79.6)	149 (78.8)	166 (80.2)
	Overweight[b]	31 (7.8)	20 (10.6)	11 (5.3)	34 (8.6)	22 (11.6)	12 (5.8)
	Obese[b]	38 (9.6)	16 (8.5)	22 (10.6)	47 (11.9)	18 (9.5)	29 (14.0)

[a] Percentiles based on mid-point for each 6 month age group e.g. 9.25 years for children aged between 9.0 and 9.5 years.
[b] Denominator is complete data.
[c] 182 missing at baseline and 222 at follow-up

Table 4.17 Regression and logistic regression analysis for BMI and obesity by obesity criteria with and without clustering, and by gender and testing for interaction by gender n=396

	BMI		IOTF		CDC2000		UK90	
Outcome	Mean difference kg/m^2 (95% CI)	p-value	Odds ratio (95%CI)	p-value	Odds ratio (95%CI)	p-value	Odds ratio (95%CI)	p-value
Taking account of clustering within schools	0.11 (-0.18 to 0.40)	0.44	0.79 (0.18 to 3.59)	0.76	1.81 (0.63 to 5.25)	0.28	2.10 (0.57 to 7.8)	0.27
Without taking account of clustering within schools	0.11 (-0.03 to 0.25)	0.13	0.79 (0.20 to 3.15)	0.74	1.81 (0.56 to 5.86)	0.32	2.10 (0.67 to 6.3)	0.20
Boys, taking account of clustering	0.09 (-0.19 to 0.37)	0.50	NA [b]	NA [b]	NA [b]	NA [b]	3.64 (0.26 to 51.4)	0.34
Girls, taking account of clustering	0.12 (-0.27 to 0.51)	0.53	NA [b]	NA [b]	NA [b]	NA [b]	1.66 (0.52 to 5.4)	0.40
Test for interaction by gender		0.71	NA [b]	NA [b]	NA [b]	NA [b]		0.45

[a] All results are adjusted for age, sex and baseline characteristic. [b] These values were not possible to calculate because there were empty cells when cross tabulating obese at baseline against obese at follow-up for boys

4.5.5. Intraclass correlation coefficient and sample size estimates

The ICC is a ratio of between-cluster variation to the total variance. An ICC of one means there is no variation within clusters and the variance is all between clusters; whereas an ICC of zero means there is no evidence of clustering.[182] The ICC and sample size estimates for screen viewing, BMI, fruit and vegetable consumption and walking or cycling to school are shown in Table 4.18. In the sample-size calculation for a full-scale randomised controlled trial, the upper limit of the 95% confidence interval was used for the ICCs for both screen viewing and BMI. The samples size estimates are to detect a minimum relative difference of 20% for binary outcomes (i.e. 0.8 or 1.2 or further from the null) or a minimum absolute difference of 0.5SD for continuously measured outcomes.

Table 4.18 Intraclass Correlation Coefficients and sample size calculation for screen viewing, BMI, fruit and vegetable consumption and walking or cycling to school (all baseline variables)

	ICC (95% Confidence Interval)	**Sample size estimates[1]: number of children (number of schools) for ICC point estimate**	**Sample size estimates[1]: number of children (number of schools) for ICC upper 95% CI**
Screen-time weekday (minutes)	0.00 (0.00 to 0.03)	126 (6)	218 (9)
Screen-time weekday <2 hours[2]	0.00 (0.00 to 0.03)	1256 (51)	2128 (87)
BMI	0.00 (0.00 to 0.02)	128 (6)	200 (8)
Obesity[2,3]	0.003 (0.00 to 0.03)	9826 (394)	15546 (622)
Fruit and vegetable portions per day	0.04 (0.00 to 0.09)	248 (10)	400 (16)
Fruit and vegetable portions per day ≥ 3[2]	0.03 (0.02 to 0.08)	2304 (93)	4544 (182)
Walking or cycling to school[2]	0.07 (0.003 to 0.14)	1738 (70)	2826 (114)

[1] All estimates assume 25 children per class; power of 80%; alpha of 0.05 to indicate departure from the null hypothesis; a two-sided alpha value; all estimates apart from binary variables are calculated for a 0.5SD change and the binary variables are calculated for a 20% change (OR=1.2 or 0.8)
[2] Proportion
[3] UK90 criteria

4.6. Results: process evaluation

4.6.1. Questionnaires with teachers

Nine of the ten teachers completed the questionnaire and a summary of the responses are given in Table 4.19 (see Figure 5.1 in Appendix 5 for more detail). For the majority of questions where a view was given at least 75% of the answers were positive or neutral 80% (8/10). The areas with more negative comments were the ease of using the pedometers and fitting the lessons into the curriculum. Few teachers received feedback from parents, used the CD or needed to prepare more materials.

4.6.2. Interviews with teachers

Eight of the ten teachers were interviewed (see details of the coding in Tables 5.2 and 5.3 in Appendix 5). The interviews lasted 20 to 60 minutes in which they were asked about the training day, measurements and lessons. The data was analysed under two themes, 'training and measurements' and 'lessons.' These are presented below.

4.6.3. Teacher interviews synthesis of data

Theme: training and measurements

Four classes were created for this theme about the training and measurements (see Table 4.20).

Table 4.19 Summary of teacher responses to questionnaire about AFLY5

Question	% positive or neutral
To what extent the training day prepared you to teach	100
Ease of doing height and weight measurements	100
Ease of doing DILQ questionnaire	100
Ease of doing screen viewing questionnaire	89
Ease of doing pedometer measurements	44
Ease of fitting lessons into the curriculum	67
Ease of using the lesson plans	100
Length of nutrition lessons	100
Response from children to nutrition lessons	100
Length of PE lessons	100
Response of children to Fit Check	100
Response of children to Freeze My TV	89
Question	**% yes or maybe**
Feedback from parents	22
Used photos of food	89
Were photos right size	78
Used CD	22
Need to prepare additional materials	44
Continue using materials	100

Table 4.20 Categories and classes for 'training and measurements' theme

Category	Class
Day in the life questionnaire	Questionnaires
Screen viewing questionnaire	
Height and weight measurements	Anthropometric measurements
Pedometers	Pedometers
Training day	Training

Class: questionnaires

The teachers reported that both the DILQ and screen viewing questionnaires were easy to complete. A couple of teachers said it had taken longer to complete with children who found writing difficult and they had paired children together to help with the writing. Two teachers thought that some children may have demonstrated social desirability in their answers or tried to shock and therefore some responses may not be accurate. One teacher said that the children had been shocked about the time they spent screen viewing.

"I thought it was very easy. They loved it – the quality of the questionnaire." (School 19)

"Some of the questionnaires are a work of fiction. One child said he had ice-cream for breakfast and I know his mother, and he didn't have ice-cream for breakfast. There is a lot of scope for the children to tell you what they think you want to hear or something which will shock you." (School 14)

"Some kids were showing off, like 'I watch 15 hours of TV'." (School 16)

"They were shocked by how much TV and computer games they watched." (School 26)

Class: anthropometric measurements

The teachers were unanimous in saying that the measurements of height and weight by the school nursing staff had been without problems. Two teachers mentioned that some children had been apprehensive about having their weight measured.

"It was very quick and easy. Not intrusive really at all." (School 23)

"The aspect of getting weighed – they didn't like the idea." (School 18)

Class: pedometers

The teachers were also unanimous in their views of the pedometers. There had been significant problems with the accuracy of recording the number of steps, with the reset button being pressed by mistake, some machines not working, the machines getting broken, lost or left at home. The teachers felt the data was inaccurate and should not be used. However, several teachers commented that the children had enjoyed wearing the pedometers and they had been an incentive for involvement in the project.

"I don't think you're going to use any of the data are you?! They broke and reset in the morning." (School 23)

"I don't think they were very accurate... It was worth doing to get them involved in the project. Don't rely on the data." (School 26)

Class: training

The teachers were unanimous in saying that the training day had been useful and enjoyable. The materials provided had been clear and they felt prepared to teach the lessons, particularly the PE lessons. A couple of teachers said they would have liked time to read through the folder or laminate materials.

"That day was absolutely brilliant – really good." (School 16)

"I thought it was a good day and clear and what you had done to adapt it. The folder was clearly labelled. The booklets and questionnaires were of a really high standard." (School 19)

Theme: lessons

Four classes were created for this theme about the measurements and the training (see Table 4.21).

Table 4.21 Categories for 'lessons' theme by class

Category	Class
Lesson plans	Views of lessons
Photos of food	
PE lessons	
Nutrition lessons	
Fit Check lesson	
Freeze My TV lesson	
Quality of lessons	
CD	
Curriculum	Integrating the project
Lessons not taught	
Continue to use materials	
Response from children	Response
Parents	
Results	
Changes to lessons	Changes and ideas
Additional materials	

Class: Views of lessons

In general the teachers were very positive about the quality of the lessons and the ease of using the lesson plans. Overall there was a preference for the nutrition lessons, although two teachers were very enthusiastic about the PE lessons and had repeated the lessons (both of these teachers were the school leads for PE).

Three teachers talked explicitly about adapting lessons because of time, to fit with other topics or to bring in other ideas.

"The children were quite interested in the nutrition lessons. Some of them were quite aware... others were up for it. A lot of it linked into the 'keeping healthy' year 5 topic." (School 28)

"To be honest I am the PE specialist for the school, so it was quite easy for me. I did a full hour on the PE lessons. It was quite a novel way of doing the circuits. .. They loved it." (School 18)

"'Adapt or die' - teacher's motto!" (School 14)

The teachers found some children struggled with the sums and graphs required in the Fit Check Journal, but mentioned that they liked the idea of setting goals. The teachers were more polarised in their views about the Freeze My TV journal; some talked about the children not engaging with it, whilst two teachers were more enthusiastic and talked about getting involved themselves.

"I love the idea (of Fit Check) but it's too much with adding up and doing the graph and doing the goals. I think it is the amount of time it takes to do these." (School 14)

"It (Fit Check) is very noticeable seeing what they did at the weekend. Sometimes they just get up and spend all day in front of the TV." (School 18)

"They weren't really interested in it (Freeze my TV). " (School 14)

"Whether you could send another letter (home) that week to say that the children are trying to miss the programme and take them for a walk and ask them how they felt.... Mine found it really difficult to miss something; they were shocked and tried to say that they would miss a programme that they wouldn't watch. So I had to do it and miss Eastenders, but I found it really difficult." (School 19)

Only one teacher talked about using the CD with the lesson plans and worksheets and the others used the paper copies in the folders. The other teachers appear to have forgotten about it.

"No. I forgot there was one because it didn't mention it." (School 14)

Class: Integrating the project

All the teachers, except one, found it difficult to fit the lessons into the time available and only three teachers said that they had taught all the lessons. For some teachers the problem was that they had taught about healthy eating the previous term, but for most teachers the number of lessons was the challenge. The PE lessons were left out entirely in one school. Three teachers taught the lessons in their Personal Social Health and Economic (PSHE) lessons and felt this area of teaching had flexibility. Several teachers commented that the themes of AFLY5 fit well with the Quality and Curriculum Authority's (QCA) 'keeping healthy' year 5 topic. In one school there were other initiatives taking place which meant that there was limited time for AFLY5. One teacher, found the topic too big, too inflexible and too long, but her view was in the minority. One teacher felt that it would work better if it was a whole school initiative or part of the curriculum.

"Had I known before I wouldn't have done the QCA 'keeping healthy unit' and I would have done this instead. I had already taught it because a lot of the lessons overlapped, but your lessons were so much more in depth." (School 14)

"I've done it in PHSE. You can be flexible in PHSE. I haven't stopped the curriculum content." (School 19)

"I have to admit we didn't do the PE lessons because we had summer dancing and all the PE lessons were dancing." (School 23)

All the teachers had plans or intentions to use at least some of the materials the following year.

"Yes. So you're not having it (the folder) back! I would prefer to teach this rather than the 'keeping healthy' (unit)." (School 14)

"We haven't planned as yet, but I would definitely use them again." (School 23)

Class: Response

The teachers reported that the children had enjoyed the lessons and gave examples of how they had engaged with it. Teachers were confident that the children's awareness had increased but most were less sure that behaviours had changed. Nearly all the teachers had received no feedback from parents and one felt that the behaviour changes needed to be supported at home. Only one teacher had sent information home and she reported parents telling her that children were asking for healthy food.

"There are lots they loved. They loved looking at different parts of the workout. My class are actually quite aware of the five foods (groups). They loved the snack attack." (School 19)

"(Regarding behaviour changes) I don't think the active side, but the nutrition and food because there were more solid lessons and I'm passionate about it. Quite a few will slightly change their diet now...It is more that the parents don't care and we do have a lot of neglected children. They will go and chose fruit at break time and milk." (School 14)

"I have had parents say to me that the children are choosing different things to eat. I let them take home the balance of good health, because it was important for them to take it home to get the message home, so I kept photocopying it." (School 14)

"Yes, positive. It has had a definite effect, like, 'I must make sure I've had my breakfast.' You hear them mention about snacks at lunchtime; not too obvious but occasional snippets and you think – wow!" (School 18)

"I'm not sure how much impact it has made outside school." (School 16)

Class: Changes and ideas

The teachers gave suggestions for improvements to lessons. These included simplifying the Fit Check journal, changing the Chain 5 vitamin lesson because it was complicated and introducing more activities. One teacher felt that the project should be a whole school initiative, but no other teachers mentioned this. One teacher suggested giving the children certificates at the end. The teachers gave examples of additions they had made to the project, such as creating a classroom display, taking in food packets, using relevant websites and putting the resources onto acetates or the whiteboard.

"I did a display in my classroom which we added to each week and it had questions on it." (School 23)

"Some of the more worksheet based ones; as a school we try to do things more practically, so the games have been really good. But the worksheets are a bit boring – think how can you make it more interesting, like using post-it notes." (School 16)

4.6.4. Summary

The majority of teachers were positive about the training they received and content of the lessons. Several teachers regarded the lessons as suitable to use in the QCA 'keeping healthy' topic. The majority of teachers found it difficult to teach all the lessons and only three teachers taught all the lessons. All the teachers who were interviewed taught at least half the lessons. They gave positive comments about the response of the children to the lessons. The teachers thought the programme had increased children's knowledge about healthy eating and physical activity, but varied in their views about its impact on behaviour. There had been very little or no contact with parents and teachers felt that parents needed to be involved to support behaviour change.

In the future the following changes should be made:

- Give information to teachers before the beginning of the school year about the topics and link to the QCA unit
- Provide a longer period for the lessons to be taught
- Indicate the key lessons if teachers can not teach all the lessons
- Reduce the length of the training day to give the teachers time to prepare
- Remove the vitamin lesson
- Simplify the Fit Check Journal
- Add certificates

4.7. Discussion

4.7.1. Main findings

Screen viewing

There was evidence that boys spent more time doing screen-based activities than girls. There was no evidence of a difference in screen time by deprivation on weekdays, but evidence of a difference by deprivation on Saturdays, with children from the least deprived areas spending more time screen viewing than those from more deprived areas.

Screen time in the control group decreased on a weekday by -14.08 and by -38.58 minutes on a Saturday. This change may be partly seasonal and partly measurement error. The regression analysis showed the intervention group reduced their screen viewing more than the control group, by -12.9 minutes on a weekday and by -18.9 minutes on a Saturday; however there was no strong statistical evidence that this differed from the null. Since this is a short-term pilot study it is probable that there were insufficient participants and insufficient follow-up time to be able to be able to determine a difference of public health importance with sufficient statistical power. There was no evidence that children from intervention schools spent less than two hours on screen-time compared with control schools at follow-up, however there was some evidence that screen time of two hours or more was reduced by 55% for girls on Saturdays.

Diet

In general the dietary patterns of the participants in this sample of English school children were unhealthy. Only 8.5% of them consumed the recommended five portions of fruit and vegetables per day. These children also consumed high levels of sweet and savoury snacks and high energy drinks. Girls consumed more fruit and vegetables than boys. Girls were also more likely to consume no high fat foods but boys consumed fewer sweet and savoury snacks and high energy drinks. In general children from more deprived schools ate healthier diets than those from less deprived schools in this study.

Whilst the gender differences noted in the study might suggest that girls and boys need to be targeted differently about specific food types, the majority of school-aged children consume an unhealthy diet with little fruit and vegetables, but comparatively large amounts of sweet and savoury snacks and high energy drinks. Likewise the interesting finding in this study that diet was not particularly unhealthy in children from the more deprived schools should not detract from the main finding that it is important to identify means of improving the diet of all children. South Gloucestershire has some pockets of deprivation but on the whole is a relatively affluent area. Thus, the fact that the majority of children from this relatively affluent area have unhealthy diets highlights the need to target interventions at all children.

The equal proportions of fruit and vegetables consumed in school, compared to outside school, is interesting and suggests that the school may be a more positive environment for encouraging the consumption of fruit and vegetables. If the differences in food consumed inside and outside school found in this study are replicated in other studies then they suggest that interventions aimed at improving diet in children should encourage lower consumption of high-energy drinks and high fat foods at home and lower consumption of snacks in school.

There was no strong or consistent evidence that the intervention affected dietary patterns in this short-term pilot.

Active travel

The two most frequent means of transport to school were walking and travelling by car. Just over half the children (52.5%) used active transport to travel to school. There was strong evidence that girls were more likely to travel to school by active transport. There was no difference in the mode of transport by deprivation. The intention to treat analysis shows evidence of increased walking or cycling to school in the control schools compared to the intervention schools at outcome. This was a surprising change and it could reflect enhanced work to increase walking to school in some of the control schools. The Local Authority had a separate incentive scheme to increase walking to school called 'Going for Gold' which was offered free of charge to all schools in South Gloucestershire. This finding has highlighted the importance of collecting information from schools about other initiatives which may influence the outcomes.

BMI

Overall, the IOTF criteria gave the lowest prevalence of obesity and the UK 1990 the highest. More girls were obese than boys by all three obesity criteria, with the difference in prevalence ranging from 1.7% to 2.7%, but there was no statistical evidence that the distribution into categories of normal, overweight or obesity differed by gender for any of the three criteria. There was evidence BMI categories differed by deprivation with the prevalence of overweight being highest in the least deprived children for all criteria and the prevalence of obesity being highest in the least and medium deprived groups.

The prevalence of obesity for both boys and girls increased from baseline to follow-up, using the UK 1990 and 2000 CDC criteria, whilst for the IOTF criteria the prevalence of obesity did not change, although the prevalence of overweight did. There was no evidence of a difference in mean BMI or the odds of obesity between pupils allocated to intervention schools and those allocated to control schools.

Process evaluation

The majority of teachers were positive about the training they received and content of the lessons. Several teachers regarded the lessons as suitable to use in the QCA 'keeping healthy' topic. All the teachers who were interviewed taught at least half the lessons. They gave positive comments about the response of the children to the lessons. The teachers thought the programme had increased children's knowledge about healthy eating and physical activity, but varied in their views about its impact on behaviour. There had been very little or no contact with parents and teachers felt that parents needed to be involved to support behaviour change. Changes to the lessons and materials were identified.

Cost

This was a pilot and feasibility study and therefore a formal cost-effectiveness analysis was not undertaken, but would be in a full-scale trial. The cost of training teachers to use the adapted material and providing sets of journals to schools was relatively cheap: approximately £110 per teacher and £2 per pupil.

4.7.2. Evidence from other relevant studies

Screen-time

There was a reduction in screen-time in the control group from the baseline to follow-up. There is no published literature on how screen-time varies by season in UK children, however, analysis of the ALSPAC cohort at age 11 has shown that physical activity levels are lowest in winter and therefore it is possible that screen-time might show an inverse seasonal pattern to physical activity.[198]

The evidence for a reduction in screen-time for girls at the weekend is interesting because in the US 'Planet Health' study there was a greater reduction in screen-viewing in girls than boys (-34.8 minutes per day for girls and -24 minutes per day for boys) and the reduction in obesity seen in girls was mediated through a reduction in screen-time.[161] Therefore this suggests that in both the US and the UK girls may be more responsive to the intervention than boys. An alternative explanation is that girls are more influenced by social desirability than boys.

BMI

The AFLY5 study found more girls were obese than boys, which differs from the national HSE results for 2006, which found levels of obesity in 2 to 10 year olds were higher in boys than girls[193] and was also found for the analysis of the pooled 1999 to 2006 HSE data for 9 to 10 year olds reported in chapter 3.

Diet

The finding that girls ate more fruit and vegetables than boys is consistent with previous UK research.[199] However, the finding that children from more deprived schools ate healthier diets than those from less deprived schools differs from the national assessment of dietary intake in children, which reported lower portions of fruit and vegetables eaten per day with higher deprivation.[199]

Analysis of eating at school and home among school aged children in the US has found that the largest proportion of total daily energy from low-nutrient, energy-dense foods, especially from sugar-sweetened beverages, chips, and baked goods, is at home, [200] which is consistent with the findings in this study. By contrast, a study of 11 year old children in Australia in 1995 found energy dense food were most commonly eaten and school and school was a more obesogenic environment than outside school.[201] Studies of consumption of packed lunches and school lunches in primary schools show that children who eat a packed lunch consume more sugar and saturated fat compared with those having a school lunch.[202,203] Further research is required to understand how the dietary intake varies by home and by school and how to improve sustained healthy eating in both environments.

School-based interventions designed to increase fruit and vegetable consumption have been shown to produce a moderate increase in intake among children. A pooled analysis across seven such studies estimated the effect size to be 0.45 servings per day (95% CI 0.33 to 0.59).[204] This is consistent with a systematic review of studies to increase fruit and vegetable consumption in children, which found that of the 15 studies reviewed, two thirds had a significant effect ranging from +0.3 to +0.99 servings per day.[128] These pilot results, whilst imprecise and inconclusive, are consistent with a modest effect of this size.

The AFLY5 study had no involvement of parents. Involving parents via school based interventions may improve their effectiveness further by ensuring consistent messages and encouraging a healthy diet both inside and outside of school. Given that many parents in the UK work, the challenge is how to involve parents in school-based interventions in a way which supports behaviour change and is accessible to all parents.

Active travel

A systematic review of active travel (walking or cycling) to school drew limited conclusions because most studies were cross-sectional. The review suggested an association between physical activity levels and active commuting to school, but a less clear association with BMI and obesity.[205] Evidence from interventions to increase walking to school is limited to isolated studies or subgroup analysis.[206]

4.7.3. Study implications

This study shows that it is feasible to transfer an intervention that has been developed and tested in the US to a UK setting, that primary schools in the UK are willing to be randomised to receive the intervention immediately or later and that the intervention and related measurements are acceptable to teachers, pupils and their parents. The study has allowed me to refine the intervention (in particular by considering how to involve parents) and measurements for further feasibility/ pilot work (see Chapters 5 and 6). The study findings suggest that similar to the US studies,[174,207] the intervention was associated with a reduction in the amount of time children spent on screen-based activities. However, the study had insufficient power to provide precise estimates of this effect and had a shorter follow-up period than the US studies. Like the US studies there was some evidence of a possible stronger effect in females compared with males, but again given the nature of this pilot study no firm conclusion can be made about this from these results.

There was no strong evidence that the intervention had beneficial effects on diet, active travel or BMI, but it is likely that this is the result of it being too small and with too short a follow-up period.

The pilot has implications for data collection to ensure: questionnaires have ID labels; the schools are not involved in other interventions/ promotional activities; and checking the measurement days are not following a school trip.

4.7.4. Strengths and limitations

Study design

The choice of a cluster RCT design combined with a process evaluation was appropriate in that it: a) allowed me to examine whether a school based cluster RCT of the intervention would be acceptable and feasible in the UK; b) allowed the sample size, using the ICC and other pilot study information, for a full scale trial to be calculated; c) provided an assessment of recruitment methods, the appropriateness of the intervention and methods of measurements and d) provided an indication of the change in the outcomes. However, I acknowledge that due to funding restrictions, the study was underpowered and of too short a duration to accurately assess the effect of the intervention on the outcomes, particularly BMI, and was therefore more successful at achieving (a) to (c) of the above than (d).

Selection of schools

The cluster randomisation design incurs a risk that there can be different responses between schools; however, differences were minimised by selecting schools in similar geographical areas with similar demographic profiles. There was some variation in the deprivation levels of the schools (from 21% to 54%). However, the vast majority of schools in the area were in the lowest 50% of school deprivation scores for England (indicating low levels of deprivation), therefore the acceptability of this study can not necessarily be transferred to schools in highly deprived areas.

Randomisation, blinding and intention-to-treat

The distribution of baseline characteristics suggests that there were no problems with the randomisation. An intention to treat analysis was undertaken. As I had been involved with the intervention, I was not blind to the allocation when I undertook the analyses. It is essential for my PhD that I conduct most of the analyses and whilst it is possible that I might complete analyses in such a way that would bias results because of prior beliefs about the intervention, all of my analysis programmes followed similar approaches to those of Debbie Lawlor and are available for inspection. My lack of blinding is therefore unlikely to have caused any bias. It was not possible to blind the schools from whether or not they received the intervention and it is possible that pupils and teachers from schools that received the intervention would complete questionnaires differently to those from the control schools. Pupils at intervention schools might have wanted to please teachers who taught the intervention lessons. However, outcomes were assessed some time after the intervention and hopefully this time difference will have been sufficient to minimise any potential bias from lack of blinding of schools.

Measurement of screen viewing

The choice of measurements was restricted by the small budget available for the study. For the main outcome measure (time spent screen viewing) a questionnaire was used that had been tested with US school children of the same age.[159] In previous research, the questionnaire has been found to have excellent test-retest reliability (r=0.94),[208] but poor levels of agreement with parental reports of screen viewing (r=0.17-0.49).[159] Information on parental report of children's screen viewing was not collected in my study. However, one cannot assume that the parental report would be more accurate than the child's since children of this age are known to engage in some of these activities without complete parental knowledge. In the US study using the TV questionnaire, the magnitude of the effect of the intervention was similar for either child's own or parental report of screen viewing.[159] In the AFLY5 study, there were similar results using no exclusions on the basis of implausible values in the child's report of screen viewing activities and when thresholds for excluding those with possible implausible values were used. The similarity of these findings suggests that if there is measurement error in the child's report it is similarly distributed across the two randomisation arms.

Ideally the revised screen time questionnaire should have been piloted before use. Also it would have been preferable to measure test-retest reliability by asking a proportion of the children to complete the questionnaire on a second occasion. In addition, the use of electronic monitoring devices[209] or observation of children at home would have provided a more objective measure of screen viewing time. Such objective approaches are expensive and more intrusive, which may alter behaviour.[210]

Measurement of diet

A strength of this study is that it used a self-completion questionnaire (DILQ) to assess 9-10 year old children's eating habits which has been found to be valid, reliable and sensitive to variation in fruit and vegetable consumption in 7-9 year olds in England.[190] The completion of the DILQ, which has creative colourful cues, was enjoyed by the children and overcomes some of the inherent challenges of levels of literacy and motivation encountered by some other more demanding methods to assess dietary intake.[190] Children at age 10 are regarded as being reasonably accurate in providing dietary information.[211] A further strength was the ability to examine location of consumption of different food types associated with different dietary constituents.

The classification of food into categories relied on the information provided by the child. Ideally full information about the food brand and portion size would be collected, such as is available during detailed 24 hour recall interviews. Methods of placing food and drink items into broad categories were used, which were informed by methods used in other studies using the same or similar questionnaires and age groups.[191,192]

A potential weakness is the children's ability to recall the food and drink from the previous day. Baranowski has reviewed the cognitive models involved in children's recall of diet.[211] Children's accuracy of recall is particularly affected by attention deficit because of information overload such as frequent eating, or distraction by another event, or over familiarity of routine foods. Further errors in recall are thought to be related to time, with less complete recall as time since the event increases. Retrieval of information from the long-term memory can be enhanced by using prompts within a 24 hour recall, such as the structure provided in the questionnaire used in this study. If children use reconstruction to draw inferences from what usually occurs on a particular day it is likely to lead to error. Children are likely to over report the number of servings of some food groups, but they can also underreport foods of which they have eaten high quantities. Children are also thought to be influenced by social desirability, with over reporting of healthy foods (e.g. fruit and vegetables) and under reporting of foods regarded to be less healthy (e.g desserts).[211]

The cognitive, behavioural and social factors associated with diet recall have been examined in a study in the UK which compared a 24 hour recall interview with 9-11 year old children to their recall of breakfast the previous day using the DILQ used in this study.[212] In addition children completed tests for episodic memory, working memory and attention. The children's attitude to breakfast was assessed and their teacher was asked to complete a classroom behaviour measure. The assessment suggests that children's recall is affected by deprivation, episodic memory, attitudes to target behaviour and classroom behaviour. However, working memory and attention did not appear to affect recall. Approximately a quarter of food items reported in the interview were not reported in the questionnaire. This varied by type of food, with a suggestion of social desirability, with fewer healthy items and more less-healthy items being omitted. The authors suggest that cluster RCTs should overcome some of the problems related to inter-individual differences in reporting accuracy because these should be randomly assigned to the intervention and control arms.[212]

Analysis of the AFLY5 intervention used diet data from 56.4% of the children. This was in part because some questionnaires were returned without the children's name completed; if the questionnaires had been labelled with three unique identifiers (name, date of birth and ID number) this would have been avoided. In addition, some schools did not return the questionnaires at follow-up. Whilst 56% is a low proportion, which may have introduced bias, it is not unusual in school based studies.[204] A systematic review and meta-analysis of nutritional school based intervention studies found that six of the seven studies had complete data on 49-60% of the pupils, with only one having data on a considerably higher proportion (75%).[204]

Measurement of physical activity

Pedometers were used in this study to provide an objective measure of physical activity, but the teachers reported that they were unreliable. This is likely to be because the pedometers were cheap (approximately £1.50 each). More expensive and superior pedometers such as the Digi-Walker SW 200/701, Walk4Life 2050 or Sun TrekLINQ (costing £13-16) have been found to be reliable in terms of reproducibility and having criterion and construct validity.[69]

Accelerometers measure acceleration rather than steps. In contrast to pedometers, accelerometers are more expensive (>£150) but have the advantage of measuring the frequency, intensity and duration of physical activity by time. Also subjects are blinded because there is no digital screen and software is required to download the data onto a computer.[213] One of the aims of this study is to reduce sedentary behaviours and increase moderate to vigorous activity, therefore, I concluded it would be preferable to use accelerometers.[214,215] The experience of using the pedometers informed the next phase of feasibility/pilot work that is described in Chapter 6, however the lack of data on physical activity meant it was not possible to calculate the ICC.

Measurement of BMI

Weight and height were measured by nine school health assistants who were employed by North Bristol NHS Trust and were trained by the Trust and experienced at taking height and weight measures with school children. The staff worked together in pairs, of which there were 22 combinations of staff, to do the measurements. Ideally one set of measurement equipment and one single pair of staff would have taken all the measurements to reduce measurement error. However, this was not possible because the only available method of obtaining the measurements was by using this group of staff. Appendix 5 shows there was digit preference for height and weight. This is consistent with the pattern of digit preference seen in the National Child Measurement Programme for Reception and Year 6 children in England, which is undertaken nationally by school nurses and school health assistants.[216] If further training could have been undertaken prior to data collection and feedback of measurements to staff given during data collection it may have reduced the digit preference. It is unlikely that the digit preference at the level of the third decimal place for height (in metres) and first decimal place for weight (in kg) would make a substantial difference to the classification of children as obese.

Missing data

A major weakness of this study was the missing data. In a full-scale trial trained researchers should administer the questionnaires to minimise missing data.

4.8. Summary

This study demonstrated it is feasible to recruit and randomise schools to this school-based obesity prevention intervention and to gain consent from parents. Not all schools will take part, but approximately two thirds of those contacted are likely to do so.

The main problems encountered were with regard to the completeness of the intervention and measurements. Most teachers taught a proportion of the lessons and therefore the intervention is probably too long for fitting into the curriculum, however the teachers had less than two terms to teach the lessons and it might be possible if taught across a whole academic year. The problems with measurements were the digit preference in the height and weight measurements, reliance on teachers to administer the questionnaires and relying on the children to write their name on the questionnaires. Both of these could be rectified by having research staff administering and collecting the questionnaires and providing pre-typed ID labels. The pedometers were the biggest problem and lessons have been learnt in terms of lack of piloting prior to using the pedometers and also the inherent weakness of pedometers compared to other, more sophisticated, movement sensors.

The ICCs for screen-time from this pilot study was 0.00 (95% CI: 0.00 to 0.03) and that for BMI was 0.00 (95% CI: 0.01 to 0.03). In the sample-size calculation for a full-scale randomised controlled trial, the upper limit of the 95% confidence interval was used for these intraclass correlation coefficients (ie. 0.03 for both screen-time and BMI). The study has provided information that a full-scale trial would require nine schools with approximately 218 pupils, to be adequately powered to precisely estimate potentially important effects for both screen time and BMI.

CHAPTER 5. AFLY5 PHASE II: DEVELOPING METHODS TO INVOLVE PARENTS

5.1. Introduction

In chapter four, I showed that whilst the AFLY5 intervention demonstrated some evidence of helping children to change their behaviours, the teachers reported that parents were not involved in the project, which may have limited the effectiveness of the intervention. Funding became available to undertake a second phase of pilot/feasibility study of the AFLY5 intervention and I therefore took the opportunity to develop a method for involving parents and examine whether involving parents enhanced the intervention. Qualitative work was conducted with parents of year 5 children to investigate the best methods for involving parents. This chapter describes the methods and results of this qualitative work. The next chapter describes the phase II pilot/feasibility study in full.

5.2. Methods

The qualitative study to determine acceptable and feasible methods of parental involvement was with parents of children in the AFLY5 phase II feasibility/pilot study schools. Full details of methods for the phase II feasibility/pilot are provided in Chapter 6; here I describe the methods for the qualitative study to determine methods for parental involvement. Parents with children in year 5 in South Gloucestershire were invited by letter to take part in a telephone interview lasting up to 30 minutes (see Letter 6.1 in Appendix 6). Parents of the year 5 children were chosen because it was important to understand the issues relating to parents of 9-10 year old children who would be involved in the AFLY5 phase

II intervention the following year. The aim was to recruit 15-20 parents across the four schools. Parents were asked to return a signed consent form with information about their availability for the interview. Reminder letters were sent two weeks later to increase the number of responses. The purpose of the interview was to discuss methods of parental involvement. The semi-structured interview schedule (see Interview Schedule 6.1 in Appendix 6) was informed by literature on the methods to involve parents in interventions to increase physical activity.[158] The interviews were conducted by me at a convenient time for the parent, and were recorded on an Olympus digital voice recorder DS-2300 with an attached conference microphone, model CM9090S. Recordings were transcribed and anonymised.

Using the same methods as in chapter 4, the transcripts of the interviews were read to aid familiarisation. Thematic analysis was used to identify the main themes.[195] Transcripts were coded electronically using Nvivo version 9.0 software using main codes and sub-codes. Ethical approval was given by the University of Bristol's Faculty of Medicine and Dentistry Committee for Ethics.

5.3. Results

In response to invitations to take part in the focus groups, consent forms were returned for a total of 9 (6%) parents from four schools (three parents each from schools 34 and 37; two parents from school 38 and one parent from school 33). All respondents were mothers; 77.8% (7/9) reported working at least part-time; and 44.4% (4/9) of the mothers had sons in Year 5. The interviews lasted between 15 and 36 minutes (mean of 22.7 minutes). See Table 6.1 in Appendix 6 for the length of each interview, number of codes assigned to each transcript and the number of references coded, and Table 6.2 for the main and sub codes. The categories and classes for the two themes of 'current parental involvement in school' and 'views of methods to involve parents in AFLY5' are provided in Table 5.1 and Table 5.2.

5.3.1. Synthesis of parent interviews

Theme: Current involvement of parents at school

Table 5.1 shows the categories and classes for this theme.

Table 5.1 Categories from parent interviews for 'current parent involvement at school' theme by class

Category	Class
Newsletter Letters	Communication
Parents' evening	Meeting staff
Assemblies Special events	Events
PTA	PTA
Level of involvement Problems with involvement	View of involvement
Help in classroom School food School trips	Ad hoc opportunities for involvement

Class: Communication

The nine parents all reported receiving school newsletters. The frequency varied between termly (3/9), monthly (2/9), fortnightly (3/8) and weekly (1/9). There was inconsistency of frequency reported within the schools, however all parents clearly regard it as an effective means of communicating important factual information from the school. Letters were also mentioned as a method of communication used between schools and parents.

"They tell you if there's been changes in staffing, they tell you if there's been activities, if a year group has been on a trip, or tell you of some upcoming events." (School 38, Parent 2)

"I think the one thing that perhaps makes parents read that in preference to other letters, I'm guessing, is that they do include photographs." (School 37, Parent 1)

Class: Meeting staff

All parents said that they could meet the classroom teacher at parents' evenings, which were once or twice a year. In addition, parents felt they could see the teacher or headteacher if they had particular concerns.

Class: Events

Just over half the parents (5/9) reported being invited to festival assemblies(e.g. Easter) or if the class was performing. Four of the parents said the school did not invite parents to special events. One parent mentioned that because many parents work very few attended. In one school the lack of space restricted parent attendance. Parents reported special events at school which parents could get involved with, such as BBQs, school fayres and music events. In one school (School 37) all the parents spoke about an annual father's day, when fathers, uncles or grandfathers spend the day in school which was very popular.

"They have that round about Father's Day, every year, and the first couple of years they had about 20 parents. This year they had about 60." (School 37, Parent 1)

Class: Parent Teachers Association (PTA)

One parent mentioned that she was involved with the PTA and she spoke of her frustration and difficulty in getting other parents involved.

"I'm secretary to the PTA, getting the PTA, sorry parents, to do anything with the PTA is an absolutely nightmare, even events which should have been fun, like the summer barbeque we had to cancel through lack of support...we're at a total loss, we have sent out questionnaires asking why parents don't get involved and what would make it easier, and no one's even bothered to return the questionnaires." (School 37, Parent 1).

Class: Ad hoc opportunities for involvement

Parents reported other opportunities to get involved at school, such as volunteering to help in the classrooms with activities such as hearing children read; helping on school trips; having a school lunch; or specific meetings on topics like Standard Assessment Tests (SATS) or sex education.

Class: View of involvement

Seven of the nine parents gave their view about the current level of parent involvement in the school and they all felt it was 'about right'. However, one parent felt that it was not possible to involve parents too much and another parent felt that there could be pressure for too much involvement.

"I mean I would never say that any involvement is never too much because it's up to parents to decide whether or not they want to be involved." (School 34, Parent 2)

"I have worked in independent schools in the past and I think in independent schools possibly there's the pressure to have more involvement and I think that is not always a good thing." (School 38, Parent 2)

The parents discussed the problems with parent involvement in schools. The most common barrier to involvement was work (their own work or the perception that other mothers' who work cannot get involved). Additional restrictions were space at school and having younger children still at home. A couple of parents expressed frustration that the same parents get involved in everything and the majority do not get involved.

"I would like to but it's more kind of really my own restrictions, not the school's, which hold me back from kind of joining in anything. Just that I work from home so it's quite busy for me. I don't have a lot of spare time." (School 34, Parent 1)

"It's the same thing everywhere; it's always the same people doing it all." (School 34, Parent 3)

Theme: Views of methods to involve parents in AFLY5 project

Table 5.2 shows the categories and classes for this theme.

Class: Current homework

Seven of the nine parents were asked whether their child was given homework and they all said the child was given weekly homework (it was an oversight on my part that this question was not asked to the other two parents). Three said the homework was always maths and one said it was spellings.

Table 5.2 Categories from parent interviews for 'views of parent involvement at school' theme by class

Category	Class
Current homework	Current homework
Activity based homework	Activity based homework
Parents' response	
Stickers	
Parent involvement	Parent involvement in homework
Compulsory	
Problems	
Barriers	Events at school
Assemblies	
Classroom activity	
Early evening event	
Workshops	
Newsletter	Newsletter

Class: Parent involvement in homework

Five parents said they usually do the homework with their child, three sometimes do it and one did not say. Parents gave reasons why they do the homework with the child, including the child likes to talk about it with the parent, the homework sometimes requires them to work in pairs, it is what they prefer to do or they find it enjoyable. However, parents noted that not all parents do get involved.

"I find that my son likes a lot of interaction over his homework, even though he's perfectly clever enough to do it by himself, it is something he likes to talk about." (School 33, Parent 1)

When asked for their views about involving parents in homework related to the AFLY5 project, two parents thought that parents would be more likely to get involved if the homework was interesting. Several parents commented that some parents will not bother to help their child and this could be difficult for those children. Several parents felt that time could be a barrier to parents being involved, so it would be important that the homework was not time consuming. Parents perceived it would be particularly difficult for parents with a lot of children. One parent, whose child has behaviour problems, felt that homework even with parent involvement was not going to engage her child.

"If the homework was interesting and stretching then I think you would get a lot of parental involvement." (School 38, Parent 2)

"The same parents that always do, will, and the same parents that never bother, won't. I think there will be a few parents who would get involved and don't know enough about healthy eating and fitness, that would be great. They're the parents that always try hard with the homework and perhaps would benefit from knowing a little bit more. But I think most of us either do or we don't and nothing will change just because it's a healthy topic." (School 37, Parent 1)

"It depends how much time you have in the evening and how many children you have." (School 38, Parent 1)

Class: Activity based homework

Parents were asked for their views on giving children ALFY5 homeworks which required parents and children to do activities such as cooking or being physically active. Most parents responded very positively and they thought it would be enjoyable and a good idea. Parents made suggestions about activities which could be included like treasure hunts and quizzes. However, some parents thought that a minority of parents might not get involved and that could isolate children whose parents did not get involved. Some parents thought it would not work if the activity was too time consuming. One parent thought it could be an infringement into home life.

"It would definitely be something that that we would both enjoy. I mean we do cook together." (School 33, Parent 1)

"But yeah getting the whole family involved to do stuff together I think it's a good thing, you know if they can come up with ideas or something, maybe do walks or treasure hunt type things." (School 34, Parent 2)

"That would be good, that's a clever idea. That would be excellent. Oh that's really clever." (School 38, Parent 1)

"I think some would and some, I mean obviously not everybody's going to join in with it, I mean we'd be happy to so probably you'd get about 50/50 people kind of actually doing it." (School 34, Parent 1)

"(laughs) I can picture some families that would really think that was an infringement....I think it would depend what you did, and how much notice, and how you approached the parents, but I think there's also big scope here for a child to feel very left out when their parents don't respond." (School 37, Parent 1)

Class: Events at school

The parents were asked to give their views of events at school to involve parents, such as assemblies, classroom activities, early evening events and workshops. The overwhelming barrier presented by parents was that many parents work and it would exclude them, or be difficult for them to be attend. Two parents commented that afternoons can be an easier time of day for parents to attend.

"I'm kind of one of the lucky few who works from home so I can be a bit flexible about going into school, but I know a lot of mums just can't and they would feel like their child's being penalised, because other children have got their parents there and their child hasn't." (School 34, Parent 1)

Parents were generally positive about attending assemblies, although the problem of work was raised by many parents. High quality presentations, or watching their own child performing were seen to be reasons to attend.

"I think if parents see their children perform at an assembly they'll pull out all the stops to get there." (School 37, Parent 1)

Four parents felt that doing activities in the classroom with children would be appealing and enjoyable but three commented that work commitments meant that not all parents could be involved and this could be upsetting for children.

"The children love it as well - having parents coming in I think. I mean actually doing something with them, you know, is good for them as well as the parents I think." (School 34, Parent 2)

Workshops met a very mixed reaction with three parents feeling that they definitely would not be appropriate or of interest and four parents saying that they would be of interest. One parent commented that the usual group of parents would attend.

"A workshop, I don't know, it could be a maybe a step too far... You could sign up for these things and then in three months time when it actually comes to it, you think, "oh I've been at work all day". Because that's happened, we've got this going on, and that

going on, and now I'm supposed to go and listen to how I should be cycling and how many lentils I should be eating. Personally I don't think it's a winner." (School 38, Parent 2)

There was a muted positive response to early evening events for families; examples were given of other school evening events which take place like discos, BBQs and musicals. However some perceived it still to be difficult for working parents, particularly fathers and unpopular with teachers.

"I think, yes, evening activities or even Saturday morning activity as a one off, I think would be more popular with a lot of parents. What it wouldn't be popular with is the teachers." (School 37, Parent 1)

Class: Newsletter

A newsletter, as a means of communicating with parents about the ALFY5 project was positively received by all parents except one parent who was an elderly lady who felt that she did not need additional information. Parents felt that information within the existing school newsletter was preferable, because parents generally read it to get information about dates and events. Therefore information about the project was more likely to be read.

"I think that the problem you might have is that people will just think oh it's a healthy thing and putting it away, rather than, with the newsletter I will read it from start to finish. So if they can almost slip little things in there.... So no in a way I think you're better off keeping it kind of general and putting in notices there." (School 34, Parent 1)

5.4. Discussion

5.4.1. Methods

There was a low response from parents to take part in the interviews even though telephone interviews were chosen because it can be difficult to find a time when parents are free to take part in a focus group or face to face interview.[217] A study with parents of children in year six about parental attitudes to children being independently active had a response for telephone interviews of 8.9% which is consistent with this study.[217] The interviews were all mothers and this, combined with the small numbers means that the results may not be representative of the majority of parents. However, the response only from mothers may reflect that mothers would be the parent most likely to be involved in any school-based intervention. The interviews included parents from all four schools that I used as the sampling frame for this study and there was a mix of parents with sons and daughters and parents who were and were not working.

5.4.2. Findings

All parents were involved to some extent in the school through the school newsletter and parents' evenings. The extent of further involvement through participating in classroom activities, attending assemblies or special events varied between schools and mothers. Parents' work and general busyness was a major barrier to involvement. Parents generally felt their level of involvement was about right.

Nearly all parents were enthusiastic about being involved in the AFLY5 project. The general school newsletter was regarded as a good way of communicating to parents about the project. Homework that included activities such as cooking and physical activity (rather than more traditional homework) was regarded as a good method of involving parents. The parents who were interviewed actually suggested some types of activities that might be used in such homeworks. Homework was also seen as having the potential to reach all parents because the schools regularly give homework. However, some parents raised concerns that not all parents would get involved with homework because of their work or general apathy and that since these activity homeworks were likely to be seen as fun by the children, those whose parents did not get involved would be disadvantaged. Assemblies, classroom activities and early evening events were regarded to be good methods of involving some parents, but working parents were likely to be excluded.

5.4.3. Relating the findings to relevant literature

Hoover-Dempsey and Sandler have created a model to describe the patterns of influence in the process of parents' involvement in children's education (see Figure 5.1).[218] Although the model looks linear, the authors suggest that the process of involvement is more complex and for each parent there will be further variables, such as their own experience of school, which will further influence their involvement. From the authors' analysis of theory and research they suggest that the initial level of deciding to be involved is mostly driven by the parent's view of their role and sense of efficacy. They suggest that general invitations to be involved may have the greatest impact when either role and /or sense of efficacy are not strong. In relation to AFLY5 this theory is relevant to the invitation for parents to be involved in the children's homework. The invitation could potentially help to engage parents who, for reasons of role or efficacy, would not normally be involved.

Figure 5.1 Model of parents' involvement in children's education (summarised from Hoover-Dempsey and Sandler)[218]

Level 5		**Child/student outcomes**	
		Skills and knowledge	
		Personal sense of efficacy for doing well at school	
Level 4		**Tempering/mediating variables**	
	Parent's use of developmentally appropriate involvement strategies		Fit between parents' involvement actions and school expectations
Level 3		**Mechanisms of involvement influencing child outcomes**	
	Modelling	Reinforcement	Instruction
Level 2		**Choice of involvement form**	
	Parent skill and knowledge	Demand on parental time and energy	Specific invitations and demand for involvement
Level 1		**Involvement decision**	
	Parent's construction of parent role	Parent's sense of efficacy for child to succeed	General invitations and demand for involvement from child & school

A study with 208 parents of US children aged seven to ten explored the predictors of parent involvement in children's general schooling.[219] This study highlighted the importance of understanding influences on involvement in order to develop interventions to increase parent involvement. The study used a multilevel model and established the predictors of parental involvement. High social economic position (SEP) and two-parent families were more likely to be involved; involvement in school may be most difficult for mothers from single-parent families and therefore consideration should be given to involvement not requiring availability. Parents who found their child difficult may withdraw from interactions and therefore may require help to work with their child at home. Cultural factors such as parents' views of learning need to be considered. A difficult context and lack of social support undermined school involvement for mothers of boys. Teacher characteristics were associated with involvement of parents of girls; girls may be more connected and attentive to their teachers and may be stronger conduits of taking messages home. The study concluded that interventions are needed beyond classroom activities to reach all families. Two findings from this study are consistent with the ALFY5 phase II interviews: the mother who found her child's behaviour to be difficult reported that the child's involvement with homework was difficult; and parents reported that classroom based activities were not able to engage all families.

A health promotion intervention in the US to promote healthy eating in children aged seven to nine compared a 15 session school-based programme to a five week correspondence course at home, where parents were sent activity packs to do with their children and points were awarded for participation.[220] The incentive for participation was entry into a draw for a holiday to Disneyworld. This study was informed by a phone survey with 208 parents who ranked 'behaviour tip sheets' and homework activities as preferable to information, phone calls or parent education nights. These views about homework and parent education nights (workshops) are consistent with the findings in the AFLY5 phase II interviews with parents. The US study found greater knowledge in the school only intervention and greater behaviour change in the home intervention. The authors concluded that parent involvement might be necessary for substantial dietary change with children and that school based and home based programmes should be designed to be complementary.

In England, the Government recently (March 2010) published a guide called 'Getting into Homework' to help parents, carers and families of school-aged children to actively engage in their child's learning at home.[221] Ten tips are given to support the child's homework. One of the ten tips is to get involved and assist their child with their homework. The AFLY5 phase II interviews with parents support this approach as something many parents do and see as valuable. Somewhat ironically, in terms of the aims of AFLY5, another of the tips is to watch TV together (for its educational value).

5.4.4. Implications

This exploratory study with parents suggests that the regular school newsletter is a good method of communicating information about ALFY5 to parents. Homework that was unconventional and included activities such as cooking and physically active games involving both parents and children could be a method to reach all parents. School based events were generally seen as being less likely to involve most parents than homeworks. These would also require additional resources from the school, teachers or the research team to deliver the event. Therefore, the newsletter and homework appear to offer the best methods to reach all parents and should be developed as an additional aspect of the ALFY5 intervention. The homeworks should be developed to reinforce the main messages of the AFLY5 intervention, particularly: eat a balanced diet; eat breakfast; eat five fruit/vegetables a day; reduce sugary drinks; freeze the TV; and increase physical activity. To engage parents there should be an explicit requirement for parents to be involved with the homework activities.

5.4.5. Development of the parent involvement intervention

Based on the interviews I developed ten homeworks to complement the teaching materials used in AFLY5 phase I. These are described in the next chapter, which also describes the results evaluating whether they added value to the AFLY5 intervention.

CHAPTER 6. AFLY5 PHASE II: PILOTING PARENT INVOLVEMENT

This chapter presents the background, methods and results from phase II of the pilot and feasibility study of Active For Life Year 5 (AFLY5). This phase builds on the first phase by (i) further examining the likely effect of AFLY5; (ii) testing the feasibility of using accelerometers to examine physical activity and sedentary behaviour in AFLY5; (iii) exploring methods of including parents in the intervention of AFLY5 and testing the feasibility and possible effectiveness of this parent involvement. In the final section of the chapter, the strengths and weaknesses of the methods and results are discussed, followed by the main implications of this phase of the pilot and feasibility study.

6.1. Background

In chapter four the AFLY5 phase I pilot and feasibility study was presented. This included a pilot cluster RCT. The qualitative evaluation in phase I found that teachers felt the lack of parental involvement in the intervention may reduce its effectiveness in changing behaviour. Furthermore, phase I highlighted the need to develop better methods of objectively assessing physical activity and sedentary behaviour. The pedometers used in phase I were deemed to be unsuitable.

As a response the next phase of pilot/feasibility work was to explore how to involve parents and undertake some initial analyses of the likely added benefit of such involvement. The first part of phase II was presented in Chapter 5. This chapter now presents the results of a further pilot intervention study. Because of the available resources, and requirements of the PCT, a before and after study of the intervention was undertaken which aimed to:

(i) further examine the likely effect of AFLY5 on improving physical activity, reducing sedentary behaviour, improving diet and preventing childhood obesity;

(ii) test the feasibility of using accelerometers to examine physical activity and sedentary behaviour in AFLY5 and to determine the ICCs for these measurements so that this could inform the sample size calculation for a full scale RCT;

(iii) test the feasibility and possible effectiveness of involving parents in the AFLY5 intervention by introducing homeworks related to the school based intervention.

The next section outlines the study design, intervention, ethics and methods. The results section begins by providing summary statistics that describe the study sample and the baseline distribution of key outcomes. I then go on to examine associations of gender and deprivation with each outcome using the baseline data only. The rationale for these initial analyses are to provide contextual information that can be used in interpretation of the before and after study results. These analyses also provide information on the face validity of the accelerometer data. Lastly, I present results for the comparison of outcomes by intervention (comparing these before and after the intervention) and explore whether there was any difference in the intervention when the parental involvement was included and when it was not. The qualitative findings, which explore child, parent and teacher attitudes to all aspects of the intervention are presented.

6.2. Methods: general

6.2.1. Study design

The inclusion criteria for this second phase of the AFLY5 study were state primary and junior schools with year 5 children (aged 9-10) in the Yate locality of South Gloucestershire. There was the opportunity and funding to do the next phase of feasibility work in South Gloucestershire and this locality was chosen because no schools had taken part in the first phase of the pilot/feasibility study. Using the UK 2004 Rural and Urban Area Classification, schools in this area of South Gloucestershire were classified as: urban> 10k (63.0%), town and fringe (7.4%), village (22.2%) and hamlet and isolated dwelling (7.4%).[183,184] Special schools (e.g. learning disabilities), private schools and schools with infants only (therefore no year 5 children) were excluded. Since this was a pilot/feasibility study, with before and after comparison, the aim was to recruit as many schools and their pupils as possible.

All eligible schools that fulfilled the inclusion criteria in the Yate area of South Gloucestershire (n=27) were invited to take part in the study (see Letter 7.1 in Appendix 7). Schools were contacted by telephone if a written response had not been received after two weeks. Sixteen schools (59.2%) agreed to be in the study with a total of 529 children in year 5. Eleven out of 17 (64.7%) schools from the urban areas took part, 1/2 (50%) from the towns and fringe areas, 3/6 (50%) from village areas and 1/2 (50%) from hamlet areas took part. Thus, compared to those invited more schools from urban areas agreed to take part compared to the three other less urban type of areas.

In order to examine whether the parental involvement improved the effectiveness of the AFLY5 intervention it was necessary to select a sub-group of schools in which parental involvement would be added to the intervention. Based on available funds, four schools were selected for the parental involvement. For funding reasons it was only possible to complete accelerometer measurements in six schools and I decided to include these measurements in all of the parental involvement schools and two of the non-parental involvement schools. In order to select the four schools for parental involvement, the 16 schools that had agreed to participate were separated into rural or urban, sorted by deprivation score and by number of children in the class. Schools with large (>50) or small (<20) numbers of year 5 children were excluded because there would be too many or too few children to use the accelerometers. The description of the 16 schools by intervention, measurements, area and deprivation is shown in Table 6.1.

Table 6.1 Description of study design by intervention, measurements, area type and deprivation (colours indicate additional interventions or measurements)

Schools (n)	Intervention	Measurements	Area type	Mean school deprivation (min, max)
10	Lessons	• Anthropometric • Diet questionnaire • Child sedentary behaviour questionnaire	7 Urban 0 Towns and fringe 2 Village 1 Hamlet	31% (24%, 44%)
2	Lessons	• Anthropometric • Diet questionnaire • Child sedentary behaviour questionnaire • Accelerometry	1 Urban 1 Towns and fringe 0 Village 0 Hamlet	32% (21%, 44%)
4	Lessons + parent involvement (using homeworks)	• Anthropometric • Diet questionnaire • Child sedentary behaviour questionnaire • Accelerometry • Parent proxy report of child sedentary behaviour questionnaire • Parent support for activity scale	4 Urban 0 Towns and fringe 0 Village 0 Hamlet	35% (23%, 47%)

All schools were provided with teaching materials and teacher training as in phase I (see section 6.2.2 on the intervention below). The teachers were offered a choice of two mornings in September 2008 for the training. The four schools with parent involvement (homework) were given coloured copies of each of the homework sessions for the children. All measurements were taken in October to December 2008 before the lessons were taught and six months later (June to July 2009) after the lessons had been completed.

6.2.2. Intervention

The intervention in all 16 schools was the AFLY5 lessons, which are described in full in chapter four. In addition, I developed ten homeworks in collaboration with teaching staff in the Healthy Schools Programme at South Gloucestershire. The aim of these homeworks was to reinforce at home the themes of eating a balanced diet, eating breakfast, eating five fruit and vegetables a day, increasing physical activity and reducing TV viewing. The descriptions of the homeworks in relation to the ten (out of sixteen) lessons are given in Table 6.2. An example of one of the homeworks is given in Figure 7.1 in Appendix 7.

6.2.3. Ethics

Ethical approval was given by the University of Bristol's Faculty of Medicine and Dentistry Committee for Ethics (see Letter 7.2 in Appendix 7). Parents were sent a letter from the University by the school and were asked to give opt out consent for each of the outcome measures (see Letter 7.3 in Appendix 7). In addition, children were asked to give their written assent to take part in each measurement (see Figure 7.2 in Appendix 7). The children initially gave assent for all the measurements on one form whilst in the classroom. In two schools there appeared to be a pattern where boys sitting together in groups chose to opt out of the measurements, particularly the weight measurement. Therefore I split the process of giving assent so that the assent for the questionnaires was given in the classroom and the assent for the anthropometric measurements and accelerometer were given whilst the child waited outside the measurement room, without the influence of other children. The pattern of several boys opting out of weight measurements was reduced.

Table 6.2 Titles of ten lessons with homeworks

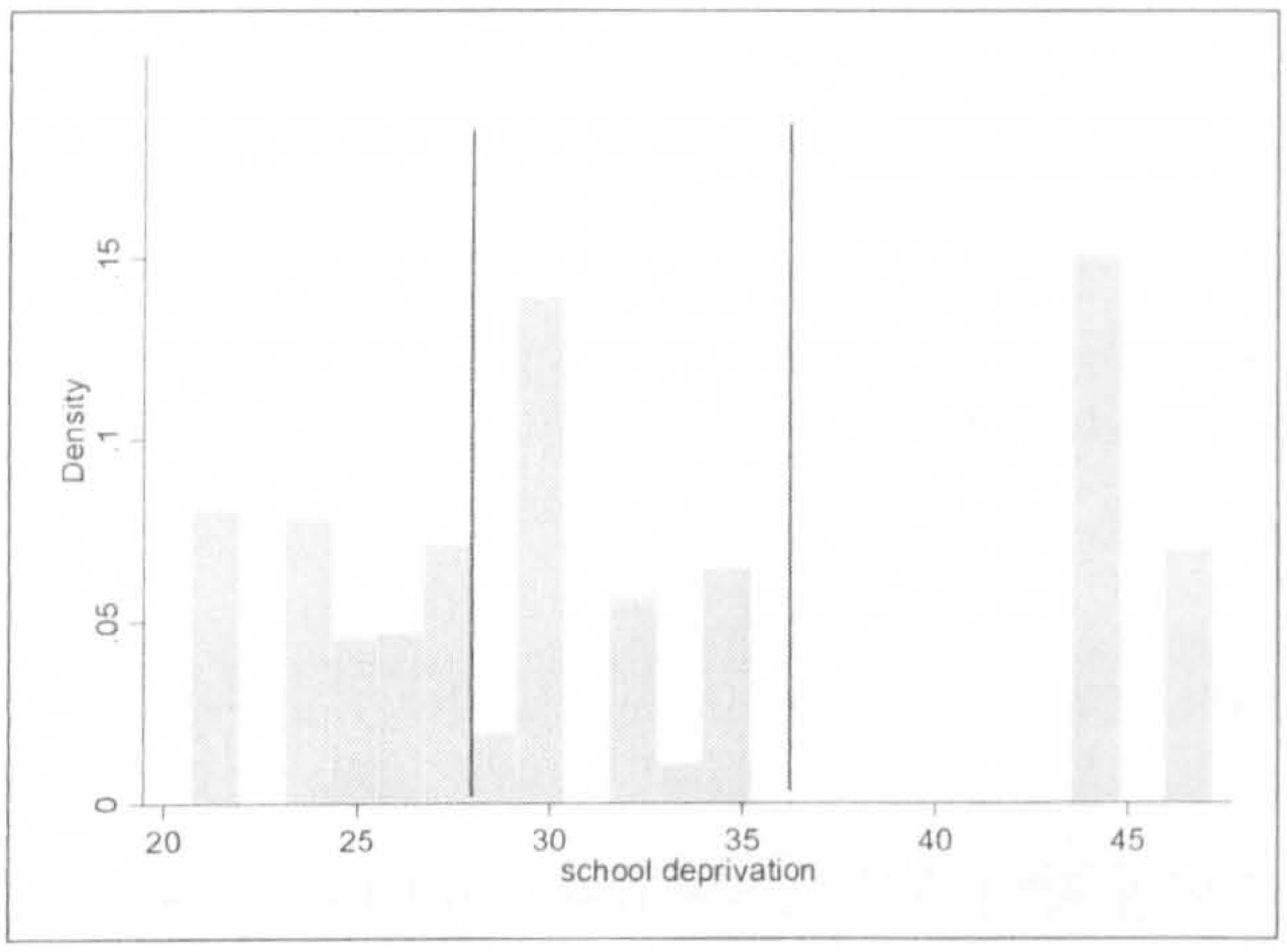
Title of homework	Brief description of homework
Fit Check 1	Goal setting: increasing activity and reducing TV. Scavenger hunt list included as suggestion.
Balance of Good Health	Cooking at home: two recipes
Five food groups	Blank Eat Well Plate: all food eaten in one day by food group
Keeping the balance	Bingo challenge card: choice of 10 activities to do out of 40
Freeze my TV	Freeze My TV: leaflet for parent and Family Freeze My TV chart
Snack attack	Snack worksheet: comparing food content of two snacks at home
Bowling for snacks	Top Grub cards: playing 'Top Trumps' game about content of food.
Think about your drink	Sugar in drinks: instructions for calculating and measuring sugar in drinks at home
Veggiemania	5 A Day: weekly planning sheet for eating 5 fruit and vegetables and chart to record what was eaten
Brilliant Breakfast	Breakfast chart: weekly record of what was eaten and drunk at breakfast and colouring in food groups

6.3. Methods: measurements

6.3.1. Deprivation

The English Government's school deprivation indicator was used to assess school deprivation (See section 4.3.1).[189] The scores for schools in this study ranged from 20.75% to 47.21%. The 16 schools were grouped into low (<=28%), medium (>28 <36%) and high (>=36%) deprivation after initial inspection of the distribution of deprivation scores to give three roughly even groups with distinct levels of deprivation (see Graph 6.1).

Graph 6.1 School deprivation scores (low score is least deprived) n=16



6.3.2. Gender and age

Gender was self-reported by children. If data were missing, records of gender from the school were used to fill in missing values. Children's age at the time of measurement was calculated from the school reported date of birth.

6.3.3. Sedentary behaviour

Selection of measure for sedentary behaviour

The possible methods that could be used to measure sedentary behaviour have been outlined in Chapter 2 (in section 2.2.4). For the purposes of this study direct observation was going to be too expensive and was not appropriate. Therefore I considered using self-report, in the form of questionnaires to provide information about frequency and duration of time spent in different behaviours alongside an objective measure of sedentary time (accelerometers).

As described in section 4.3.3 of Chapter 4 in AFLY5 Phase I the Robinson questionnaire was used to determine hours spent on screen viewing.[159] This questionnaire was easy to use with this age group and on the whole provided data with face validity. However, the questionnaire asked the child to give bands of time, e.g. 15 minutes, rather than exact amounts of time and was restricted to screen based sedentary behaviours. Therefore, following a review of available measures and discussion with my supervisors I considered two possible alternative questionnaires for use in phase II: the Self-Administered Physical Activity Checklist[222] and a sedentary behaviour questionnaire used in a previously published Australian study.[223]

The Self-Administered Physical Activity Checklist (SAPAC), is a survey tool to assess physical activity in children that was developed in the US as part of the Child and Adolescent Trial for Cardiovascular Health (CATCH).[224] The SAPAC primarily measures physical activity but includes four questions on sedentary behaviours before school and after school: TV or video watching; computer, internet; video, computer games; talking on the phone. The SAPAC has been validated using accelerometers with 320 children (mean age of 12.5 (SD 1.2)). The SAPAC had weak correlation (r=0.24) with moderate and vigorous physical activity measured by accelerometery.[224] However, there was no separate validation of the sedentary behaviour questions with the objectively measured sedentary time. In addition, the four sedentary behaviour questions appear to provide less detail than the Robinson questionnaire used in phase I.

Salmon et al have developed a more detailed measure of sedentary behaviours for use in 10 to 12 year old children and used this in a study in Australia.[223] The questionnaire includes items about TV viewing, computer games, computer and internet use (not games), playing indoors with toys, sitting and talking, talking on the phone, listing to music, playing a musical instrument, playing board games, reading, art and craft and the option of including other sedentary activities. The questions are about total time spent in each activity on weekdays and weekends and also ask the child to select one of five pictures of faces that indicated how much they enjoyed the activity. In the Australian study, children completed the measure at school under supervision by the researcher and parents also completed the same questionnaire at home about their child's sedentary behaviours (proxy report). Salmon et al assessed two week test-retest reliability for the time spent in screen based behaviours (calculated using a subset of the questions) during the week and at the weekend for the parent's proxy reports and one week test-retest reliability for the children's reports. The test-retest reliability of the proxy-reported time spent in each of the screen based activities ranged from 0.6 to 0.8. The convergent validity between parent's proxy report and child's self-reported data was reasonable, as measured by Spearman's rank correlation coefficient (television viewing, Rho=0.61; computer use, Rho=0.47; playing electronic games, Rho=0.44). Parent proxy reported sedentary time was reported to be more reliable than children's self-report, however no data was given to substantiate this. This study collected accelerometery data from the children but no data was presented to compare sedentary time assessed by accelerometery and the questionnaire.

I decided to use Salmon's sedentary behaviour questionnaire because the test-retest reliability looked reasonable and I felt it would be useful to examine the feasibility of collecting information on sedentary behaviour from both the child and their parent and to compare agreement between these two and also how associations of with the intervention varied between child's own report and parent report of their sedentary behaviour. The questionnaire was comprehensive in the questions it covered about sedentary activity, without being onerous and was practical to administer in a classroom setting. It also allowed the separation of weekday and weekend sedentary time. However, I decided to make some changes to the questionnaire informed by the design of other sedentary behaviour questionnaires such as Robinson's assessment of TV viewing[159] and SAPAC[222]:

- Splitting the Monday to Friday time into 'before school' and 'after school'
- Asking the question about the previous day and previous Saturday, not the total time for weekdays and weekends, to reduce errors in assessing or adding up time over a week or weekend
- Adding 'hours' and 'minutes' to each answer box in place of an empty box
- Adding 'not Wii or Dance Dance Revolution' to the question about time spent playing Playstation, Nintendo, XBOX, or computer games (because new generation active computer games use more energy than playing sedentary computer games)[225]
- Combining the questions about playing indoors with toys and playing board or card games
- Adding pictures alongside each activity.

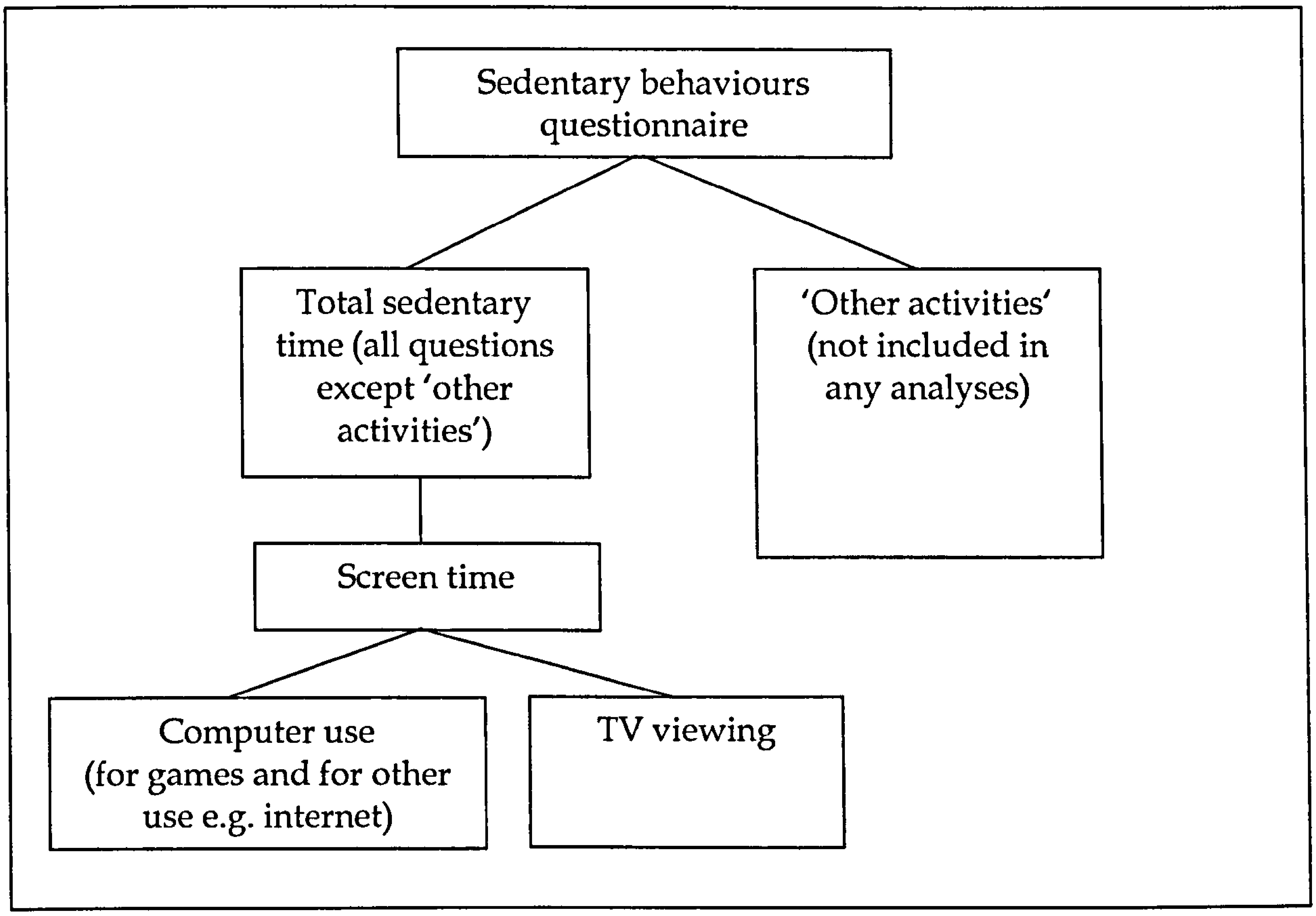
To check that the revised version was appropriate for UK children, a convenience group of four children aged nine to ten were selected to pilot the revised questionnaire. The child and one of their parents were asked to return the completed questionnaire and answer four questions: how long did it take you to complete it; was anything not clear; was anything missing; does the wording of any of the questions need changing. One child and one parent commented that it would be useful to include a question about whether the days for which activities were being reported were unusual or not. One child was confused by wording in one part of the question regarding whether activities that did not involve exercise could be called activities. The questionnaires were reported to have taken 15 minutes by one child and 47 minutes by a second (two children did not respond to this question). Only one parent reported the time taken to complete the questionnaire (five-ten minutes) and none of the parents or children suggested adding any further questions. As a result of this initial pilot of the questionnaire I added a question to indicate if the previous day or Saturday was not a normal day. The final versions of the questionnaire for parents and children are in Questionnaire 7.1 and 7. 2 in Appendix 7.

Method of measuring sedentary behaviour

The sedentary behaviour questionnaire was printed in colour and each questionnaire was labelled with the child's full name, date of birth and an identification number. The children completed the questionnaires in school on any day except a Monday (to ensure the previous day they were referring to was not a Sunday). I gave the children instructions in the classroom about how to complete the questionnaire and the classroom teacher supervised the completion of the questionnaire whilst the children were taken out for the anthropometric measurements. I collected the questionnaires from the children before leaving the school. In six schools (the four parent involvement schools and two receiving just the lessons, matched by deprivation) the children were given a parent proxy report version of the questionnaire, a letter explaining the questionnaire and a stamped addressed return envelope to take home (see Letter 7.4 in Appendix 7). Reminder questionnaires and letters were sent to the school to give to the children if a response had not been received within two weeks. Children in one school were asked to repeat the questionnaire one week later to test for reliability.

The sedentary behaviour questionnaire data was analysed as illustrated in Figure 6.1. Other activities were not included in any analyses as the children listed activities in this section that were largely non-sedentary.

Figure 6.1 Sedentary behaviour questionnaire components of analysis



6.3.4. Accelerometer measurement of sedentary time and physical activity

Physical activity and sedentary time was measured using the GT1M ActiGraph accelerometer. The GT1M was used because it has been widely used in research with children (see section 2.2.3. for further information about the reliability and validity of the accelerometer).[54,75,76]

Parents were asked to give opt out consent for the children to wear the accelerometers. Each accelerometer was initialised to collect count data at 10 second epochs starting at 05.00 hours on the day after the children would be given the accelerometer and to finish at 15.00 hours on the day when the accelerometers were collected The delayed start was to ensure that the data collection started at the beginning of the day, rather than the time when the child was given the accelerometer and also to avoid inflated measurements on the first day when the novelty of the accelerometer was at its maximum. The aim was to give the accelerometers to schools on Wednesday, to allow for data collection on three weekdays (Thursday, Friday and Monday) and two weekend days. The accelerometers were collected the following Tuesday, downloaded, recharged, reinitialised and taken to the next school the following day.

I explained to the children in the classroom what the accelerometers measure, how they should be worn and when they should be removed. Each child was given their accelerometer individually at the time of the anthropometric measurements and the child was asked what they remembered about when the accelerometer should be worn and removed (to check for understanding and to answer any queries about particular sporting activities like gymnastics and judo). An information sheet about wearing the accelerometer was given to each child (see Figure 7.3 in Appendix 7).

The accelerometer data were downloaded using the ActiLife Lifestyle Monitor System software to create dta files. The files were analysed for each school as a batch using MAHUFFE Analyzer Version 1.9.0.3. with the criteria shown in Table 6.3. Puyau's cut points for sedentary, light, moderate and vigorous levels of activity were used.[81] A number of thresholds that have been suggested for defining sedentary, light, moderate and vigorous levels of activity in children[60,77,81,226] but I chose to use the Puyau thresholds because they were derived using whole room calorimetry with six to sixteen year old children for several days; this method is highly regarded and the age range in the study included the age of children in the ALFY5 study. See section 2.2.3. for more detail about the thresholds. A correction factor of 0.91 applied to the cut points, as recommended by Corder et al, because the GT1M accelerometer records fewer counts per minute compared to model 7164 which was used by Puyau to calculate the cut points (see Table 6.3).[83]

Table 6.3 Criteria for analysing accelerometery data in MAHUFFE software

Description	Criteria applied
Physical activity levels (Criteria from Puyau)	Sedentary: 0 to 726 counts
	Light: 727 to 2910 counts
	Moderate: 2911 to 7460 counts
	Vigorous: 7461 counts and above
Non-excluded time	At least 10 minutes
Minimum number of minutes	600 or 500 minutes
Exclude runs of zeros	20 minutes

Summary data for each child was created by day and by hour. Studies with children have restricted the hours of analysis to between 07.00 and 21.00 (mean age 8.6 $\pm$0.4 years)[227], 07.00 and 21.00 hours (mean age 10.5 $\pm$0.8 years)[228] and 07.00 and 21.00 hours[76] (mean age 11.3 $\pm$0.3 years). The accelerometer data collected in this study were checked to see when the children were active. The majority of children were active between 06.00 and 22.00 hours and therefore these cut points were applied to the data. Children with any days of data at a minimum of 500 minutes and 600 minutes were selected for further analysis.

Time spent in sedentary activities was calculated by subtracting the light, moderate and vigorous minutes of activity from the total activity time (between 06.00 and 22.00 hours). This is because the sedentary time calculated by the MAHUFFE software includes the times when the accelerometer is unworn, even though excluded runs of zeros for 20 minutes have been excluded from the total wear time (Kate Westgate at the MRC Epidemiology Unit in Cambridge, personal communication). In the analysis the accelerometer data was adjusted for the number of daylight minutes on the days that they were worn (data obtained from standard tables) because of the seasonal difference in the time period of data collection before and after the intervention and because previous work has shown that activity varies by hours of daylight.[229]

Initial analysis of the measurements before the intervention showed that several children were not wearing the accelerometers for ten hours a day and for the target of five days, therefore ethical approval was sought before the follow-up measurements to give the children the incentive of a small prize (a rubber bouncy ball) if they wore the accelerometer for five days and ten hours a day.

6.3.5. Parent support for physical activity

Parents activity-related parenting practices was assessed using an adapted version of Davison et al's 'parent activity support scale'.[230] The scale has been published with seven sub-scale questions about logistic support and explicit modelling. Davison et al subsequently revised the scale and added sub-scale questions about limiting sedentary behaviours (K. Davison, personal communication).

The revised version was piloted with two parents (a father and mother) who were asked to answer four questions: how long did it take you to complete it; was anything not clear; was anything missing; does the wording of any of the questions need changing. The questionnaire took three minutes to complete and the parents made some minor suggestions for changes which were incorporated in the final version. A copy of the full revised questionnaire is shown in Questionnaire 7.3 in Appendix 7 and the questions are given in Table 6.4.

Parents of children in the four parent involvement schools were asked to complete the parent activity support scale before and after the intervention. The questionnaire was sent home via the child on the day the child took part in the measurements, with a letter explaining how to use the accelerometer and asking the parent to complete this questionnaire and the sedentary behaviour questionnaire (see Letter 7.4 in Appendix 7). A stamped addressed envelope was enclosed. Reminder letters and questionnaires for parents who had not responded were sent to the school two weeks later and the teacher was asked to give them to the child to take home.

Table 6.4 Parent activity support scale sub-scale questions about explicit modelling, logistic support and limiting sedentary time (numbers relate to the order of the questions)

Explicit modelling	1. I enjoy exercise and physical activity.
	3. I often organise family outings that involve physical activity (e.g. going for a walk, a bike ride, or swimming).
	4. I frequently exercise or do something active with my child.
	6. I exercise or am physically active on a regular basis.
	11. I use my behaviour to encourage my child to be physically active.
Logistic support	5. I go out of my way to book my child into sports and other activities that are physically active (e.g. after school clubs, swimming lessons).
	7. I often take my child to places where he/she can be active (e.g. parks, playgrounds, sport games or practices)
	9. I often watch my child participate in sporting activities (e.g. watch your child perform at a football match or a dance performance).
Limiting sedentary time	2. I limit how long my child plays video or computer games (including GameBoy).
	8. My child can only watch a few programmes on TV each day
	10. I tell my child to go outside and do something active if he/she has been doing indoor activities for a long time.
	12. I limit how long my child can use the computer for things other than homework.

The returned questionnaires were entered by one data entry clerk onto an Access database. The data was transferred to Stata version 11. The questions were grouped into three sub-scales (K. Davison, personal communication): explicit modelling of physical activity, limiting sedentary behaviours and logistic support for physical activity (see Table 6.4). The answers to these sub-scale questions were averaged. The median scores were calculated and parents were coded as being at or above the median, or below the median.

6.3.6. Active travel

Children's mode of travel to school was measured using the 'Day in the life questionnaire' (DILQ)[190] which was used in the phase I study (see Questionnaire 4.2 in Appendix 4). See more detail about the questionnaire in section 1.3.4. and in the diet section below (section 6.3.9). Children reported travelling to and from school by foot, bicycle, car, bus or a combination.

6.3.7. Height and weight

Unlike in phase I of AFLY5 where nine school health assistants measured the children's height and weight, in this second phase I undertook all the height measurements to remove inter-rater error and one of four assistants undertook the measurement of weight. Prior to starting the fieldwork I received training in accurately completing these measurements by staff who work at the ALSPAC clinic. The measurements were undertaken in a separate room or area of the school away from the classroom. Height (without shoes) was measured to the nearest 0.1 cm with a free-standing Leicester portable standiometer. Weight (without heavy clothing) was measured to the nearest 0.1 kg on one Seca 899 portable scale with a separate electronic display. The scale was checked for accuracy using a 20kg calibration weight.

Obesity was defined using BMI and the criteria for obesity from the IOTF,[36] 2000 CDC[171] and the UK 1990[170] reference population. See section 3.1.2 for further information about how these three criteria differ. Conventionally in the UK the UK1990 criteria are used, but because this study was testing an intervention from the US and given the differences in prevalence found using the three criteria reported in chapter 3, it was thought useful to present the results using the three criteria.

For the 2000 CDC and UK 1990 cut-off points I took the mid-point for each 6 month age period e.g. 9.25 for ages 9.0 to 9.5 years. For the 2000 CDC percentiles, the cut-off points were based on half months, therefore the closest to 9.25 years was 111.5 months rather than 111 months. The 85th and 95th percentile cut-off points were used for boys and girls. For IOTF the cut-off points are provided for children by half year intervals e.g. 9, 9.5 and 10 year olds. A mid-point was created for 9.25 and 9.75.

6.3.8. Waist circumference

The measurements were undertaken in a separate room or area of the school away from the classroom. I undertook all the waist measurements to remove inter-rater error. Measurements were taken over light clothing (shirt, t-shirt or dress) with the child in a standing position using a non-elastic, flexible Seca measuring tape (number 201). Waist circumference was measured midway between the tenth rib and the iliac crest and measured to the nearest 0.1cm (known as the natural waist).[44] The waist circumference was used to estimate central adiposity using the UK specific McCarthy waist circumference percentiles for children.[44] The International Diabetes Federation has suggested criteria a cut-off point of ≥90th centile of waist circumference for age, sex, and ethnic origin in children aged six and above for defining central adiposity (obesity).[45]

6.3.9. Diet

Dietary behaviours were assessed using the DILQ[190] which was the same as in phase I (see section 1.3.4). The DILQ provides information about the children's entire food and drink intake the previous day. I explained the questionnaire to the children in class and teachers were asked to supervise the children completing the questionnaire whilst individual children were taken out for anthropometric measurements. I collected completed questionnaires before leaving the school.

Questionnaire responses were entered into a Microsoft Access database by one member of staff. Food was coded using the categories outlined in Figure 4.2 in Appendix 4 of fruit and vegetables, sweet and savour snacks, high energy drinks and high fat food. Codes were assigned to all new versions of spellings in addition the words assigned codes from the pilot study. This coding was used to generate automatic coding of the text in Access. I wrote rules for assigning food and drinks to each category and a data entry clerk undertook a manual verification of the automatic coding or changes to the coding. The coder checked with me any items that could be allocated to more than one of the outcome categories or where spellings were difficult to interpret. After these discussions and initial complete coding I checked a randomly generated 10%sample of the diet entries for the children; any differences between the initial or second coders were agreed by discussion with my supervisors. 0.25% of the original codes required changing after my second coding; half of the changes were for the category of 'other food' which is not included in the analysis.

6.3.10. Day of assessment before and after intervention

I tried to ensure that all measurements and questionnaires were taken on the same day before and after the intervention. However, the visits to schools also had to be arranged at a convenient time for the teachers in order to fit in with other events. For the schools where accelerometer measurements were taken I worked particularly hard to ensure that these were all on the same day (Wednesday) so that the accelerometer could start to be worn on Wednesday and be ready for collection on Monday after school or Tuesday morning, giving me time to download the data ready to take the accelerometers to another school the following Wednesday. This maximised the chance of the children wearing the accelerometers for the required number of days. In half the schools the measurements and questionnaires before and after the intervention were on the same day; therefore in these schools the diet and sedentary questionnaires related to the same day of the week. In five out of six of the schools wearing accelerometers the visits were on the same day. In three of the remaining 11 schools the questionnaire and anthropometric measurements were on the same day. Table 7.1 in Appendix 7 shows the dates of the measurements before and after the intervention.

6.3.11. Data management

The data collected from the schools was entered onto an Access database by one data clerk at the University of Bristol. For all variables, rules were created to minimise errors in data entry, such as data entry being restricted to '0 or 1' where a binary answer was indicated. An error check was run on a sample of the data. The paper copies were retained and stored at the Department of Social Medicine in a locked, restricted access location.

6.3.12. Statistical analysis

The statistical analysis is summarised firstly by assessment of data quality, secondly by descriptive analysis and thirdly by before and after intervention comparisons.

The quality of the data from the height, weight and waist circumference measures was assessed. The individual measurements were assessed for digit preference (rounding up or down to whole or half numbers) for the third decimal place for height and the first decimal place for weight and waist. For a random distribution it would be expected that about 10% of measures would be to the nearest whole number, and 10% to the nearest half number. A further 10% of measures would be recorded for each of the other decimal places. The BMI at baseline was plotted against BMI at follow-up and BMI was plotted against waist circumference to identify any outliers which could be transcribing errors at data collection or typing errors at data entry.

The quality of the screen-time data was assessed by determining maximum possible times for weekdays and weekends and removing outliers (see section 4.3.3). The quality of the diet data was assessed by determining whether the data was incomplete if the child indicated they were not in school for part of the day or if more than half of the questions were incomplete or there was no text for the three main meals. The accelerometer data were assessed for the number of hours of data collected per day. Data were included if a minimum of 500 minutes or 600 minutes were recorded for at least three days.

Data were described before the intervention by mean (standard deviation) or median (interquartile range) for continuous measurements and numbers (%) for categorical variables. Previous evidence suggests that behaviours and adiposity are influenced by deprivation and gender; therefore data for the whole study sample are described and also by gender and area deprivation, using the before intervention data. The Kruskal-Wallis non-parametric test and the Pearson Chi Squared test were used to test differences by gender and area deprivation.

For the diet data only, the percentages of portions consumed per day by location (i.e. in and outside school) were assessed. Diet was the only outcome measure that had information regarding location. A t-test was used to compare the mean percentages of each food between the two locations. It was assumed *a priori* that the percentages for all food types would be expected to be higher for food/drink consumed outside school than in school, since two meals are consumed outside school during week days and in total more time is spent outside school than in school.

The before and after intervention comparison was undertaken using a paired t-test (after-before). For non-normally distributed data geometric means are presented. Odds ratios for binary data were calculated and the null hypothesis of no difference comparing after to before interventions (an odds ratio of 1) was tested using McNemar's test for paired data. These before and after comparisons were undertaken for all schools in phase II and also separately for schools that involved parents and those that did not. Linear and logistic regression were used to compare outcomes between schools that involved parents and those that did not, whilst adjusting for baseline variables, gender, age and school cluster.

6.4. Methods: process evaluation

6.4.1. Child focus groups data collection

Focus groups were chosen as the method to explore children's experiences and views of the AFLY5 phase II intervention. Focus groups avoid the limitations of literacy and reading levels and provide the opportunity to explore issues in more detail than can be achieved through a questionnaire and in a more comfortable peer-based setting than a one to one interview.[231] Focus groups are an organised group discussion with the aim of eliciting perceptions, feelings, attitudes and experiences in a non-threatening environment.[232] Kennedy et al advise that by age 10 children are able to convey their thoughts and feelings to one another and they are able to engage in focus groups for up to 90 minutes.[231]

Parents of children in the four schools with the additional parent involvement were sent letters inviting their child to take part in a focus group (see Letter 7.5 in Appendix 7). Parents were asked to send written consent in a stamped addressed envelope. Reminders were sent to schools to send home if only two or fewer responses had been received within two weeks. The focus groups were held during the school day at the school in a separate room from the classroom. No school staff were present during the focus groups. I facilitated the focus groups with assistance from Byron Tibbets (research assistant) who took hand written notes. The focus groups were recorded on an Olympus digital voice recorder DS-2300 with an attached conference microphone, model CM9090S.

I explained to the children what the focus group was for and asked the children to sign their assent to take part. I outlined the following ground rules:

- use first names
- nothing will be attributed directly to named individuals or schools
- one person to speak at a time
- allow everyone to contribute
- respect one another's views

To break the ice and to help the transcriber identify the children's voices, I started by asking each child to give their name and their favourite subject or activity at school. A list of questions was used to guide the discussion (see Figure 7.4 in Appendix 7). The focus of the questions was to find out what the children thought about the homeworks and whether their parents were involved, including what facilitated or was a barrier to parent involvement. To aid the discussion about the homeworks, each child was given a set of six smiley faces with the following words describing the faces: loved it, liked it, didn't like it, hated it, don't know, didn't do it. During the discussions about each homework I asked the children to hold up the face which described how they felt about the homework and to explain why; this approach was informed by guidance from Kennedy et al about conducting focus groups with children and the advantages of using activities.[231] All the recordings were transcribed and anonymised to protect confidentiality.

6.4.2. Parent interviews data collection

Parents in the four schools with the additional parent involvement intervention were sent letters via the school in May 2009 inviting them to take part in a telephone interview to give their views of the AFLY5 project (see Letter 7.6 in

Appendix 7). Reminder letters were sent in June 2009 because of a poor response. A semi-structured interview schedule was used to guide the interview (see Interview Schedule 7.1 in Appendix 7). All interviews were undertaken by myself at a time convenient for the parent using a conference telephone. The interview was recorded on an Olympus digital voice recorder DS-2300 with an attached conference microphone, model CM9090S. The recordings were transcribed and anonymised to protect confidentiality.

6.4.3. Parent end of project questionnaire

In addition to the parent interviews, parents in the four schools with the additional parent involvement intervention were sent letters in June 2009 inviting them to complete a questionnaire about the AFLY5 phase II project and a prepaid return envelope (see Letter 7.7 and Questionnaire 7.4 in Appendix 7). Data were entered into Access by a data entry clerk and transferred to Stata for analysis of the quantitative answers and to Nvivo for the free text answers.

6.4.4. Teacher interviews

The four teachers in the schools with the additional parent involvement were invited to take part in a face to face semi-structured interview with me at their school (see Interview Schedule 7.2 in Appendix 7). In three schools the teacher was interviewed, in one of these an additional year 5 teacher was also interviewed, and in the fourth school an assistant teacher who taught the lessons was interviewed instead of the classroom teacher. The interviews were recorded on an Olympus digital voice recorder DS-2300 with an attached conference microphone, model CM9090S. The recordings were transcribed and anonymised to protect confidentiality.

6.4.5. Qualitative analysis

The analysis of the child focus groups and parent interviews used the same methods as in Chapter 4 (see section 4.4.3).

6.4.6. Teacher end of project questionnaire

At the time of follow-up measurements teachers in all sixteen schools were given a questionnaire to complete about the project (see Questionnaire 7.5 in Appendix 7). The questionnaire asked the teachers to rate their views on the training, the measurements, how the lessons fitted with the curriculum, which lessons were taught, the quality of the lessons, whether the lessons were taught by another teacher, the ease of using the lesson plans, whether the lessons supported behaviour change, feedback from parents and whether they would continue to use the materials. Data was entered into Access by a data entry clerk and transferred to Stata for analysis.

6.5. Results: quantitative analysis

6.5.1. Assessment of data quality

The assessment of data quality is presented in Appendix 8.

Completeness of measurements

The participation of children and parents in measurements varied by school. The participation in each measurement before and after the intervention is shown by intervention group and by school in Appendix 8 (Tables 8.1 to 8.5). Fewer children were absent before the intervention (4.2%) than after the intervention (7.2%). Very few parents requested that their child did not complete measurements; the highest opt out was for weight and waist measurements, which was on average 3%.

6.5.2. Descriptive data before AFLY5 intervention

The children had a mean (SD) age of 9.7 (0.3) before the AFLY5 phase II intervention and 50.75% of the participants were female. The school deprivation indicator for the schools ranged from 20.8 to 47.2, with a mean (SD) of 32.3 (8.6).

Sedentary behaviours

461 children completed the baseline sedentary behaviour questionnaire. Children were excluded from the analysis where their total sedentary time or total screen time exceeded pre-determined values (see section 6.3.3 and Appendix 8). 148 (32%) children were excluded from sedentary time on weekdays, 114 (25%) children from sedentary time on Saturday, 51 (11%) children from screen time on weekdays and 37 (8%) children from screen time on Saturdays. The sedentary behaviour questionnaire data were assessed for reliability using Bland-Altman plots and the kappa statistic (see Graphs 8.14 to 8.17 in Appendix 8). Whilst the number of data points for the test-retest reliability was small, there appeared to be a lot of variation and this appeared to increase with larger reported times spent in sedentary or screen viewing behaviour. The sedentary behaviour questionnaire measure appeared to differentiate children at the extreme ends of time spent in sedentary behaviour but the variation suggested it was not reliable and therefore unlikely to be accurate in measuring changes in response to an intervention. The assessment of inter-rater reliability for child reported and parent report sedentary and screen time using Bland-Altman plots shows there was a low level of agreement (see Graphs 8.18 to 8.21 in Appendix 8). However, it is not possible to say which is correct because the child may have a better knowledge of how they have spent their time, but the parents may be more accurate in estimating time.

Spearman's rank correlation was used to compare the child's reported sedentary time with the accelerometer data (time spent in sedentary, light and moderate and vigorous physical activity (MVPA)). These analyses were repeated to compare parent report of sedentary time to the accelerometer data. There was very weak correlation between questionnaire and accelerometer measures of sedentary time for all measurements (ranging from -0.13 to 0.11 for children and -0.02 to 0.07 for parents). Given the lack of agreement between the sedentary time reported by children and parents and the weak correlation of both with accelerometer time it is not possible to determine whether child or parental report of sedentary time is the better measure. The child and parent reported sedentary time changed from before to after intervention in the same direction and to a similar extent, as will be reported later. Therefore both assessments of sedentary behaviour, as well as accelerometer data will be compared before and after the intervention.

88.2% of children before the AFLY5 intervention wore the accelerometers for at least 10 hours a day for one day and 75% of children had data collected both before and after the intervention for one day. The restriction of a minimum of three days data reduced the percentage of children with at least 600 minutes a day of wear time from 88.2% to 57.5% before the AFLY5 intervention and from 75% to 45.6% for children with data both before and after the intervention. Further assessment of the data completeness by school is provided in Appendix 8.

Table 6.5 shows the total median sedentary and screen time spent before the AFLY5 intervention from the sedentary behaviours questionnaire, excluding outliers, by gender. Boys spent more time than girls in sedentary activities and in screen viewing activities.

Table 6.5 Total child reported time in minutes spent in sedentary and screen time before the AFLY5 intervention excluding outliers, measured by the sedentary behaviours questionnaire

		Sedentary time			Screen time		
Activity		**n**	**Median (IQR)**	**Range min, max**	**n**	**Median (IQR)**	**Range min, max**
Total weekday[a]	All	313	280 (168, 434)	0, 719	410	120 (50, 225)	0, 720
	Boys	138	345 (195, 509)	16, 709	184	180 (90, 270)	0, 720
	Girls	175	252 (164, 375)	0, 719	226	81 (30, 150)	0, 566
Total Saturday[a]	All	347	340 (192, 543)	0, 1080	424	160 (60, 300)	0, 1579
	Boys	163	400 (205, 615)	0, 1080	197	226 (105, 360)	0, 1241
	Girls	184	300 (158, 469)	0, 1053	227	110 (40, 210)	0, 1579

[a] Does not include 'other activities' because the reported activities involved physical activity

Screen viewing categorised in number of hours

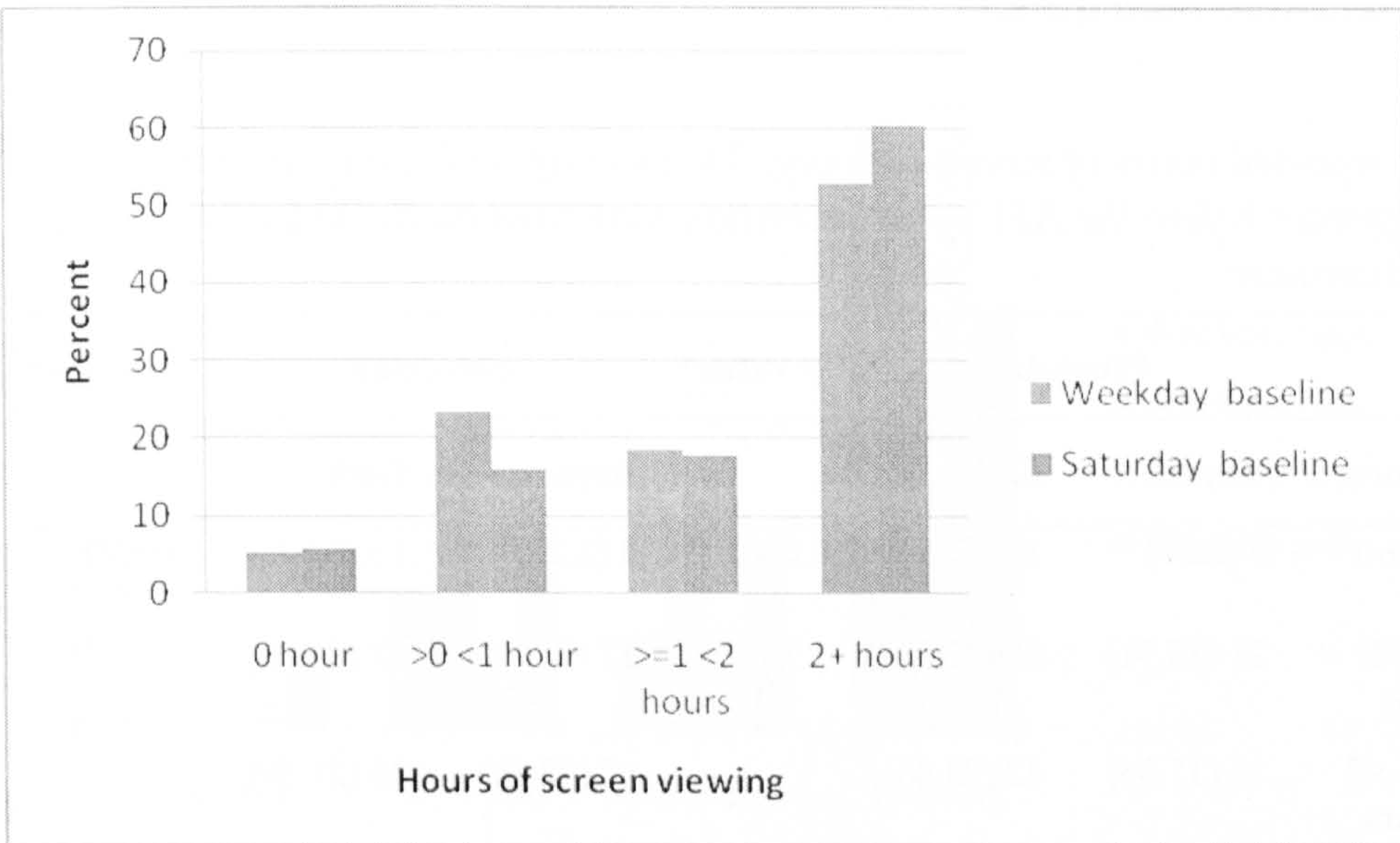
Table 6.6, Graph 6.2 and Graph 6.3 show the screen viewing data categorised into hours of viewing and separated into TV and computer use. The majority of children before the AFLY5 intervention reported over 2 hours of screen time (53% on weekday; 60% on Saturday). The children spent more time watching TV than using computers.

Table 6.6 Total child reported screen viewing (TV and computer) before the AFLY5 intervention for children with before and after measurements, measured by the sedentary behaviours questionnaire (n=308)

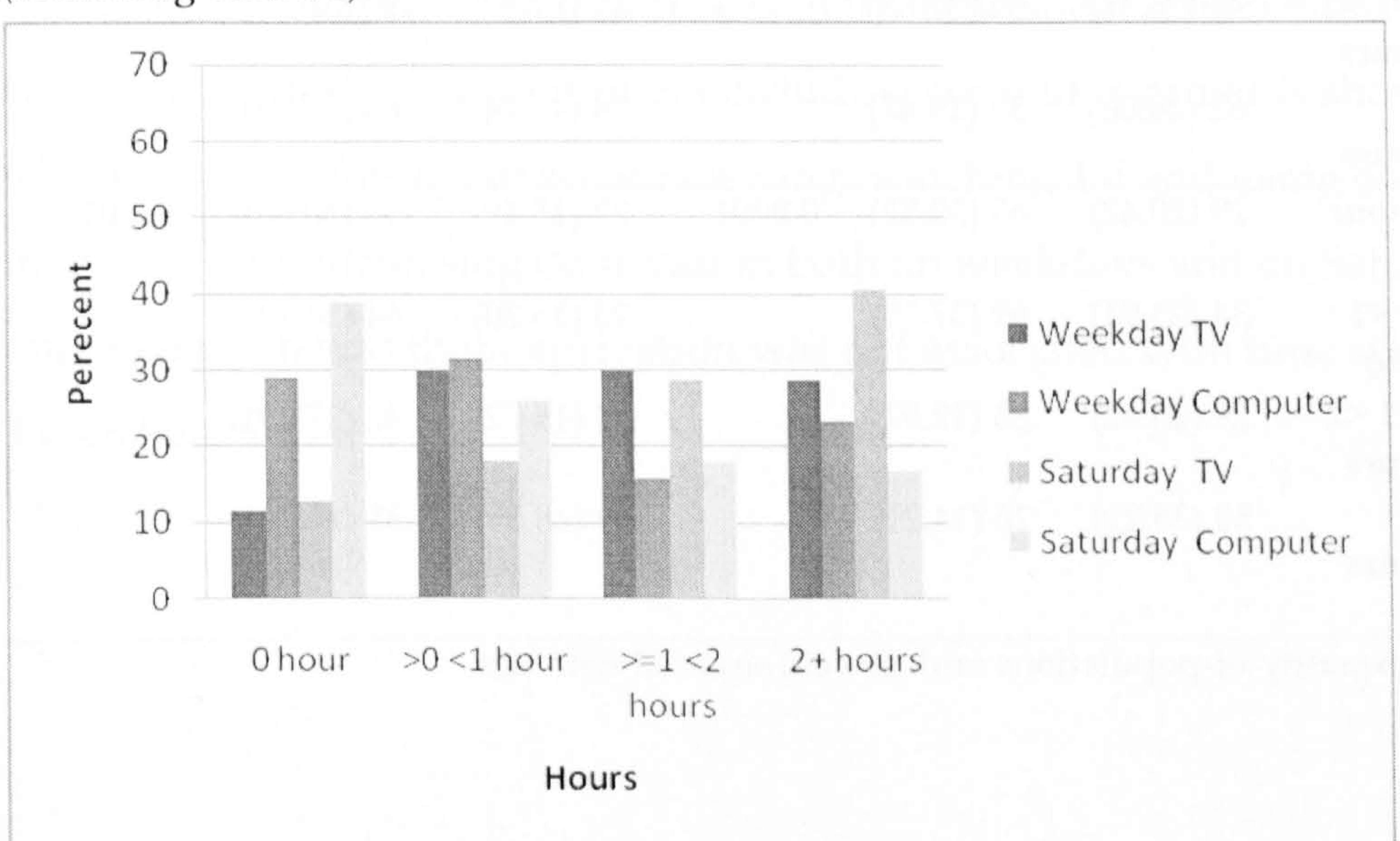
	Hours	Weekday n (%)	Saturday n (%)
Total screen viewing n=308[a]	0 hour	16 (5.19)	18 (5.84)
	>0 <1 hour	72 (23.38)	49 (15.91)
	>=1 <2 hours	57 (18.51)	55 (17.86)
	2+ hours	163 (52.92)	186 (60.39)
TV n=345[a]	0 hour	40 (11.59)	44 (12.75)
	>0 <1 hour	103 (29.86)	62 (17.97)
	>=1 <2 hours	103 (29.86)	99 (28.70)
	2+ hours	99 (28.70)	140 (40.58)
Computer n=325[a]	0 hour	94 (28.92)	126 (38.77)
	>0 <1 hour	103 (31.69)	85 (26.15)
	>=1 <2 hours	52 (16.00)	59 (18.15)
	2+ hours	76 (23.38)	55 (16.92)

[a] The denominator is number of children and varies because the exclusion of total minutes on a weekday $\geq$720 and $\geq$1080 removed more children from the total screen viewing than the separate TV and computer analysis

Graph 6.2 Percentage of children spending 0 to 2 hours+ screen viewing before the AFLY5 intervention from child reported sedentary questionnaire (excluding outliers)



Graph 6.3 Percentage of children spending 0 to 2 hours+ watching the TV or using the computer before the AFLY5 intervention from child reported sedentary questionnaire (excluding outliers)



Analysis by gender

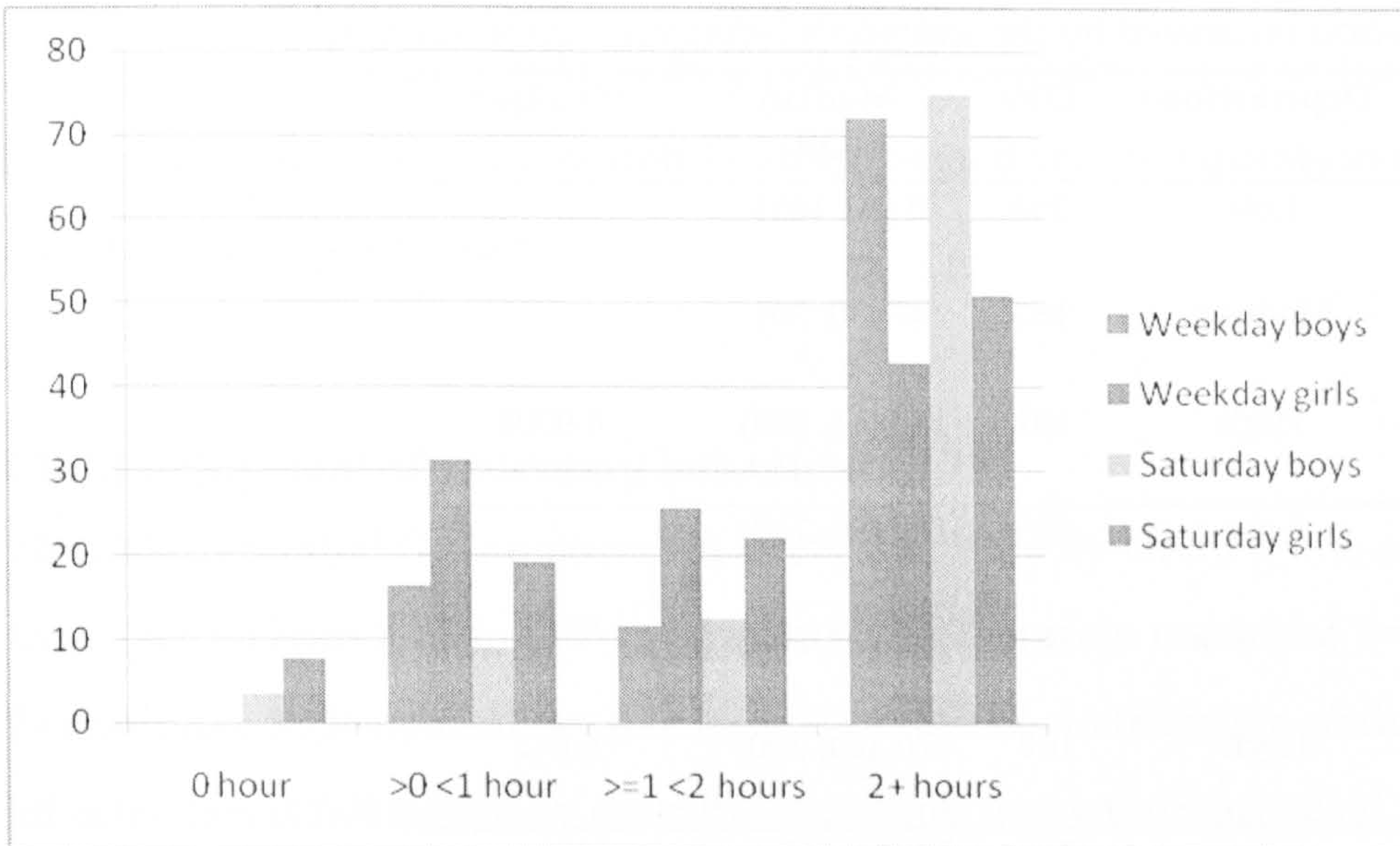
Table 6.7 and Graph 6.4 show the hours of screen viewing before the AFLY5 intervention by gender and separated into TV and computer use. Boys reported more screen viewing, more TV watching and more computer use on the previous weekday and Saturday than girls.

Table 6.7 Child reported hours of screen viewing, TV viewing and computer use (categorical) by gender before the AFLY5 intervention measured by the sedentary behaviours questionnaire

		Weekday		p value[a]	Saturday		p value[a]
	Hours	Boys	Girls		Boys	Girls	
Total screen viewing n=308	0 hour	3 (2.27)	13 (7.39)	0.0001	3 (2.27)	15 (8.52)	0.0001
	>0 <1 hour	21 (15.91)	51 (28.98)		12 (9.09)	37 (21.02)	
	>=1 <2 hours	15 (11.36)	42 (23.86)		17 (12.88)	38 (21.59)	
	2+ hours	93 (70.45)	70 (39.77)		100 (75.76)	86 (48.86)	
TV n=345	0 hour	9 (5.81)	31 (16.32)	0.0001	17 (10.97)	27 (14.21)	0.02
	>0 <1 hour	43 (27.74)	60 (31.58)		22 (14.19)	40 (21.05)	
	>=1 <2 hours	41 (26.45)	62 (32.63)		42 (27.10)	57 (30.00)	
	2+ hours	62 (40.00)	37 (19.47)		74 (47.74)	66 (34.74)	
Computer n=325	0 hour	29 (20.42)	65 (35.52)	0.0001	22 (15.49)	56 (30.60)	0.0001
	>0 <1 hour	34 (23.94)	69 (37.70)		23 (16.20)	64 (34.97)	
	>=1 <2 hours	29 (20.42)	23 (12.57)		28 (19.72)	32 (17.49)	
	2+ hours	50 (35.21)	26 (14.21)		69 (48.59)	31 (16.94)	

[a] Kruskal-Wallis equality-of-populations rank test chi squared with ties

Graph 6.4 Hours of screen viewing by gender before the AFLY5 intervention measured by the sedentary behaviours questionnaire n=292



Analysis by deprivation

Assessment of deprivation differences in the time spent screen viewing, watching TV and using computers including computer games is shown in Table 6.8. In general time spent screen viewing, watching TV and using computers increased with increasing deprivation both on weekdays and on Saturdays. The only exception was that deprivation was not associated with time spent watching TV on Saturdays.

Table 6.8 Median times spent screen viewing, watching TV and using computers (including computer games) by deprivation group on weekdays and Saturdays before the AFLY5 intervention measured by the sedentary behaviours questionnaire

Activity	Deprivation [a]	Obs	Median (IQR)	p value [b]
Screen time weekday[b]	Low	154	70 (30, 165)	
	Medium	155	147 (30, 70)	
	High	101	140 (61, 240)	0.0001
Screen time Saturday[b]	Low	163	120 (50, 240)	
	Medium	161	180 (80, 350)	
	High	100	170 (64, 300)	0.012
TV viewing weekday[b]	Low	167	50 (10, 115)	
	Medium	162	70 (30, 136)	
	High	112	70 (30, 140)	0.0004
TV viewing Saturday[b]	Low	173	80 (15, 150)	
	Medium	165	90 (40, 170)	
	High	112	70 (30, 175)	0.376
Computer use weekday[b]	Low	162	20 (0, 60)	
	Medium	158	60 (5, 120)	
	High	103	20 (0, 120)	0.002
Computer use Saturday[b]	Low	169	30 (0, 80)	
	Medium	161	70 (10, 170)	
	High	106	60 (1, 180)	0.003

[a] Low=<28% school deprivation; medium >28<36 school deprivation; high >=36 school deprivation. [b] Kruskal-Wallis equality-of-populations rank test chi squared with ties

Other activities

The children reported many different activities in the final question about 'other' activities. Most of the activities they reported were active not sedentary (Table 8.16 in Appendix 8), even though I had explained that the questionnaire was about sedentary activities.

Child Enjoyment of sedentary behaviours

The children rated their enjoyment of each activity by circling one of five smiley faces (see Graphs 8.22 to 8.33 in Appendix 8). The scale used was 1=hate it, 2=don't like it, 3=neutral, 4= like it, 5=love it. The distribution of the rankings for all activities is not normally distributed, so median values are used (see Table 6.9). Homework and playing a musical instrument were the only activities which received a predominantly neutral-negative rating, whereas the others were predominantly positive-neutral. The highest rating of enjoyment was given by boys for computer games.

Table 6.9 Median enjoyment of sedentary activities before the AFLY5 intervention (1=hate it, 5=love it)

Activity	All n=532 Median rank (IQR)	Boys n=262 Median rank (IQR)	Girls n=270 Median rank (IQR)
TV, DVDs or Videos	4 (4,5)	4 (4,5)	4 (4,5)
Computer games	4 (4,5)	5 (4,5)	4 (3,5)
Computer	4 (3,4)	4 (3,5)	4 (3,4)
Homework	3 (1,4)	2 (1,4)	3 (2,4)
Indoor games	4 (3,5)	4 (3,5)	4 (3,5)
Talking	4 (3,4)	3 (3,4)	4 (3,5)
Phone or text	4 (3,4)	3 (2,4)	4 (3,4)
Listening to music	4 (3,5)	3 (4,5)	4 (4,5)
Playing music	3 (2,4)	3 (2,4)	4 (3,5)
Reading	4 (3,5)	4 (3,5)	4 (4,5)
Art and craft	4 (3,5)	4 (2,5)	4 (4,5)

Sedentary time measured by accelerometer

146 (62.4%) of children had 3 days of accelerometer and a minimum of 500 minutes per day of data before the intervention and 129 (55.1%) had a minimum of 600 minutes per day. Table 6.10 shows the number of children with 3 days of before and after intervention accelerometer data for 500 minutes and 600 minutes by gender and school deprivation. More girls than boys provided complete data and more children in low deprivation schools provided complete data. The distribution of minutes of sedentary before the intervention was slightly negatively skewed (see Graphs 8.35 and 8.36 in Appendix 8). The gender and deprivation differences in the mean minutes of sedentary time before and after the intervention are shown in Table 6.11. The sedentary time was similar by gender and by school deprivation.

Table 6.10 Number of children with a minimum of 3 days and 600 minutes per day of accelerometer wear time before the intervention by gender and school deprivation (n=146 for 500 minutes and n=129 for 600 minutes)

		Minimum number of minutes for 3 days n (%)	
		500 min	**600 min**
Gender	Boys	65 (44.5)	60 (46.5)
	Girls	81 (55.5)	69 (53.5)
Deprivation[1]	Low	80 (54.8)	74 (57.4)
	High	66 (45.2)	55 (42.6)

[1] School deprivation classified as: low =<28%; high >=36%

Table 6.11 Sedentary time measured by accelerometer by gender and deprivation for children with at least 500 or 600 minutes of data for at least 3 days before the AFLY5 intervention

	Minutes of sedentary time	Gender[1]	500 minutes Mean (SD)	600 minutes Mean (SD)
Gender	Before the intervention	Boys	587.0 (59.3)	603.0 (56.7)
		Girls	590.2 (60.1)	617.5 (55.6)
		p value[2]	0.76	0.21
Deprivation[3]	Before the intervention	Low	588.3 (59.0)	609.0 (57.6)
		High	588.3 (60.7)	606.2 (56.6)
		p value[2]	0.71	0.93

[1] For 500 minutes boys=65 and girls=81 ; for 600 minutes boys=60 and girls=69. [2]Kruskal-Wallis equality-of-populations rank test chi squared with ties. [3]High deprivation >36% school indicator and low deprivation <28% school indicator. 80 children with 500 minutes data were in low deprivation schools and 74 children with 600 minutes. 66 children with 500 minutes data were in high deprivation schools and 55 children with 600 minutes.

Physical activity

The analysis of physical activity measured by accelerometer is restricted to children with a minimum of 3 days of accelerometer data before the intervention measurements. The distribution of accelerometer total counts, counts per minute and minutes of moderate and vigorous physical activity before the AFLY5 intervention were slightly positively skewed (see Graphs 8.37 to 8.42 in Appendix 8). The gender differences in accelerometer analysis are shown in Table 6.12. Boys recorded more counts per minute and spent more time in moderate and vigorous physical activity (MVPA) than girls. Table 6.13 shows there was no evidence of a difference in moderate and vigorous time by deprivation.

Table 6.12 Gender accelerometer analysis for children with at least 500 (n=119) or 600 minutes (n=102) of data for at least 3 days before the intervention

Activity	Gender[1]	500 minutes Mean (SD)	600 minutes Mean (SD)
Minutes of MVPA	Boys	38.52 (13.16)	39.10 (13.81)
	Girls	30.82 (12.39)	32.43 (13.09)
	p value[2]	0.003	0.005
Counts	Boys	393,407 (100,317)	402,360 (104,940)
	Girls	357,431 (117,268)	379,609 (123,359)
	p value[2]	0.005	0.11
Counts per minute	Boys	543.4 (138.0)	539.5 (142.9)
	Girls	494.3 (158.2)	505.6 (165.6)
	p value[2]	0.008	0.10

[1] For 500 minutes boys=50 and girls=71 ; for 600 minutes boys=60and girls =57[69]

Table 6.13 Deprivation analysis of mean minutes of moderate and vigorous physical activity before AFLY5 intervention for children with at least 500 and 600 minutes of data for at least 3 days with before intervention data

	500 minutes	600 minutes
Deprivation[1]	Mean (SD)	Mean (SD)
Low	34.8 (14.4)	35.6 (14.7)
High	33.6 (11.9)	35.4 (12.6)
p value[2]	0.72	0.92

[1] High deprivation >36% school indicator and low deprivation <28% school indicator. 80 children with 500 minutes data were in low deprivation schools and 74 children with 600 minutes. 66 children with 500 minutes data were in high deprivation schools and 55 children with 600 minutes. [2]Kruskal-Wallis equality-of-populations rank test chi squared with ties.

Parent support for physical activities

126 (53.8%) parents completed the parent support for physical activity scale questionnaire. The completeness of the twelve questions ranged from 96% to 97.6% (See Table 8.19 in Appendix 8). 93.7% of respondents were mothers and 6.4% were fathers. The results for mothers and fathers have been combined because the small number of fathers. Davison found that although mothers and fathers tended to report different methods of encouraging their daughter to be physically active, there was positive correlation of mothers and fathers within families.[230] Parents reported their agreement to the statements in an adapted version of Davison et al's questionnaire assessing parents' activity-related parenting practices (see section 6.3.5 above for more information about the changes made).[230] The parents' responses to each question are given in Table 8.20 in Appendix 8.

The questions were grouped into three sub-scales: explicit modelling (five questions), limiting sedentary behaviours (four questions) and logistic support (three questions).

The answers to the modelling, sedentary and logistic support questions were combined and an average score generated for each sub-scale. The distribution of scores were all negatively skewed (see Graphs 8.43 to 8.45 in Appendix 8) with the majority of parents reporting some degree of modelling, logistic support and limiting sedentary activities. There was no evidence of a difference in the median parent ratings by child's gender (see Table 6.14). Parents from schools in areas of high deprivation were less likely to limit their children's sedentary behaviour than those from schools in areas of low deprivation, but parental modelling and logistic support did not seem to vary by area deprivation (see Table 6.15).

Table 6.14 Median and standard deviations for parent activity support scale sub-scale scores before intervention (n=120)

Sub-scale	Gender[1]	Median (SD)	p value for gender[2]
Modelling physical activity	All	4 (3.4, 4.2)	
	Boys	4 (3.4, 4.2)	
	Girls	3.8 (3.4, 4.2)	0.39
Limiting sedentary time	All	3.75 (3.5, 4.3)	
	Boys	3.75 (3.5, 4.5)	
	Girls	4 (3.5, 4.25)	0.92
Logistic support	All	4 (3.7, 4.7)	
	Boys	4 (3.7, 4.3)	
	Girls	4.3 (3.8, 4.7)	0.44

[1] 57 boys, 54 girls, 9 missing gender
[2] Chi-squared with ties

Table 6.15 Number and percentage of parents with above median levels of modelling, limiting sedentary and logistic support by deprivation group

Sub-scale	Low deprivation	High deprivation	p value[2]
Modelling physical activity	42 (64.5)	20 (32.3)	0.17
Limiting sedentary behaviours	47 (58.0)	34 (42.0)	0.01
Logistic support	57 (67.1)	28 (32.9)	0.51

[1] School deprivation score: low (0) =<28%; medium (1) >28<36; high (2) >=36
[2] Pearson chi²

Active travel

Data were available for 485 children. The children self-reported their mode of transport to school as walk, cycle, bus or car in the DILQ. Few children cycled (6.0%) or took the bus (0.4%) and these children are combined with the children who walked or travelled by car, respectively. Just over half (55.5%) of the participants travelled to school by active transport (walking or cycling) (see Table 6.16). There was no difference by gender in mode of transport. Children in more deprived schools were more likely to travel to school by active travel.

Table 6.16 Transport to school at baseline by whole cohort, by gender and deprivation

		Transport to school n (%)			
		Active: walk or cycle only	Non-active: bus or car only	Active and non-active: walk or cycle AND bus or car	Other
Total study sample n=485		269 (55.5)	203 (41.9)	11 (2.3)	2 (0.4)
By gender	Male n = 231	130 (56.3)	92 (39.8)	8 (3.5)	1 (0.4)
	Female n = 254	139 (54.7)	111 (43.7)	3 (1.2)	1 (0.4)
	p-value[a]		0.90		
By school based deprivation[b]	Low n = 188	89 (47.3)	91 (48.4)	6 (3.2)	2 (1.1)
	Medium n = 168	95 (56.6)	70 (39.5)	3 (1.8)	0 (0.0)
	High n = 129	85 (65.9)	42 (32.6)	2 (1.6)	0 (0.0)
	p-value[a]		0.01		

[a] Kruskal-Wallis equality-of-populations rank test. [b] deprivation categories based on the school deprivation index: low =<28%; medium >28<36; high >=36.

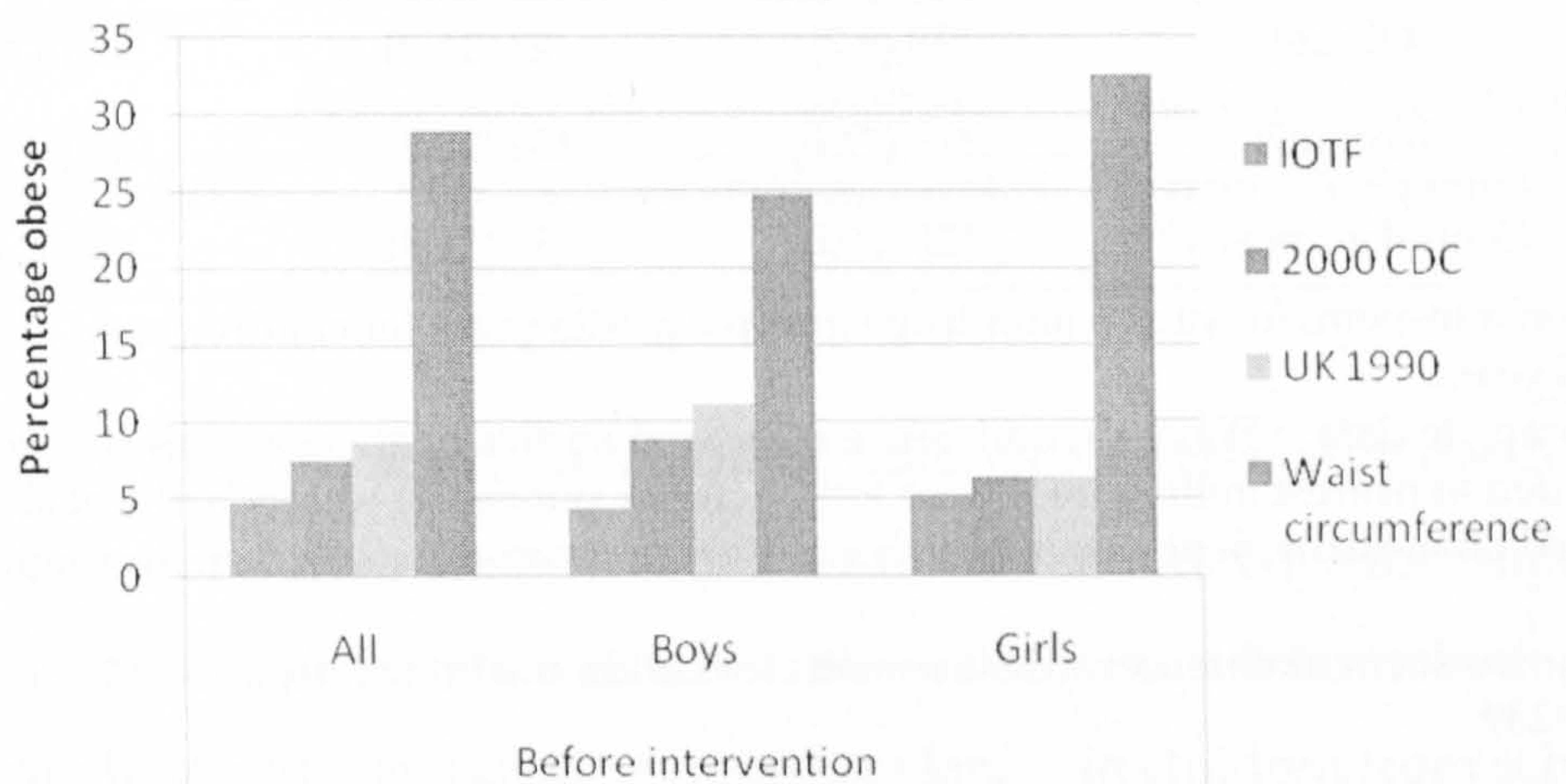
Height weight and waist circumference

The weight and waist data were are approximately normally distributed (see Graphs 8.46 to 8.51 in Appendix 8). The check of data quality identified one waist circumference data point which was incorrectly entered, which is a data entry error rate of 0.04% for the height, weight and waist data. There was slight digit preference for height, weight and waist, but it was not as marked as in phase I. There was inverse digit preference for the digits zero and five for waist circumference after the AFLY5 (see Graphs 8.55 to 8.60 in Appendix 8). Table 6.17 provides the descriptive analysis of height, weight and waist circumference for all children by number of observations, mean, standard deviation and range.

Table 6.17 Anthropometric measurements before AFLY5 intervention

	n (%)	N (%) Missing	Mean	SD	Min	Max
Height (m)	478 (92.8)	37 (7.2)	1.38	0.06	1.21	1.60
Weight (kg)	441 (85.6)	74 (14.4)	33.69	7.30	21.20	74.30
Waist circumference	441 (85.6)	74 (14.4)	61.15	7.67	49.00	97.40
BMI	438 (85.0)	77 (15.0)	17.65	2.84	13.36	31.47

Graph 6.5 Percentage of children obese before the intervention by obesity criteria (all children with BMI n=376 and waist n=389 measurements before and after the intervention)



All children with before BMI or waist measurements

Table 6.18 BMI and waist circumference indications of overweight and obesity before AFLY5 intervention for all children with before intervention measurements

		All children with before intervention measurements		
		All n=438	Boys n=205	Girls n=233
				n (%)
IOTF[a]	Normal[b]	355 (81.1)	167 (81.5)	188 (80.7)
	Overweight[b]	62 (14.2)	29 (14.1)	33 (14.2)
	Obese[b]	21 (4.8)	9 (4.4)	12 (5.2)
CDC 2000[a]	Normal[b]	351 (80.1)	162 (79.0)	189 (81.1)
	Overweight[b]	54 (12.3)	25 (12.2)	29 (12.4)
	Obese[b]	33 (7.5)	18 (8.8)	15 (6.4)
UK90[a]	Normal[b]	367 (83.8)	166 (81.0)	201 (86.3)
	Overweight[b]	33 (7.5)	16 (7.8)	17 (7.3)
	Obese[b]	38 (8.7)	23 (11.2)	15 (6.4)
Waist circumference[c,d]	Normal[b]	313 (71.0)	152 (75.2)	161 (67.4)
	Central adiposity[b]	128 (29.0)	50 (24.8)	78 (32.6)

[a] Percentiles based on mid-point for each 6 month age group e.g. 9.25 years for children aged between 9.0 and 9.5 years.
[b] Denominator is complete data. [c] Waist circumference measured midway between tenth rib and iliac crest and recorded to nearest millimetre. Obese >=90th centile published by McCarthy et al (2001). Centiles based on measurement without clothes and these measurements taken over light clothing.
[d] Total number at for waist circumferences measurements for children with before: all n=441, boys n=202, girls n=239

Table 6.19 shows the cross-tab of the four obesity criteria. There are differences in the classification of normal, overweight and obesity using these different criteria.

Table 6.19 Cross-tab obesity criteria before the intervention

		UK90 n (%)			
		Normal	Overweight	Obese	P value[c]
IOTF[a]	Normal	354 (80.8)	1 (0.3)	0 (0.0)	
	Overweight	13 (3.0)	32 (7.3)	17 (3.9)	
	Obese	0 (0.0)	0 (0.0)	21 (4.8)	<0.001
CDC 2000[a]	Normal	351 (80.1)	0 (0.0)	0 (0.0)	
	Overweight	16 (3.7)	33 (0.0)	5 (1.1)	
	Obese	0 (0.0)	0 (0.0)	33 (7.5)	<0.001
Waist circumference	Normal	306 (72.0)	3 (0.7)	0 (0.0)	
	Central adiposity	52 (12.2)	29 (6.8)	35 (8.2)	<0.001

[a] For BMI n=438 [b] For waist circumference n=425 [c] Pearson Chi Squared

Table 6.20 shows the mean BMI and waist circumference by gender and deprivation before the AFLY5 phase II intervention. Boys had slightly larger waist circumference than girls and mean BMI was similar in both genders. Both mean BMI and waist circumference are larger in children from schools in more deprived areas. Consistent with this finding Table 6.21 shows that obesity prevalence, classified using the IOTF and 2000 CDC and central adiposity defined using the 1990 waist circumference criteria is greater in schools from more deprived areas. There is some evidence of the same association with the UK 1990 criteria, but it is weaker.

Table 6.20 Mean BMI and waist circumference by gender and deprivation before AFLY5 intervention

		Mean (SD)	
		BMI[a]	Waist circumference (cm)[b]
Gender	Boys	17.64 (2.89)	61.62 (7.47)
	Girls	17.65 (2.8)	60.76 (7.83)
	p value[c]	0.75	0.06
Deprivation[d]	Low $\leq$ 35	17.13 (2.48)	59.79 (6.79)
	Medium > 35<44	17.92 (3.01)	61.26 (7.75)
	High $\geq$ 44	18.07 (2.96)	63.09 (8.4)
	p value[c]	0.007	0.003

[a] For BMI boys n=205, girls n=233 [b] For waist boys n=202, girls n=239 [c] Kruskal-Wallis equality of populations rank test (X^2 with ties) [d] For BMI low deprivation n=175, medium deprivation n=147 high deprivation n=116. For waist low deprivation n=179, medium deprivation n=144, high deprivation n=1

Table 6.21 Analysis of obesity categories by deprivation before AFLY5 intervention

		Deprivation Low ≤ 35 n (%)	Deprivation Medium > 35<44 n (%)	Deprivation High ≥ 44 n (%)	P value[c]
IOTF[a]	Normal	155 (88.6)	116 (78.9)	84 (72.4)	
	Overweight	15 (8.6)	21 (14.3)	26 (22.4)	
	Obese	5 (2.9)	10 (6.8)	6 (5.2)	0.007
2000 CDC[a]	Normal	153 (87.4)	117 (79.6)	81 (69.8)	
	Overweight	14 (8.0)	16 (10.9)	24 (20.7)	
	Obese	8 (4.6)	14 (9.5)	11 (9.5)	0.005
UK 1990[a]	Normal	158 (90.3)	119 (81.0)	90 (77.6)	
	Overweight	8 (4.6)	12 (81.6)	13 (11.2)	
	Obese	9 (5.1)	16 (10.9)	13 (11.2)	0.04
Waist circumference[b]	Normal	139 (77.7)	102 (69.4)	72 (61.0)	
	Central Obesity	40 (22.3)	42 (28.6)	46 (40.0)	0.001

[a] For BMI low deprivation n=175, medium deprivation n=147 high deprivation n=116 [b] For waist low deprivation n=179, medium deprivation n=144, high deprivation n=118 [c] Pearson X^2 test

Diet

Diet questionnaires before the intervention were returned by 485 (91.7%) children; however, the questionnaires were incomplete for 28 children and therefore were excluded from the analysis. At baseline only 22 (4.8%) of the children reported consuming 5 or more portions of fruit and vegetables per day. Table 6.22 shows the median portions per day and the percentages of children meeting the set "healthy eating" amount for each of the four dietary outcomes by deprivation and gender: 'healthy' consumption of fruit and vegetable (>= 3 portions per day), sweet and savoury snacks (0 or 1 portions per day), high fat foods (0 per day) and high energy drinks (0 or 1 portions per day).

At baseline approximately a quarter of the whole sample consumed healthy amounts of fruit and vegetables (26.7%), sweet and savoury snacks (23.9%). By contrast, nearly half of the children (49.9%) ate healthy (zero) amounts of high fat foods and drank healthy (one or zero) high energy drinks (46.0%) (see Table 6.22).

Table 6.22 shows that girls were more likely to consume more portions a day of fruit and vegetables than boys. There is no evidence of gender differences for snack, high fat food or high energy drink.

Children from the most deprived schools in the study population were less likely to consume healthy amounts of fruit and vegetables and sweet or savoury snacks than children in the less deprived schools. There was no clear association of deprivation with consumption of high fat foods or high energy drinks.

Table 6.22 Baseline dietary characteristics of 9-10 year old children in AFLY5 phase II study by gender, school deprivation and location of consumption (n = 457 with complete data)

		Fruit & Vegetable consumption		Sweet/savoury snack consumption		High fat food consumption		High energy drink consumption	
		Median (IQR) portions per day	n (%) consuming healthy amount[a]	Median (IQR) portions per day	n (%) consuming healthy amount[a]	Median (IQR) portions per day	n (%) consuming healthy amount[a]	Median (IQR) portions per day	n (%) consuming healthy amount[a]
Total study sample		1 (1,3)	122 (26.7)	2 (2,3)	109 (23.9)	1 (0,1)	228 (49.9)	2 (1,2)	210 (46.0)
By gender	Male n = 208	1 (0,2)	44 (21.2)	2 (1,3)	57 (27.4)	1 (0,1)	99 (47.6)	2 (1,2)	101 (48.6)
	Female n = 249	2 (1,3)	78 (31.3)	2 (2,3)	52 (20.9)	0 (0,1)	129 (51.8)	2 (1,2)	109 (43.8)
	P-values[b]	0.0001		0.37		0.56		0.46	
By school based deprivation	Low n = 184	2 (1,3)	59 (31.2)	2 (1,3)	48 (26.1)	0 (0,1)	99 (53.8)	2 (1,2)	87 (47.3)
	Medium n =154	1 (1,3)	46 (29.9)	2 (2,3)	38 (23.4)	1 (0,1)	73 (47.4)	2 (1,2)	71 (46.1)
	High n = 119	1 (1,2)	17 (14.3)	3 (2,4)	25 (21.0)	1 (0,1)	56 (47.1)	2 (1,2)	52 (43.7)
	P-values[b]	0.01		0.009		0.38		0.94	

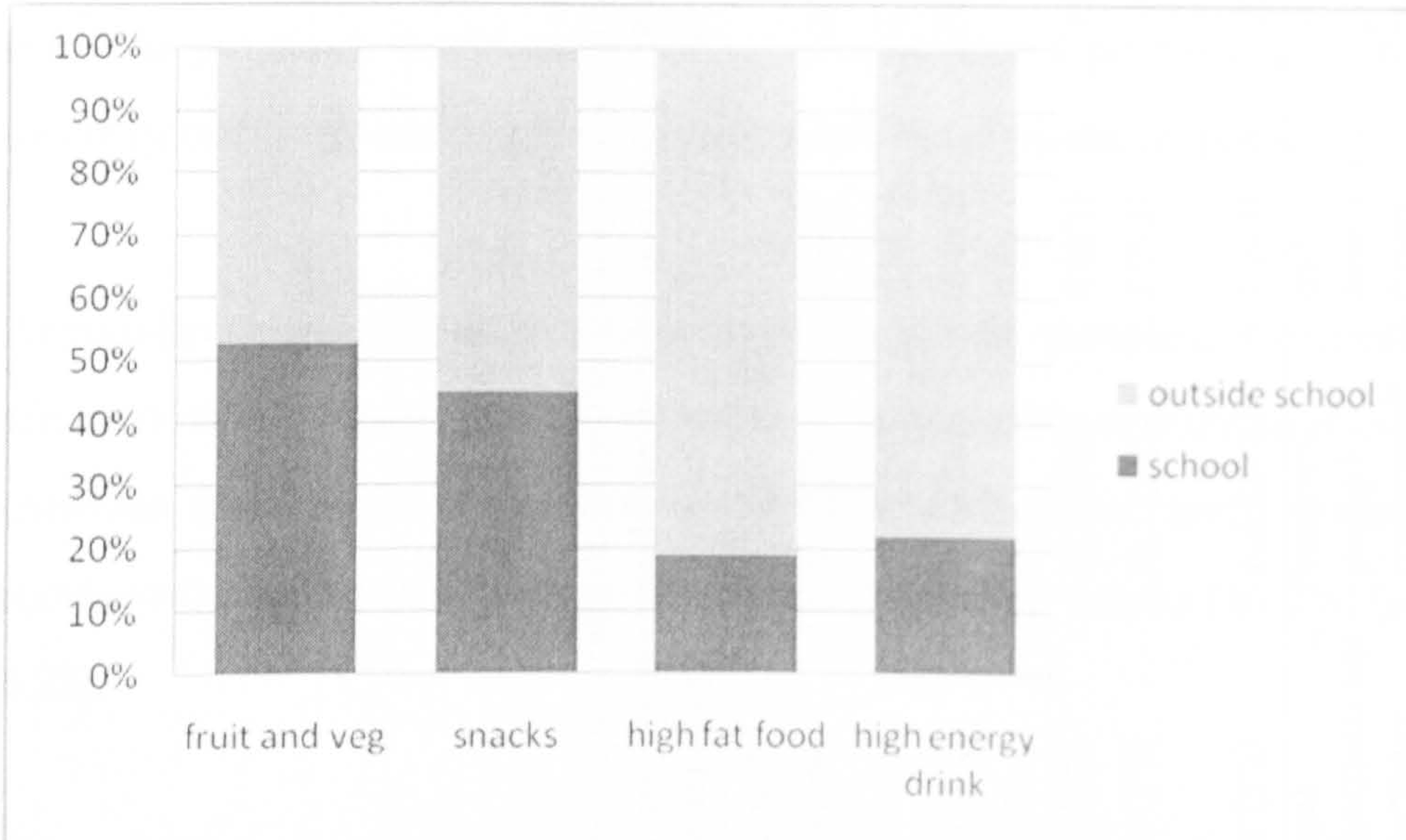
[a] For these outcomes healthy were defined as: Fruit and veg ($\geq$3); Snacks ($\leq$1); High fat food (0); High energy drink ($\leq$1)

[b] p-values used the Kruskal-Wallis test for comparisons of medians and chi^2 for comparisons of proportions; for the associations with deprivation schools p-values were used to test a null hypothesis of no-linear trend across the three categories, for gender and location of consumption the p-values tested the null hypothesis of no differences between the exposure categories.

Location

Higher proportions of all food groups except fruit and vegetables were consumed outside school than inside school (p values <0.001 from t-test). More than half of all fruit and vegetables consumed was consumed at school (52.6%) but there was no evidence of a difference (p values from t-test p=0.12). See Graph 6.6.

Graph 6.6 Proportion of mean portions of food/drink consumed at school or outside school



Summary of descriptive data

The gender differences were: boys spent more time in sedentary behaviours but also boys recorded more accelerometer counts per minute and spent more time in MVPA; boys had slightly larger waist circumference; boys consumed fewer portions a day of fruit and vegetables.

The differences by deprivation were: children in more deprived areas spent more time in sedentary behaviours; parents in more deprived schools reported less limiting of children's sedentary behaviours; children in more deprived schools were more likely to travel to school by active travel; children from schools in more deprived areas had higher mean BMI and waist circumference; children from the most deprived schools were less likely to consume healthy amounts of fruit and vegetables and snacks.

6.5.3. Analysis by intervention

Child reported sedentary behaviours measured by questionnaire

Child reported sedentary time was not normally distributed. Therefore, rather than comparing the mean values after the intervention to before, the geometric mean was calculated and a ratio of geometric means presented with differences between before and after compared using a paired t-test. Table 29 shows the geometric means before and after the intervention for all schools and stratified by schools involving parents and those not. After the intervention the sedentary, screen and TV time were lower on average in all schools. The difference between after and before the intervention appeared greater for schools without parental involvement than for those with parental involvement.

In Table 6.24 the child reported sedentary behaviour questionnaire data is presented for screen and TV time categorised as two hours or more compared to less than two hours. For all schools there were reductions in the odds ratios of two or more hours of screen or TV time. However, for most of these the odds ratios were reduced by a greater extent in the non parent involvement schools.

Table 6.25 compares questionnaire-reported sedentary time outcomes after the intervention by whether the intervention had parental involvement or not. After the intervention sedentary time appears to have reduced slightly in parent involvement schools compared to non parent involvement schools but screen and TV time appear to have increased, although for the majority the 95% confidence intervals include the null value. The adjusted results differed little from the unadjusted results. In summary, the findings suggest that the AFLY5 intervention is effective at reducing child-reported sedentary behaviour, all be it that this is a before and after study and therefore may be influenced by other changes occurring over time. However, there was no evidence that the parental involvement resulted in greater effectiveness of the intervention.

Parent proxy reported child sedentary behaviours measured by questionnaire

The parent proxy reported sedentary behaviour time is presented using geometric means. Table 6.26 shows the geometric means before and after the intervention for all schools and stratified by schools involving parents and those not. After the intervention the sedentary, screen and TV time were lower on average in all schools, with the greatest reductions on Saturdays rather than weekdays. The difference between after and before the intervention appeared slightly greater for schools with parental involvement than for those without parental involvement. Many of the 95% confidence intervals included the null value.

In Table 6.27 the parent proxy reported sedentary behaviour questionnaire data is presented for screen and TV time categorised as two hours or more compared to less than two hours. For all schools there were reductions in the odds ratios of two or more hours of screen or TV time. However, for most of these the odds ratios were reduced by a greater extent in the non parent involvement schools. All the 95% confidence intervals included the null value.

Table 6.28 compares parent proxy reported sedentary time outcomes after the intervention by whether the intervention had parental involvement or not. After the intervention sedentary, screen and TV time appear to have increased slightly in parent involvement schools compared to non parent involvement schools, although for the majority the 95% confidence intervals include the null value.

However, the two or more hours of screen and TV time is mixed, with the results showing increases and decreases in parent involvement compared to non parent involvement schools. The adjusted results for TV time differed from the unadjusted results. In summary, the findings suggest that the AFLY5 intervention is effective at reducing parent reported sedentary behaviour, all be it that this is a before and after study and therefore may be influenced by other changes occurring over time. However, there was no evidence overall that the parental involvement resulted in greater effectiveness of the intervention.

Sedentary time measured by accelerometery

Sedentary time measured by accelerometery before and after the intervention for all schools and stratified by schools involving parents and those not is shown in Table 6.29. After the intervention there was no difference in sedentary time in all schools. The difference between after and before the intervention appeared greater for schools with parental involvement.

Table 6.30 compares sedentary time after the intervention by whether the intervention had parental involvement or not. For children with at least 500 minutes of accelerometer data per day, sedentary time appears to have increased slightly (2.6%) in parent involvement schools compared to non parent involvement schools. However, for children with at least 600 minutes of accelerometer data per day, sedentary time appears to have decreased slightly (-1.2%) in parent involvement schools compared to non parent involvement schools. The adjusted results differed from the unadjusted results. The 95% confidence intervals for the adjusted results include the null value. In summary, the findings suggest that the AFLY5 intervention has no effect on sedentary time. There was no consistent evidence that the parental involvement changed the effectiveness of the intervention.

Table 6.23 Difference in geometric means of child reported sedentary and screen time measured using the sedentary behaviour questionnaire before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1]			No parent involvement schools[1]			Parent involvement schools[1]		
	Geometric Mean (SD)			Geometric Mean (SD)			Geometric Mean (95% CI)		
	Before	After	Ratio of geometric means (95% CI) p value[2]	Before	After	Ratio of geometric means (95% CI) p value[2]	Before	After	Ratio of geometric means (95% CI) p value[2]
Mean minutes of sedentary time weekday	242.0 (2.21)	210.8 (2.39)	0.87 (0.76, 1.00) p=0.04	253.1 (2.19)	215.7 (2.28)	0.85 (0.74, 0.98) p=0.03	212.0 (2.28)	196.89 (2.71)	0.93 (0.66, 1.30) p= 0.66
Mean minutes of sedentary time Saturday	293.1 (2.42)	203.3 (2.33)	0.70 (0.61, 0.79) p<0.001	311.0 (2.22)	212.0 (2.14)	0.68 (0.58, 0.80) p=<0.001	250.35 (2.92)	181.70 (2.83)	0.73 (0.56, 0.94) p=0.02
Mean minutes of screen time weekday	107.6 (2.84)	88.1 (2.56)	0.82 (0.72,2.98) p=0.002	108.2 (2.79)	83.1 (2.66)	0.77 (0.67, 0.88) p = 0.0002	105.58 (3.00)	106.24 (2.20)	1.01 (0.73, 1.38) p=0.97
Mean minutes of screen time Saturday	152.9 (2.91)	105.5 (2.73)	0.69 (0.60,0.79) p<0.001	156.6 (2.82)	102.3 (2.72)	0.65 (0.56, 0.77) p=<0.001	141.90 (3.24)	116.15 (2.79)	0.82 (0.62, 1.08) p= 0.15
Mean minutes of TV time weekday	66.2 (2.81)	57.9 (2.52)	0.87 (0.76, 1.01) p=0.06	67.6 (2.84)	54.6 (2.63)	0.81(0.69, 0.95) p=0.01	62.34 (2.72)	69.10 (2.14)	1.11 (0.83, 1.48) p= 0.48
Mean minutes of TV time Saturday	92.8 (2.79)	71.1 (2.62)	0.76 (0.66, 0.89) p=0.0008	95.9 (2.47)	69.9 (2.52)	0.73 (0.62, 0.86) p=0.0001	84.49 (3.77)	74.81 (2.95)	0.89 (0.60, 1.31) p=0.54

[1] *Children with before and after intervention data: 220-287 children all schools (numbers vary by category because of variation in the number of outlier values excluded)* ; 160 -219 children in parent involvement schools; 58-68 children in non-parent involvement schools. [2] Paired t-test for continuous variables.

Table 6.24 Odds ratio of child reported sedentary and screen time measured using the sedentary behaviour questionnaire before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1] N (%)			No parent involvement schools[1] N (%)			Parent involvement schools[1] N (%)		
	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]
≥2 hours of screen time weekday	163 (52.92)	126 (40.91)	0.48 (0.31,0.73) p=0.0004	124 (53.45)	92 (39.66)	0.41 (0.24,0.68) p=0.0002	39 (51.32)	34 (44.74)	0.68 (0.31, 1.46) p=0.29
≥2 hours of screen time Saturday	186 (60.39)	147 (47.73)	0.49 (0.33,0.72) p=0.0002	143 (61.64)	108 (46.55)	0.43 (0.27,0.67) p=0.0001	43 (56.58)	39 (51.32)	0.76 (0.34, 1.67) p=0.47
≥2 hours of TV time weekday	99 (28.70)	65 (18.84)	0.51 (0.33,0.78) p=0.0011	71 (27.73)	47 (18.36)	0.54 (0.33,0.87) p=0.008	28 (31.46)	18 (20.22)	0.44 (0.17,1.07) p=0.05
≥2 hours of TV time Saturday	140 (40.58)	102 (29.57)	0.54 (0.67,0.79) p=0.0008	106 (41.41)	74 (28.91)	0.52 (0.34, 0.80) p=0.001	34 (38.20)	28 (31.46)	0.63 (0.25,1.46) p=0.24

[1] Children with before and after intervention data: 335-360 children all schools; 84-92 children in parent involvement schools; 248-268 children in non-parent involvement schools. [2] McNemar's test for null hypothesis that odds do not differ before and after the intervention

Table 6.25 Linear and logistic regression of outcome (child report sedentary outcomes) after intervention comparing schools with to those without parental involvement (footnotes on next page)

	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted*[2] ratio of geometric means[3,4] or odds ratio[4] of outcome after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* ratio of geometric means[3,4] or odds ratio[4] of outcome after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
	Mean (SD)			
Mean minutes	After	After	Ratio of geometric means[3,4]	Ratio of geometric means[3,4]
Sedentary time weekday	215.7 (2.28)	196.89 (2.71)	0.92 (0.74,1.13) p=0.39	0.93 (0.76,1.13) p=0.42
Sedentary time Saturday	212.0 (2.14)	181.70 (2.83)	0.91 (0.63,1.31) p=0.58	0.89 (0.57,1.37) p=0.56
Screen time weekday	83.1 (2.66)	106.24 (2.20)	1.21 (0.95,1.53) p=0.11	1.20 (0.95,1.52) p=0.12
Screen time Saturday	102.3 (2.72)	116.15 (2.79)	1.13 (0.78,1.64) p=0.51	1.08 (0.69,1.68) p=0.73
TV time weekday	54.6 (2.63)	69.10 (2.14)	1.28 (1.04,1.59) p=0.02	1.39 (1.02, 1.89) p=0.04
TV time Saturday	69.9 (2.52)	74.81 (2.95)	1.08 (0.84,1.40) p=0.53	1.03 (0.76, 1.40) p=0.84
	N (%)		Odds ratio[5] regression	Odds ratio[5] regression
≥2 hours of screen time weekday	92 (39.66)	34 (44.74)	1.12 (0.64,1.97) p=0.69	1.00 (0.60,1.67) p=0.99
≥2 hours of screen time Saturday	108 (46.55)	39 (51.32)	1.32 (0.73,2.37) p=0.37	1.27 (0.64,2.54) p=0.49
≥2 hours of TV time weekday	47 (18.36)	18 (20.22)	1.04 (0.60,1.81) p=0.88	1.06 (0.56,2.03) p=0.85
≥2 hours of TV time Saturday	74 (28.91)	28 (31.46)	1.26 (0.77,2.07) p=0.35	1.24 (0.71,2.17) p=0.45

Footnotes for Table 6.25

[1] Children with before and after intervention child reported sedentary behaviour questionnaire data were: 229 children all schools; 58 children in parent involvement schools; 171 children in non-parent involvement schools. Children with before and after intervention child reported screen time data from sedentary behaviour questionnaire data were: 287 children all schools; 68 children in parent involvement schools; 219 children in non-parent involvement schools. Children with before and after intervention child reported TV time data from sedentary behaviour questionnaire data were: 262 children all schools; 65 children in parent involvement schools; 197 children in non-parent involvement schools.

[2] For the *unadjusted* linear regression of log mean difference by intervention (parent intervention compared to non-parent intervention) allowing for school cluster, showing exponentiated coefficient (i.e. ratio of geometric mean), 95% confidence intervals and p value. For the ratio of geometric means the null value is 1; >1 indicates increased minutes in parent intervention schools compared to non parent intervention schools; <1 indicates reduced minutes in parent involvement schools compared to non parent involvement schools

[3] For the *adjusted* linear regression of log mean difference by intervention (parent intervention compared to non-parent intervention) the data is adjusted for minutes of daylight before intervention, minutes of daylight after intervention age, gender and school cluster, showing exponentiated coefficient (i.e. ratio of geometric mean), 95% confidence intervals and p value. For the ratio of geometric means the null value is 1; >1 indicates increased minutes in parent intervention schools compared to non parent intervention schools; <1 indicates reduced minutes in parent involvement schools compared to non parent involvement schools

[4] 166 to 210 for children with full data for linear regression in all schools; n= 41 to 50 for children with full data for linear regression in parent involvement schools; n=125 to 160 for children with full data for linear regression in non-parent involvement schools.

[5] For proportions of $\geq$2 hours vs <2hours, logistic regression of difference by parent involvement adjusting for before intervention proportions of $\geq$2 hours vs <2hours, minutes of daylight before intervention, minutes of daylight after intervention age, gender and school cluster. The odds ratio >1 is increased odds of $\geq$2 hours TV or screen time, 95% confidence intervals and p value.

Table 6.26 Difference in means of parent reported sedentary and screen time measured using the sedentary behaviour questionnaire before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1]			No parent involvement schools[1]			Parent involvement schools[1]		
	Geometric mean (SD)			Geometric mean (SD)			Geometric mean (SD)		
	Before	After	Ratio of geometric means (95% CI) p value[2]	Before	After	Ratio of geometric means (95% CI) p value[2]	Before	After	Ratio of geometric means (95% CI) p value[2]
Mean minutes of sedentary time weekday	229.4 (1.74)	219.8 (1.65)	0.96 (0.83,1.11) p=0.56	210.48 (1.78)	204.56 (1.62)	0.97 (0.76,1.24) p=0.81	247.09 (1.70)	233.82 (1.67)	0.95 (0.79,1.14) p=0.55
Mean minutes of sedentary time Saturday	377.8 (1.72)	284.2 (1.80)	0.75 (0.64,0.88) p=0.0005	338.50 (1.62)	270.57 (1.76)	0.80 (0.64,1.00) p=0.05	417.85 (1.78)	297.20 (1.84)	0.71 (0.57,0.89) p=0.004
Mean minutes of screen time weekday	110.6 (2.19)	105.4 (1.82)	0.95 (0.78,1.17) p=0.64	94.21 (2.35)	93.67 (1.70)	0.99 (0.71,1.40) p=0.97	125.33 (2.03)	115.51 (1.90)	0.92 (0.71, 1.19) p=0.53
Mean minutes of screen time Saturday	383.5 (1.69)	270.1 (1.82)	0.70 (0.60,0.82) p<0.0001	351.70 (1.62)	259.0 0 (1.77)	0.74 (0.59,0.93) p=0.01	414.48 (1.75)	280.55 (1.87)	0.68 (0.55,0.84) p=0.0006
Mean minutes of TV time weekday	84.06 (1.93)	77.34 (1.81)	0.92 (0.75,1.13) p=0.42	73.00 (1.96)	70.43 (1.89)	0.96 (0.68,1.37) p=0.83	94.26 (1.88)	83.45 (1.75)	0.89 (0.68,1.15) p=0.35
Mean minutes of TV time Saturday	145.40 (1.63)	122.69 (1.72)	0.84 (0.73,0.98) p=0.03	122.48 (1.79)	109.52 (1.81)	0.89 (0.71,1.12) p=0.32	168.82 (1.40)	135.44 (1.61)	0.80 (0.65,0.99) p=0.04

[1] *Children with before and after intervention: 57-76 parents all schools; 31-40 parents in parent involvement schools; 26-36 parents in non-parent involvement* schools. [2] Paired t-test for continuous variables.

Table 6.27 Odds ratio of parent reported sedentary and screen time measured using the sedentary behaviour questionnaire before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1] N (%)			No parent involvement schools[1] N (%)			Parent involvement schools[1] N (%)		
	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]
$\geq$2 hours of screen time weekday	34 (43.59)	30 (38.46)	0.76 (0.34,1.67) p=0.47	13 (36.11)	11 (30.56)	0.71 (0.18,2.61) p=0.56	21 (50.00)	19 (45.24)	0.80 (0.27,2.25) p=0.64
$\geq$2 hours of screen time Saturday	75 (96.15)	72 (92.31)	0.40 (0.04,2.44) p=0.26	36 (100)	34 (94.44)	0.00 (0.00,5.32) p=0.16	39 (92.86)	38 (90.48)	0.67 (0.06,5.82) p=0.65
$\geq$2 hours of TV time weekday	25 (31.65)	17 (21.52)	0.53 (0.21,1.26) p=0.12	10 (27.78)	7 (19.44)	0.57 (0.12,2.25) p=0.37	15 (34.88)	10 (23.26)	0.50 (0.13,1.61) p=0.20
$\geq$2 hours of TV time Saturday	53 (67.09)	47 (59.49)	0.63 (0.25,1.47) p=0.24	22 (61.11)	17 (47.22)	0.50 (0.13,1.61) p=0.20	31 (72.09)	30 (69.77)	0.83 (0.20,3.28) p=0.76

[1] Children with before and after intervention screen time data: 78 children all schools; 42 children in parent involvement schools; 36 children in non-parent involvement schools. Children with before and after intervention TV time data: 79 children all schools; 43 children in parent involvement schools; 36 children in non-parent involvement schools.

[2] McNemar's test for null hypothesis that odds do not differ before and after the intervention

Table 6.28 Linear and logistic regression of outcome (parent report sedentary outcomes) after intervention comparing schools with to those without parental involvement (footnotes on next page)

	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted*[2] ratio of geometric means[3,4] or odds ratio[5] of outcome after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* ratio of geometric means[3,4] or odds ratio[5] of outcome after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
Mean minutes	Mean (SD)		Ratio of geometric means[3,4]	Ratio of geometric means[3,4]
Sedentary time weekday	204.56 (1.62)	233.82 (1.67)	1.10 (0.81,1.50) p=0.46	1.21 (0.91,1.63) p=0.15
Sedentary time Saturday	270.57 (1.76)	297.20 (1.84)	1.04 (0.73,1.49) p=0.77	1.15 (0.84,1.57) p=0.30
Screen time weekday	93.67 (1.70)	110.32 (2.01)	1.17 (0.80,1.71) p=0.34	1.22 (0.81,1.85) p=0.27
Screen time Saturday	259.00 (1.77)	280.55 (1.87)	1.02 (0.76,1.38) p=0.87	1.04 (0.90,1.19)p=0.51
TV time weekday	70.43 (1.89)	83.45 (1.75)	1.16 (0.78,1.75) p=0.38	0.99 (0.64,1.54) p=0.96
TV time Saturday	109.52 (1.81)	135.44 (1.61)	1.08 (0.81,1.43) p=0.54	1.56 (1.15,2.11) p=0.01
	N (%)		Odds ratio[5]	Odds ratio[5]
$\geq$2 hours of screen time weekday	11 (30.56)	19 (45.24)	1.70 (0.47,6.07) p=0.42	2.37 (0.65,8.67) p=0.19
$\geq$2 hours of screen time Saturday	34 (94.44)	38 (90.48)	0.78 (0.28,2.17) p=0.64	0.47 (0.16,1.44) p=0.16
$\geq$2 hours of TV time weekday	7 (19.44)	10 (23.26)	1.32 (0.49,3.53) p=0.58	0.56 (0.26,1.21) p=0.14
$\geq$2 hours of TV time Saturday	17 (47.22)	30 (69.77)	2.18 (1.03,4.61) p=0.04	2.48 (1.01,6.08) p=0.05

Footnotes for Table 6.28

[1] Children with before and after intervention: 57-76 parents all schools; 31-40 parents in parent involvement schools; 26-36 parents in non-parent involvement schools.

[2] For the *unadjusted* linear regression of log mean difference by intervention (parent intervention compared to non-parent intervention) allowing for school cluster, showing exponentiated coefficient (i.e. ratio of geometric mean), 95% confidence intervals and p value. For the ratio of geometric means the null value is 1; >1 indicates increased minutes in parent intervention schools compared to non parent intervention schools; <1 indicates reduced minutes in parent involvement schools compared to non parent involvement schools

[3] For the *adjusted* linear regression of log mean difference by intervention (parent intervention compared to non-parent intervention) the data is adjusted for minutes of daylight before intervention, minutes of daylight after intervention age, gender and school cluster, showing exponentiated coefficient (i.e. ratio of geometric mean), 95% confidence intervals and p value. For the ratio of geometric means the null value is 1; >1 indicates increased minutes in parent intervention schools compared to non parent intervention schools; <1 indicates reduced minutes in parent involvement schools compared to non parent involvement schools

[4] 52 to 63 for children with full data for linear regression in all schools; n= 29 to 38 for children with full data for linear regression in parent involvement schools; n=23 to 31 for children with full data for linear regression in non-parent involvement schools.

[5] 61 to 72 for children with full data for logistic regression in all schools; n= 35 to 41for children with full data for logistic regression in parent involvement schools; n=26 to 31 for children with full data for logistic regression in non-parent involvement schools. For proportions of $\geq$2 hours vs <2hours, logistic regression of difference by parent involvement adjusting for before intervention proportions of $\geq$2 hours vs <2hours, minutes of daylight before intervention, minutes of daylight after intervention age, gender and school cluster. The odds ratio >1 is increased odds of $\geq$2 hours TV or screen time, 95% confidence intervals and p value.

Table 6.29 Difference in means of accelerometer sedentary time before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1]			No parent involvement schools[1]			Parent involvement schools[1]		
	Mean (SD)			Mean (SD)			Mean (SD)		
	Before	After	Difference in means (95% CI) p value[2]	Before	After	Difference in means (95% CI) p value[2]	Before	After	Difference in means (95% CI) p value[2]
Mean minutes of accelerometer sedentary time (500 minutes)	588.8 (59.5)	597.8 (60.8)	8.92 (-3.0, 20.8) p=0.14	599.5 (61.5)	582.9 (55.5)	-16.7 (-35.55,2.21) p=0.08	582.3 (57.7)	606.8 (62.4)	24.49 (9.99,38.99) p=0.001
Mean minutes of accelerometer sedentary time (600 minutes)	611. 1 (56.3)	611.5 (56.0)	0.40 (-12.9,13.6) p=0.95	618.3 (64.0)	596.4 (54.9)	-21.9 (-43.34,-0.45) p=0.05	606.6 (51.0)	620.8 (55.1)	14.2 (-2.20,30.60) p=0.09

[1] Children with before and after intervention data with a minimum of 500 minutes accelerometer data: 119 children all schools; 74 children in parent involvement schools; 45 children in non-parent involvement schools. [2] Paired t-test for continuous variables. Children with before and after intervention data with a minimum of 600 minutes accelerometer data: 102 children all schools; 63 children in parent involvement schools; 39 children in non-parent involvement schools. [2] Paired t-test for continuous variables.

Table 6.30 Linear regression of outcome (accelerometer sedentary time) after intervention comparing schools with to those without parental involvement

	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted* mean difference[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* mean difference[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
	Mean (SD)			
Mean minutes of accelerometer sedentary time (500 minutes)	582.9 (55.5)	606.8 (62.4)	29.40 (8.55,50.24) p=0.02	15.28 (-5.24,35.80) p=0.11
Mean minutes of accelerometer sedentary time (600 minutes)	596.4 (54.9)	620.8 (55.1)	25.76 (-4.63,56.16) p=0.08	-7.11 (-24.03,9.80) p=0.33

[1] Children with before and after intervention data with a minimum of 500 minutes accelerometer data: 119 children all schools; 74 children in parent involvement schools; 45 children in non-parent involvement schools. [2] Paired t-test for continuous variables. Children with before and after intervention data with a minimum of 600 minutes accelerometer data: 102 children all schools; 63 children in parent involvement schools; 39 children in non-parent involvement schools. [2] Paired t-test for continuous variables.

[2] Linear regression of mean difference by intervention (parent intervention compared to non-parent intervention) at adjusted for adjusting for before intervention sedentary minutes, minutes of daylight before intervention, minutes of daylight after intervention, age, gender and school cluster, showing coefficient, 95% confidence intervals and p value.

[3] 105 children with 500 minutes of data for linear regression in all schools; n= 63 for children with full data for linear regression in parent involvement schools; n= 42 for children with full data for linear regression in non-parent involvement schools. 90 children with 500 minutes of data for linear regression in all schools; n= 53 for children with full data for linear regression in parent involvement schools; n= 37 for children with full data for linear regression in non-parent involvement schools.

Physical activity measured by accelerometery

Table 6.31 shows the physical activity time measured by accelerometry before and after the intervention for all schools and stratified by schools involving parents and those not. After the intervention, time spent in MVPA and counts per minute (a measure of total physical activity) increased in all schools after adjustment for confounders. The difference between after and before the intervention appeared greater for schools with no parental involvement.

Table 6.32 compares physical activity time outcomes after the intervention by whether the intervention had parental involvement or not. After adjustment the intervention for children with at least 600 minutes of data per day, the minutes of moderate and vigorous activity and counts per minute appear to have increased in parent involvement schools compared to non parent involvement schools. There were very small increases in parent involvement schools compared to non parent involvement for children with at least 500 minutes of data per day. In summary, the findings suggest that the AFLY5 intervention is effective at increasing physical activity including moderate and vigorous activity, all be it that this is a before and after study and therefore may be influenced by other changes occurring over time. However, parental involvement appears to increase the effectiveness of the intervention.

The intraclass correlation coefficient for accelerometry measures (sedentary minutes, MVPA and counts per minute) and sample size calculation to detect a 0.5 SD difference are shown in Table 6.33. A sample size of 1016 participants from 41 schools would provide 80% power to detect a 0.5 SD differences between those allocated to the intervention and those not for all three at a 5% significance level if the upper limit of the 95%CI of the ICC is used in the calculation.

Table 6.31 Difference in means of MVPA, accelerometer counts per minute before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1]			No parent involvement schools[1]			Parent involvement schools[1]		
	Mean (SD)			Mean (SD)			Mean (SD)		
	Before	After	Difference in means (95% CI) p value[2]	Before	After	Difference in means (95% CI) p value[2]	Before	After	Difference in means (95% CI) p value[2]
Mean MVPA minutes (500 minutes)	34.73 (13.44)	38.23 (17.72)	3.50 (32.29,37.17) p=0.01	31.62 (1.90)	42.56 (18.13)	10.94 (6.48,15.40) p<0.0001	36.62 (13.57)	35.59 (17.06)	-1.03 (-3.00,1.93) p=0.49
Mean MVPA minutes (600 minutes)	35.77 (13.92)	43.75 (20.54)	7.99 (4.43,11.54) p<0.0001	32.19 (12.34)	44.52 (17.69)	12.33 (7.66,17.00) p<0.0001	37.99 (14.46)	43.28 (22.24)	5.30 (0.34,10.26) p=0.04
Mean counts per minute (500 minutes)	520.5 (153.9)	536.4 (189.7)	42.82 (11.51,74.13) p=0.008	471.1 (116.8)	593.7 (155.4)	122.59 (82.8,162.4) p<0.0001	520.1 (152.0)	564.9 (197.5)	44.82 (8.43,81.20) p=0.02
Mean counts per minute (600 minutes)	520.1 (152.0)	564.9 (197.5)	44.82 (8.44,81.20) p=0.02	471.3 (109.1)	603.5 (155.5)	132.2 (86.6,177.7) p<0.0001	550.6 (166.2)	544.9 (206.7)	-5.70 (-46.60,35.22) p=0.78

[1] Children with before and after intervention data for minimum of 500 minutes were: 119 children all schools; 74 children in parent involvement schools; 45 children in non-parent involvement schools. Children with before and after intervention data for a minimum of 600 minutes were: 102 children all schools; 63 children in parent involvement schools; 39 children in non-parent involvement schools. [2] Paired t-test for continuous variables.

Table 6.32 Linear regression of outcome (MVPA, accelerometer counts and counts per minute) after intervention comparing schools with to those without parental involvement

	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted* mean difference[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* mean difference[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
	Mean (SD)			
Mean MVPA minutes (500 minutes)	42.56 (18.13)	35.59 (17.06)	-11 .49 (-20.20,-2.78) p=0.02	0.36 (-2.48,3.19) p=0.76
Mean MVPA minutes (600 minutes)	44.52 (17.69)	43.28 (22.24)	-5.19 (-25.01,15.52) p=0.55	15.90 (1.53,30.27) p=0.04
Mean counts per minute (500 minutes)	593.7 (155.4)	564.9 (197.5)	-102.00 (-206.91,2.98) p=0.06	6.45 (-33.48, 46.38) p=0.70
Mean counts per minute (600 minutes)	603.5 (155.5)	544.9 (206.7)	-110.33 (-245.11,24.45) p=0.09	60.37 (2.68,118.06) p=0.04

[1] Children with before and after intervention data for a minimum of 500 minutes were: 119 children all schools; 74 children in parent involvement schools; 45 children in non-parent involvement schools. Children with before and after intervention data for a minimum of 600 minutes were: 102 children all schools; 63 children in parent involvement schools; 39 children in non-parent involvement schools. [2] Paired t-test for continuous variables.

[2] Linear regression of mean difference by intervention (parent intervention compared to non-parent intervention) at adjusted for adjusting for before intervention , age, gender and school cluster, showing coefficient, 95% confidence intervals and p value.

[3] 105 children with full data for linear regression in all schools with 500 minutes data; n= 63 for children with full data for linear regression in parent involvement schools; n= 42 for children with full data for linear regression in non-parent involvement schools. 90 children with full data for linear regression in all schools with 600 minutes data; n= 53 for children with full data for linear regression in parent involvement schools; n= 37 for children with full data for linear regression in non-parent involvement schools.

Table 6.33 Sample size calculations for accelerometry data for a full-scale RCT for power of 80%, alpha of 0.05 and minimum effect detectable 0.5 standard deviation

	ICC (95%CI)	Sample size estimates: number of participants (number of schools)[a]	
		Point estimate	Upper confidence interval
Sedentary minutes	0.02 (0.00,0.11)	252 (11)	620 (25)
MVPA minutes	0.07 (0.00,0.21)	452 (19)	1016 (41)
Counts per minute	0.11 (0.00,0.29)	30 (2)	64 (3)

[a] All numbers are the total number of children required (i.e. half of these would be randomised to the intervention and half to the control arm) assuming 25 children per class and equal numbers of schools in each of the randomised arms; numbers in brackets are total numbers of schools required.

Parent support for activity scale

Table 6.34 the sub-scales of parent reporting modelling physical activity, limiting sedentary time and logistic support for their child to be active were compared before and after the intervention for all schools and stratified by schools involving parents and those not. In all schools there were small increases in modelling and limiting sedentary time and decreased logistic support. There appeared to be no difference for modelling and limiting sedentary time after and before the intervention by parent involvement, but there was a slight increase in logistic support in non parent involvement schools.

In Table 6.35 the data is presented for each sub-scale categorised as greater than or equal to the baseline median value. For all schools there were increases in the odds ratios for modelling and limiting sedentary time and decrease in logistic support. The largest increases were seen in non parent involvement schools. However, for most of these the odds ratios were reduced by a greater extent in the non parent involvement schools. All the 95% confidence intervals include the null value.

Table 6.36 compares the parental support for activities after the intervention by whether the intervention had parental involvement or not. After the intervention modelling physical activity appears not to have changed in parent involvement schools compared to non parent involvement schools but limiting sedentary time and logistic support appear to have decreased, although the 95% confidence intervals include the null value. The adjusted results did not differ from the unadjusted results. In summary, the findings suggest that the AFLY5 intervention does not affect parent support for activities. There was no evidence that the parental involvement altered the effectiveness of the intervention.

In Table 6.37 the odds ratio of accelerometer data and parent support for activity scales are presented. The accelerometer data includes sedentary minutes, MVPA minutes and counts per minute above or equal to the median and the parent support for activity scales includes parents reporting above or equal to the median values for each subscale. The OR were highest for limiting sedentary time and logistic support than modelling for all the accelerometer measurements. Therefore, this suggests that parents who are more likely to limit sedentary time and provide logistic support are associated with children who have higher sedentary time and children with higher physical activity time.

Table 6.34 Difference in means of parents reporting agreement for modelling physical activity, limiting sedentary time and logistic support for physical activities, measured using the Parent Support For Activity Scale, before and after the AFLY5 intervention

	All schools[1]			No parent involvement schools[1]			Parent involvement schools[1]		
	Geometric Mean (SD)			Geometric Mean (SD)			Geometric Mean (SD)		
	Before	After	Ratio of geometric means (95% CI) p value[2]	Before	After	Ratio of geometric means (95% CI) p value[2]	Before	After	Ratio of geometric means (95% CI) p value[2]
Modelling physical activity	3.82 (1.17)	3.93 (1.15)	1.03 (1.00,1.06) p=0.04	3.84 (1.20)	3.94 (1.20)	1.03 (0.97,1.09) p=0.32	3.81 (1.16)	3.93 (1.12)	1.03 (1.00,1.06) p=0.02
Limiting sedentary time	3.75 (1.27)	3.84 (1.31)	1.03 (0.97,1.09) p=0.40	3.84 (1.29)	4.09 (1.19)	1.07 (1.00,1.14) p=0.06	3.69 (1.26)	3.68 (1.37)	1.00 (0.91.1.09) p=0.97
Logistic support	4.04 (1.19)	3.90 (1.29)	0.96 (0.91,1.02) p=0.20	4.06 (1.21)	4.08 (1.22)	1.00 (0.95,1.06) p=0.87	4.03 (1.17)	3.78 (1.33)	0.94 (0.86,1.02) p=0.15

[1] Number of parents reported modelling question before intervention = 120 and 88 after intervention. Number of parents reported logistic support questions before intervention = 122 and 92 after intervention. Number of parents reported limiting sedentary behaviour questions before intervention = 120 and 89 after intervention. [2] Paired t-test for continuous variables.

Table 6.35 Odds ratio of parents reporting above and equal to median agreement for parents reporting agreement for modelling physical activity, limiting sedentary time and logistic support for physical activities, measured using the Parent Support For Activity Scale

	All schools[1] N (%)			No parent involvement schools[1] N (%)			Parent involvement schools[1] N (%)		
	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]
Modelling physical activity[3]	36 (54.6)	41 (62.1)	2.67 (0.64, 15.61) p=0.23	15 (53.6)	18 (64.3)	4 (0.40,197.0) p=0.38	21 (55.3)	23 (60.5)	2 (0.29,22.12) p=0.69
Limiting sedentary time[3]	46 (69.7)	48 (68.1)	1.33 (0.41, 4.67) p=0.59	19 (70.4)	22 (81.5)	*Not calculated because cell includes 0*	27 (69.2)	26 (66.7)	0.83 (0.20,3.28) p=1.00
Logistic support[3]	48 (69.6)	47 (72.7)	0.89 (0.39, 2.60) p=1.00	20 (71.4)	20 (71.4)	1.00 (0.13,7.47) p=1.00	28 (68.3)	27 (65.9)	0.83 (0.20,3.28) p=1.00

[1] Number of parents in all schools reported modelling question before and after intervention = 66. Number of parents reported logistic support questions before and after intervention = 69 after intervention. Number of parents reported limiting sedentary behaviour questions before and after intervention = 66.

Number of parents in non parent involvement schools reported modelling question before and after intervention = 27. Number of parents reported logistic support questions before and after intervention = 28 after intervention. Number of parents reported limiting sedentary behaviour questions before and after intervention = 27.

Number of parents in parent involvement schools reported modelling question before and after intervention =38. Number of parents reported logistic support questions before and after intervention = 39 after intervention. Number of parents reported limiting sedentary behaviour questions before and after intervention = 41.

[2] McNemar's chi squared test. [3] Median values for parent support for activity sub-scales: modelling ≥4, sedentary ≥3.75, logistic ≥4

Table 6.36 Linear regression of outcome (parents reporting agreement for modelling physical activity, limiting sedentary time and logistic support for physical activities, measured using the Parent Support For Activity Scale) after intervention comparing schools with to those without parental involvement

	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted* mean difference[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* mean difference[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
	Mean (SD)			
Modelling physical activity	3.94 (1.20)	3.93 (1.12)	1.01 (0.98,1.04) p=0.46	1.01 (0.98,1.04) p=0.46
Limiting sedentary time	4.09 (1.19)	3.68 (1.37)	0.91 (0.80,1.04) p=0.12	0.90 (0.79,1.02) p=0.09
Logistic support	4.08 (1.22)	3.78 (1.33)	0.93 (0.83,1.03) p=0.13	0.93 (0.81,1.06) p=0.21

[1] Number of parents reported modelling question before intervention = 120 and 88 after intervention. Number of parents reported logistic support questions before intervention = 122 and 92 after intervention. Number of parents reported limiting sedentary behaviour questions before intervention = 120 and 89 after intervention.

[2] Linear regression of log mean difference by intervention (parent intervention compared to non-parent intervention) adjusted for before intervention minutes, minutes, age, gender and school cluster, showing coefficient, 95% confidence intervals and p value. Exponentiated value gives geometric mean.

[3] 61-64 parents with full data for linear regression in all schools; n= 37-39 for children with full data for linear regression in parent involvement schools; n= 24-25 for children with full data for linear regression in non-parent involvement schools.

Table 6.37 Odds ratios of accelerometer measures (sedentary minutes, MVPA minutes and counts per minute) at and above the median for parent support for activity sub-scales (modelling physical activity, limiting sedentary time and logistic support) at and above the median before intervention (n=81-83)

Parent support for activity sub-scale	Child accelerometer measure (for children with minimum of 600 minutes data) OR (95% CI) p value[1]		
	Sedentary minutes[2]	MVPA minutes[2]	Counts per minute[2]
Modelling[3]	1.09 (0.59,2.00) p=0.89	0.90 (0.45,1.79) p=0.87	1.05 (0.53,2.08) p=1.00
Sedentary[3]	2.2 (1.16,4.36) p=0.01	1.59 (0.83,3.11) p=0.17	1.89 (0.99,3.68) p=0.05
Logistic[3]	1.92 (0.95,4.09) p=0.07	1.56 (0.80,3.13) p=0.21	1.92 (0.95,4.09) p=0.07

[1] p value for McNemar's chi-squared test. [2] Median values for accelerometer data: sedentary minutes ≥610.78, MVPA minutes ≥ 34.33, counts per minute ≥ 509.89. [3] Median values for parent support for activity sub-scales: modelling ≥4, sedentary ≥3.75, logistic ≥4

Active travel

Children's reported mode of transport to school was compared before and after the AFLY5 intervention (see Table 6.38). Changes were seen in all schools before and after the intervention with increases in the odds ratio of any active travel. However for all estimates the 95% confidence intervals included the null value.

The logistic regression analysis shows that there was an increased odds ratio of 40% for any active travel after the intervention in the parent involvement schools compared with the non parent involvement schools (see Table 6.39). The estimate included the null value.

Table 6.38 Odds ratio of children reporting any active travel (walk or cycle) or no active travel (bus or car) before and after the AFLY5 intervention

	All schools[1] N (%)			No parent involvement schools[1] N (%)			Parent involvement schools[1] N (%)		
	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]
Any active travel	220 (57.9)	239 (62.9)	1.52 (0.98,2.39) p=0.05	158 (55.8)	171 (60.4)	1.54 (0.90,2.69) p=0.10	62 (63.9)	68 (70.1)	1.50 (0.68,3.41) p=0.27

[1] Children with before and after intervention data were: 380 children all schools; 97 children in parent involvement schools; 283 children in non-parent involvement schools. [2] McNemar's test for null hypothesis that odds do not differ before and after the intervention. [2] The odds ratio >1 is increased odds of active travel and <1 is reduced odds, 95% confidence intervals and p value.

Table 6.39 Logistic regression of children reporting any active travel (walk or cycle) or no active travel (bus or car) after intervention comparing schools with to those without parental involvement

	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted* odds ratio[2] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* odds ratio[2] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
	Mean (SD)			
Any active travel	171 (60.4)	68 (70.1)	1.42 (0.77, 2.62) p=0.27	1.40 (0.76, 2.61) p=0.28

[1] Children with before and after intervention data were: 380 children all schools; 97 children in parent involvement schools; 283 children in non-parent involvement schools. [2] The odds ratio >1 is increased odds of travelling by active travel and <1 is reduced odds, 95% confidence intervals and p value.

Height, weight and waist circumference

Differences in mean BMI and waist circumference values before and after the AFLY5 intervention are shown in Table 6.40. Mean BMI and waist circumference were higher in parent involvement schools than non parent involvement schools before intervention. Mean BMI and waist circumference increased by a small amount in all schools and by the greatest amount in parent involvement schools.

The odds ratios for overweight and obesity according to the UK 1990 waist circumference criteria and BMI UK 1990, 2000 CDC and IOTF criteria are presented in Table 6.41. There was a reduced risk (OR=0.60) of children having a waist circumference classified >90th percentile, however the confidence intervals include the null, and no difference by intervention group. There was an increase in the OR for all classifications of overweight and obesity, with the highest OR for the 2000 CDC criteria. The OR for obesity in parent involvement schools did not change, although they increased in non parent involvement schools (extrapolated from the increased OR for all schools, because it was not possible to calculate the OR for non parent involvement schools with a value of zero including in one cell).

The linear and logistic regression analysis showed increases in the mean differences and all estimates of overweight/obesity and obesity by the 2000 CDC and IOTF criteria in parent involvement schools. There was a decreased risk of obesity in parent involvement schools as measured by the UK 1990 criteria, however the 95% confidence intervals included the null value (see Table 6.42).

Table 6.40 Difference in means of BMI and waist circumference before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1]			No parent involvement schools[1]			Parent involvement schools[1]		
	Mean (SD)			Mean (SD)			Mean (SD)		
	Before	After	Difference in means (95% CI) p value[2]	Before	After	Difference in means (95% CI) p value[2]	Before	After	Difference in means (95% CI) p value[2]
Mean (SD) BMI m/kg^2	17.5 (2.8)	17.8 (2.9)	0.32 (0.25, 0.39) p<0.001	17.3 (2.6)	17.6 (2.7)	0.29 (0.21, 0.37) p<0.001	17.9 (3.0)	18.3 (3.1)	0.39 (0.26,0.51) p<0.001
Mean (SD) waist circumference (cm)	60.9 (7.5)	61.1 (7.5)	0.16 (-0.8,0.40) p=0.18	60.3 (7.2)	60.4 (7.0)	0.14 (-0.14, 0.41) p=0.34	62.3 (8.1)	62.6 (8.1)	0.22 (-0.24, 0.68) p=0.35

[1] Children with before and after intervention BMI data were: 376 children all schools; 114 children in parent involvement schools; 262 children in non-parent involvement schools. Children with before and after intervention waist circumference data were: 389 children in all schools; 118 children in parent involvement schools; 271 children in non-parent involvement schools.

[2] Paired t-test for continuous variables.

Table 6.41 Odds ratio of overweight/obese comparing before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1] N (%)			No parent involvement schools[1] N (%)			Parent involvement schools[1] N (%)		
	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]
Central overweight & obese by waist	108 (27.8)	92 (23.7)	0.6 (0.29,1.18) p=0.11	66 (24.4)	56 (20.7)	0.6 (0.23,1.47) p=0.22	42 (35.6)	36 (30.5)	0.6 (0.17,1.82) p=0.32
General overweight & obese UK 1990	52 (13.8)	61 (16.2)	3.25 (1.00,13.68) p=0.03	33 (12.6)	36 (13.7)	1.75 (0.44,8.15) p=0.37	19 (16.7)	25 (21.9)	Cannot calculate because 0 in one cell
General obese UK 1990	28 (7.5)	31 (8.2)	4 (0.40,197.0) p=0.18	14 (5.3)	17 (6.5)	Cannot calculate because 0 in one cell	14 (12.3)	14 (12.3)	1.00 (0.01,78.5) p=1.00
General overweight & obese 2000 CDC	65 (17.3)	76 (20.2)	6.5 (1.47,59.33) p=0.005	40 (15.3)	47 (17.9)	4.5 (0.93,42.8) p=0.03	25 (21.9)	29 (25.4)	Cannot calculate because 0 in one cell
General obese 2000 CDC	24 (6.4)	29 (7.7)	6 (.73,276) p=0.06	11 (4.2)	15 (5.7)	Cannot calculate because 0 in one cell	13 (11.4)	14 (12.3)	2 (0.10,118.0) p=0.56
General overweight & obese IOTF	60 (16.0)	71 (18.9)	3.75 (1.19,15.52) p=0.01	37 (14.1)	43 (16.4)	2.5 (0.72,10.92) p=0.11	23 (20.2)	28 (24.6)	Cannot calculate because 0 in one cell
General proportion obese IOTF	15 (4.0)	18 (4.8)	4 (0.40,197) p=0.18	7 (2.7)	10 (3.8)	Cannot calculate because 0 in one cell	8 (7.0)	8 (7.0)	1.00 (0.01, 78.5) p=1.00

[1] Children with before and after intervention BMI data were: 376 children all schools; 114 children in parent involvement schools; 262 children in non-parent involvement schools. Children with before and after intervention waist circumference data were: 389 children in all schools; 118 children in parent involvement schools; 271 children in non-parent involvement schools. [2] McNemar's test for null hypothesis that odds do not differ before and after the intervention

Table 6.42 Linear and logistic regression of children reporting outcome (BMI, waist circumference and proportion overweight/obese) before and after the AFLY5 intervention (footnotes on next page)

	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted* mean difference[2,3] or odds ratio[4] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* mean difference[2,3] or odds ratio[4] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
Mean (SD) BMI m/kg^2	17.6 (2.7)	18.3 (3.1)	0.09 (-0.06,0.25) p=0.22	0.11 (-0.04, 0.25) p=0.15
Mean (SD) waist circumference (cm)	60.4 (7.0)	62.6 (8.1)	0.21 (-0.90,1.32) p=0.69	0.21 (-0.90, 1.32) p=0.70
N (%) overweight & obese by 1990 waist criterion	56 (20.7)	36 (30.5)	1.59 (0.92,2.74) p=0.10	2.01 (1.00, 4.04) p=0.05
N(%) overweight & obese UK 1990	36 (13.7)	25 (21.9)	2.72 (1.22,6.06) p=0.02	2.65 (0.74, 9.52) p=0.14
N (%) obese UK 1990	17 (6.5)	14 (12.3)	0.49 (0.04,5.57) p=0.57	0.46 (0.01, 16.87) p=0.67
N (%) overweight & obese 2000 CDC	47 (17.9)	29 (25.4)	3.38 (1.65,6.91) p=0.001	3.24 (1.54, 6.81) p=0.002
N (%) obese 2000 CDC	15 (5.7)	14 (12.3)	3.11 (1.06,9.16) p=0.04	6.57 (1.67, 25.78) p=0.007
N (%) overweight & obese IOTF	43 (16.4)	28 (24.6)	3.54 (1.94,6.44) p<0.001	3.47 (1.89, 6.37) p<0.001
N (%) proportion obese IOTF	10 (3.8)	8 (7.0)	2.22 (1.06,4.64) p=0.04	3.40 (0.83, 13.92) p=0.09

Footnotes for Table 6.42

[1] Children with before and after intervention BMI data were: 376 children all schools; 114 children in parent involvement schools; 262 children in non-parent involvement schools. Children with before and after intervention waist circumference data were: 389 children in all schools; 118 children in parent involvement schools; 271 children in non-parent involvement schools.

[2] For mean BMI and waist circumference, linear regression of mean difference by intervention (parent intervention compared to non-parent intervention) at adjusted for adjusting for before intervention BMI, age, gender and school cluster, showing coefficient, 95% confidence intervals and p value.

[3] 166 to 210 for children with full data for linear regression in all schools; n= 41 to 50 for children with full data for linear regression in parent involvement schools; n=125 to 160 for children with full data for linear regression in non-parent involvement schools.

[4] For proportions of obese/overweight, logistic regression of difference by intervention adjusting for before intervention binary obesity, before intervention BMI, age, gender and school cluster. The odds ratio >1 is increased odds of obesity, showing odds ratio, 95% confidence intervals and p value.

Diet

Table 6.43 shows the differences in eating healthy portions of the categories of food and eating breakfast before and after the intervention for all schools and stratified by schools involving parents and those not. After the intervention the healthy portions of fruit and vegetables, snacks, high energy drink and eating breakfast increased in all schools; healthy portions of high fat food decreased. The majority of 95% confidence intervals included the null value. The difference between after and before the intervention appeared greater for schools with parental involvement for snacks and high energy drinks than for those without parental involvement.

Table 6.44 compares dietary outcomes after the intervention by whether the intervention had parental involvement or not. After the intervention consumption of healthy portions of snacks and high energy drinks appears to have increased in parent involvement schools compared to non parent involvement schools but fruit/vegetables and eating breakfast decreased, although all the 95% confidence intervals include the null value. The adjusted results did not differ from the unadjusted results. In summary, the findings suggest that the AFLY5 intervention is effective at increasing consumption of healthy portions of fruit and vegetables, snacks, high energy drink and eating breakfast, all be it that this is a before and after study and therefore may be influenced by other changes occurring over time. However, there was suggestion that parental involvement resulted in greater effectiveness of the intervention for healthy portions of snacks and high energy drinks.

Table 6.43 Odds ratio of eating healthy amounts of fruit and vegetables, snacks, high fat food and high energy drinks comparing before and after AFLY5 intervention for all schools, and by parent involvement

	All schools[1]			No parent involvement schools[1]			Parent involvement schools[1]		
	N (%)			N (%)			N (%)		
	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]	Before	After	Odds Ratio (95% CI) p value[2]
Healthy portion of fruit and vegetables per day (≥3)	107 (28.0)	120 (31.4)	1.25 (0.85,1.84) p=0.27	82 (29.0)	95 (33.6)	1.36 (0.87,2.15) p=0.19	25 (25.3)	25 (25.3)	1.00 (0.47,2.14) p=1.00
Healthy portions of Snacks (≤1)	89 (23.3)	112 (29.3)	1.46 (1.01,2.14) p=0.05	66 (23.3)	79 (27.9)	1.32 (0.86,2.03) p=0.22	23 (23.2)	33 (33.3)	2.11 (0.91,5.30) p=0.09
Healthy portions of high fat food (0)	191 (50.0)	170 (44.50)	0.80 (0.59,1.08) p=0.15	141 (49.8)	125 (44.2)	0.79 (0.55,1.12) p=0.20	50 (50.5)	45 (45.5)	0.83 (0.46,1.48) p=0.58
Healthy portions of high energy drinks (≤1)	177 (46.3)	178 (46.6)	1.02 (0.71,1.45) p=1.00	132 (46.6)	123 (43.5)	0.83 (0.54,1.26) p=0.42	45 (45.5)	55 (55.6)	1.71 (0.85,3.58) p=0.14
Eaten breakfast (yes)	373 (97.6)	378 (99.0)	2.25 (0.63,10.00) p=0.23	277 (97.9)	281 (99.3)	3.00 (0.54,30.40) p=0.29	96 (97.0)	97 (98.0)	1.50 (0.72,17.96) p=1.00

[1] Children with before and after intervention diet data were: 382 children all schools; 99 children in parent involvement schools; 283 children in non-parent involvement schools. [2] McNemar's test for null hypothesis that odds do not differ before and after the intervention

Table 6.44 Logistic regression by intervention group of healthy amounts of fruit and vegetables, snacks, high fat food and high energy drinks before and after intervention

Healthy amounts	No parent involvement schools[1]	Parent involvement schools[1]	*Unadjusted* odds ratio[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value	*Adjusted* odds ratio[2,3] after the intervention comparing schools with parent involvement to those without parent involvement (95%CI) p value
	n (%)			
Healthy portion of fruit and vegetables per day (≥3)	95 (33.6)	25 (25.3)	0.77 (0.39,1.54) p=0.46	0.81 (0.40,1.62) p=0.54
Healthy portions of Snacks (≤1)	79 (27.9)	33 (33.3)	1.34 (0.83,2.18) p=0.24	1.25 (0.77,2.05) p=0.37
Healthy portions of high fat food (0)	125 (44.2)	45 (45.5)	1.05 (0.55,2.02) p=0.88	1.00 (0.53,1.91) p=1.00
Healthy portions of high energy drinks (≤1)	123 (43.5)	55 (55.6)	1.79 (0.92,3.48) p=0.09	1.77 (0.88.3.53) p=0.11
Eaten breakfast (yes)	281 (99.3)	97 (98.0)	0.33 (0.08,1.14) p=0.13	0.31 (0.07,1.43) p=0.13

[1] Children with before and after intervention diet data were: 382 children all schools; 99 children in parent involvement schools; 283 children in non-parent involvement schools. [2] McNemar's test for null hypothesis that odds do not differ before and after the intervention

[2] 353 children with full data for logistic regression in all schools; n= 88 for children with full data for linear regression in parent involvement schools; n= 265 for children with full data for linear regression in non-parent involvement schools.

[3] For proportions of healthy amounts, logistic regression of difference by intervention adjusting for before intervention diet variable, age, gender and school cluster. The odds ratio >1 is increased odds of obesity, showing odds ratio, 95% confidence intervals and p value.

6.5.4. Summary of quantitative results

A summary of the post intervention results are presented in Table 6.45. Overall the AFLY5 intervention appears to improve reported sedentary behaviour, consumption of healthy portions of fruit and vegetables and snacks, with these findings being consistent with what found in phase I. The phase II study has shown that the intervention appears to improve active travel to school and high energy drinks, which was not found in phase I. In addition, it has shown that it appears to improve physical activity volume and MVPA and mean waist circumference. There was no evidence that the intervention reduced levels of sedentary behaviour when objectively assessed with accelerometery. Overall the parental involvement does not make a notable difference but may increase the effectiveness of changes in sedentary time, physical activity, active travel to school and some aspects of diet.

Table 6.45 Summary of AFLY5 phase II intervention results

	Some evidence that ALFY5 intervention has a beneficial effect yes/no/worse[1]	Any evidence that a beneficial effect is greater in schools with parental involvement yes/no
Child reported sedentary behaviour questionnaire	Yes	No
Parent reported sedentary behaviour questionnaire	Yes	No
Accelerometer recorded sedentary time	No	Yes
Accelerometer recorded MVPA	Yes	Yes
Accelerometer recorded physical activity (counts)	Yes	Yes
Parent support for activity scale	No	No
Active travel to school	Yes	Yes
Diet	Yes (fruit & snacks) No (energy drinks) Worse (fatty food)	Yes (snacks & energy drinks) No (fruit and fatty food)
Mean BMI	Worse	No
Overweight and obese by UK 1990	Worse	No
Obese by UK 1990	Worse	Yes
Mean waist circumference	No	No
Obese by waist circumference	Yes	No

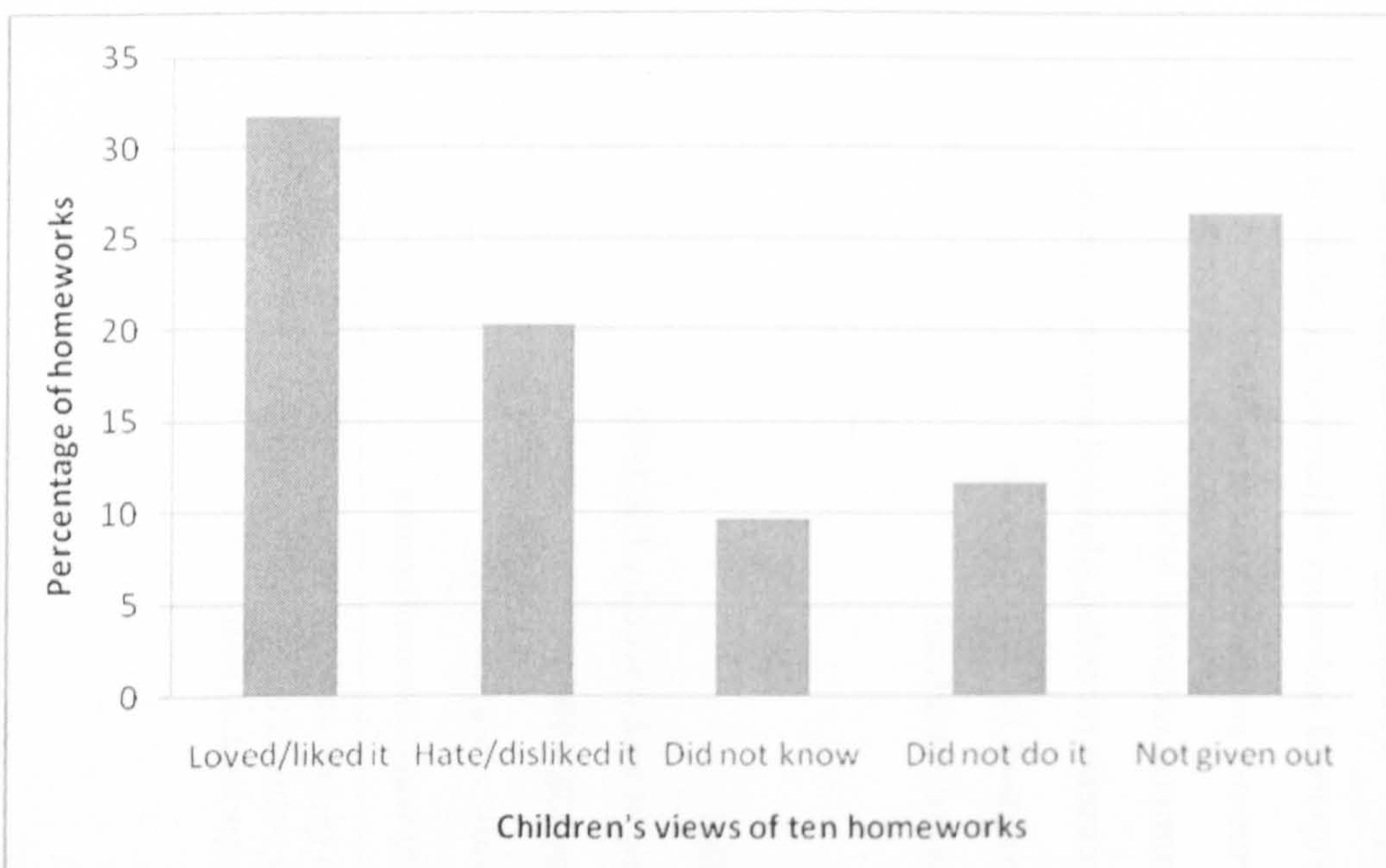
[1] Yes, no (point estimate for association essentially null), worse (results suggest outcome worse after intervention are based on point estimates not p-values). The null value is taken as an arbitrary +/- 5% from the null so any ratio of 0.94 or 1.06 or more extreme not null whereas any of 0.95 or 1.05 or closer to the null categorised as null.

6.6. Results: process evaluation

6.6.1. Child focus groups descriptive

In response to invitations to take part in the focus groups, consent forms were returned for a total of 34 children from four schools, with an average of 8.5 children per school. Twenty children were girls (58.8%). In two schools with eleven and nine children, two focus groups were held, therefore six focus groups were held in total. The focus groups lasted for a mean time of 45 minutes. For each of the ten homeworks the children held up one of six smiley face pictures to indicate how they felt about it. 31.7% of the homeworks were loved or liked by the children and 20.3% of the homeworks were hated or disliked. For 9.7% of the homeworks the children did not know what they thought and 11.8% were not completed, despite having received them, and a further 26.5% of homeworks were not given out. In Table 8.22 in Appendix 8 the children's views of the individual homeworks are given. Graph 6.7 shows a summary with the categories of love/like it and hate/dislike it combined.

Graph 6.7 Children's views of ten Active for Life Year 5 homeworks from child focus groups (n=34)



The transcript of each focus group was coded into main codes and sub-codes (see Tables 8.23 and 8.24 in Appendix 8). The text relating to the children's views of the homeworks were extracted and children's views of whether as a result of the project they had made changes in their diet, physical activity or sedentary behaviours. Further categories were applied to the data as shown in Table 8.25 in Appendix 8. Framework analysis was undertaken, and a chart was created for the following themes, with a row for each child: love or liked the homework; hate or dislike the homework; didn't know what they thought of the homework; did not do the homework; changes to diet; changes to physical activity; changes to sedentary behaviour. An example of a chart is shown in Table 8.26 in Appendix 8. Either a summary of the text for each child or a quote was inserted into the chart. For each chart the text in the categories was analysed further and classified into the classes which will be presented below.

6.6.2. Child focus groups synthesis of data

Theme: Love or like the homeworks

The classes and categories for this theme are shown in Figure 6.2.

Class: Engaged with the activities

These children (20/34 children; 6/6 focus groups) enjoyed doing activities within the homeworks such was writing, colouring, dancing, cooking and the scavenger hunt.

"Well I do like cooking and I can cook meals by myself, I've done it before but I's like I said before I do like doing hands on things and it just made it more fun as it was homework." (Girl 4, Group 1, School 33)

Figure 6.2 Categories from child focus group 'love or like the homework' theme by class

Category	Class
Liked going outside	
Challenge or competition	
Liked the activity	
It was fun	Engaged with activity
It was easy	
Choice of activity	
Doing exercise in a fun way	
Doing it with Mum	
Novel homework	Novelty
Something to do	
Doing something I wouldn't normally do	
Learning about exercise	Enjoyed learning
Learning about food	
Family/friends were involved	Enabled social contact
Don't know	Other
Didn't do hw at home	

The activities captured their interest by being fun (14/34 children; 6/6 focus groups), offering choice (6/34 children; 4/6 focus groups) or challenge (5/34 children; 4/6 focus groups).

"I liked the one where you had a bingo card and you had to do like loads of fun activities." (Girl 4, School 37)

"I liked it because sometimes I like setting sort of challenges for myself and some of the things on there I do quite like I enjoy doing." (Boy 1, Group 1, School 33)

The activities provided additional enjoyment when they were undertaken with family or friends (16/34 children; 5/6 focus groups).

"My mum took us like round the whole of Bristol I think and it was like really fun cos like you don't like have to do one thing you've got like a choice like things to do." (Boy 7, School 37)

"I had a free choice of what I was gonna do so I chose some crackers and biscuits, two like things that are relatively the same then I decided like to compare them with...even though they are basically the same thing they have a lot different." (Girl 2, Group 2, School 33)

Class: Novelty

Some activities were undertaken for the first time (13/34 children; 5/6 focus groups).

"I really liked it because it kind of made me do things that I don't normally do like I don't usually walk up the stairs ten times a day." (Boy 2, Group 1, School 33)

"Well its really fun because I don't often get to cook. I think the only time I really cook properly was when I helped my dad do the fajitas... But my sister she came round and we made like a banana and chocolate smoothie and when we worked together like doing it as

a team and like having someone to share it with you, not just cooking on your own. I think that's what made me like it a lot." (Girl 2, Group 2, School 33)

Some of the homeworks had the element of novelty and being different to normal homeworks because they were fun or were activity based (3/34 children; 3/6 focus groups).

"Yeah I liked it because it's a bit different cos some homework is all like answering questions and then like if you look on it there's a a fun thing to do like sort of to do with the homework and when I did it some of the stuff I got it like some of the stuff was like really easy to find and then you've got to look more carefully yeah..so I liked that." (Girl 5, Group 2, School 34)

"It was actually quite good homework cos that's not what homework is normally doing, its normally work sheets and things like that." (Boy1, Group 1, School 33)

Activities such as bingo or the scavenger hunt showed the children how to be active when doing everyday activities or in fun ways (1/34 children; 1/6 focus groups).

"Its really fun because like you're doing exercise but you're doing it in a fun way because whilst you're out looking for things you're like walking about and running and exercising and it's even more fun." (Girl 6, School 37)

Activities such as cooking provided some children with opportunities to do it with a parent for the first time (4/34 children; 3/6 focus groups).

"I liked it because well I never have the chance to cook with my mum." (Girl 6, Group 1, School 33)

Class: Enjoyed learning

The homeworks provided some children with the opportunity to reflect on their lifestyle or what they eat (9/34 children; 3/6 focus groups).

"Doing the questions actually made me think about how my lifestyle and how things happen round me." (Girl 4, Group 1)

There were examples where the children saw what they had learnt being put into action as they changed what they ate or did (4/34 children; 3/6 focus groups).

"I liked it because when I was writing it down when I finished it I was looking at it, I was like like the first of the day I was like ate really healthily but we eat unhealthy and then when it gone to the end it got healthier and healthier where I was learning." (Girl 5, School 38)

There was a recognition that some of the learning would equip them for later life (1/34 children; 1/6 focus groups).

"I really liked it because its kind of like helping us when like our future because like when we get to like the age like fifteen we're gonna need to know how to cook for a few years time when we move out like of our mum's house or something. So like cos we need to like know how to cook so like we're prepared for the future". (Boy 5, School 37)

Class: Enabled social contact

The activities which required parental support provided additional enjoyment for most children because they did not usually do the activity at all, or with their mother, such as cooking, bike rides or scavenger hunt (17/34 children, 5/6 focus groups).

"Because me and my mum like we did get to spend time because she's always looking after my little brothers and umm she's most look so I really enjoyed it because we got to spend time together and I got to help her with all the things." (Girl 1, School 37)

The homeworks provided the opportunity to play more outside which was usually with friends or family (3/34 children, 36/ focus groups).

"Good because I had a chance to go outside and play more... cos I never go outside really." (Girl 2, Group 1, School 34)

There was enjoyment expressed at doing homework as a family (3/34 children, 2/6 focus groups).

"Because as well as it was quite fun to try and stop your TV but it was also quite fun that I could get like my family to be with my homework."(Boy 3, Group1, School 34)

Theme: Hate or don't like the homeworks

The classes and categories for this theme are shown in Figure 6.3.

Class: Lack of engagement with activities

These children did not enjoy elements of the homework activities, such as worksheets, writing, colouring, cooking healthy food, eating fruit and vegetables being physically active or restricting TV viewing (14/34 children, 6/6 focus groups).

"I don't usually eat vegetables at all you know in a day". (Girl 2, School 37)

Figure 6.3 Categories from child focus group 'hate or did not like it homework' theme by class

Category	Class
Found it difficult	Lack of engagement in activity
Didn't like the activity	
Boring	
Repetitive	
Passé subject	
Not relevant	
Too busy	
Got behind	Practical problems with activity
Couldn't remember what they had done	
Family not involved	
Felt under pressure	Found it difficult to make changes
Felt told what to do	

"I don't like making healthy things....But I like to making like cakes or flapjacks and stuff like that but I don't really like making up other stuff." (Girl 3, School 37)

Activities which were repetitive were not appealing because of problems remembering to do it (8/34 children, 3/6 focus groups) or being too busy (5/34 children, 3/6 focus groups).

"I did it, did a bit of it but I kind of lost track and sometimes it would get boring cos I was always putting the same thing." (Girl 3, Group 2, School 33)

Some children found that the work wasn't novel (3/34 children, 1/6 focus groups).

"Well ...I mean like we've been learning about the food categories so basically an hour every week...an hour a day so we like knew enough about it and we we knew that cabbages were like fruit and, like crisps were like being all salty fatty too." (Boy 3, Group 1, School 33)

In some cases the family were unsupportive which made the activities less appealing (5/34 children, 3/6 focus groups).

"Yeah and I asked my little sister and she said no she didn't wanna do it, with my dad he said no and my mum said nah and then said she'd send a letter as well and then I was like well there's no point in me doing it then." (Girl 5, School 38)

Class: Practical problems with the activity

There were examples given where children struggled to do the homeworks because they didn't understand what to do (10/34 children, 3/6 focus groups), or they required family support which wasn't forthcoming (5/34 children, 3/6 focus groups).

"I didn't like it because umm like I didn't get what to do and I tried doing it and I got it like wrong." (Girl 8, School 37)

Some children found it difficult to keep up with repetitive homeworks like recording breakfast each day (4/34 children, 3/6 focus groups).

"Umm I didn't like it because umm I was a bit behind on the schedule and so if it was on Sunday then I would do it on Tuesday and it was like really busy and then you can't you can't remember what you have on the actual date." (Girl 4, Group 1, School 33)

Some children and families were too busy to do the homeworks (5/34 children, 3/34 focus groups).

"Well I didn't do it because cos my dad couldn't and it said you had to do it with a parent/carer and my mum and dad were always busy and then I couldn't I wasn't able to do it and like brothers and sisters they had like exams and things on....I didn't actually have any time to actually do it." (Girl 4, Group 1, School 33)

Class: Found it difficult to make changes

Some children felt it was not relevant to make changes, either because they did not want to or because they felt they were already eating healthy food, being physically active or not watching a lot of TV (3/34 children, 1/6 focus groups).

"I wasn't really sure to set a goal because I do a club of literally every night and so I don't know I didn't think I could actually set a goal for myself I thought I was alright as I was." (Girl 5, Group 1, School 33)

Changes were difficult to make where the child did not like the activity, such as eating more fruit and vegetables, changing their snacks, watching less TV or being more active (3/34 children, 2/6 focus groups).

"Cos I don't like doing exercise I just like sitting around." (Girl 4, School 38)

A small number of children did not like the awareness they had gained about the content of food or felt under pressure to change.

"Normally I enjoy eating it but now I don't because I know how much fat's gone in." (Girl 4, School 37)

Theme: Didn't do the homework

The classes and categories for this theme are shown in Figure 6.4.

Figure 6.4 Categories from child focus group 'did not do homework' theme by class

Category	Class
Didn't know what to do	
Difficult	Homework was difficult
Family not involved	Lack of adult support
Teacher	
Didn't get round to it	
Didn't want to do it	Did not engage with the homework
Too busy	
Away	Away
Lost	Lost

Class: Away

Some children were on holiday or ill when at least one homework was given so did not complete it (8/34 children, 4/6 focus groups).

Class: Homework was difficult

These children found the homework confusing, difficult or did not know what to do (9/34 children, 4/6 focus groups). Examples of difficulties were engaging family members with the freeze my TV family challenge which led to them not doing the homework (6/34 children, 3/6 focus groups).

"Well because none of my parents or my sister didn't want to do it." (Girl 6, Group 1, School 33)

Other problems encountered were their residential area not being close to wildlife which made the scavenger hunt difficult (1/34 children, 1/6 focus groups).

"There's no like wildlife round by us." (Girl 7, School 37)

Some children needed adult support to complete the homework and it wasn't forthcoming (8/34 children, 3/6 focus groups).

"My mum likes sleeps in all day then at night she goes to work and my dad gets home at half past five, and like till my dad get gets home my sister is in the hall with her friends and like their my dad's like busy doing something else and I never like get a chance to go out and stuff like that". (Girl 7, School 37)

Class: Did not engage with the homework

Some children did not want to do the activity, or they didn't get round to doing it; it appears that the homework was treated as an optional extra (6/34 children, 3/6 focus groups).

"I just didn't wanna do it....because I'm out a lot of the time and I couldn't get round to doing it." (Girl 4, School 38)

Sometimes busyness was the barrier - either the child was too busy (particularly with being late home or doing a lot of clubs) (6/34 children, 4/6 focus groups) or the parents were too busy to help (5/34 children, 2/6 focus groups).

"I couldn't do the scavenger hunt because my mum and dad were too busy." (Girl 6, Group 1, School 33)

Class: Lack of adult support

On occasions the children needed additional explanation or support from the teacher and the teacher forgot or said that they did not need to do the homework (2/34 children, 1/6 focus groups).

"I asked the teacher and it was and she said she'll help me but she forgot." (Girl 4, School 37)

For other children they needed support from their parents and they were too busy or did not want to do the activity, particularly the freeze my TV (5/34 children, 2/6 focus groups).

"I normally get home at half three or four and like by the time I get home my my mum makes my tea and its like in the microwave and then my mum gotta get go to work". (Girl 7, School 37)

Theme: Didn't know what they thought about the homeworks

The classes and categories for this theme are shown in Figure 6.5.

Figure 6.5 Categories from child focus group 'did not know what they thought about the homework' theme by class

Category	Class
Difficult and easy Tired	Mixed experience
Difficult	Aspects were difficult
Can't remember	Forgotten

Class: Mixed experience

Some children found homeworks a mixed experience, with easy and difficult elements which meant they were undecided in how they felt about it (2/6 children, 2/6 focus groups).

"Cos it was hard and it was easy as well." (Boy 2, Group 2, School 34)

Alternatively the context of doing the homework, such as being tired at the end of the day, affected their ambivalence about the homework (1/6 children, 1/6 focus groups).

"I I did it but I didn't really know what I felt about it because umm usually we have our tea quite late so I was always tired after I'd had it." (Girl 3, Group 2, School 33)

Class: Aspects of homework were difficult

Some children were ambivalent because they found aspects of the homework difficult, such as particular questions, or they found the choice of snack to be a challenge (6/34 children, 5/6 focus groups).

"I didn't know because I'm between sort of alright and didn't like it because I thought it was a little bit hard and it was sort of the same as (another child) I got a lot of choices of like food umm which I like." (Boy 1, Group 1, School 33)

Some practical problems were found such as forgetting to do it and then having to do it in a rush or finding labels on snacks (2/6 children, 2/6 focus groups).

"I forgot to do it but then on the last day when we had to hand it in I had to quickly get up early and then rush around and do it all and then my mum and then after I had done that I had breakfast and I had to just go off to school." (Boy 1, Group 2, School 34)

Problems were encountered in getting families to be involved in tasks such as the freeze my TV family challenge (2/34 children, 1/6 focus groups).

"It was hard to get everybody to like join in. After you'd written the name down they wouldn't always like do it." (Girl 3, Group 2, School 34)

Class: Forgotten

A group of children didn't have a view because they could not recall doing the homework; which may have been because it had not been given out (3/34 children, 2/6 focus groups).

"But I can't remember what I actually done". (Boy 1, Group 1, School 33)

Theme: Physical activity changes

The classes and categories for this theme are shown in Figure 6.6.

Figure 6.6 Categories from child focus group 'changes to physical activity' theme by class

Category	Class
Already active No change Not sure if project led to change	No change
More active Family support	More sports activities More active play

Class: Project did not lead to changes in physical activity

Several children reported that they were already very active and therefore the project had not affected their physical activity (5/34 children, 2/6 focus groups).

"Because most of the time I was always out anyway...I always ride my bike to school since about Marchish I started riding my bike to school all the way and back and ever since then I like my bike's already out so it kind of like convinces me to go out." (Girl 5, School 37).

Others did not give a reason but were clear that the project had not affected their activity (1/6 children, 1/6 focus groups); alternatively a clear reason was given, such as the barrier of having the family dog in the garden so the child was unable to play outside (1/6 children, 1/6 focus groups).

"Cos when I get home there's like nothing to do cause I don't like I cant go in my garden cause my dog he's in the garden... so there's nothing else really left to do and I don't really watch TV so I play on my XBOX." (Boy 5, Group 2, School 33).

Some children gave examples of additional sporting activities, but were not sure if it was because of the project (2/34 children, 2/6 focus groups).

Class: More sports activities

Children gave examples of how the project has assisted them in starting new sporting activities, such as squash and football (2/34 children, 1/6 focus groups).

"From the project me and mum and dad have started looking for a football team for me to play and now I've got one." (Boy 1, School 38)

Class: More active play or travel

Many examples were given of more active play or travel, such as riding bikes, walking the dog, playing football and active games (12/34 children, 5/6 focus groups).

"It has changed for me cause like when I used to go outside and play we normally just we used to play a game and I went in but now we have fun like playing more active games and have races and stuff." (Boy 1, School 37)

Further examples were given of parents supporting these activities, such as organising bike rides (3/34 children, 3/6 focus groups).

"On Sunday (friend's) mum takes us on bike rides a lot now, me and my uncles and my sister, my cousin we go on bike rides a lot and now I like I don't like sit in my room and watch TV anymore". (Girl 7, School 37)

Theme: Sedentary behaviour changes

The classes and categories for this theme are shown in Figure 6.7.

Figure 6.7 Categories from child focus group 'changes to sedentary behaviours' theme by class

Category	Class
Less screen time	Cut down on screen time
Less TV	More active play
No change	No change

Class: No change in sedentary behaviour

A few children reported that the project had made no changes to their time spent TV watching or using the computer, but they were in a minority compared with the number who reported no change in physical activity (2/34 children, 2/6 focus groups).

Class: Switching TV watching to active play

Children gave examples of watching less TV in the context of now spending more time playing outside instead (4/34 children, 2/6 focus groups).

"Yeah because then you get to go out and play with your friends more than just watching telly and playing on the computer." (Boy 1, Group 1, School 34)

Examples were given where parents supported the change, such as taking the child for a walk instead of watching TV.

"It has made a change because my mum usually says like that we're going out for a walk or something instead of watching telly." (Girl 2, Group 1, School 34)

Examples were given where the project had prompted the child to reflect on the time they spend watching TV (/ children, / focus groups).

"Yeah it like made me think about umm what how much I was playing on my video games or uhh watching telly and made me go outside more". (Boy 1, Group 1, School 34)

Class: Cutting down on screen time

Some children gave examples of how the project has led them to reduce their time using the XBOX, computer or Wii (3/34 children, 2/6 focus groups).

"Well its sort of a bad habit of mine but I've mentally addicted to my XBOX.. I cut down on it (XBOX) a bit I used to go on it like twenty four seven." (Boy 5, Group 2, School 34)

Theme: Diet changes

The classes and categories for this theme are shown in Figure 6.8.

Class: Healthy diet changes

Children gave examples of changes they had made to their diets which focused on eating more fruit and vegetables (13/34 children, 4/6 focus groups) and fewer sweet foods (5/34 children, 3/6 focus groups). Examples of changes were eating fruit and vegetables for pudding, at school lunch, snacks and breakfast and children cited changes in their attitudes to fruit and vegetables, and naming foods they now liked to eat.

Figure 6.8 Categories from child focus group 'changes to diet' theme by class

Category	Class
Awareness	
Eating in moderation	
Specific lesson prompt	
Less enjoyment of food	Healthy diet changes
Cooking	
Fruit and vegetables	
Eats less sweet foods	Changes at home
Family changes	
Didn't want to change	
Continues eating sweet food	
Already eat healthy food	Lack of change
Rebound	

"Its changed like sometimes when, when you get home from school you just have like a little packet of crisps but now like I have a banana or something like that to keep me going." (Girl 8, School 37)

"Because when we had the breakfast one on some breakfasts I have angel cake and then it there was quite a lot of things that were like I kept getting like the purple (the colour of the high fat and sugar food group on the Eat Well Plate) with like the bad food so then I started there was about two or three days there was umm where I've had an apple instead of the angel cake." (Girl 5, Group 2, School 34)

Sweet foods were talked about in terms of eating them in moderation, having a greater awareness of the content of food (5/34 children, 3/6 focus groups) and, for one child, less enjoyment of sweet or fatty foods because of this awareness.

"Well we need to kind of keep what your eating kind of moderation don't you and not each too much or something so, well, may be two bars of chocolate or may be three bars of chocolate every week." (Boy 2, Group 1, School 33)

Examples of changes were given in what they choose to eat at breakfast and what they choose to buy themselves (3/34 children, 2/6 focus groups).

Class: Changes at home

Children in one focus group gave numerous examples of changes which they had encouraged or their mothers' had made at home, such as eating more fruit and vegetables, more salad, fewer puddings, fewer chips and fish fingers (6/34 children, 1/6 focus groups).

"Well I think it changed a lot because normally round my dad's he like cooks us like fish fingers and stuff like that and I've asked him to like give us like pasta and stuff and stuff like that." (Girl 4, School 37)

"My mum start like buying things like apples and bananas and water melons now like she's like always cooking like a healthy meal for tea now."(Girl 7, School 37)

"Before we like started this project my mum would like probably give us like pizza with chips but now she gives us like pizza, pizza with salad." (Girl 8, School 37)

Class: Lack of change

A group of children had not made changes in their eating because of their preference for food such as cake, because they could not be bothered (2/34 children, 2/6 focus groups) or because they felt they were already eating a healthy diet (2/34 children, 2/6 focus groups).

"No because I like my chocolate cake...And chocolate biscuits every morning". (Boy 2, Group 2, School 34)

"Well it doesn't actually affect me because I am already like eating healthy." (Girl 3, Group 1, School 33)

A couple of examples were given where the project seemed to have reinforced unhealthy eating behaviour, as a reaction to not wanting to change or by the child regarding the project as a diet or period of abstinence, followed by embracing unhealthy food when the project ended (2/34 children, 1/6 focus groups).

"Because I couldn't eat chocolate I eat more now cause I didn't eat when I was doing the project." (Girl 4, School 38)

"I've ate more... Ahh I think it was because some of it I couldn't be bothered to do so I went like really like a wee bit prickly so I just carried on doing what I normally do." (Girl 5, School 38)

Summary of child focus groups

The majority of homeworks were given out (73.5%) and 61.7% were completed by the children. Of those completed, 51.4% were loved or liked, 32.9% were hated or disliked and 30.6% there was not a view. 45% of homeworks were given out *and* completed. The most popular homeworks were cooking and the scavenger hunt. The least popular were Freeze My TV and the five a day (fruit and vegetable) chart. A summary of the themes and classes is provided in Table 6.46.

Table 6.46 Summary of child focus group themes and classes

Theme	Class	Evaluation
Loved of liked homework	Engaged with activity	Children enjoyed activities which were fun, offered choice, challenge or social contact
	Novelty	Activities which were new to the child or regarded to be unusual for homework were popular
	Enjoyed learning	Children enjoyed learning new skills or seeing the impact of learning on their decisions
	Enabled social contact	Activities requiring adult support and time with parents, family or friends were enjoyed
Hated of disliked homework	Lack of engagement in activity	Specific activities which were not enjoyed by the child, or were repetitive were not popular
	Practical problems with activity	Difficulties, such as being busy, or needing adult support which was not available
	Found it difficult to make changes	Either feeling they did not need to make changes or did not want to make the proposed change
Did not do the homework	Homework was difficult	Found the homework difficult or difficulty engaging their family
	Lack of adult support	Lack of support from the teacher or parent, particularly because adults were busy
	Did not engage with homework	Busyness of the children and parents was a barrier to engaging in the homework
	Away / Lost	Ill or on holiday or lost the homework
Did not know what they thought about homework	Mixed experience	Undecided because they found it easy and difficult
	Aspects were difficult	Ambivalent because some parts were difficult or they did not like having to make choices
	Forgotten	Difficulty recalling the homework and therefore did not have a view
Changes to diet	Healthy diet changes	Eating more fruit and vegetables, reduced sweet foods, eating in moderation and awareness
	Changes at home	Child or parent had made changes at home, mainly more fruit and vegetables
	Lack of change	A group of children did not want to make changes, could not be bothered or felt no need
Changes to physical activity	No change	Already very active, so no need for change or barrier to more active play outside
	More sports activity	Examples of starting new sports for a few children
	More active play or travel	Examples of more active play, active travel and support from parents
Changes to sedentary behaviours	No change	A few children said sedentary behaviours had not changed
	Switching TV to active play	*Examples of switching from TV watching to playing outside or going for a walk*
	Cutting down on screen time	*Examples of reductions in computer games*

6.6.3. Parent interviews descriptive

Four mothers from three schools were interviewed. Three mothers had sons in year 5 and one mother had a daughter. The interviews lasted between 16 and 37 minutes (mean of 22 minutes) (see Table 8.28 in Appendix 8). The main and sub-codes are shown in Table 8.29 in Appendix 8. The transcript of each focus group was coded as per the child focus groups.

6.6.4. Parent interview synthesis of data

Theme: Homework

The categories and classes for this theme are shown in Figure 6.9.

Class: Memory of the homeworks

The parents were asked about each homework in turn and said how many of the ten homeworks they remembered. One parent remembered five homeworks, two parents remembered six homeworks and one parent remembered seven homeworks.

Class: General views of homeworks

One mother felt strongly that children dislike homework regardless of its content. In contrast the other three parents were positive about the homeworks and gave examples of what homeworks their child had enjoyed doing. One of the parents commented that the homework had been instead of the child's normal homework, which made it manageable and it would have been difficult to do in addition to the usual homework. Three of the parents commented that it can be difficult to fit homework in, particularly if the children have less than a week to complete it and if there are other children in the family.

Figure 6.9 Categories and classes assigned to parent interviews about the AFLY5 homework

Category	Class
Fit check homework Cooking homework Eat Well Plate homework Bingo homework Freeze TV homework Snack homework Top Grub homework Sugar in drinks homework Fruit and vegetable chart homework Breakfast chart homework	Memory of the homeworks Relevance of topics for behaviour change
Time Homework general	General views of the homeworks
Homework as method to involve parents	Homework as method to involve parents
Changes to diet Change to physical activity Awareness Need for change	Behaviour change

"Children just hate doing anything in the way of homework even if it you know its something that we, you and I, might consider enjoyable." (Mother 1, School 33)

"She did really good actually, we took a photo after. We've got this lovely photo of (child's name) with the pizza." (Mother 1, School 38)

"It was good. He enjoyed that one (talking about snack homework)." (Mother 2, School 33)

"I think if it had been extra it would have been like 'oh god we've got another bit of homework' you know it would have prioritised. I said 'no you've only got that to do'." (Mother 1, School 34)

"(Its) difficult to sit down with for all of them on a one to one basis to do the, the stuff umm so ...yeah it is time consuming." (Mother 2, School 33)

Class: Relevance of topics for behaviour change

Two of the four parents said that the topics were not relevant to their child or family because they were already very active, watched little TV and ate healthy food. Therefore they felt that it had little impact on the child or the family. In particular two parents chose not to do the freeze my TV homework. One of these parents (Mother 1, School 33) was consistently negative about the project because she regarded it not to be relevant. In contrast another mother (Mother 1, School 34) spoke of positive behaviour changes arising from the project including specific homeworks prompting the family to be more active and several references to 'pricking her conscience' about TV watching or activity, although it did not always lead to definite action.

"He was ok about it, he doesn't watch a great deal of TV anyway. Normally he's outside and he's not if the weathers good he's out. And he's not much of a TV watcher. It wasn't one we didn't actually try and reduce it cos it's, you know, he doesn't watch much as it is." (Mother 2, School 33)

"No we received it (talking about Freeze My TV homework) but we didn't want, I didn't want to do it. Well we're very active family anyway. You know, we spend very little time watching TV, so I didn't feel it was to do any to deprive him of the few programmes that he does watch...and to involve the whole family as well I didn't think it was particularly on, you know." (Mother 1, School 33)

"Well he gets a bit narky (about the fruit and vegetable homework) actually cause he eats loads of fruit and veg anyway so that sounded all a bit patronising." (Mother 1, School 33)

"Well in all fairness to me its preaching to the converted cause I already do all that sort of thing and those other parents I've spoken to do as well. So I mean it may it may be for a certain number of parents but I would say on the whole we're so like we're so well aware from other sources of what we should be giving our children and what we should be eating ourselves you know and the amount of exercise ...I mean I suppose it does no harm for the children to have it rammed down their throat a bit more but ...it didn't really have any effect on us I don't think cos we already do that sort of thing anyway."" (Mother 1, School 33)

"Our family we do try to aim for a very healthy diet and a very healthy life style, apart from my husband, but yeah see so, so it may be wasn't as relevant to us as perhaps some other people." (Mother 1, School 38)

"I think it's already gone and pricked your conscience and it was like, you know what you should do, but it's in black and white it just prompts you to go out and do it." (Mother 1, School 34)

"When the family had to fill in (the freeze my TV homework)...a lot of discussion went on...'Oh but I like to watch things ', so it was discussed, but nothing was put firmly down...So yeah we it, it did prick a conscience but we didn't actually....you know (put) pen to paper (and) actually commit to what less we're gonna watch." (Mother 1, School 34)

"He did start looking at labels...cos he said he could eat three bowls of cereal for one of the biscuits." (Mother 1, School 34)

Class: Behaviour change

Two of the parents said that the project had not changed their children's eating, one said it had to a certain extent and one (Mother 1, School 34) gave several example of change including trying to use food less as a comfort food, the child choosing fruit instead of crisps after school and buying a smoothie machine. Three parents said it had not changed their children's physical activity and one (Mother 1, School 34) indicated that she wanted to increase his activity but there were barriers to doing so. All four parents gave examples of how the children's awareness of healthy eating had changed. One mother, again the mother in school 34, also volunteered that she thought change was important in order to make a difference when the children are older and because her son is a bit overweight.

"I don't think it has (changed what he eats) but occasionally he'll pipe up I mean if if he's sat there with a balanced meal he may pipe up and say this is a balanced meal because its got a certain amount of protein and a certain amount of carbohydrates which probably he

wouldn't have got from me so I don't think its changed the way he eats but perhaps its made him think a bit more about you know when he looks at his plate he can actually see the different food types more clearly." (Mother 1, School 33)

"Yes in as much that he's thinking about what he's eating now and he does actually comment this is healthy, this isn't healthy and uhh so he's much more aware now about health issues." (Mother 2, School 33)

"No cos he's already always on the go. There's not a moment goes by when he's not doing something...No because I don't have to worry about them sitting in front of the TV. For them that's a little bit of a rest its, its not something they do all the time." (Mother 2, School 33)

"When [son's name] comes home from school he says I'm starving because he's at that age when he's growing, growing fast and needs something. Like he'll think what can I have and I say 'well you know what's in the cupboard' so he would in a way he would just sort have gone and picked up the first packet of crisps or something. He'll think 'oh well no I'll have a piece of fruit', although he loves fruit, and he always has had fruit, he tended to have the fruit and the crisps.... So yes it has made him think and its made it easier for me because I don't have to say no because he's made the decision himself." (Mother 1, School 34)

"He is quite conscious, conscious of his weight I wouldn't say he was.... grossly overweight but yeah he probably just carry I say more than he should do." (Mother 1, School 34)

"I think you know catching children at this age ...hopefully in twenty years time it will make a difference." (Mother 1, School 34)

Class: Homeworks as a method to involve parents

Three of the parents were positive about using homeworks as a method to involve parents, with the caveat that the topics were not necessarily ones which were relevant to one of the three and with the caveat from another parent that the initial reaction of parents at the school was that the topics were intrusive. Examples were given of how homework is something which is routinely completed, so it has the benefit of not being an extra activity. In contrast one parent (Mother 1, School 33) was generally negative because she focused on the topics and felt that parents are already aware of healthy eating and exercise.

"Well it was good it was it was quite, quite interesting but I think it's our family we do try to aim for a very healthy diet and a very healthy life style." (Mother 1, School 38)

"Brilliant ..brilliant. Cos sometimes it's hard to get in contact with parents and if the child is doing the homework it's part of you know a regular day to day thing isn't it, doing homework, finding time to do it, so I think it's a good idea." (Mother 2, School 33)

"I think initially when it came home like most parents is like what a cheek you know what right have you got to see what we eat or what we drink and I think that's you know that was the conversation that went round... But as we got more involved with it and you like you say its staring in your face on the telly and everything else, about the problems of weight but I find the more he got involved the more you." (Mother 1, School 34)

A summary is provided in Table 6.47 below, which includes the findings from the parent questionnaires which will be presented next.

6.6.5. Parent questionnaires descriptive

The parent questionnaires were returned by 25/150 (16.7%) parents in the four parent involvement schools. The majority of respondents were mothers; therefore the analysis is not separated by parental gender (see Table 8.30 in Appendix 8).

6.6.6. Parent questionnaires outcomes

On average parents recalled seeing 67.7% of the homeworks (ranging from 61.5 to 73.8% by school), 26.6% of the homeworks were not remembered (ranging from 21.3 to 38.3% by school) and for 5.2% of the homeworks the parents did not know (ranging from 0 to 15.4% by school). There was evidence of a difference between schools in the parental recall of three homeworks (bingo, sugar in drinks and the breakfast chart) where more parents in one school did not remember seeing the homework than in the other schools (see detail by schools in Table 8.32 in Appendix 8). The parents were invited to give free text comments about each of the homeworks. For the majority of the homeworks (7/10) the majority (63/77 (81.8%)) of comments were very positive and noted that the children and family had enjoyed the activity and found it helpful. The homeworks which were the exception to this were freeze my TV, where only 5/14 (35.7%) of the comments were positive; Top Grub, where 5/5 (100%) parents said it had not been played at home; and the Fit Check goal scavenger hunt, with only 2/4 (50%) of parents saying it was enjoyable.

The parents gave their views about whether the AFLY5 project had helped to change what the child eats and the child's physical activity. 29.2% of parents said that it had changed what their child eats and 16.7% of parents said it had changed the child's physical activity. There were differences between schools in the proportion saying that there had been change in physical activity, but not differences between schools for diet. The school (school 34) with the highest proportion of parents reporting change (75%) was also the school where parents in the interviews also gave the greatest number of examples of change arising from the project. This school is also the most deprived school in the study. Thirteen parents gave free text comments about examples of changes to the child's eating under the themes of: no examples but comments about eating (5/13), fewer sweet foods (3/13), more fruit and vegetables (2/13), child opts for healthy snack (2/13), reduced sugary drinks (1/13) and more balance across food groups (1/13).

"I have been more aware to put in 5 a day options in lunchbox - and that's now a habit - and readily eaten by kids." (School 33)

"Since taking part in this he is quite reluctant to eat crisps and chocolate." (School 38)

Ten parents gave comments in the question about examples of changes to be more physically active. The comments were grouped under the themes of the child being more active (6/10), less screen time (3/6) and no change because the child was already active (3/10).

"More active. Less computer & TV." (School 34)

"My child is very active already." (School 37)

The parents were asked to give ideas for homeworks to encourage healthy eating at home. Nine parents gave comments. The themes were more cooking activities (5/10), more emphasis on obesity (1/10), information about portion sizes (1/10), suggested weekly meal sheets (1/10) and activities involving calculations (1/10).

"We enjoyed the healthy eating cooking at home recipes." (School 7)

"Suggested meal sheets for a weekly menu?" (School 38)

The parents were asked to give ideas for homeworks to encourage physical activity. Five parents gave comments on the themes of the bingo card, an exercise sheet, school clubs instead of homework, chart to record laps of the garden and no ideas.

"I think the money would be better spent providing after school clubs that are 'active' not 'homework', children see these as very different things!" (School 37)

"How many times they can run around the garden, doing a tally chart. Estimating how many times they think they'll do it and how altered in reality." (School 38)

In response to the question for ideas about how parents can be involved with the project, five parents responded. Only three of the parents gave ideas, which were to use email, to create and sell a book of cheap healthy recipes from children across the region, and to have a parent meeting at the beginning and the end.

A summary of the findings from the interviews and questionnaires with parents is shown in Table 6.47.

Table 6.47 Summary of parent interview and questionnaire themes and classes

Parent interview theme	Class	Evaluation
Homework	Memory of homework	On average of 60% of homeworks were remembered
	Views of homework general	Three parents said children enjoyed the homeworks and one said children hate all homework. Finding the time to complete homeworks is difficult so easier if replaces usual homework
	Relevance of topic for behaviour change	Half parents felt healthy eating, increasing activity and decreasing sedentary time was irrelevant because already healthy. One mother found homeworks helpful and prompted change.
	Behaviour change	One mother gave examples of changes to eating and the others gave examples of child's increased awareness of food content and food groups. Three said there were no changes to the child's activity levels. One found barriers to increasing activity such as money and safety.
	Homework as a method to involve parents	Three mothers were positive about homework as a practical method to involve parents because routine activity. One felt negative about homework and the topics.
Parent questionnaire theme	**Class**	**Evaluation**
Homework	Memory of homework	On average of 68% of homeworks were remembered.
	Behaviour change	29% of parents said it had changed what the child eats and 17% said it changed the child's activity. Examples were more fruit and vegetables, fewer sweet food and more balance, more physical activity and less screen time. Examples of no change because children already active and eating healthy food.
	Ideas for homework activities	For diet: cooking, information about obesity, portion size information, weekly meal sheets, calculation activities. For physical activity: bingo, exercise sheet, clubs and laps in garden.
	Ideas for involving parents	Email, create recipe book and meetings with parents.

6.6.7. Teacher interviews descriptive

Teachers in the four parent involvement schools were invited to take part in an interview after the intervention. In three schools one teacher was interviewed and in one school (where the lessons had been taught across three classes) two teachers were interviewed. These two teachers were interviewed separately. The interviews lasted between 9 and 23 minutes (mean of 15.4 minutes) (see Table 8.33 in Appendix 8). The transcript of each interview was coded as per the child focus groups. The main codes and sub-codes are shown in Table 8.34 in Appendix 8.

6.6.8. Teacher interviews synthesis of data

Theme: Homeworks

The class and categories for this theme are show in Figure 6.10.

Figure 6.10 Categories from teacher interviews about theme of homework by 'class'

Category	Class
Normal homeworks	
Number of homeworks given out	
Number of homeworks returned	
Improvements to homeworks	Exposure of homeworks
Teachers' experience of using homeworks	Enjoyment of activity based homeworks
Popular homeworks	

Class: Exposure of the homeworks

The teachers across the four schools said that the majority of homeworks had been given out.

"They were all given out and given out on time." (Female teacher 1, School 37)

"Not all of them I don't think, I think, I, oh I just can't remember. I might have missed out two or three." (Male teacher, School 38)

In one school they said that all the homeworks had been given out and in the other three a couple of homeworks had not been given out. However, the teachers said that not all the homeworks had been completed and handed in. In two of the four schools the teachers said it was usual for homeworks not to be returned by all children, whereas in the other two schools the teachers felt that response to this homework was lower than usual and thought that this was due to the fact that the homework was not set by the teacher.

"We've always had a problem with homework with the children but actually high percentages did come did come back because the presentation's different." (Female teacher, School 34)

"Whether it was because they see it as not set homework from the teacher that wasn't set homework from me therefore to them it's almost, you know, oh do they have to do it do or not." (Male teacher 2, School38)

"To start with the majority were returning them but that became as the weeks went on even though you try and chase it up they weren't all coming back in so it did tail off as we got to the end of the project." (Female teacher 2, School 37)

Class: Enjoyment of activity based homeworks

The teachers reported that the homeworks which were popular were ones where the children had to do activities, such as cooking, Top Grub game, Bingo, scavenger hunt, measuring sugar or comparing snacks. The less popular ones were where the children had more writing and keeping weekly records, such as Freeze My TV, fruit and vegetables and breakfast weekly planners.

"The measuring of the sugar was an absolute hit and that made a dramatic impression on them that measuring the sugar for the drinks. A lot of them said they've changed what they are drinking."(Female teacher, School 33)

"Lots of them were fine there was just a couple that found it a bit, quite, found it a bit complicated."(Male teacher, School 38)

Theme: Parent involvement

The class and categories for this theme are show in Figure 6.11.

Figure 6.11 Categories from teacher interviews about theme of parent involvement by 'class'

Category	Class
Project included in newsletter	Newsletter
Parents involved in project Homework and parent engagement	Spectrum of parent responses
Ideas about involving parents in project	Workshops and meetings

Class: Spectrum of responses from parents

Teachers responses suggested there were mixed responses from parents. Some gave examples of feedback in parents' evenings of positive responses and activities they have enjoyed. One teacher gave examples of negative reactions to the behaviour changes from some parents. Others gave the impression that they felt a lot of parents were not particularly engaged with the project.

"I've had a few comments back saying that they really enjoyed the one where as it was it was making pizza or smoothies." (Male teacher, School 38)

"We've literally had one or two where we had one or two come in and saying my child doesn't want to freeze their TV and that." (Female teacher 1, School 37)

"I didn't feel that our parents particularly engaged." (Female teacher 1, School 37)

"I think some more than others... I think it's probably a few out there that really weren't bothered about it at all and other ones that that really thought yeah this is a good idea let's get, let's get involved with it." (Male teacher, School 38)

"No negative feedback at all from parents and I was waiting for something about the television but nothing... I think a few people mentioned it in parents evening because I sort of said well we're doing this and sending it home and they were quite pleased, it was all positive." (Female teacher, School 34)

Class: Workshops and meetings

When the teachers were asked for ideas about how parents could be involved, two suggested workshops, one suggested an after school meeting and one could not think of anything. The two schools where teachers suggested workshops have previously held parent workshops on literacy and numeracy in the evenings and the teachers thought a similar approach could work for this project. However, one of these two teachers noted that there is a core of committed parents who will attend meetings. One teacher despaired and said it is difficult to know how to involve parents and noted that paper based methods are not good at involving parents in the school because it is in a socially deprived area.

"I wouldn't know a way round it to be honest. I think unfortunately it's those types of families that the children are left to do the homework by themselves and if they're not encouraged then it's not going to necessarily be completed." (Female 2 teacher, School 37)

"The only thing I'd say to get parents in is workshops." (Female teacher, School 34)

Class: School newsletter

The teachers all said that information about the project had been included in the school or year 5 newsletter. In one school the reminder letter about putting information in the newsletter had been the prompt and in another school the teacher said that she had used the information provided on the CD.

"About three or four times we put things in, like we did the introduction bit we took it off your disc." (Female teacher, School 34)

Theme: Behaviour change

The class and categories for this theme are show in Figure 6.12.

Figure 6.12 Categories from teacher interviews about theme of behaviour change by 'class'

Category	Class
General behaviour change	Unsure if changes made
Diet changes	Examples of changes
Physical activity and sedentary behaviour changes	Sustaining changes

Class: Unsure if changes made

The teachers in two of the four schools voiced reservations about whether the project had led to real changes in behaviour. In another school the teacher felt that changes in diet were dependent on the parents.

"I doubt that there's much change in what they do normally. I mean I've got sporty ones in there and I've got ones that prefer to play computer games all day." (Male teacher, School 38)

"I think it made them more aware I wouldn't necessarily say they've changed it for definite ." (Female 2 teacher, School 37)

"The problem is its getting the message home to the parents really." (Female teacher, School34)

Class: Examples of changes

The teachers felt that awareness had increased and teachers in three of the four schools gave examples of changes they felt the children had made to their diet or activity levels. In one school the teacher had asked the children to write reflectively about what they had learnt from the project and she gave examples from this about changes they had made.

"I think certainly from what they wrote, unless they were just writing to impress (laughs), I would say yes but quite a few of them spoke about sort of cutting down their sugary drinks and trying to do more activity at home." (Female teacher 1, School 33)

"I would say yes in that they're definitely wanting to be more active, they're asking for more equipment out at play times to actually play games and go and do things, umm ...and make they, they want to be generally, they want to be quite active." (Female teacher, School 34)

Class: Sustaining change

One of the teacher's spoke about change in the context of difficulty sustaining any changes that had been made.

"I know that some of them have quite a passion for it but its keeping the momentum going really." (Female teacher, School 34)

A summary of the themes from the teacher.interviews is provided in Table 6.49.

6.6.9. Teacher questionnaires descriptive

The teacher end of project questionnaire was returned by 11/16 (68.8%) of schools; three of the four parent involvement schools returned the questionnaire. Two of the eleven responses were from male teachers.

6.6.10. Teacher questionnaires outcomes

Table 6.48 shows the responses from teachers to questions about the ALFY5 project. The training, measurement and ease of following the lesson plans were positively received. The majority of teachers found it reasonably easy to fit the lessons into the curriculum and only one teacher found it very difficult.

The teachers reported teaching an average of 11.4 lessons out of 16 (71.3%) (ranging from 7 to 14) (see Table 8.36 in Appendix 8 for detail). This differed by type of lessons; with an average of 4.8/6 (80%) nutrition lessons taught compared to 6.5/10 (65%) physical activity lessons (including Freeze My TV). The majority of teachers rated the majority of lessons as being good. Three teachers rated lessons as being 'poor'; two teachers rated one lesson each, and the third teacher rated four lessons - the Fit Check and Freeze My TV lessons.

60% of teachers reported year 5 children were in more than one class and in these other classes some or all the lessons were taught. 36% of teachers thought the Fit Check had helped children to change behaviour and 64% thought it may have helped behaviour change. The same proportion, 36% thought the Freeze My TV had helped change behaviour, with 46% saying it may have helped and 18% thought it did not help. The teachers reported that negative comments had not been given from parents, 40% of teachers reported positive comments and the remainder reported no comments. 70% said they would continue to use the materials and 30% they might. None of the teachers said that they would not continue to use the materials.

Table 6.48 Teachers' views of the project and lessons (n=11)

	Teachers n (%)				
	Not at all prepared	Not prepared	Ok	Prepared	Fully prepared
Training day prepared for teaching the lessons[1]	0 (0)	0 (0)	0 (0)	2 (20)	8 (75)
	Very disruptive	Disruptive	Ok	Not disruptive	Not at all disruptive
Experience of researchers doing the measurements[2]	0 (0)	0 (0)	2 (20)	2 (20)	6 (60)
	Very difficult	Difficult	Ok	Easy	Very easy
Ease of fitting the lessons into the curriculum	1 (9.1)	0 (0)	3 (27.3)	4 (36.4)	3 (27.3)
	Very difficult to understand	Difficult to understand	Ok	Easy to understand	Very easy to understand
Ease of understanding lesson plans	0 (0)	0 (0)	2 (18.2)	8 (72.7)	1 (9.1)
	Not applicable	None in other class	Some in other class	All in other class	Other
Teaching the project if some Y5 children in other classes	4 (40)	0 (0)	5 (50)	1 (10)	0 (0)
	Don't know	No	Maybe	Yes	
Whether the "Fit Check" helped children to make behaviour changes	0 (0)	0 (0)	7 (63.6)	4 (36.4)	
	Don't know	No	Maybe	Yes	
Whether the "Freeze My TV" help children to make behaviour changes	0 (0)	2 (18.2)	5 (45.5)	4 (36.4)	
	Many negative	Some negative	None	Some positive	Many positive
Comments received from parents[2]	0 (0)	0 (0)	6 (60)	4 (40)	0 (0)
	No	May be	Yes		
Plans to continue using the materials[2]	0 (0)	3 (30)	7 (70)		

[1] Two teachers who taught the lessons did not attend the training. [2] One teacher was not the class teacher and not involved with the measurements, parental comments, or future plans.

A summary of the teacher interviews and questionnaires is show in Table 6.49.

6.6.11. Summary of process evaluation

A summary of the process evaluation data from children, parents and teachers is provided in Table 6.50 for the commonly explored themes of homework, parent involvement and behaviour change.

Table 6.49 Summary of teacher interview and questionnaire theme and classes

Teacher interview theme	Class	Evaluation
Homework	Exposure of homeworks	The majority of homeworks were given out but not all were completed or returned. This is partly an inherent problem with homework and partly because the homeworks were additional and not set by the teachers and perceived as optional.
	Enjoyment of activity based homeworks	Popular homeworks were activity based like cooking, Top Grub game and bingo. The weekly charts were less popular.
Parent involvement	Spectrum of parent responses	Some examples were given of engaged parents, a few negative comments from parents but overall a feeling that parents were not very engaged
	Workshops and meetings	Workshops, similar to existing ones on numeracy and literacy, were suggested or a meeting for parents at school to engage them more
	Newsletter	All schools put information about the project in the school or year 5 newsletter
Behaviour change	Unsure if changes made	Half the teachers voiced reservation about the project leading to behaviour changes and noted parents need to be involved.
	Examples of changes	Children's awareness had increased and 3 of 4 teachers felt changes in diet or activity had been made
	Sustaining changes	Initial enthusiasm can be difficult to sustain
Teacher questionnaire theme	**Class**	**Evaluation**
Lessons	Exposure to lessons	On average 71.3% of lessons were taught. More nutrition than physical activity lessons were taught. The majority of lessons were rated as good.
Behaviour change	Behaviour change	All the teachers felt the Fit Check journal had or may have helped behaviour change. 82% of teachers thought the Freeze My TV journal had or may have supported behaviour change.

Table 6.50 Summary of process evaluation data from child focus groups, parent interviews and questionnaires, and teacher interviews and questionnaires

Theme	Summary
Homework	• Teachers said most of the homeworks had been given out; children reported receiving 73% of homeworks; and parents recalled 60-68% of homeworks. • Teachers said not all homeworks were completed; children reported completing the majority of homeworks, with an average of 84% of homeworks which were given out being completed. • Children and parents reported that more homeworks were enjoyed than were not enjoyed. Teachers, children and parents agreed that the popular homeworks were activity-based. In addition, children reported enjoying homeworks which were novel or involved social contact. • Children reported not completing homeworks if they were difficult, lacked adult support, they were busy, ill or away. Time was reported to be a pressure by some children and parents. Teachers also said that they felt initial enthusiasm waned.
Parent involvement	• All the teachers reported including information about the project in the school newsletter and all the parents remembered reading about it in the newsletter. • Teachers felt that some parents were engaged, a few were disengaged and many were not particularly engaged in the project. • Children reported enjoying homeworks where they did activities with their parents. • Most parents felt homeworks were a practical way of involving parents in the project because homework is a routine activity. • Parents suggested additional methods of involving parents to be email, recipe book, or meetings with parents. Teachers also felt meetings with parents or workshops at schools would be appropriate.
Behaviour change	• Many children gave examples of changes to their diet, particularly increased fruit and vegetables, less sugary food and eating in moderation. Examples were also given of changes at home. A minority of children resisted making changes or felt change was not needed. Parents reported fewer changes to diet (29% of parents responding to questionnaire) but parents felt the children's awareness had increased. Some teachers felt the children had made changes to diet. • Many children and parents felt that the children were already active and did not watch a lot of TV, therefore changes were not needed. Some examples of increased active play, active travel or switching from screen use to active play were given by children. Only 17% of parents reported their child making physical activity changes. All teachers felt the Fit Check journal had helped or may have helped the children to make changes to activity levels and majority of teachers felt the same for the Freeze My TV journal.

6.7. Discussion

6.7.1. Main findings

(i) Further examining the likely effect of AFLY5

Results from this phase II pilot/feasibility study suggest that the AFLY5 intervention may effectively reduce sedentary behaviour, in particular screen viewing, increase healthy portions of fruit and vegetables and snacks, eating breakfast, active travel to school and increase physical activity levels and MVPA and reduce mean waist circumference, but there was little evidence that it had important effects on BMI, overweight or obesity. For sedentary behaviour, fruit/vegetables and snacks these findings are consistent with those in phase I of the AFLY5 pilot/feasibility study, adding strength to the suggestion that the intervention is effective. The phase II study demonstrated that it was feasible to use accelerometers in this age group with the AFLY5 intervention and that a small incentive of a bouncy ball increased the wear time so that more children wore them for the required time after the intervention. The ICCs for the accelerometer measurements were calculated and the sample size calculations from this were consistent with those that were calculated for other outcomes in phase I. The quantitative results did not provide strong statistical evidence that the parental homework involvement improved any beneficial effects of the intervention, but it may increase the effectiveness of changes in sedentary time, physical activity, active travel to school and some aspects of diet. The process (qualitative) analyses suggested that most of the homeworks were enjoyed by parents and children and were thought by some parents to have helped them improve their children's diet and physical activity.

(ii) Testing the feasibility of using accelerometers to examine physical activity and sedentary behaviour in AFLY5

The study has provided information about the practicalities of collecting accelerometery data within the ALFY5 study, but also noted the difficulties in obtaining sufficient number of days of data. The study has provided assessment of the reliability of the sedentary behaviour questionnaire, which can help to inform the choice of an alternative method to measure sedentary time. The reliability assessments suggest that additional tests of reliability will be required before using another instrument.

The ICC for accelerometer measured MVPA in this study was 0.07 (95% CI 0.00, 0.21). A literature review by Murray estimated that the school level ICCs for most health behaviours, excluding those assessed by accelerometer, tend to be less than 0.05 (typical range of 0.005-0.05).[233] Therefore the ICC AFLY5 Phase II is within this expected range. However, the ICCs for accelerometry (Actigraph) measurements from other studies with children and adolescents range from 0.02 to 0.08; 0.02 (95% CI -0.008, 0.17) in 14 year old girls of mixed ethnicity (40.8% White) in the US[234]; 0.05 (95%CI 0.01 to 0.1) in the PEACH study with children in Bristol aged 11 to 12 years (personal communication Russ Jago, 2010); and 0.08 (95% CIs not given) in a study of children aged 7 to 11 in Switzerland.[235] This suggests that the ICC calculated in the AFLY5 phase II study may be higher than expected. In order to avoid underpowered studies it has been suggested that a conservative estimate of the ICC (i.e. one at the upper end of a range that would not underestimate the study sample size) should be used.[234] My use of the upper 95% confidence interval of the ICC to calculate the sample size follows this advice and would ensure that the numbers required in a full scale RCT were not underestimated.

(iii) Testing the feasibility and effectiveness of including parents in AFLY5

The study has provided evidence that homeworks are a feasible way of involving parents; the majority of homeworks were sent out and returned and the majority were enjoyed by the children. The degree of parent involvement varied, but it appears to be an effective way of involving parents and there was a high degree of parental awareness of the project aims. The findings are mixed but suggest that parent involvement may have led to decreased TV viewing over 2 hours, reduced sedentary time, increased physical activity, increased active travel to schools, increased eating healthy portions of snacks and high energy drinks and reduced risk of obesity (by the UK 1990 definition). However, the caveat is that many of the estimates included the null value, the intervention groups were not randomised and the before and after measurements were measured in different seasons.

6.7.2. Evidence from previously published relevant studies

In this section I focus primarily on evidence regarding parental effects on childhood physical activity, sedentary behaviour, diet and obesity risk. I then briefly discuss evidence from other studies on the use of accelerometers in studies of children of this age. Discussion of published studies of school based interventions to improve childhood physical activity, sedentary behaviour, diet and obesity risk are discussed in section 2.6.1.

Parental involvement and childhood physical activity

Children in the ALFY5 phase II study reported that involvement of parents or friends in the homework activities enabled them to be physically activity and they enjoyed doing activities with parents or friends. These findings are consistent with a local research project in Bristol called '3 Ps' (parents, peers and physical activity) with children aged 10 to 11, which found that parental encouragement through financial support, co-participation or modelling enabled them to be active, however this was more common in less deprived schools, whereas in more deprived schools the children reported more verbal encouragement or demands.[236] A review of literature involving parents in studies to prevent cardiovascular disease in children found that children's physical activity beliefs and behaviours are influenced by parental modelling.[237] In contrast, Sallis found that parental encouragement and support to be active was more strongly associated with children's participation in activity than parent's role modelling.[238] Whilst there is conflicting evidence about the relative contribution of different forms of parental support for children's physical activity, there is evidence that parents are important, which supports the rationale for involving them in the AFLY5 intervention.

The Bristol 3Ps study also found that friends provided support to initiate physical activity and enjoyment was the most important factor in maintaining involvement.[239] Conversely, parents in the 3Ps study reported limiting children's independent activity because of lack of open spaces, fears of safety and traffic, and proximity of friends.[217] These themes of support from friends and restrictions in children's physical activity were reported in the AFLY5 focus groups with children and interviews with parents.

Consistent with these findings from the AFLY5 and 3Ps studies are other studies which show that time spent outdoors is associated with levels of physical activity.[76,238,240] A study in Bristol using Global Positioning System measurement to assess location identified whether children aged 11 were inside or outside and physical activity was measured by accelerometry.[241] Physical activity was found to be more than 2.5 times higher outdoors than indoors (1346 (SD=907) vs 509 (SD=283) counts per minute; $p<0.001$) and both time outdoors and physical activity were higher in the summer months ($p<0.001$). An Australian study found that for every additional hour spent outdoors during cooler months

MVPA (measured by accelerometry) increased by 27 minutes per week in children aged ten to twelve.[242] A longitudinal study of children in Australia found social opportunities positively predicted young boys time outdoors (aged five to six) and parental encouragement for activity positively predicted time outside in girls.[243] In contrast, lack of adult supervision for active play outdoors negatively predicted time outdoors in older girls and boys (aged ten to twelve). A different study has identified that parental logistic support is positively associated with increased physical activity girls aged ten to eleven.[155]

In the AFLY5 phase II study there was an increase in the proportion of children travelling to school by active travel and this increased more in the parent involvement schools. Research in Bristol has identified that 11 year olds who walk to school gain 11% of their MVPA and had accelerometer counts per minute 43% higher than those travelling to school between 08.00 and 09.00 hours.[76] Therefore a change in travel to school could be important.

The AFLY5 study also found parents and children reported that busyness and time were barriers to physical activity. These findings were also found in the Bristol 3Ps research,[236] and cost in low SEP schools was found also to be a barrier.[236] Cost was not frequently mentioned in the AFLY5 study, but where it was, it was consistent with this finding.

Parental involvement and childhood sedentary behaviour

Studies have found that the home environment (access to media devices and family rules) as well as parents' sedentary behaviour influences children's media use and sedentary time.[244,245] The Bristol 3Ps study found that high parental TV viewing was associated with high TV viewing in children and parent.[245] In addition, time spent together as a family during the week is more likely to be sedentary than active.[246] Parents' sedentary time and TV viewing was not measured in the AFLY5 study, but these findings emphasise the influence parents have upon children's sedentary behaviours and therefore the importance of involving them in interventions to reduce sedentary time.

A study of children aged 11 to 12 and their parents found both groups had little concern about excessive electronic media use (TV, computer games and DVDs) and even though 88% parents reported their child engaged in $\geq$2 hours electronic media time a day, they generally perceived the child's activity, sedentary and social leisure time was an adequate mix.[244] The AFLY5 phase II interviews with parents were consistent in finding that they viewed children's sedentary and active time to be balanced and their screen time was not excessive.

In the AFLY5 phase II study, parents from schools in areas of high deprivation were less likely to limit their children's sedentary behaviour than those from schools in areas of low deprivation (as measured by the parent support for activity scale) and the children had higher screen time than less deprived areas. In contrast the Bristol 3Ps project found that children in more deprived schools reported their parents suggesting they limit their sedentary time (e.g. switch off the TV) and go outside to play.[236] The range of deprivation in Bristol is greater than in South Gloucestershire and therefore this may account for the apparent difference.

Parental involvement and childhood dietary behaviour

A literature review of studies involving parents in the prevention of child cardiovascular disease found children's beliefs and behaviours about healthy eating are influenced by positive parental modelling. Analysis of fruit and vegetable consumption in seven year old children in ALSPAC found consumption of fruit and vegetables appears to be influenced by parental rules about daily consumption and parental consumption.[247] These studies again support the concept of involving parents in the AFLY5 intervention.

In a study with parents and children aged seven to eight and ages ten to eleven which explored the role of parents in promoting a healthy diet, parents felt that they had the primary responsibility for promoting a healthy lifestyle and schools were important because children spend a large amount of their time in school, but the school role was secondary to the parents.[248] The parents also emphasised the important influence of child peer pressure and children's tendency to want to conform to what other children are eating.

Studies that directly test the effects of parent involvement

In chapter two I identified that whilst interventions to change physical activity, dietary and sedentary behaviours have been undertaken with parent or family involvement, there has been little research to understand the impact of parent involvement. In chapter two I outlined the findings from a review of methods to engage parents to increase children and adolescents' physical activity.[158] The review concluded that sending materials home, such as newsletters and homework, were not effective at changing physical activity in 8/11 studies. The AFLY5 phase II study supports this finding for child and parent proxy reported sedentary behaviours, but not for changes in accelerometer measured sedentary and physical activity or diet, where this study suggests improvements with the addition of homework. The review found effective methods to engage parents were contacting families via organised activities and face-to-face interactions and/or telephone contact with parents that provide parent training, family counselling, or preventive messages may be effective.[158]

In contrast, the Child and Adolescent Trial for Cardiovascular Health (CATCH) study compared a school only intervention to a school plus family intervention and a control group.[249] The school and family intervention comprised of homework (in the form of activity packs) and family fun events. Whilst there was no evidence overall of a benefit in diet or physical activity in the school plus family intervention compared to school only, more detailed analysis showed evidence of a parent dose response.[249,250] The dose was measured by the return of parent completed activity cards from the homework activities (79% were returned). Diet and physical activity knowledge and beliefs and self-reported MVPA increased with increasing parent involvement in the activities. This suggests that homework activities can engage parents and the degree of engagement can be translated into change in knowledge and beliefs.

A systematic review of qualitative studies with parents about obesity prevention in children aged from birth to 12 years identified six themes which are summarised in Table 8.38 in Appendix 8.[251] Common issues identified in the systematic review which were also identified in the process evaluation of the ALFY5 phase II study were: lack of time, busyness, overweight and obesity being seen as an issue for the future and a problem affecting other people's children, parents had greater knowledge about the need for a healthy diet than for an active lifestyle to prevent overweight, parents had safety concerns about outdoor play and the cost of physical activity programmes. The review identified many societal and environmental factors which were perceived to be influences on children's behaviours but were beyond the scope of the ALFY5 intervention. It may be that for obesity prevention interventions to be effective, broader changes are required beyond the scope of educational, behaviour change interventions, such as those addressed through community interventions.[252,253]

AFLY5 parents were on the whole supportive of the project and the changes it was promoting; parents also supported their involvement in the project. Some parents in the AFLY5 interviews expressed the view that obesity interventions such as AFLY5 should start earlier and there is evidence from other work that supports this approach. In a different study with parents of children aged seven to eight and ten to eleven, parents felt they should be involved in obesity prevention interventions to ensure lasting change and modelling positive behaviours.[254] In addition, they felt that obesity prevention needs to start before children are in primary school because behaviours are shaped early in life.

6.7.3. Strengths and limitations

Study design

The choice of a before and after design combined with a process evaluation was appropriate in that it: a) allowed me to examine whether parental involvement using homework would be acceptable and feasible in the UK; b) allowed the ICC for accelerometer data to be calculated; c) provided an assessment of recruitment methods, the appropriateness of the intervention and methods of measurements and d) provided an indication of the change in the outcomes. However, I acknowledge that due to funding restrictions, the study was underpowered and of too short a duration to accurately assess the effect of the intervention on the outcomes and was therefore more successful at achieving (a) to (c) of the above than (d). Given that it was a pilot study, this is not unexpected, however it does limit what can be concluded from the study.

The main weakness of the before and after study design was the lack of randomisation and therefore there is a risk that other things (other than the intervention) are responsible for any changes in outcomes, or indeed may have cancelled out any truly beneficial effect of the intervention. Of potentially important relevance here is the fact that the before intervention measurements were conducted in winter months and the after in the summer months because resources only allowed me to conduct a six month study. It is possible that any beneficial associations are due to the fact that in general activity levels and healthy diet are greater in the summer compared to the winter. A before and after design was chosen because there were only resources available to do the parent involvement in a small number of schools, and therefore it was desirable to select the schools purposively to ensure a range of demography and deprivation.

Blinding

My involvement in the entire process of the study from design, recruitment, measurement and analysis has inevitably meant that I have not been blinded to which schools were receiving the lessons or the lessons and homework. However, the methods of analysis were discussed with my supervisors before undertaking the analysis and my Stata 'do files' are available for inspection.

Measurement of physical activity and sedentary behaviour using accelerometers

The objective measurement of physical activity and sedentary behaviour using accelerometers was a strength of this study and efforts were made to ensure that in five out of six of the schools wearing accelerometers the visits were on the same day. It would have been preferable for the children to have been given the accelerometers to wear for seven days to increase the number of children with a minimum of three days of data. The limited budget for the study (and consequently the number of accelerometers available) and the pressure to collect the accelerometer data as quickly as possible, to allow the schools to start the intervention, meant the children only had the accelerometers for four complete days (six days including the first and last day). A consequence was that only 45.6% of children had data before and after the intervention for a minimum of three days and 600 minutes per day and these children were more likely to be girls and from less deprived schools. All the accelerometers were (eventually) returned, which provides useful information for calculating the number of accelerometers which would be required in a large scale study.

Parent support for physical activity

53.8% of parents completed the questionnaire about parent support for physical activity. This is a reasonable response rate. However, nearly all the respondents were mothers and it would have been preferable to have data from both parents. The questionnaire was useful in identifying the parents' approach to the three domains of modelling, limiting sedentary time and providing logistic support. However, without parental accelerometry data it was not possible to validate the modelling responses.

Measurement of diet

The strengths and weakness of the DILQ for measuring diet have been covered in Chapter 4 and will not be repeated here. However, it is worth noting that a strength of this study was that diet questionnaire data was collected for 91.6% children compared to 74.5% children in the phase I study.

Process evaluation

A strength of the study was the extensive process evaluation with children, parents and teachers. Children participated well in the focus groups and the use of the smiley faces allowed all the children to give their views on each homework. Telephone interviews were chosen as a method of collecting qualitative information from parents because a study with parents of children in year 6 demonstrated that it is difficult to arrange focus groups at a time which participants could all attend.[217] The study with year 6 parents about parental attitudes to children being independently active had a response rate of 8.9%. In the AFLY5 study the response was lower at 2.7%. A variety of options were considered to engage parents in the process evaluation and it was decided that the response from parents to the questionnaires had been reasonable, and therefore this was used in the form of a brief end of project questionnaire. However, the response rate was lower than for other questionnaires at 16.7%.

Teachers from all the parent involvement schools took part in the process evaluation and the majority of teachers from the other schools. The combination of qualitative data from children, parents and teachers has allowed comparison of views and evidence to be corroborated.

6.7.4. Implications for RCT and further research

Implications for RCT

The main implications of this work are for the design of the full scale RCT of the ALFY5 intervention. It provides further evidence for doing a full scale RCT and shows accelerometers can and should be used to measure sedentary and physical activity, with the ICC and sample size calculated for doing so.

The process evaluation suggests that parental involvement via homeworks is enjoyable and reported to be useful with some quantitative support for a greater effect on diet. The process evaluation suggests that the homeworks which were less enjoyed by the children should be replaced by homeworks which have an activity component rather than only worksheet based. In the full scale RCT the schools should be asked to make the homework compulsory but with plenty of time for the families to complete the homework and to replace the usual homework with the AFLY5 homework. This may be more acceptable to the schools if some of the homeworks involve a maths or literacy component, because these were reported to be the usual homework subjects. Schools should continue to be encouraged to put information about the project into the school newsletter.

The intervention suggests that it may increase active travel to school. This is not currently a particular focus of the intervention, but the literature should be reviewed to consider whether a lesson or homework could be adapted to promote active travel more specifically.

The Freeze My TV homework was not positively received by most children and parents. It may be important to change from the negative message of 'watch less TV' to the more positive message of 'spend more time outdoors'.[243] The use of a positive rather than a negative behaviour change message has been found to be more effective in a diet study, which compared promoting fruit and vegetable intake compared with promoting the decrease of fat and sugar intake.[255] Families in the 3Ps study reported valuing the social time together afforded by family physical activity and therefore this benefit could be highlighted when encouraging family physical activity time.[246] If the AFLY5 intervention encouraged more time outdoors, children of this age may need additional support from adults or other children. Initiatives which bring groups of children together via safe routes to safe play areas may help to promote children's independence.[217]

Parent involvement

The review of parents' views of overweight prevention identified that parents think that strategies to promote healthy weight should start early in a child's life.[251] The need to give children the best start to life has been emphasised by the Marmot Review of health inequalities in the UK.[256] Cross-sectional and cohort studies have investigated associations with physical activity,[257,258] sedentary behaviour,[259,260] diet,[261] feeding practices[262] and obesity[87,263] in preschool children. A review of risk factors for overweight in preschool children, and analysis of risk factors at age 3 in the Millennium Cohort both highlighted the role of parents.[264,265] However, little obesity prevention work has been undertaken with pre-school children and their parents.

O'Connor concluded from the review of methods to engage parents in interventions to increase child physical activity levels, that theoretical models of parental engagement need to be developed to support the design of interventions.[158] Models could also be developed for parental engagement in limiting sedentary time and promoting healthy eating.

The ALFY5 pilots and other school based interventions have found mixed results (as discussed in chapter 2), which suggests to me that there are some benefits from raising awareness in the school setting, however to address the extent of the obesity epidemic and the complexity of the underlying causes, school interventions are not sufficient. Broader environmental, social, political and economic changes will also be required,[19] as we have seen for other public health issues such as smoking[266] and climate change.[267]

6.8. Summary

AFLY5 Phase II has provided further evidence that this intervention can be delivered in schools in England and may have some beneficial effects. Enhancing the intervention with parental involvement using homeworks had mixed effects on the outcomes, but the qualitative assessment suggests that most children and parents enjoyed the homeworks. This phase demonstrated the feasibility of using accelerometers in school children of this age and allowed me to calculate the ICC for accelerometery outcomes.

CHAPTER 7. DISCUSSION

The aim of this final chapter is to summarise the main results of the three studies forming this thesis: a) comparison of child and adolescent obesity between England and the US and when using different criteria to define child obesity; b) AFLY5 phase I feasibility and pilot cluster RCT; c) AFLY5 phase II pilot before and after intervention including parent involvement. This will be followed by a discussion of the implications of the work for future research and policy. Full details of the three studies, including a discussion of the findings and the major strengths and limitations, are reported in chapters 3, 4 and 6; therefore this information is not repeated here.

7.1. Summary of main findings

7.1.1. Child and adolescent obesity in England and the US

Mean BMI, prevalence of overweight/obesity and obesity were all lower in English children at ages 9 to 10 compared with US children using nationally representative data collected between 1999 to 2006. The difference in prevalence of obesity by each of the three criteria was at least 8.3%. US adolescents (aged 12 to 17) had the highest prevalence of obesity by age group compared to England using all three criteria to assess obesity (UK 1990, 2000 CDC and IOTF). In contrast, English children aged 2 to 5 had higher mean BMI and higher prevalence of obesity using the 2000 CDC criteria compared to the US. The results demonstrate very marked differences in the prevalence of childhood obesity by age, gender and country when different, established methods for defining childhood obesity are applied to the data. The research implications of the higher prevalence of obesity in US children aged 9 to 10 year olds by the three criteria, is that obesity prevention interventions in countries such as

England with lower prevalence may show less absolute effect on obesity and may therefore be less cost effective, whilst still contributing to important lifestyle changes to prevent obesity.

7.1.2. AFLY5 Phase I

The ALFY5 Phase I study demonstrated that it is feasible to recruit and randomise UK schools to a school-based obesity prevention intervention that was previously evaluated in the US, with approximately two thirds of schools taking part and the majority of parents giving consent. Most teachers taught a proportion of the lessons and the intervention is probably too long for fitting into the curriculum in just two terms. In a full-scale RCT the intervention would be implemented over a longer time period from September to March/April (the end of the Easter term). Pedometers were identified as being unreliable and therefore in phase II (summarised below) I explored the use of accelerometers. Teachers identified a lack of parental involvement as potentially limiting the likely effect of the intervention and this was also further evaluated in phase II.

The ICC for screen-time was 0.00 (95% CI: 0.00 to 0.03) and that for BMI was 0.00 (95% CI: 0.00 to 0.02). The effect size of the primary outcome of screen viewing was a mean difference in minutes at the end of the intervention (intervention schools minus control schools) adjusted for baseline levels and clustering within schools of -12.92 (95% CI: -45.9 to 20.03) for weekday and -18.91 (95% CI: -61.03 to 23.41) for Saturday. There were conflicting results for the odds ratio of obesity at the end of the intervention, but the most widely used measure of obesity internationally gave an odds ratio of obesity comparing intervention to control groups of 0.79 (95% CI: 0.18 to 3.59). There was no strong or consistent evidence that the intervention affected dietary patterns in this short-term pilot. The odds ratio of walking or cycling to school, comparing intervention to control schools, was 0.27 (95% CI: 0.11 to 0.69).

7.1.3. AFLY5 Phase II

Interviews with parents of year 5 children informed the development of methods to involve parents in the AFLY5 phase II study. Homework was regarded as a good method of involving parents, which had the potential to reach all parents because the schools regularly give homework. It was particularly felt that non-traditional activity based homework would be most appropriate and likely to be completed. As a result of this exploratory work ten homeworks were developed and piloted in 4/16 schools in AFLY5 phase II.

Results from the AFLY5 phase II study suggest that the AFLY5 intervention may effectively reduce sedentary behaviour, in particular screen viewing, increase healthy portions of fruit and vegetables and snacks, eating breakfast, active travel to school and increase physical activity and MVPA and reduce mean waist circumference, but there was little evidence that it had important effects on BMI, overweight or obesity. For sedentary behaviour, fruit/vegetables and snacks these findings are consistent with those in phase I of the AFLY5 pilot/feasibility study, adding strength to the suggestion that the intervention is effective. The quantitative results did not provide strong statistical evidence that the parental homework involvement improved any beneficial effects of the intervention, but it may increase the effectiveness of changes in sedentary time, physical activity, active travel to school and some aspects of diet. The short duration of the intervention and follow-up and relatively small sample size with parental involvement may mean that there was insufficient power to detect additional benefit.

The qualitative results suggest that the homeworks were an effective way of involving parents and also identified some of the homeworks as being less appealing to parents and children than others. This information will be used in the full-scale RCT, where we will use the homeworks that were seen as more fun, such as cooking and the scavenger hunt.

The phase II study demonstrated that it was feasible to use accelerometers in this age group with the AFLY5 intervention and that a small incentive of a bouncy ball increased the wear time so that more children wore them for the required time after the intervention. The ICCs for the accelerometer measurements were calculated and the sample size calculations from this were consistent with those that were calculated for other outcomes in phase I. The study has provided assessment of the reliability of the sedentary behaviour questionnaire, which will inform the choice of an alternative method to measure sedentary time and assess inter- and intra-rater reliability before using another instrument.

In the sample-size calculation for a full-scale RCT, the upper limit of the 95% confidence interval was used indicated that 52 schools with approximately 1300 pupils would be required (allowing for a 20% non-consent or data collection), to be adequately powered to precisely estimate potentially important effects.

7.2. Implications for research

The implications of this work for research are discussed with respect to the AFLY5 intervention, theories of change, measurement of obesity and timing of obesity prevention interventions.

7.2.1. AFLY5 intervention

The main implications of this work are for the design of the full scale RCT of the ALFY5 intervention. An outline application to undertake a full-scale RCT of AFLY5 has been shortlisted by the National Institute for Health Research and a full application will be submitted in August 2010. The phase I and II work has provided ICCs which show with 52 schools (~1300 pupils) it will be possible to detect minimal effects that would be of public health importance with 90% power at the 0.05 alpha level for all primary outcomes. The full scale cluster RCT would be over 3 years, with the intervention being applied over most of a school year and follow-up measurements after one year (end of intervention period) and a year later. The RCT will include an assessment of cost-effectiveness, which will be important to demonstrate whether the cost-effectiveness demonstrated for Planet Health ($4,305 (£2,957) per QALY saved) is found AFLY5.[268]

The process evaluation suggests that the homeworks which were enjoyed less by the children should be replaced by homeworks which have an activity component. In the full scale RCT the schools should be asked to make the homework compulsory but with plenty of time for the families to complete it and to replace the usual homework with the AFLY5 homework. This may be more acceptable to the schools if some of the homeworks involve a maths or literacy component, because these were reported to be the usual homework subjects. Schools should continue to be encouraged to put information about the project into the school newsletter.

The phase I intervention suggests that it may not increase active travel to school, whilst the phase II intervention suggest that it does. Active travel is not currently a particular focus of the intervention, but studies have shown that 11 year olds who walk to school have physical activity levels 43% higher (accelerometer counts per minute) during the hour before school than children who travel by car.[76] There is currently little robust evidence to show the effectiveness of interventions to support active travel to school[206] and therefore careful consideration would be needed to see whether an AFLY5 lesson or homework could be adapted to promote active travel more specifically.

The Freeze My TV homework was not positively received by most children and parents. It may be important to change from the negative message of 'watch less TV' to the more positive message of 'spend more time outdoors'.[243] The use of a positive rather than a negative behaviour change message has been found to be more effective in a diet study, which compared promoting fruit and vegetable intake compared with promoting the decrease of fat and sugar intake.[255] Families in the 3Ps study reported valuing the social time together afforded by family physical activity and therefore this benefit could be highlighted when encouraging family physical activity time.[246]

7.2.2. Theories of change

The US intervention on which AFLY5 is based was informed by social cognitive theory and behavioural choice theory. However, the involvement of parents was an addition to the intervention after phase I and there is a lack of information about how parents can facilitate physical activity and screen-viewing behaviour change for their children.[158] Theoretical models could usefully be developed for parental engagement in interventions aimed at limiting children's sedentary time, promoting healthy eating and promoting physical activity in children.

7.2.3. Measurement of obesity

Until there is clear evidence for adopting one method to assess child obesity, data from the three criteria presented here should be reported in future research. Furthermore, obesity intervention studies consistently report a null effect on the prevalence of obesity, or overweight and obesity combined, even when positive changes have been seen for measures of adiposity such as BMI z-score and waist circumference.[252,269] This suggests that the magnitude of effect is relatively small, but also questions what measure is appropriate to determine whether these interventions are 'effective'. Further research should explore what is meaningful at a population level for public interventions to prevent overweight in children.

by modelling small changes in different anthropometric measures into future incidence of obesity-related disease and costs.

7.2.4. Timing of obesity prevention interventions

Despite the associations of overweight/obesity with adverse outcomes at all ages it is currently unclear at what age interventions to prevent overweight/obesity should start. Recent research from ALSPAC suggests that the age group targeted in AFLY5 is the right age group for obesity prevention because: a) adiposity changes at ages 8.5-10 are associated with fat mass at age 15 and a range of cardiovascular disease risk factors[18]; and b) the peak incidence of obesity during childhood and adolescence is in the mid childhood ages of 7-11.[270,271]

7.3. Implications for policy

The implications of this work for policy relate to the areas of obesity surveillance, integration of obesity prevention into existing initiatives and the Government's role in preventing obesity.

7.3.1. Obesity surveillance

Childhood obesity surveillance in England collects height and weight data annually through the National Child Measurement Programmes with children in reception year and year 6.[216] The analysis of these data are presented exclusively using the UK 1990 cut-points. If the analysis of these data also used the 2000 CDC and the IOTF criteria it would facilitate international comparisons. The Health Survey for England annually collects data across all age groups to provide national surveillance on obesity in children and adolescents, but the numbers sampled are too small to provide analysis at a local level.[164] It would be helpful if the National Child Measurement Programme could be extended to at least one of the seven year groups in secondary schools to provide local information to inform local interventions to prevent and manage obesity. This information would show how patterns of obesity develop from primary to secondary children and will help to inform obesity prevention interventions in secondary school settings.

7.3.2. Integration of obesity prevention into existing initiatives

The Healthy Schools programme is a nation-wide initiative in England which was started in 1999. Within an audit framework, schools are encouraged to make changes to enable the school environment and policies to promote health. An interim evaluation of the initiative found that schools value the initiative because schools believe promoting physical and emotional health is an important part of the school's role in preparing children for life.[272] The Healthy Schools programme includes a focus on food and physical activity in schools. If the AFLY5 intervention is found to be effective and cost-effective through the large scale RCT, it could be integrated into schools through the Healthy Schools initiative.[188]

In 2009 the English Government launched a new large-scale (£75 million) initiative called Change4Life, which is a 'society-wide movement' that aims to prevent childhood obesity by encouraging families to eat better and move more (http://www.nhs.uk/change4life).[273,274] The focus of the initiative is social marketing and the initial advertising campaign targeted young families with children aged 5 to 11 years.[274] At the heart of the initiative were eight behaviour changes with simple descriptors similar to and including the 'five a day' message (see Figure 7.1).

Figure 7.1 Change4life behaviour changes

The Government first year report on Change4life report reports that mothers with children of the target age group have a high level of awareness of the initiative and three in ten claim to have made a change to their children's behaviours (approximately 1 million mothers).[274] Interviews with mothers who had seen the Change4life adverts found 9-16% reporting taking action on physical activity and 13-19% taking an action on diet (range represents highest and lowest points across the year). Interestingly, these figures are not dissimilar to the proportions of parents reporting taking action in AFLY5, although the AFLY5 found parents reported more changes in diet than physical activity.

The Change4life initiative is of relevance to AFLY5 for three reasons. Firstly, there is an opportunity to brand the AFLY5 as a Change4life initiative. Secondly, some of the eight key behaviour change messages are consistent with the focus of AFLY5 and the same wording/images could be incorporated. Thirdly, during 2010 the Change4life team are planning to do more to support families with behaviour change and this will involve providing materials for schools to encourage children to make pledges to change their diet and/or activity levels.[274] There could be scope for discussing with Change4life whether AFLY5 could be used as a vehicle to support families with behaviour change, though ideally we would want the opportunity to properly evaluate its effect before seeing it more widely used.

7.3.3. The Government's role in preventing obesity

Whilst school interventions to prevent obesity, such as the one I have piloted here, tend to show some evidence of effect, the size of change is often small. However, this modest effect may still be important at a population level. This is because of the prevention paradox, that even a small shift in the population mean can lead to real improvement in health in contrast to a strategy which targets those at high risk.[275] Nonetheless school based interventions alone are unlikely to be sufficient to reverse the obesity epidemic. Other public health problems which require behaviour change such as smoking[266], seat belt wearing[276] and climate change[267] have demonstrated that broader environmental, social, political and economic changes are required to gain a substantial behaviour change. The Foresight report on obesity suggested that a substantial increase in food or fuel prices, such as precipitated by climate change, might be the only scenario in which a spontaneous reversal of obesity would occur. The Foresight report argues that unless a paradigm shift occurs at societal and Government levels, it is predicted that by 2050 the prevalence of obesity in under 20 year olds will be 25% in the UK.[19]

7.4. Summary

The comparisons with the US showed marked differences in the prevalence of obesity by different criteria to assess child/adolescent obesity. The comparisons highlighted the importance of reporting obesity using multiple criteria to ensure meaningful comparisons can be made between countries for surveillance and research purposes. Although overweight/obesity prevalence was higher in US children in the target age range for my study than English children, levels were high in the English children. The AFLY5 phase I and II pilots have provided evidence that it is feasible to adapt the 'Eat well keep moving' intervention from the US to England and the intervention is well received by schools, children and parents. The work has provided a wealth of information, including that required to estimate an appropriate sample size and best methods for outcome assessment and delivery of the intervention, to inform a full scale RCT. The AFLY5 phase I and II work suggest the intervention may lead to improvements in sedentary behaviour, MVPA, active travel to school, eating healthy portions of fruit/vegetables, snacks and high energy drinks. A full-scale RCT of AFLY5 will provide robust evidence about the effect sizes. There may be opportunities to integrate AFLY5 into existing initiatives such as Healthy Schools and Change4life. However, to curb the rise in childhood obesity broader changes, beyond educational initiatives, are likely to be required.

To finish, I refer to the father of medicine, Hippocrates, whose words demonstrates that our understanding of the importance of healthy nutrition and physical activity is not new, but our understanding of changing human behaviour is still a work in progress:

> *"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health."*[277]

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APPENDICES

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APPENDIX 1. INTRODUCTION

This appendix relates to chapter 1. In Table 1.1 the risk factors associated with the development of obesity in children are outlined.

Table 1.1 Risk factors associated with the development of obesity in children and type of evidence available

Risk Factor	Detail of risk factor	Type of evidence*
Single-gene defects and obesity syndromes	Single-gene defects in which obesity is the specific abnormality are related to the leptin or the melanocortin system	Reports of case series cited in reference[1]
	Syndromes in which obesity is a manifestation: Prader–Willi, Cohen, Alstrom and Bardet–Biedl	Reports of gene studies cited in reference[1]
Endocrine disease	Hypothyroidism, Cushing's disease, Cushing's syndrome, Growth hormone deficiency, Growth hormone resistance, Hypophosphataemic rickets, Pseudohypoparathyroidism	Reports of case series cited in reference[1]
Central nervous system pathology	Hypothalamic damage can result in 'hypothalamic obesity syndrome' - a severe form of obesity in children and adolescents	Review of biological and observational studies[2]
Inheritance	A significant genetic component; genome-wide association studies have identified genetic variants that are robustly associated with greater BMIs	Twin[3] and family[4] studies Genome-wide association studies[5,6]
	Parental obesity more than doubles the risk of adult obesity in children under 10 years of age; 80% of children with two obese parents become obese.	Cohort study[7]
	A number of studies suggest that assortative mating (that is non-random mating driven by those of similar body size tending to be more likely to mate with each other) may be a drive for the obesity epidemic. As the obesity epidemic continues this could become a vicious cycle.	Cross-sectional study[8]
	Increasing evidence that at a given BMI children and infants of South Asian origin have more fat mass and specifically more visceral adiposity. Recent evidence suggests these differences are present at birth.	Cross-sectional study[9]
	Unclear what contribution genetics, epigenetics and behaviours make to patterning of adiposity between different groups.	
Intrauterine exposure to gestational diabetes	In populations at high risk of obesity and diabetes (such as Pima Indians) there is good evidence that intrauterine exposure to maternal gestational diabetes results in increased obesity risk later in life via intrauterine mechanisms, but whether this is an important risk factor for obesity in populations with lower diabetes and obesity prevalence is unclear.	Non-systematic review of observational studies[10] Longitudinal study that included within sibling comparison[11] Cross-sectional survey linked to a cohort study[12]
Intrauterine exposure to maternal obesity	A study that compared offspring obesity in those whose mothers had had bariatric surgery for extreme obesity prior to pregnancy to offspring of those mothers receiving surgery after their pregnancy suggests that extreme maternal obesity in pregnancy is an intrauterine risk factor for offspring obesity.	Case series with bariatric surgery as instrumental variable for maternal weight loss from extreme obesity[13]
Birth weight	Small babies for gestational age who exhibit catch-up growth may be at risk of obesity in childhood	Systematic review (observational studies)[14]
	Higher birth weight is associated with overweight in adolescence	Non-systematic review[15]
BMI rebound	Early BMI rebound is associated with greater risk of obesity (< 5.5 age), but this may be statistical artifact.	Non-systematic review (observational studies)[16]

Table 1.1 Continued

Risk Factor	Detail of risk factor	Type of evidence*
Television viewing	A positive correlation between hours of viewing and overweight, which is stronger with increasing age	Systematic review (observational and experimental studies)[17]
Energy expenditure	Low levels of physical activity are associated with obesity	Prospective cohort studies[18-20]
	Children with inactive parents are more likely to be inactive	
Sleep	Increasing evidence that there is an optimal sleep duration, with shorter sleep duration than this optimal associated with increased risk of obesity	Cohort study[21]
Diet	Observational evidence suggests breast feeding may be associated with reduced risk of obesity, but detailed systematic reviews of this association suggest that much of it is explained by confounding and a recent RCT supports this.	Systematic review (observational studies),[22] RCT [23]
	Emerging evidence that dietary fat, carbohydrate and sweetened beverages are a significant risk for obesity	Cross-sectional study,[24] Prospective cohort study,[25] Systematic review (observational and experimental studies)[26]
	Parental feeding restriction was associated with increased energy intake and body weight status	Non-systematic review (observational, experimental and qualitative studies)[27]
	Eating less energy at breakfast and missing breakfast are both associated with increased risk of obesity	Cross-sectional studies cited in reference[28]
	Portion size has been associated with the amount of food consumed and it seems logical that increased food consumed increases risk of obesity	Between subjects parallel-group design[29] Prospective study[30]
Family structure	Inconsistent evidence for single children or single parents being associated with obesity	Cohort studies cited in reference[1]
Urban versus rural	Children in urban areas are more likely to be obese than those in rural areas	Cross-sectional studies cited in reference[11]
Socio economic status	Limited and inconclusive evidence that low socio-economic status is associated with increased risk of childhood obesity in developed countries	Systematic review (cross-sectional studies)[12]
Leukaemia therapy	There is increased risk of obesity following therapy for acute lymphatic leukaemia	Cohort[11]
Medications	The role of pharmacological agents in causing weight gain in children has not been extensively studied	Report of studies cited in reference[1]

* The most recent study of highest evidence level from the review of the literature is cited for most risk factors rather than providing a comprehensive list of all studies. For some risk factors more than one reference is included when different study types, or studies in different populations are relevant.

APPENDIX 2. LITERATURE SEARCH

This appendix relates to chapter 2. The literature search strategy took part in stages. The first search was a broad search to identify reviews of obesity to inform an overview of obesity for two overviews published in the BMJ.[34,35] For these a search of Medline was undertaken on 6/5/08 as shown in Table 2.1. The search was limited to review articles published between 1/1/2005 to 4/4/2008 because the National Institute of Health and Clinical Excellence (NICE) review of obesity had included publications up to 2005 and the NICE review was a key reference.[36] 1005 titles and abstracts articles were identified.

Table 2.1 Obesity Medline Search Strategy

Search Number	Search
1	Child$
2	paediatric
3	pediatric
4	adolescent
5	1 OR 2 OR 3 OR 4
6	Obes$
7	overweight
8	6 OR 7
9	5 AND 8

The second search was to update the earlier review and to add evidence to address the key questions in relation to my thesis. Medline was searched from 1950 to 01/12/09. The search terms were informed by the 2009 Cochrane Review of interventions to prevent childhood obesity.[37] The search strategy is shown in Table 2.2. 1189 articles were found; the titles of all articles and abstracts were reviewed. The search strategy was repeated in Embase (1980 to 2009 on 03/12/09) and 1348 articles were found. The titles and abstracts were all reviewed. A total of 75 articles were retrieved in full from the two searches. From the two searches the number of articles by topic were: 24 physical activity, 18 school based interventions, 15 diet, 16 parents/family, 8 obesity prevention, 7 obesity treatment and 5 sedentary behaviours.

Table 2.2 Diet, physical activity and sedentary behaviour reviews' search strategy

Search Number	Search	Medline Results	Embase Results
1	exp Exercise/	50195	91622
2	exp Exercise Therapy/	20646	19921
3	exercis$.af.	203837	166793
4	(aerobics or physical therapy or physical activity).af.	68817	66969
5	(fitness adj (clas$ or regime$ or program$)).af.	522	433
6	(aerobics or physical therapy or physical training or physical education).af.	54933	30698
7	dance therapy.af.	155	47
8	physical activity.af.	32837	49177
9	exp Health Promotion/	38368	26980
10	Health Education/	46195	29929
11	(health promotion or health education).af.	106929	65410
12	(media intervention$ or community intervention$).af.	1068	750
13	health promoting school$.af.	132	76
14	((school or community) adj2 program$).af.	10081	8513
15	((school or community) adj2 intervention$).af.	3328	2523
16	(family intervention$ or parent$ intervention).af.	802	726
17	(parent$ adj2 (behavio?r or involve$ or control$ or attitude$ or educat$)).af.	19707	22476
18	9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17	136139	96059
19	exp Obesity/pc [Prevention & Control]	7372	3556
20	exp Primary Prevention/	96220	11110
21	(primary prevention or secondary prevention).af.	24983	24428
22	(preventive measure$ or preventative measure$).af.	12028	9208
23	(preventive care or preventative care).af.	2667	1603
24	(obesity adj2 (prevent$ or treat$)).af.	8999	11647
25	19 or 20 or 21 or 22 or 23 or 24	138087	48140
26	exp "Review"/	1525915	982940
27	review.af.	1859078	1276405
28	systematic review.af.	17274	35830
29	26 or 27 or 28	1861169	1276405
30	exp Child/	1335388	659119
31	child$.af.	1694226	987907
32	(young people or young person).af.	11025	8279
33	(schoochildren or school children).af.	13470	6817
34	(pediatr$ or paediatr$).af.	641403	883176

Table 2.2 continued

35	(boys or girls or youth or youths).af.	90293	63971
36	30 or 31 or 32 or 33 or 34 or 35	1938883	1319638
37	18 or 25	266301	140206
38	sedentary behavio?r.af.	430	366
39	physical inactivity.af.	2293	1884
40	exp Television/	24464	3635
41	television.af.	13683	7145
42	38 or 39 or 40 or 41	30631	9217
43	exp running/ or exp swimming/ or exp walking/	36050	38022
44	(sport or cycling or walk$ or run$).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]	174754	170020
45	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 43 or 44	414830	368444
46	exp Obesity/dh [Diet Therapy]	4584	0
47	exp Diet, Fat-Restricted/ or Diet/	88310	54788
48	Diet/ or exp Diet, Reducing/	94225	53440
49	Diet/ or exp Diet Therapy/	118630	153879
50	(diets or diet or dieting).af.	259184	210502
51	(diet$ adj (modif$ or therapy or intervention$ or strateg$)).af.	16131	26327
52	(low calorie or calorie control$ or healthy eating).af.	2944	2255
53	exp Dietary Fats/	60295	17793
54	(fruit or vegetable$).af.	53092	48595
55	(high fat$ or low fat$ or fatty food$).af.	15812	15299
56	46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55	331816	282575
57	42 or 45 or 56	749481	629041
58	29 and 36 and 37 and 57	1559	1640
59	limit 58 to (english language and "review articles" and humans)[a]	1189	1348

[a]Limit not valid in EMBASE; records were retained.

APPENDIX 3. PREVALENCE OF CHILD AND ADOLESCENT OBESITY IN ENGLAND AND THE US

This appendix relates to chapter 3.

Measurement of height and weight in the HSE and NHANES surveys

In the HSE, height and weight were measured in participants' homes by trained researchers. Height was measured using a portable stadiometer. Informants were asked to remove their shoes. One measurement was taken, with the participant stretching to the maximum height and the head aligned in the Frankfort horizontal plane. Height was recorded to the nearest millimeter. Weight was measured using Soehnle, Seca and Tanita electronic scales with a digital display. Participants were asked to remove their shoes and any bulky clothing. Weight was recorded to the nearest 100g.

In NHANES, height and weight were measured in the body measurement room of the NHANES Mobile Examination Centre by trained health technicians. Height was measured using a fixed stadiometer. One measurement was taken, with participants instructed to breathe in and stand as tall as possible and the head aligned in the Frankfort horizontal plane. Height was recorded to the nearest millimeter. Weight was measured using a Toledo electronic scale with a digital display. Participants were asked to wear only underwear, disposable paper gowns, and foam slippers. Weight was measured in pounds and automatically converted to kilograms, recorded to the nearest 100g.

Prevalence of overweight and obesity

Table 3.1 show the prevalence of overweight and obesity in England and the US for children and adolescents aged 2 to 17 and Table 3.2 shows the prevalence of obesity.

Table 3.1 Percentage of children and adolescents overweight and obese[1] by age group and study for 1999 to 2006

	2000 CDC			UK 1990			IOTF		
	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)	England % (95% CI)	US % (95% CI)	Difference[2] % (95% CI)
Boys									
2 - 5	31.7 (30.2 to 33.1)	24.9 (21.7 to 28.0)	6.8 (3.3 to 10.3)	17.3 (16.1 to 18.6)	13.7 (11.4 to 16.0)	3.6 (1.0 to 6.2)	19.8 (18.5 to 21.1)	15.3 (12.9 to 17.7)	4.5 (1.8 to 7.2)
6 - 11	23.7 (22.7 to 24.8)	33.1 (30.0 to 36.3)	-9.4 (-6.1 to -12.7)	19.6 (18.6 to 20.7)	29.0 (26.1 to 31.9)	-9.4 (-6.3 to -12.4)	19.7 (18.7 to 20.8)	29.2 (26.3 to 32.1)	-9.5 (-6.5 to -12.5)
12 - 17	21.2 (20.1 to 22.3)	33.0 (30.5 to 35.5)	-11.8 (-9.1 to -14.5)	20.7 (19.6 to 21.8)	32.8 (30.3 to 35.3)	-12.1 (-9.4 to -14.8)	22.5 (21.3 to 23.6)	34.5 (32.2 to 36.8)	-12.0 (-9.5 to -14.5)
2 - 17	24.7 (24.0 to 25.4)	31.2 (29.2 to 33.2)	-6.4 (-4.4 to -8.5)	19.5 (18.8 to 20.1)	27.0 (25.2 to 28.8)	-7.5 (-5.6 to -9.4)	20.7 (20.1 to 21.4)	28.0 (26.3 to 29.8)	-7.3 (-5.5 to -9.1)
Girls									
2 - 5	33.9 (32.4 to 35.4)	23.2 (20.6 to 25.8)	10.7 (7.7 to 13.7)	15.0 (13.6 to 16.4)	13.6 (11.4 to 15.8)	1.4 (-1.1 to 3.9)	23.9 (22.3 to 25.6)	18.4 (16.0 to 20.8)	5.4 (2.6 to 8.4)
6 - 11	20.1 (19.1 to 21.2)	30.7 (27.7 to 33.7)	-10.5 (-7.4 to -13.6)	19.7 (18.6 to 20.9)	25.0 (22.2 to 27.8)	-5.3 (-2.3 to -8.3)	26.5 (25.2 to 27.8)	30.9 (27.9 to 34.0)	-4.4 (-1.2 to -7.7)
12 - 17	18.1 (17.1 to 19.1)	31.5 (28.8 to 34.1)	-13.3 (-10.5 to -16.2)	22.6 (21.4 to 23.9)	28.6 (26.0 to 31.2)	-6.0 (-3.1 to -8.8)	26.9 (25.5 to 28.2)	32.6 (30.0 to 35.2)	-5.8 (-2.9 to -8.6)
2 - 17	22.7 (22.0 to 23.4)	29.2 (27.4 to 34.1)	-6.5 (-4.6 to -8.4)	19.7 (18.9 to 20.5)	23.7 (22.1 to 25.4)	-4.0 (-2.2 to -5.8)	26.0 (25.2 to 26.9)	28.6 (26.8 to 30.4)	-2.6 (-0.7 to -4.5)
All									
2 - 5	31.7 (30.2 to 33.1)	24.0 (21.8 to 26.3)	7.6 (5.0 to 10.3)	16.3 (15.4 to 17.3)	13.7 (12.0 to 15.4)	2.7 (0.7 to 4.6)	21.6 (20.5 to 22.6)	16.9 (15.1 to 18.7)	4.7 (2.6 to 6.8)
6 - 11	23.7 (22 7 to 24.8)	31.9 (29.4 to 34.5)	-8.2 (-5.5 to -10.9)	19.7 (18.9 to 20.5)	27.1 (24.8 to 29.4)	-7.4 (-5.0 to -9.8)	22.7 (21.8 to 23.5)	30.1 (27.6 to 32.5)	-7.4 (-4.9 to -9.9)
12 - 17	21.2 (20.1 to 22.3)	32.2 (30.2 to 34.3)	-11.0 (-8.7 to -13.3)	21.6 (20.7 to 22.4)	30.7 (28.7 to 32.7)	-9.2 (-7.0 to -11.3)	24.4 (23.6 to 25.3)	33.6 (31.6 to 35.5)	-9.1 (-7.0 to -11.3)
2 - 17	24.7 (24.0 to 25.4)	30.2 (28.6 to 31.8)	-5.5 (-3.8 to -7.2)	19.6 (19.1 to 20.1)	25.4 (23.9 to 26.8)	-5.8 (-4.3 to -7.3)	23.0 (22.5 to 23.6)	28.3 (26.8 to 29.9)	-5.3 (-3.7 to -6.9)

[1] *Overweight is defined as having age-gender specific Body Mass Index (BMI) above the 85th centile in the 2000 CDC/ UK1990 growth charts or above the criteria for overweight in the IOTF classification.* [2] *Difference is England percentage minus US percentage, i.e. positive values indicate English figure higher than US.*

Table 3.2 Percentage of children and adolescents obese[1] by age group and study for 1999 to 2006

	2000 CDC			UK 1990			IOTF		
	England	US	Difference[2]	England	US	Difference[2]	England	US	Difference[2]
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Boys									
2 - 5	14.4	12.1	2.4	8.5	7.2	1.3	5.1	4.6	0.6
	(13.3 to 15.7)	(9.9 to 14.3)	(0.1 to 4.8)	(7.5 to 9.4)	(5.6 to 8.8)	(-0.6 to 3.1)	(4.4 to 5.9)	(3.3 to 5.8)	(-0.9 to 2.0)
6 -11	9.2	17.5	-8.3	10.6	18.4	-7.8	4.8	9.9	-5.1
	(8.5 to 10.0)	(15.3 to 19.7)	(-6.0 to -10.5)	(9.8 to 11.4)	(16.0 to 20.8)	(-5.3 to -10.3)	(4.2 to 5.4)	(8.3 to 11.5)	(-3.4 to -6.7)
12 -17	8.3	17.9	-9.6	11.4	21.4	-10.0	5.3	14.1	-8.8
	(7.5 to 9.0)	(16.1 to 19.7)	(-7.7 to -11.6)	(10.6 to 12.3)	(19.3 to 23.5)	(-7.7 to -12.2)	(4.7 to 5.9)	(12.4 to 15.8)	(-7.1 to -10.5)
2 -17	10.1	16.4	-6.3	10.4	17.0	-6.6	5.1	10.3	-5.2
	(9.6 to 10.6)	(15.2 to 17.7)	(-5.0 to -7.6)	(9.9 to 10.9)	(15.6 to 18.4)	(-5.1 to -8.1)	(4.7 to 5.4)	(9.3 to 11.3)	(-4.2 to -6.3)
Girls									
2 -5	12.4	11.7	0.7	7.3	7.2	0.0	6.3	6.7	-0.4
	(11.1 to 13.7)	(9.5 to 13.8)	(-1.7 to 3.2)	(6.2 to 8.3)	(5.6 to 8.8)	(-1.9 to 1.9)	(5.3 to 7.3)	(5.1 to 8.3)	(-1.3 to 2.3)
6 -11	10.7	15.5	-4.7	10.5	15.2	-4.7	6.9	11.6	-4.7
	(9.8 to 11.7)	(13.3 to 17.6)	(-2.5 to -7.0)	(9.5 to 11.4)	(13.0 to 17.4)	(-2.4 to -7.1)	(6.1 to 7.6)	(9.5 to 13.7)	(-2.5 to -6.9)
12 -17	9.8	16.0	-6.2	12.6	19.0	-6.4	7.3	14.1	-6.8
	(8.9 to 10.7)	(14.1 to 17.9)	(-4.1 to -8.3)	(11.5 to 13.6)	(16.9 to 21.1)	(-4.1 to -8.7)	(6.5 to 8.1)	(12.4 to 15.8)	(-5.0 to -8.6)
2 -17	10.8	14.8	-4.0	10.5	14.8	-4.3	6.9	11.4	-4.5
	(10.1 to 11.4)	(13.3 to 16.1)	(-2.5 to -5.5)	(9.9 to 11.1)	(13.5 to 16.1)	(-2.9 to -5.7)	(6.4 to 7.4)	(10.2 to 12.7)	(-3.2 to -5.8)
All									
2 -5	13.5	11.9	1.7	7.9	7.2	0.7	5.6	5.6	0.0
	(12.7 to 14.5)	(10.2 to 13.6)	(-0.2 to 3.6)	(7.2 to 8.6)	(6.1 to 8.4)	(-0.6 to 2.1)	(5.0 to 6.2)	(4.6 to 6.6)	(-1.1 to 1.2)
6 -11	9.9	16.5	-6.6	10.6	16.9	-6.3	5.7	10.7	-5.0
	(9.3 to 10.5)	(14.7 to 18.3)	(-4.8 to -8.5)	(9.9 to 11.2)	(14.9 to 18.8)	(-4.3 to -8.3)	(5.2 to 6.1)	(9.3 to 12.1)	(-3.6 to -6.5)
12 -17	8.9	16.9	-8.0	11.9	20.2	-8.3	6.2	14.1	-7.9
	(8.4 to 9.5)	(15.4 to 18.5)	(-6.4 to -9.6)	(11.3 to 12.6)	(18.5 to 21.9)	(-6.5 to -10.0)	(5.7 to 6.7)	(12.8 to 15.5)	(-6.5 to -9.3)
2 -17	10.4	15.6	-5.2	10.4	15.9	-5.5	5.9	10.8	-5.0
	(10.0 to 10.8)	(14.5 to 16.7)	(-4.0 to -6.4)	(10.0 to 10.8)	(14.8 to 17.0)	(-4.3 to -6.7)	(5.6 to 6.2)	(10.0 to 11.8)	(-4.0 to -5.9)

[1] Obesity is defined as having age-gender specific Body Mass Index (BMI) above the 95th centile in the 2000 CDC/ UK 1990 growth charts or above the criteria for obesity in the IOTF classification. [2] Difference is England percentage minus US percentage, i.e. positive values indicate English figure higher than US

APPENDIX 4. AFLY5 PHASE I: METHODS

This appendix relates to chapter 4.

Letter 4.1 Invitation to schools to take part in ALFY5 Phase I

South Gloucestershire Council

South Gloucestershire NHS
Primary Care Trust

Active for Life

Healthy

Monarch Court
Emerald Park
Emerson's Green
South Gloucestershire
BS16 7FH

Address of school

Telephone. 0117 330 2400
Fax 0117 330 2401

Date: 23 November 2005
Ref:

Dear *Name of head teacher*

Invitation to take part in '*Active for Life Year 5' - school obesity prevention project*

We would like to invite your school to take part in an exciting new project to help prevent and reduce obesity in children.

Levels of obesity are steadily increasing and both the NHS and Local Authority have been set the target to halt the year on year rise in obesity in under 11 year olds. Childhood obesity is one of the priorities identified in the Local Area Agreement. We have been successful in bidding for money from the Department of Health to develop and pilot an obesity prevention programme for year 5 classes in South Gloucestershire. The attached summary provides information about the project, what it will involve and the benefits to schools.

The project is based on a programme developed in the USA. Sixteen lesson plans in several subject areas (maths, language, PHSE and PE) will be adapted by British primary school teachers for the national curriculum. The lessons cover topics about healthy eating, physical activity and reducing TV viewing.

We are inviting primary schools in South Gloucestershire, which are geographically and demographically similar, to take part in the project. The first twenty schools which respond to say that they would like to take part will be randomised to two phases of the project. All twenty schools will receive one day of training for the year 5 teacher and the lesson plans in January or September 2006.

Please complete the response form and return it by Monday 12th December to Ruth Kipping at the Primary Care Trust. If you have any questions about the project please do not hesitate to contact Ruth Kipping: 0117 330 2434 or ruth.kipping@sglos-pct.nhs.uk

Yours sincerely,

C Payne

Jane C. Spouse

Dr Chris Payne
Director of Public Health
South Gloucestershire
Primary Care Trust

Dr Jane Spouse
Assistant Director of Children and Young People
South Gloucestershire Council

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

Chairman: Brian Goodson CB OBE
Chief Executive: Penny Harris

Page 2

South Gloucestershire Council

South Gloucestershire NHS
Primary Care Trust

Active for Life

Healthy

Active for Life - school obesity prevention project

Response Form

Name of Headteacher: ....

Name of school: ....

☐ No, we would not like to take part in the project

If no, please tell us why: ....

....

☐ Yes, we would like to take part in the project

Please give the name of the year 5 teacher: ....

Please give the telephone number of the year 5 teacher: ....

Please give the email address of the year 5 teacher: ....

Does the class use an interactive white board?........yes / no

Please give the number of children in the year 5 class? ....

If your school is randomised to phase 1, will your year 5 teacher be free to attend the training day on 20th January (funding for a supply teacher will be provided)?

☐ Yes ☐ No

Please return this form by 12th December to:
Ruth Kipping, Directorate of Public Health and Community Development,
South Gloucestershire Primary Care Trust, 1 Monarch Court, Emerald Business Park,
Emersons Green, South Gloucestershire BS16 7FH
Tel 0117 330 2434 Email: ruth.kipping@sglos-pct.nhs.uk

We will inform you in December about which phase of the project you will be in and to provide further information.

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

Chairman: Brian Goodson CB OBE
Chief Executive: Penny Harris

Table 4.1 Lesson Titles and Learning Objectives

Title	Learning Objective
Fit Check 1	Introduce students to keeping a record of physical activity
Fit Check 2	Introduce children to interpreting results and setting goals
Safe workout: PE Introduction (theory)	Identify and sequence the components of a safe and healthy work out Demonstrate a safe work out
Balance of Good Health (nutrition)	Understand concept of healthy living Balance of Good Health and its importance for a healthy diet
Five foods countdown (PE)	Complete an endurance work out Move for a set time without stopping List a variety of foods from the food groups Demonstrate awareness of five food groups in Balance of Good Health
Five food groups (nutrition)	Role of different nutrients (especially macronutrients) Serving recommendations and portion sizes
Musical Fare (PE)	Demonstrate an endurance activity Demonstrate a pace that works for a set time Demonstrate knowledge of the five food group in Balance of Good Health
Keeping the balance (nutrition)	Meaning of balance Importance of a balanced diet
Three kinds of fitness (PE)	Demonstrate five parts of a safe workout Demonstrate different exercises that help improve endurance, strength and flexibility fitness Identify different parts of fitness
Freeze my TV	Analyse leisure time to identify time spent watching TV Create list of alternative activities
Snack attack (nutrition)	Describe the importance of selecting healthy snacks Analyse food labels to locate nutritional information and fat content
Bowling for snacks (PE)	Demonstrate an endurance workout Demonstrate a pace that they can follow for a set time Describe a healthy snack Categorise a healthy snack
Chain Five (nutrition)	Know the benefits of eating a variety of fruit and vegetables in order to get required vitamins and minerals
Veggiemania (PE)	Complete an endurance workout Demonstrate a pace that works for a set time Learn the importance of eating five fruit and vegetables a day
Brilliant Breakfast (nutrition)	To know the importance of having a healthy breakfast To know consequences of <u>not</u> having a healthy breakfast
Fit Check	To revisit and redo the Fit Check.

Figure 4.1 Example of AFLY5 lesson plan

South Gloucestershire 'Active for life Year 5' adapted from 'Eat Well, Keep Moving'

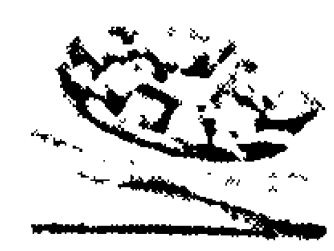
Lesson 11

Snack attack

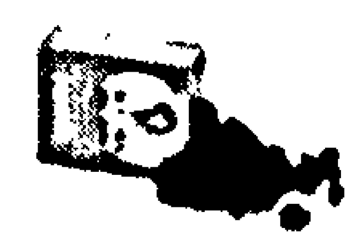
Objectives:
1. Students will describe the importance of selecting healthy snacks.
2. Students will analyse food labels to locate information on nutrient and fat content.

Estimated Teaching time:
50 minutes

Related subject area:
Healthy eating



Materials:
1. Transparency 1, "Eatwell plate"
2. Transparency 2, "Reading Food Labels"
3. Worksheet 1 Food labels
4. Worksheet 2 Design your own food label
5. Snacks and drinks, or a variety of empty snack food packages (you can ask students to bring these in)



Background

There are "sometimes" foods and there are "everyday" foods, but there are no "bad" foods that should never be eaten. However, many people tend to eat too many foods high in saturated fats, salt, and refined sugar. Did you know that one can of cola contains about 10 teaspoons of sugar? Snack foods tend to have a lot of fat and refined sugar: ideally one should eat only limited amounts of these kinds of foods ("sometimes" foods), and should eat more of the nutrient-rich foods ("everyday" foods).

The purpose of this lesson is to help students make better snack choices by recognizing sources of fat and fat content. It is important to remember that most saturated fat comes from animal sources (including beef, chicken, pork, and dairy products). The few exceptions are coconut oil and palm oil, which are also rich in saturated fat.

Reading food labels is an effective way to compare the fat and nutrient content of various snack foods. The place to find out whether a food is relatively high or low in a nutrient is the Nutrition Information label.

Teaching activity
1. Ask students to make a list of their 10 favourite snack foods or drinks.

2. Show the Eatwell plate transparency. Ask students to identify the group in which each snack belongs. Fill in snack names in the appropriate space on the diagram.

Lesson 11 1

South Gloucestershire 'Active for life Year 5' adapted from 'Eat Well, Keep Moving'

3. Discussion questions

   Question 1: Into which group were most of their snacks placed?
   Question 2: Were most of their snack choices low in fat, salt, and/or sugar?

   Discuss the importance of selecting on a regular basis foods that are low in fat. Note that high-fat snacks, are usually high-calorie foods that, when used in excess, may promote excessive weight gain. The body stores fat as an energy reserve, and can do so in almost unlimited amounts. However, eating high-fat snacks ("sometimes food") once in a while is fine.

4. Brainstorm on the board some ideas of snacks which are low in fat content.

5. Show the "Reading Food Labels" transparency (2) and explain the labeled information. Explain that reading the labels is the way to determine the nutrient content of the foods we eat.

6. Give out the snacks and drinks or the snack packs to look at the labels and discuss.

7. Distribute worksheet (1) representing popular snack foods. Have students locate and record the calories per serving, the amount of fat grams per serving as listed on the food label. Also look at the ingredients list and identify foods that contain high levels of sodium [salt] and sugar.

8. Explain to students that high-fat snacks can be eaten once in a while and should be considered "sometimes foods." On a regular basis, they should choose more foods that are lower in fat.

9. Ask students to design a label for a low-fat snack food that would appeal to their peers (worksheet 2).

Lesson 11 2

Figure 4.1 continued

South Gloucestershire 'Active for life Year 5' adapted from 'Eat Well, Keep Moving'

Worksheet 1
Food labels

Can you guess which label belongs to which food?

Nutritional Information 1		
	Per 100g	Per bar
ENERGY (kJ) kcal)	2102 kJ 507 kcal	445 kJ 106 kcal
PROTEIN	5.9g	1.2g
CARBOHYDRATE of which SUGARS	62.0g 49.3g	13.0g 10.4g
FAT of which SATURATES	26.1g 17.8g	5.5g 3.7g
FIBRE	1.1g	0.2g
SODIUM	0.1g	trace

Nutritional Information 2		
	Per 100g	Per bar
ENERGY (kJ) kcal)	1522kJ 360kcal	609kJ 144kcal
PROTEIN	6.3g	2.5g
CARBOHYDRATE	73.0g	29.2g
FAT	4.7g	1.9g

Nutritional Information 3		
Typical value	Per 100g	Per pack
ENERGY	2180kJ 525kcal	1090kJ 263kcal
PROTEIN	6.5g	3.3g
CARBOHYDRATE of which SUGARS	50.0g 0.5g	25.0g 0.3g
FAT of which SATURATES	33.0g 10.g	16.5g 5.0g
FIBRE	4.0g	2.0g
SODIUM	1.2g	0.6g

Nutritional Information 4		
Typical value	Per 100g	Per pack
ENERGY	710kJ 168kcal	1331kJ 316kcal
PROTEIN	11.1g	20.8g
CARBOHYDRATE	20.7g	38.8g
FAT	4.7g	8.6g

Fruity cereal bar

Tuna sandwich

KitKat 2 bars

Crisps

Figure 4.1 continued

South Gloucestershire 'Active for life Year 5' adapted from 'Eat Well, Keep Moving'

Worksheet 2
Design your own food label

Nutritional Information		
Average values	Per 100g	Per Serving
ENERGY (kJ) **(kcal)**		
PROTEIN		
CARBOHYDRATE		
FAT		
FIBRE		
SODIUM		

Lesson 11 5

Figure 4.1 continued

South Gloucestershire 'Active for life Year 5' adapted from 'Eat Well, Keep Moving'

Worksheet 1
Solutions to Food labels

		Fat per 100g	Sugar per 100g	Protein per 100g
1	Kitkat	26.1g	49.3g	5.9g
2	Fruity cereal bar	4.7g	-	6.3g
3	Crisps	33g	0.5g	6.5g
4	Tuna sandwich	4.6g	-	11.1g

Lesson 11 6

South Gloucestershire Council

South Gloucestershire NHS Primary Care Trust

Active for Life

Active for Life Year 5
Questionnaire about watching TV and other activities

What is your name?..

What is the name of your school?..

What is your date of birth?...

The questions ask you how long you spent watching the TV and doing other activities before and after school yesterday, and all day last Saturday.

If yesterday was not a usual day (for example, if you were unwell, or went out before or after school for a special treat and did things that you would not usually do) please tick this box ☐ and answer the question by thinking about what you do on a usual school day.

If last Saturday was not a usual Saturday please tick this box ☐ and answer the questions by thinking about what you do on usual Saturdays.

It is not a test and there are no right or wrong answers. Please answer each question honestly. Your teacher will not be looking at your answers. They will be used to help us plan ways of keeping children healthy. Please put **ONE** tick for each question to show how long you spent doing the activity.



YESTERDAY Before School

How much time did you spend yesterday before school
(from when you woke up until the start of school)

	None	15 minutes or less	30 minutes	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours or more
1 Watching television (NOT including videos on a VCR)	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Watching films or videos on a VCR	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Playing video games (like Nintendo or Sega, not including games on a computer)	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Playing on a computer (NOT including homework)	☐	☐	☐	☐	☐	☐	☐	☐	☐
5 Playing outside	☐	☐	☐	☐	☐	☐	☐	☐	☐
6 At classes or clubs (like Brownies, Cub Scouts, religious school or Judo classes)	☐	☐	☐	☐	☐	☐	☐	☐	☐

YESTERDAY After School

How much time did you spend yesterday after school
(from the end of school until you went to bed)

	None	15 minutes or less	30 minutes	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours or more
1. Watching television (NOT including videos on a VCR)	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Watching films or videos on a VCR	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Playing video games (like Nintendo or Sega, not including games on a computer)	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Playing on a computer (NOT including homework)	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Playing outside	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. At classes or clubs (like Brownies, Cub Scouts, religious school or Judo classes)	☐	☐	☐	☐	☐	☐	☐	☐	☐

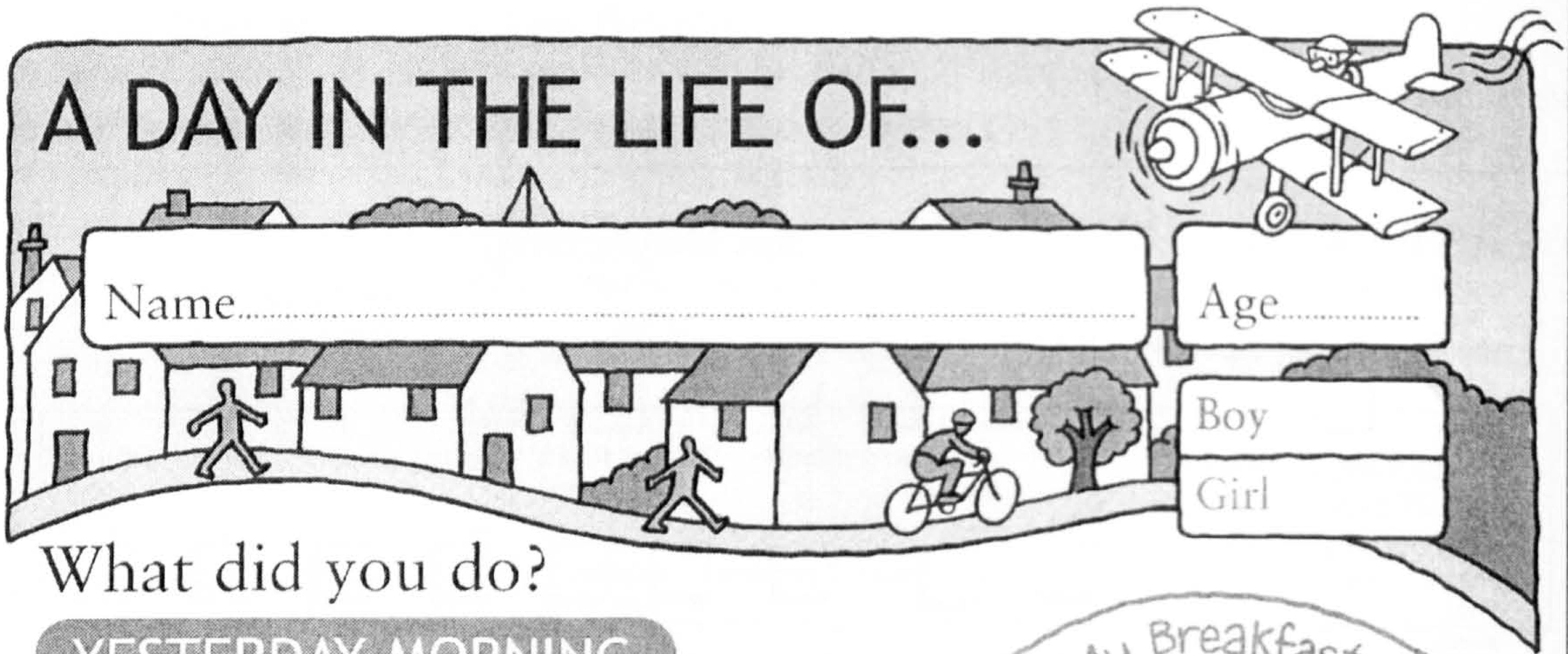
LAST SATURDAY — All Day Long

Last Saturday, how much time did you spend all day long:

	None	15 minutes or less	30 minutes	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours or more
1. Watching television (NOT including videos on a VCR)	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Watching films or videos on a VCR	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Playing video games (like Nintendo or Sega, not including games on a computer)	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Playing on a computer (NOT including homework)	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Playing outside	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. At classes or clubs (like Brownies, Cub Scouts, religious school or Judo classes)	☐	☐	☐	☐	☐	☐	☐	☐	☐

Thank you very much!

A DAY IN THE LIFE OF...



What did you do?

YESTERDAY MORNING

1 Did you have something to eat and drink for breakfast? (What did you have?)

....

....

....drink..

My Breakfast

Draw your breakfast here

2 Did you watch television yesterday morning?

Yes	No

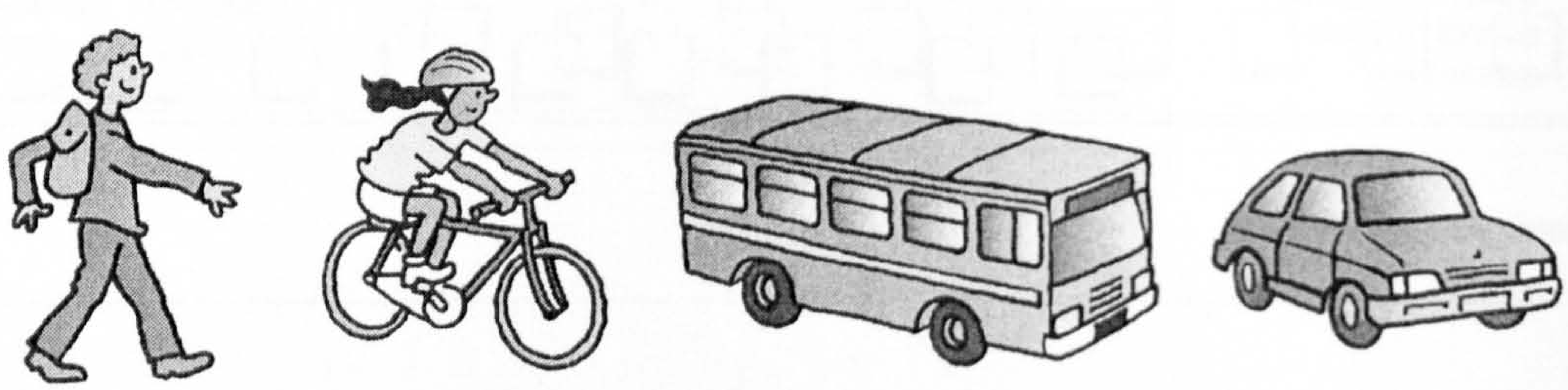
3 Did you eat or drink anything on the way to school? (What did you have?)

....

....

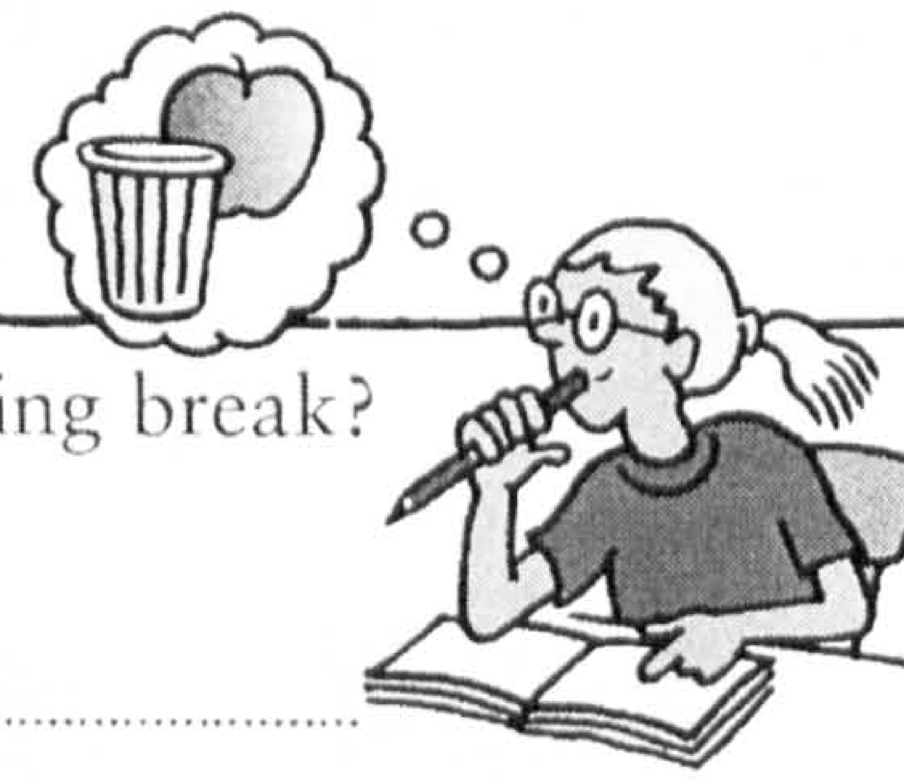
....

4 How did you travel to school yesterday morning?



. walk	cycle	by bus	by car

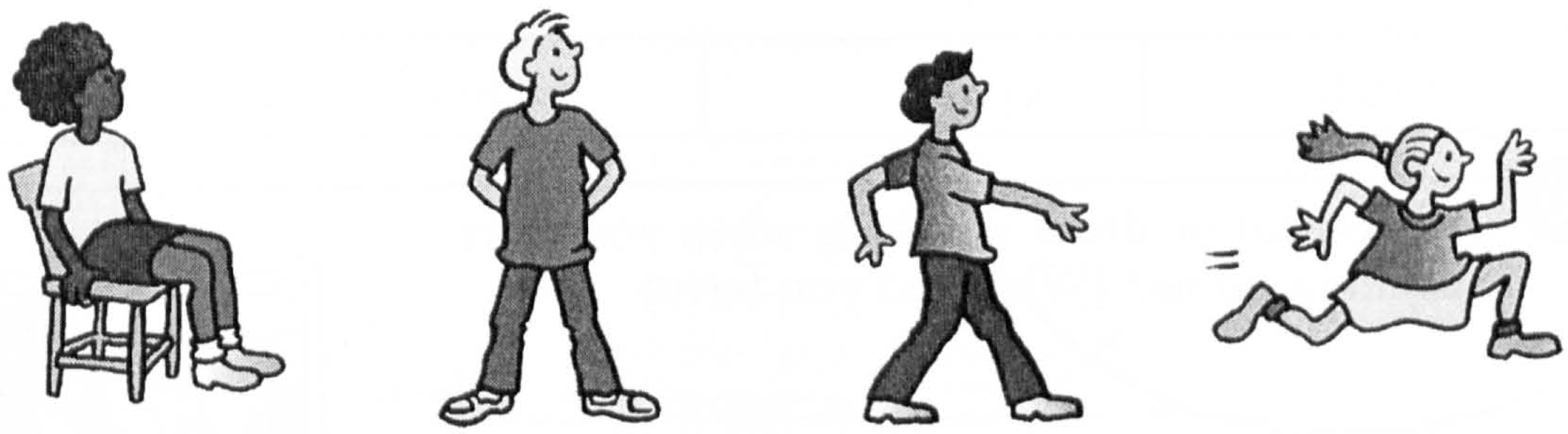
YESTERDAY AT SCHOOL



5 Did you have anything to eat or drink at morning break? (What did you have)

....

6 What did you do at morning break (interval) yesterday?



sit around	stand around	walk around	run around

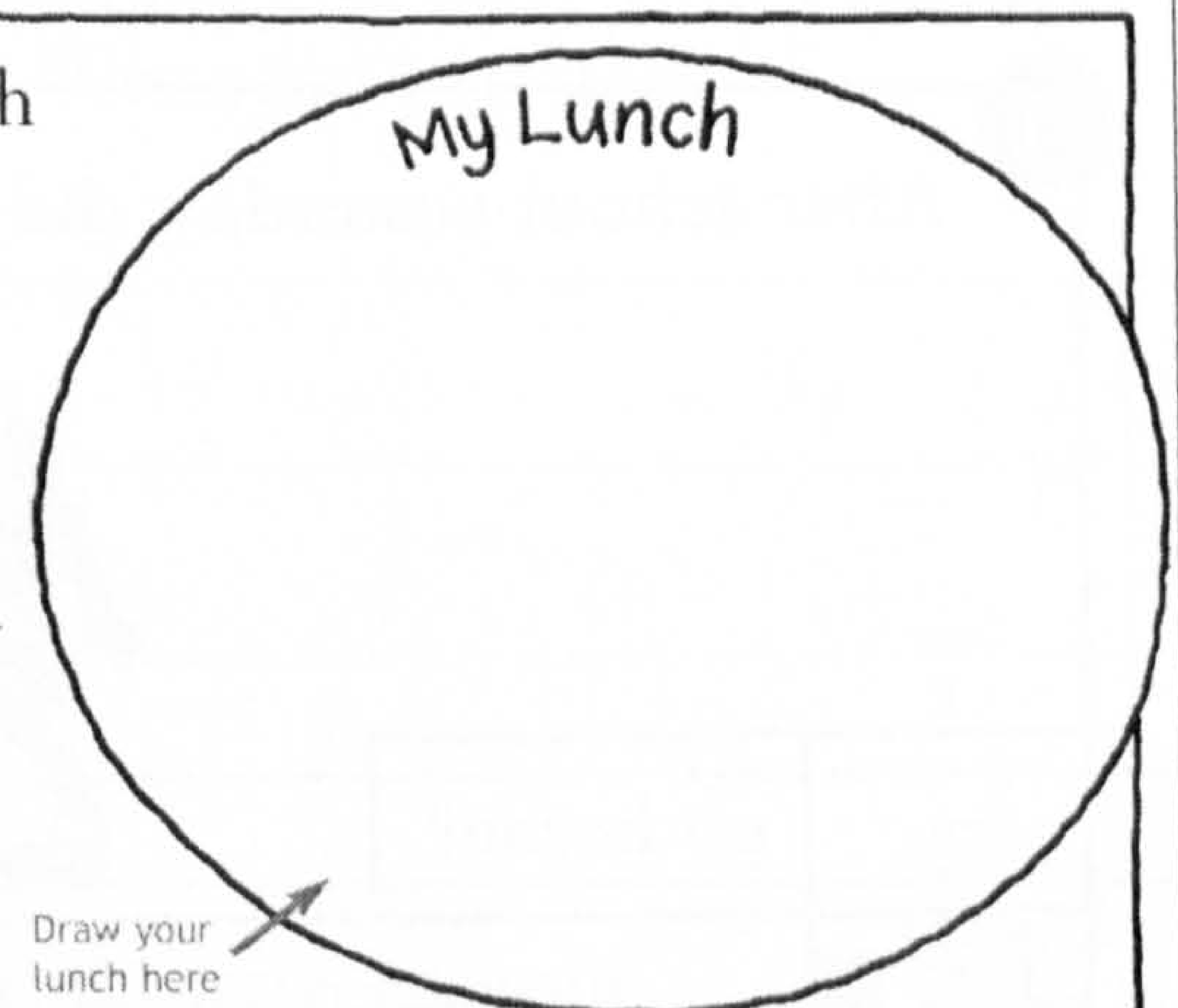
7 Did you eat and drink anything for lunch yesterday? (What did you have?)

School dinner	Pack lunch

....

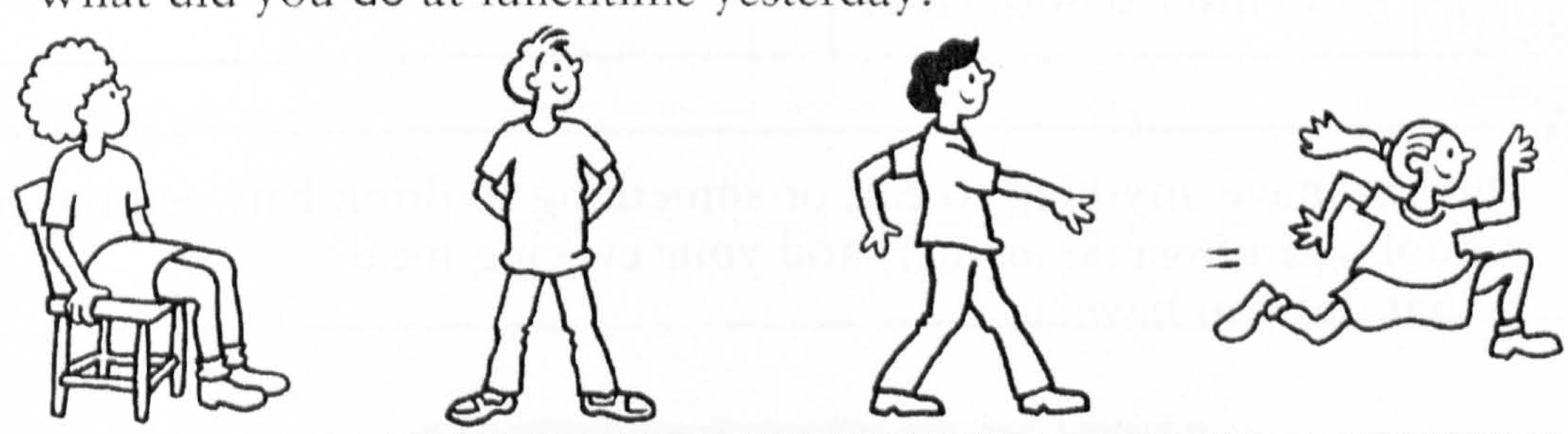
....

..................................drink..



8 What did you do at lunchtime yesterday?

You can colour in these activities

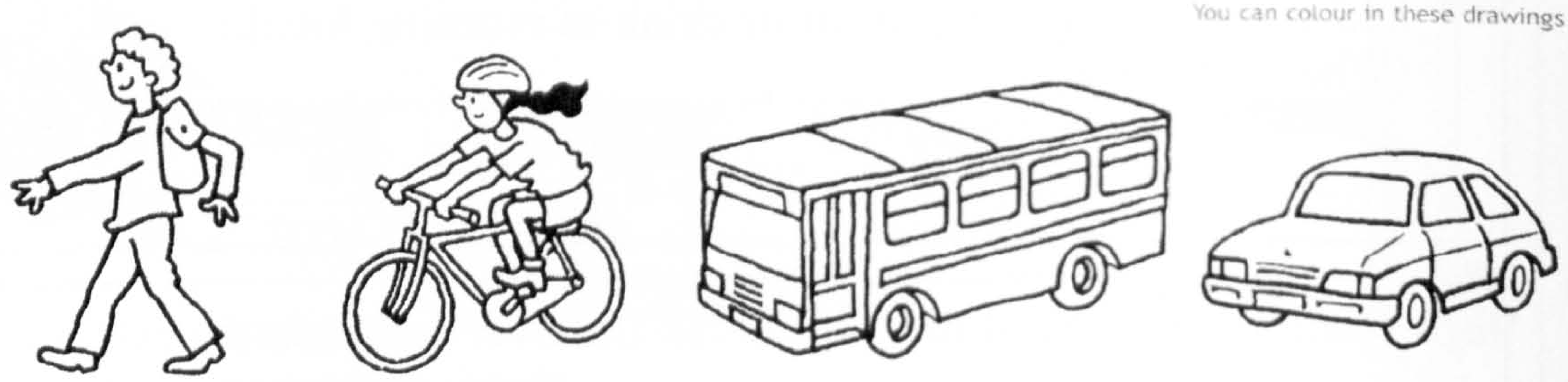


sit around	stand around	walk around	run around

AFTER SCHOOL

9 How did you travel home after school or your after school care yesterday?

You can colour in these drawings



walk	cycle	by bus	by car

10 Did you eat or drink anything when you were travelling home? (What did you have)

....

....

11 After school yesterday, did you:

	go home?
	go to a club (eg Brownies, Cubs, swimming, football?)
	go to after school club?

12 Did you have anything to eat, or something to drink between the end of school (apart from the journey) and your evening meal? (What did you have?)

....

AFTER SCHOOL (continued)

13 Did you play outside yesterday after school?

Did you play outside yesterday after school?	Yes	No

14 Did you have an evening meal yesterday?
(What did you have?)

....

....

pudding...

...................................drink......................................

My Evening Meal

Draw your evening meal here

15 Did you watch television yesterday evening?

Yes	No

16 Did you do anything else after your evening meal yesterday? What did you do?

....

....

....

17 Did you have anything else to eat or drink between your evening meal and before you went to bed?
(What did you have?)

....

....

THANK YOU VERY MUCH

Coding the diet data

Figure 4.2 Food and drink items in the categories

Category	Food/drink items
Fruit and vegetables[a]	Fruit and vegetables: fresh, stewed, tinned, dried, cereal with fruit, fruit tuck, multiples of smaller fruit, salads, pulses (maximum of one score per day). Composite foods were excluded e.g. apple pie.
Snacks	Cake, muffins, scones, croissants, biscuits, muesli bars, chocolate, chocolate bars, sweets, confectionary, ice confectionary, puddings, sweet pies or pastry, diary desserts, custard, hot cross buns, malt loaf, poptart, jelly, potato crisps, corn chips, manufactured savoury snacks, dry or savoury biscuits, crispbread, nuts, pepperami, popcorn, pretzels, crackers (when not part of a meal).
High fat foods	Chips, fries, potato wedges, hashbrowns, smiles, sausage, burger, chicken, fish and turkey coated food (e.g. nuggets, fishfingers, chicken dippers), KFC, MacDonalds, veggiburger, meat pastries and pies, kebabs, pizza, scampi, bacon, fish cakes, scotch eggs, sausage roll, fritters, hotdog, hot pocket, pancake, waffle.
High energy drinks	Fruit juice, fruit juice drink, cordial, flavoured mineral water, carbonated and still soft drinks, smoothies, chocolate drinks, yoghurt drinks, milkshake.

[a] The authors of the DILQ recommend that fruit juice was not included in assessing fruit and vegetable consumption because children are often unsure whether a drink is a squash, a fruit drink or a pure fruit juice. [38]

Questionnaire for Teachers in the Active for Life Year 5 Project

Please complete this questionnaire to give us feedback about your views of the Active For Life Year 5 Project. The name of your school will be used to identify the responses from schools with increased parental involvement. Your answers will be treated in confidence.

Name of School: ....

Name of teacher completing questionnaire: ....

1. To what extent did the training day prepare you for teaching the lessons?

Not at all prepared	Not prepared	Ok	Prepared	Fully prepared

2. How easy was it to do the height and weight measurements?

Very difficult	Difficult	Ok	Easy	Very easy

3. How easy was it to the pedometer measurements?

Very difficult	Difficult	Ok	Easy	Very easy

4. Did you have problems with any of the following:

Pedometers resetting	
Lost pedometers	
Pedometers left at home	
Broken pedometers	

5. How easy was it to the 'A day in the life' questionnaire?

Very difficult	Difficult	Ok	Easy	Very easy

6. How easy was it to the TV questionnaire?

Very difficult	Difficult	Ok	Easy	Very easy

7. How easy or difficult was it to fit the lessons into the curriculum?

Very difficult	Difficult	Ok	Easy	Very easy

8. What were the lessons like to teach: please indicate any lessons you did not teach; and any which were particularly good or poor

Lesson	Title	Did not teach	Good	Poor
1.	Fit Check 1			
2.	Fit Check 2			
3.	Safe workout: PE Introduction (theory)			
4.	Balance of Good Health (nutrition)			
5.	Five foods countdown (PE)			
6.	Five food groups (nutrition)			
7.	Musical Fare (PE)			
8.	Keeping the balance (nutrition)			
9.	Three kinds of fitness (PE)			
10.	Freeze my TV			
11.	Snack attack (nutrition)			
12.	Bowling for snacks (PE)			
13.	Chain Five (nutrition)			
14.	Veggiemania (PE)			
15.	Brilliant Breakfast (nutrition)			
16.	Fit Check			

9. Were the lesson plans:

Very difficult to understand	Difficult to understand	Ok	Easy to understand	Very easy to understand

10. Were the nutrition lessons:

Too short	Ok	Too long

11. What was the general response from children to the nutrition lessons:

Very negative	Negative	Ok	Positive	Very positive

12. Were the PE lessons:

Too short	Ok	Too long

13. What was the general response from children to the physical activity lessons:

Very negative	Negative	Ok	Positive	Very positive

14. What was the general response from children to the Fit Check:

Very negative	Negative	Ok	Positive	Very positive

15. What was the general response from children to Freeze My TV:

Very negative	Negative	Ok	Positive	Very positive

16. What type of feedback did you receive from parents?

Many negative comments	Some negative comments	No comments	Some positive comments	Many positive comments

17. Will you continue using the materials?

No	May be	Yes

18. Did you use the photos of food?

No	Yes

19. Where the photos the right size?

No	Yes

20. Did you use the CD rom with the lessons?

No	Yes

21. Did you need to prepare any further materials?

No	Yes

Thank you.

Interview schedule for Active for Life Year 5 teachers

Training day

1. Could the training day have been improved?

Measurements: experience of the practicalities and response from children

2. Height/weight
3. Pedometers
4. A day in the life
5. TV questionnaire

Lessons

6. Ease of fitting it in with curriculum
7. Format of lesson plans
8. Length of lessons
9. Fit check – ease of teaching and response from children
10. Freeze My TV - ease of teaching and response from children
11. Any particularly good/poor lessons
12. Response from children to nutrition lessons
13. Response from children to physical activity lessons
14. Any feedback from parents
15. Any response from other teachers

General impression of the impact of the lessons on:

16. The children's awareness of healthy eating/phy activity
17. The children's behaviours regarding healthy eating/phy activity
18. The time children spend on screen activities

Future

19. Would you want to continue using the materials?

Other school activities

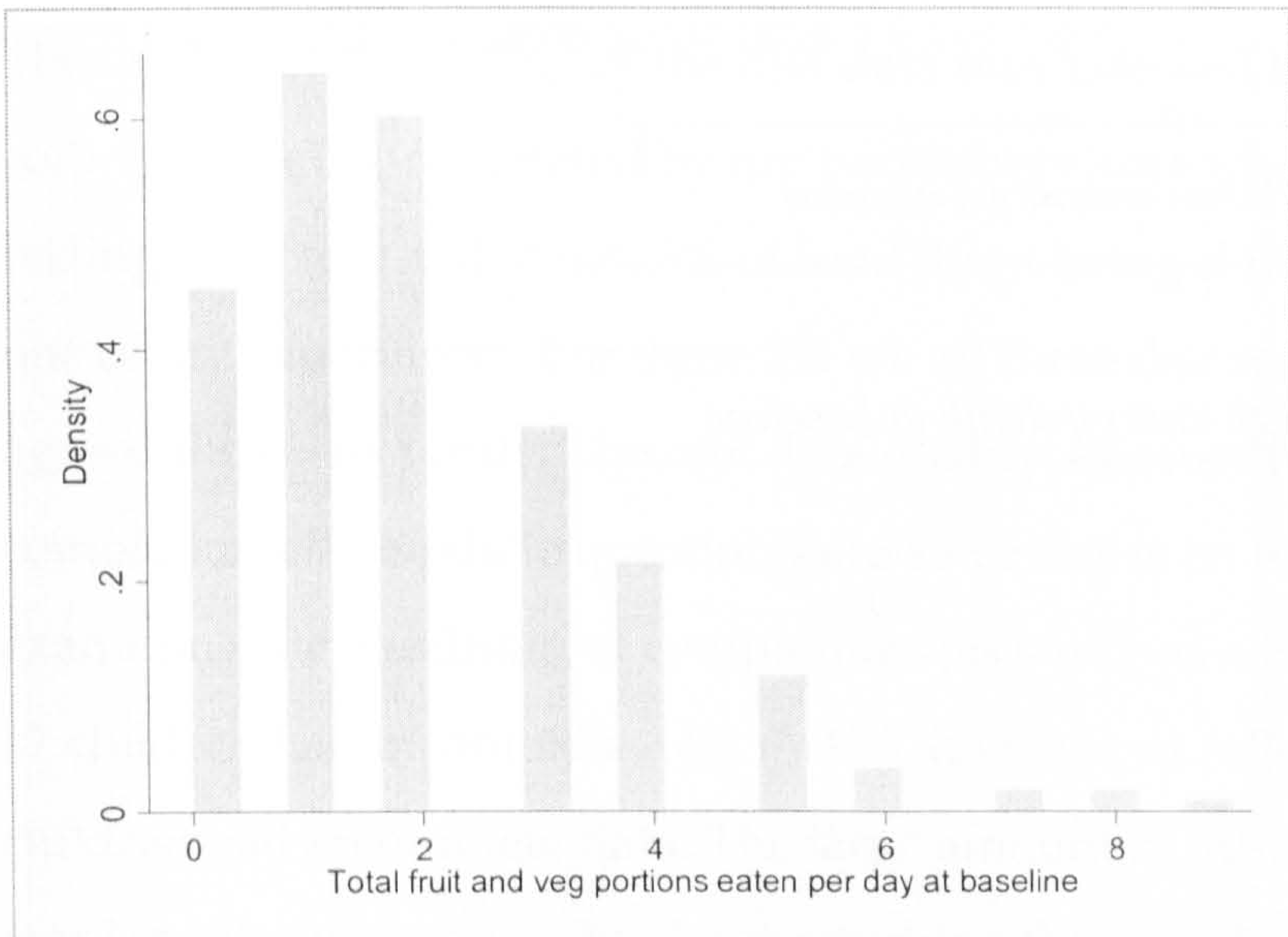
20. Were there other projects or events taking place during January – July 2006 which promoted healthy eating and physical activity?

APPENDIX 5. AFLY5 PHASE I: RESULTS

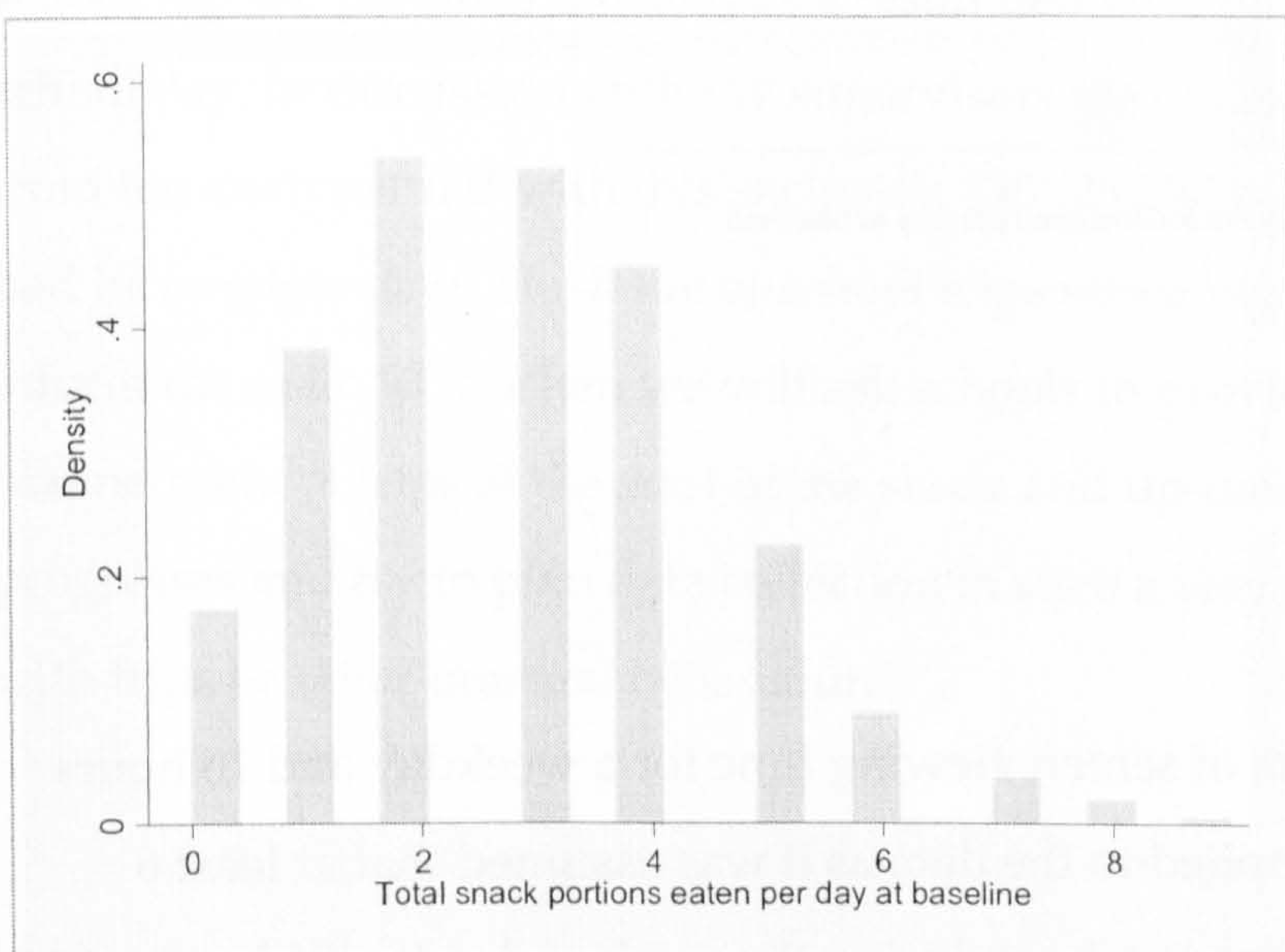
This appendix relates to chapter 4.

AFLY5 Phase I descriptive data

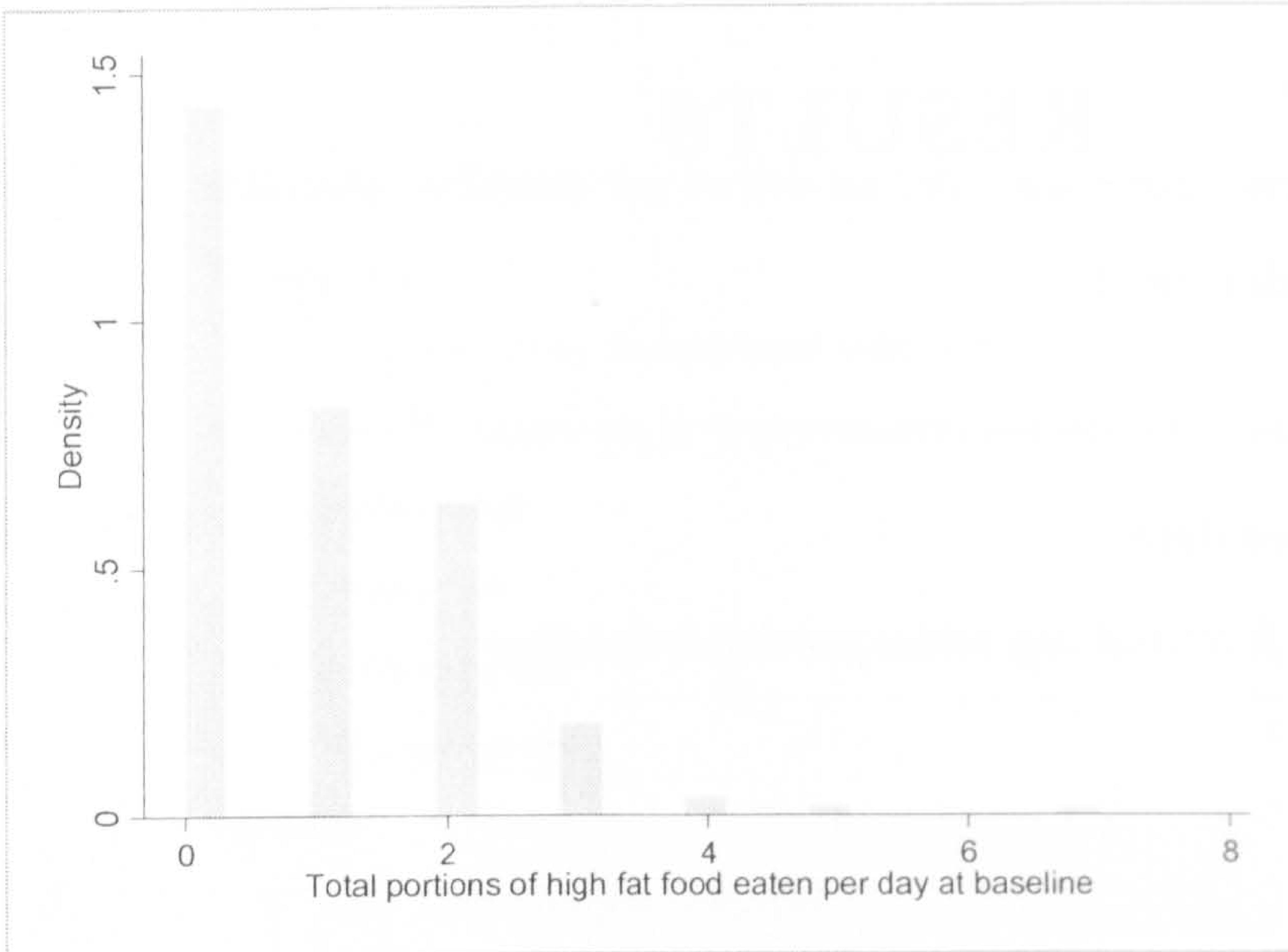
Graph 5.1 Total portions of fruit and vegetables per day at baseline



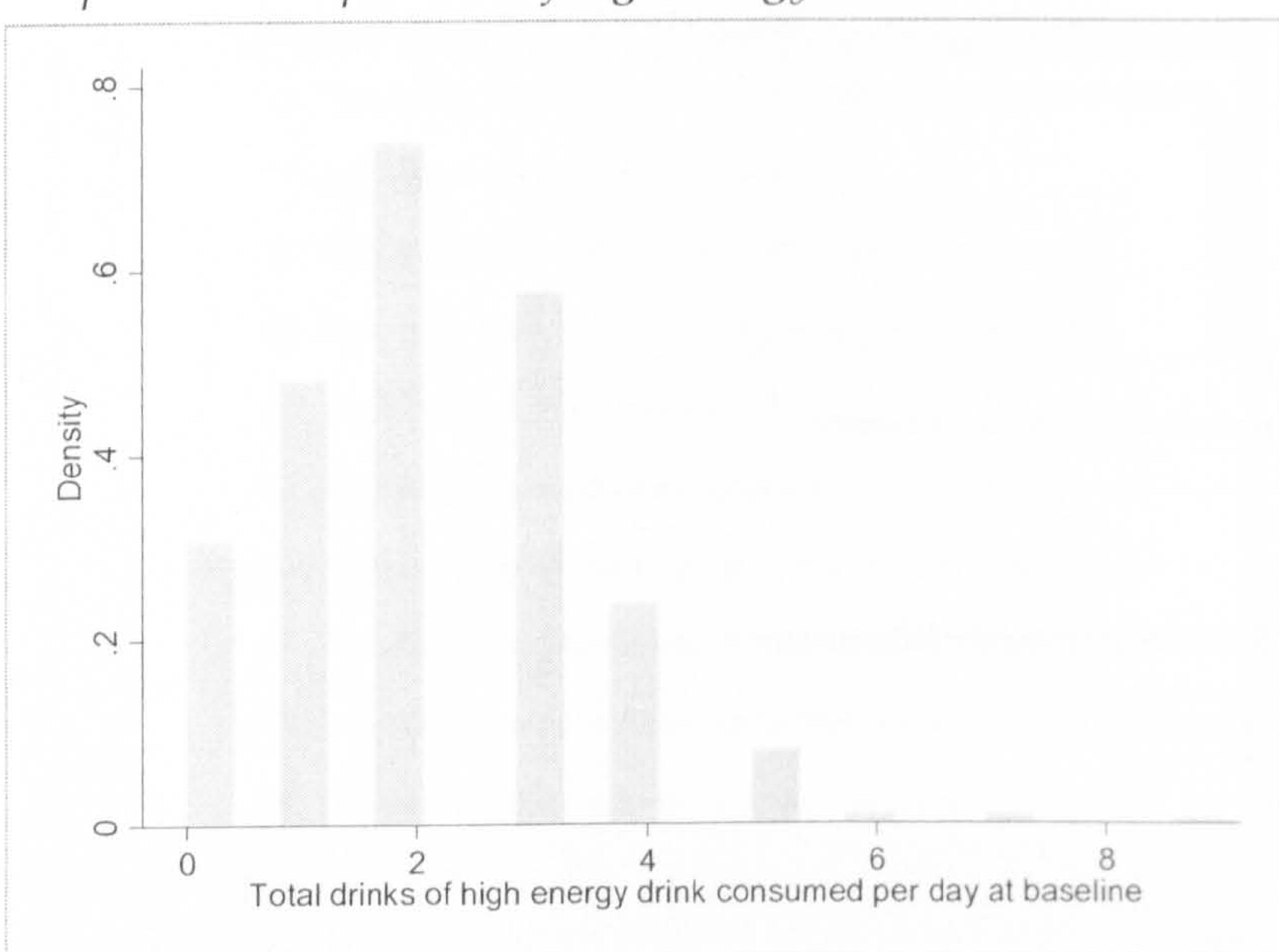
Graph 5.2 Total portions of snacks per day at baseline



Graph 5.3 Total portions of high fat food per day at baseline



Graph 5.4 Total portions of high energy drink at baseline



Data quality

Screen viewing

Maximum limits of 12 hours of screen viewing time for a weekday and 18 hours for a weekend data were applied to the data as it was assumed that at least 6 hours per day would be spent at school during the week and at least 6 hours of sleep on all days. Before doing the main analyses children were excluded from the analyses with a sum of 720 minutes or greater of screen-based activities for the weekdays and a sum of 1080 minutes of such activities for Saturday. At baseline this resulted in one child being excluded from the intervention schools and six from the control schools, and at follow-up this resulted in 34 children being excluded from the intervention schools and 55 from the control schools prior to analyses.

Diet

The quality of the coding of the diet data was assessed by comparing my initial coding to coding completed by my two supervisors who were blind to my coding. This resulted in just 3% of food items being differently coded by me or one of my supervisors. For these 3% we all three discussed the differences and agreed the correct code. The diet data quality was further examined by completion of the whole questionnaire since this is an important aspect of examining the feasibility of completing this study as a full scale RCT. At baseline 17 children had incomplete data (3.3%), however at follow-up 110 (21.4%) children had incomplete data. The large amount of incomplete data at follow-up was largely due to one school not returning the questionnaires. In addition I discovered when collecting questionnaires that another school had been on a school trip the previous day and as a result had very different diet to a normal school day. In discussion with my supervisors we decided to exclude this school from the analyses and with this exclusion 130 (25.2%) of the children at follow-up had incomplete data. The issue of school trips was a valuable lesson that will inform the main RCT when we will ask schools to provide us with dates of planned school trips at the start of the study and up-date this as the study progresses and try to plan data collection in such a way that it does not clash with trips or other unusual behaviour.

Physical activity

The pedometer data were assessed for quality based on the teacher interviews and questionnaires, which consistently reported problems with the pedometers particularly that the reset button was easily pressed by accident and therefore the daily record of steps was inaccurate.

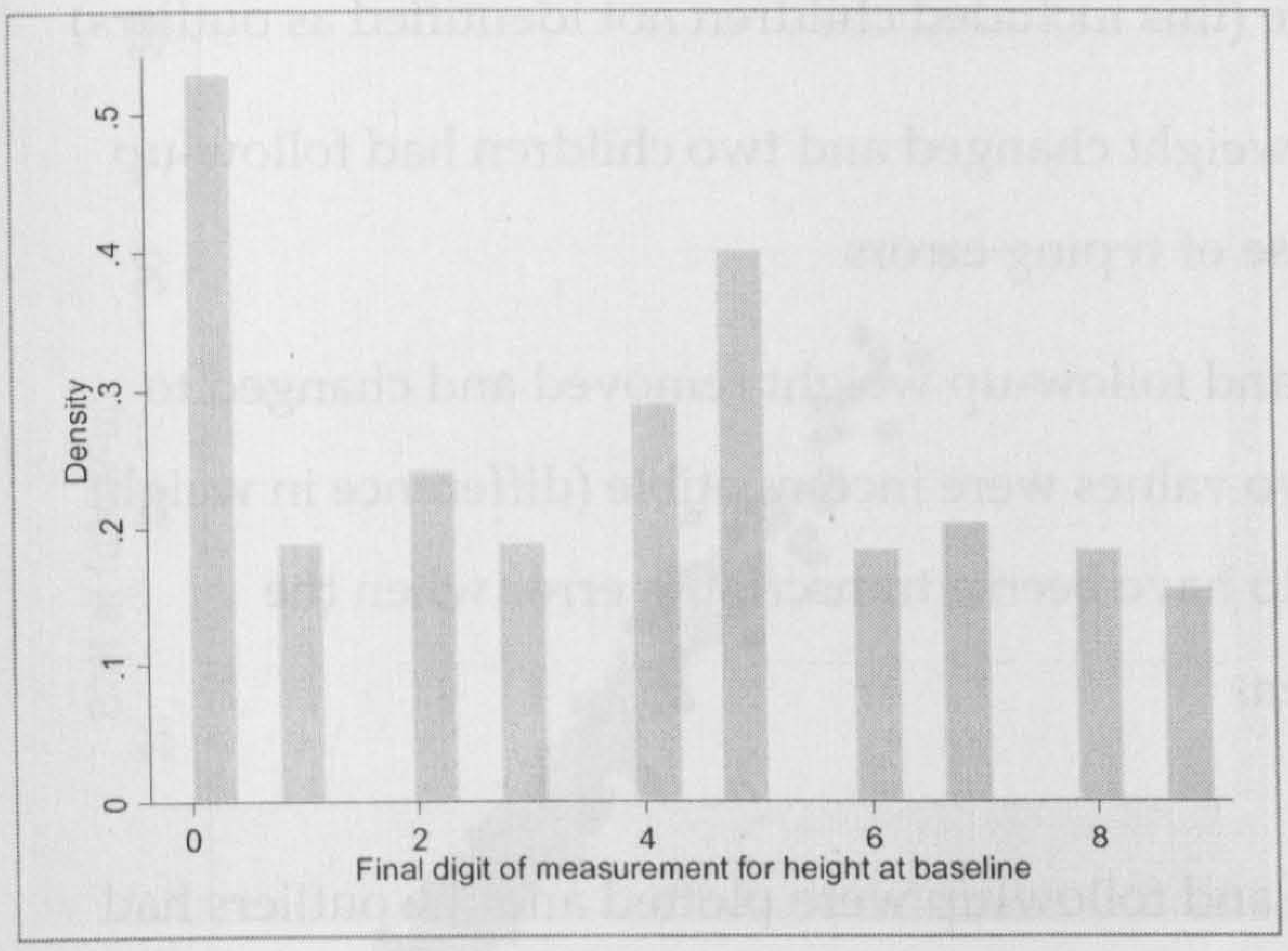
Active travel

The responses to the DILQ questionnaire about travel to school were checked for face validity.

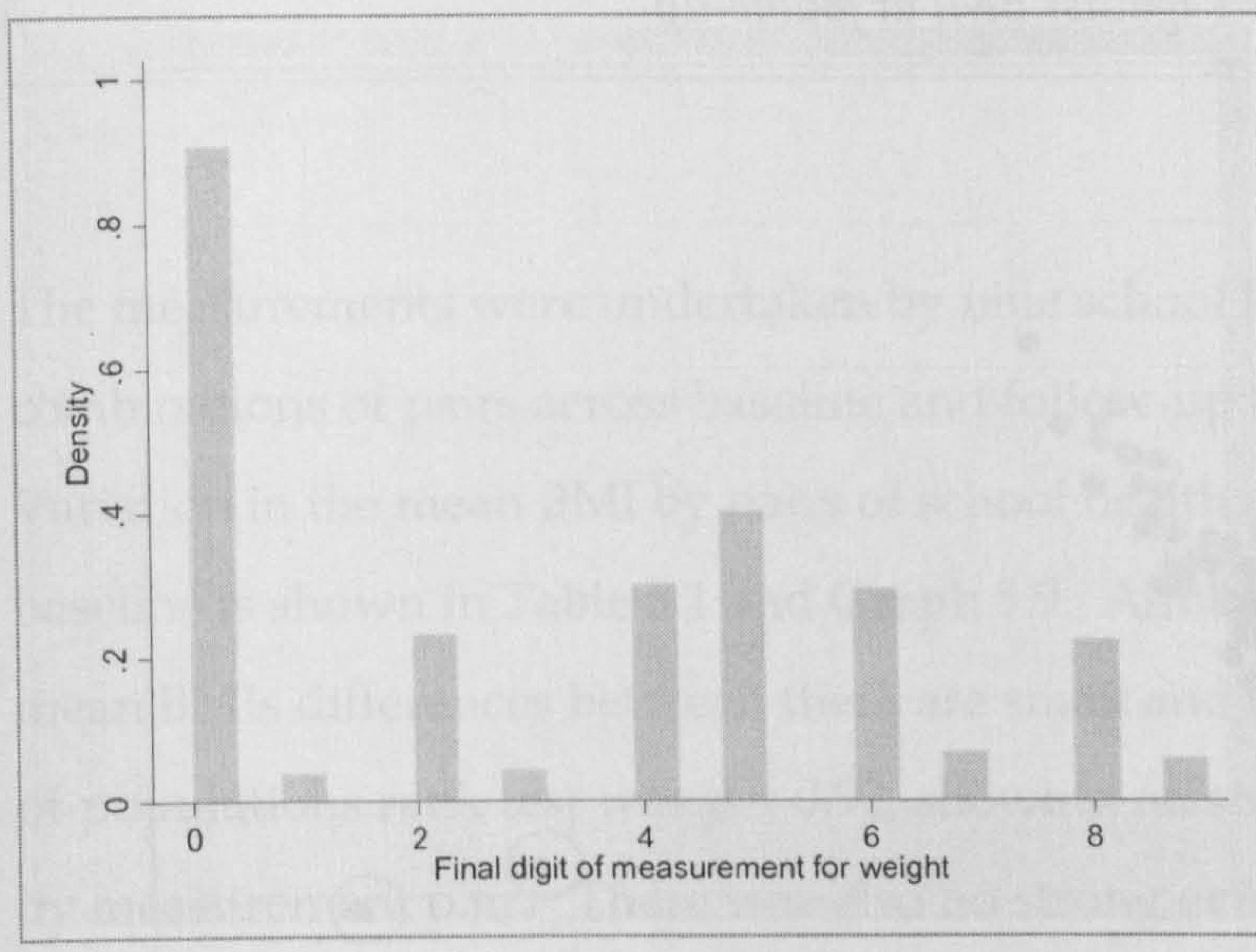
Height and weight

The distribution of all height measures (at baseline) shows very strong digit preference to whole and half numbers, and that of weight measures to whole numbers (see Graph 5.5 and Graph 5.6).

Graph 5.5 Digit preference (to three decimal places) for height measurements at baseline (n=531)



Graph 5.6 Digit preference (to one decimal place) for weight measurements at baseline (n=532)

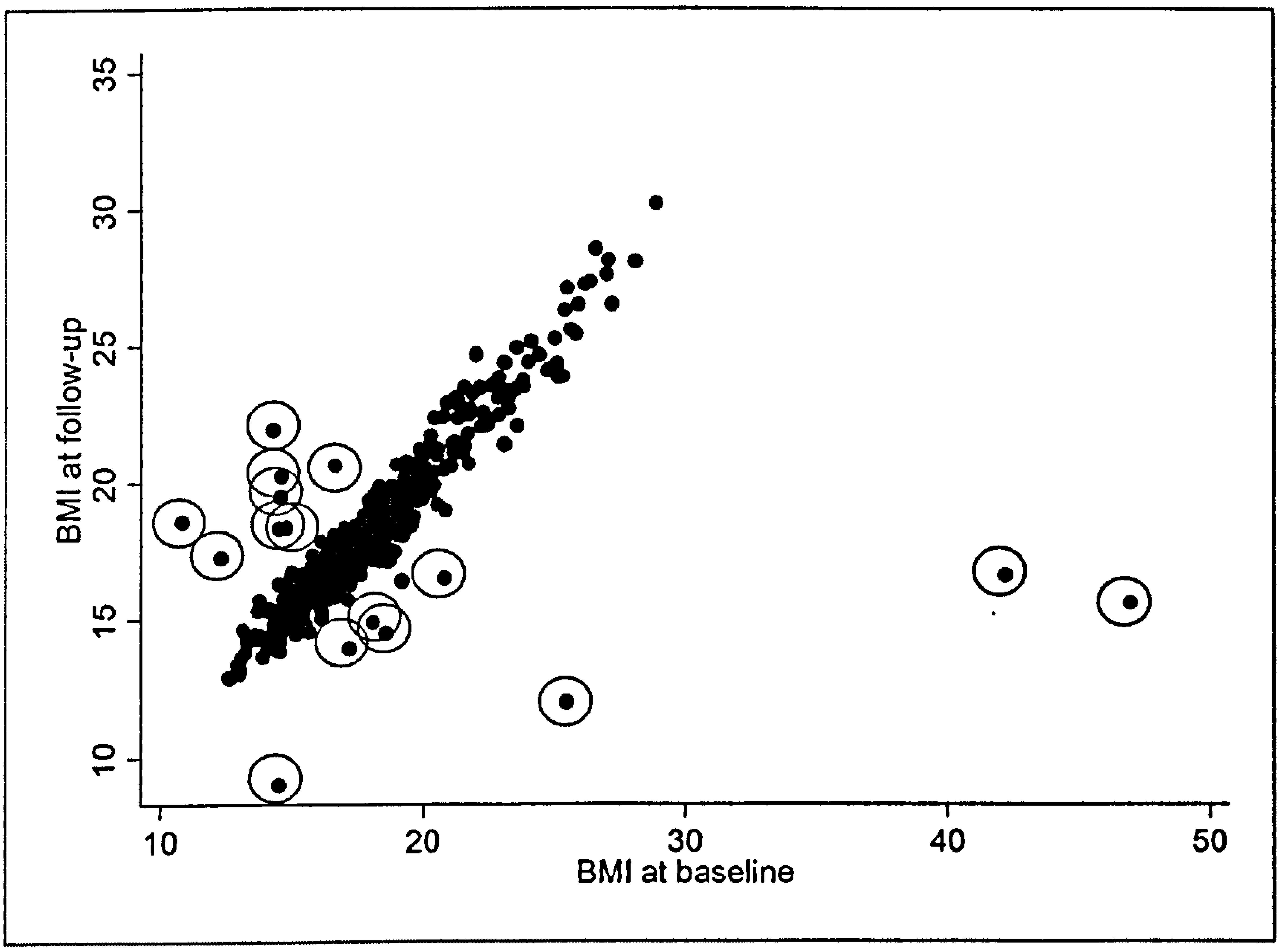


The BMI values at baseline and follow-up were plotted to check for outliers (see red circles indicating outliers on Graph 5.7). Fifteen values looked upon visual inspection of the graph to be outliers. In all cases there were discrepancies in the weights at baseline and follow-up; the original paper copies were checked and the following changes made:

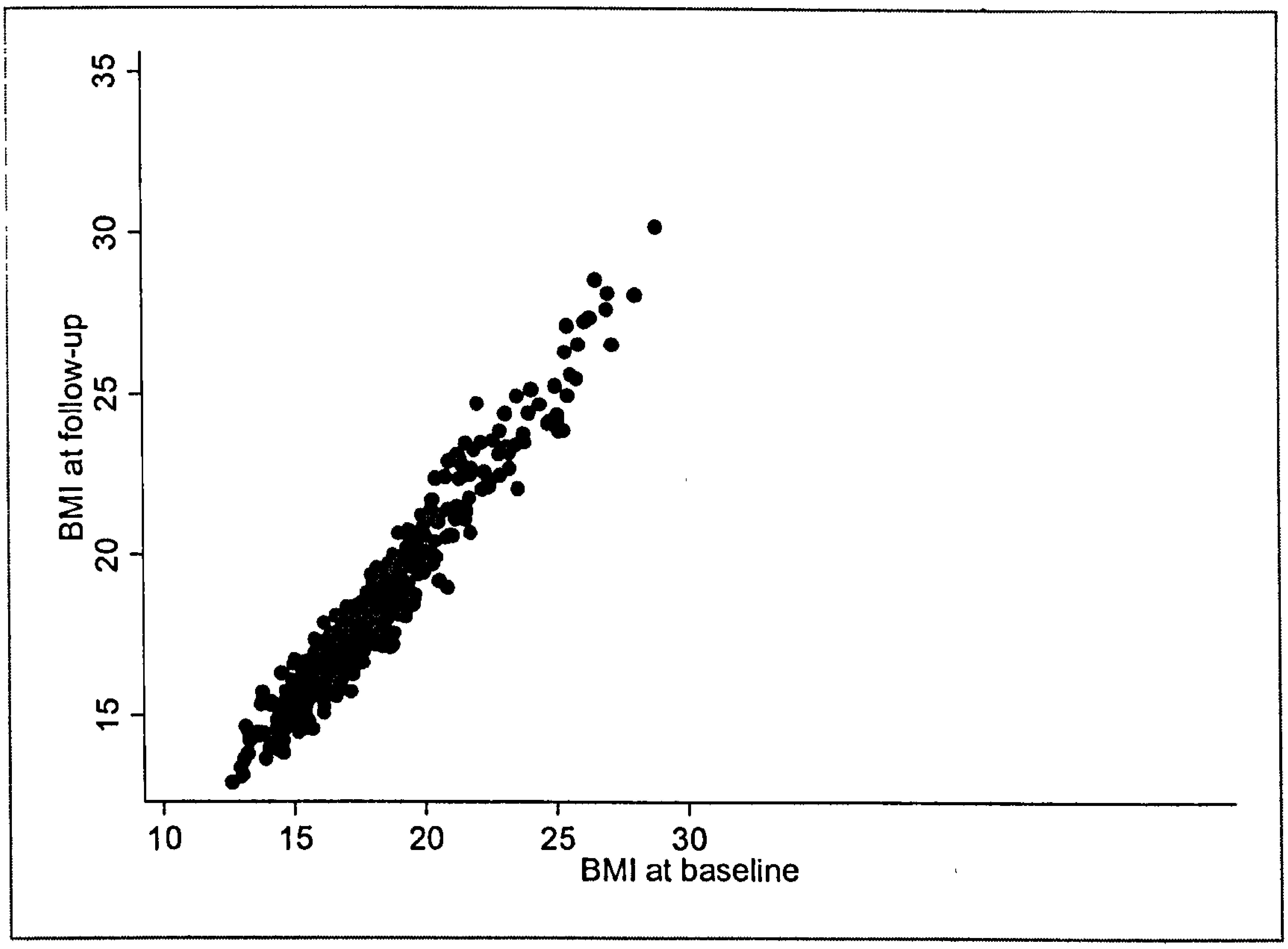
- 16 children had baseline height and weight data changed because a typing error had occurred and the data had been entered for the wrong child all the way down the page (this included children not identified as outliers)
- 3 children had baseline weight changed and two children had follow-up weight changed because of typing errors
- 4 children had baseline and follow-up weight removed and changed to missing because the two values were incompatible (difference in weight >10kg) and it appears to have been a transcribing error when the measurement was taken.

The corrected BMI at baseline and follow-up were plotted and the outliers had been removed (see Graph 5.8).

Graph 5.7 BMI at baseline plotted against BMI at follow-up



Graph 5.8 BMI at baseline plotted against BMI at follow-up with corrected weight values

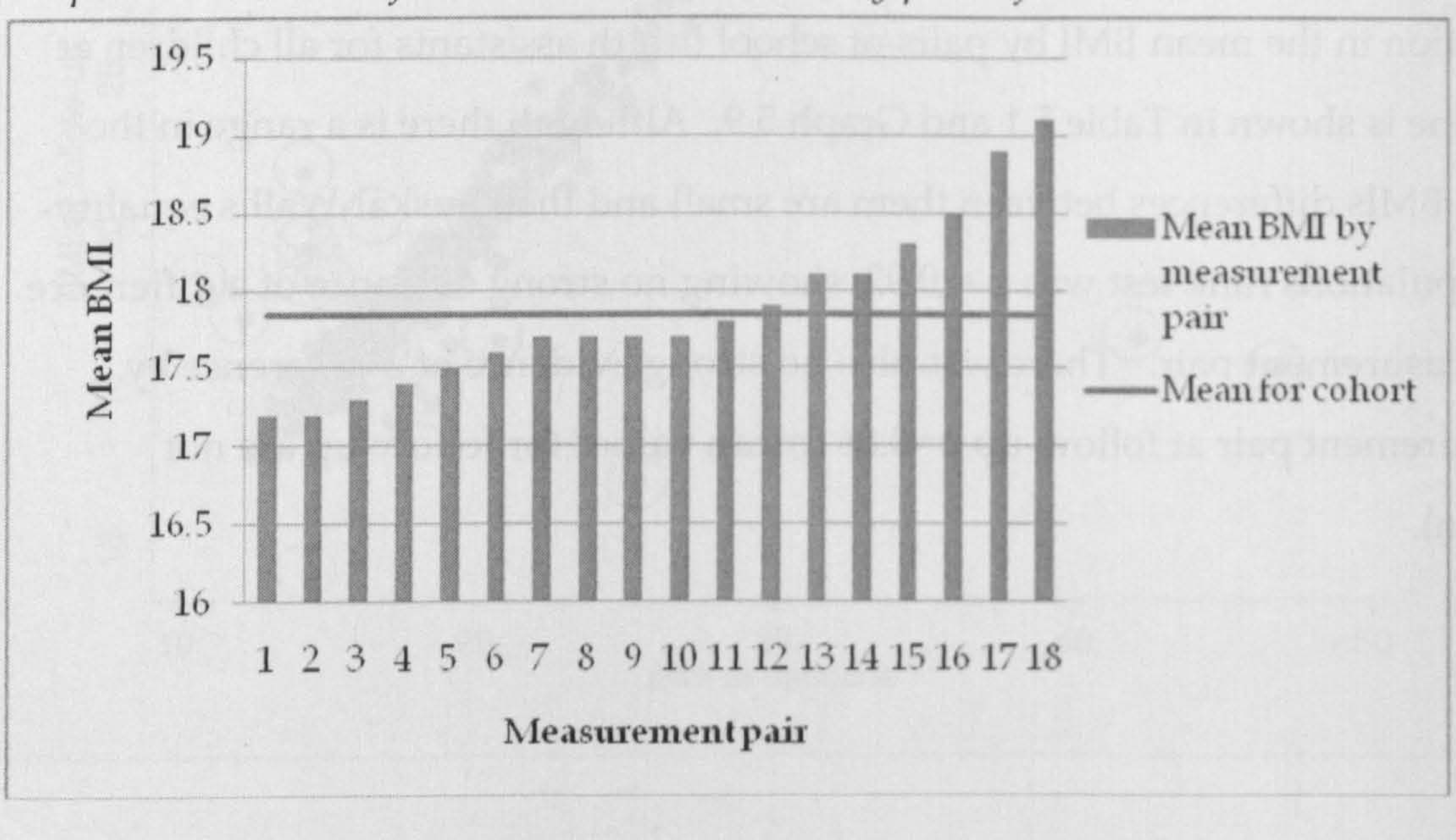


The measurements were undertaken by nine school health assistants in 22 combinations of pairs across baseline and follow-up (18 pairs at baseline). Variation in the mean BMI by pairs of school health assistants for all children at baseline is shown in Table 5.1 and Graph 5.9. Although there is a range in the mean BMIs differences between them are small and the Kruskal-Wallis equality-of-populations rank test was p = 0.92, showing no strong evidence of a difference by measurement pair. There was also no strong evidence of a difference by measurement pair at follow-up p=0.86 (mean values for follow-up are not shown).

Table 5.1 Variation in mean BMI by measurement pairs at baseline

Number of pair	Mean (SD)	N observations
1	17.2 (2.0)	15
2	17.2 (2.5)	25
3	17.3 (2.8)	64
4	17.4 (2.5)	33
5	17.5 (2.4)	18
6	17.6 (2.8)	27
7	17.7 (2.8)	15
8	17.7 (2.9)	22
9	17.7 (3.1)	57
10	17.7 (3.8)	25
11	17.8 (3.6)	23
12	17.9 (2.2)	26
13	18.1 (2.7)	21
14	18.1 (3.9)	54
15	18.3 (2.8)	36
16	18.5 (3.3)	21
17	18.9 (3.6)	25
18	19.1 (6.9)	23

Graph 5.9 Mean BMI for all children at baseline by pairs of school health assistants



Graph 5.10 Distribution of body mass index at baseline for all children (n = 531)

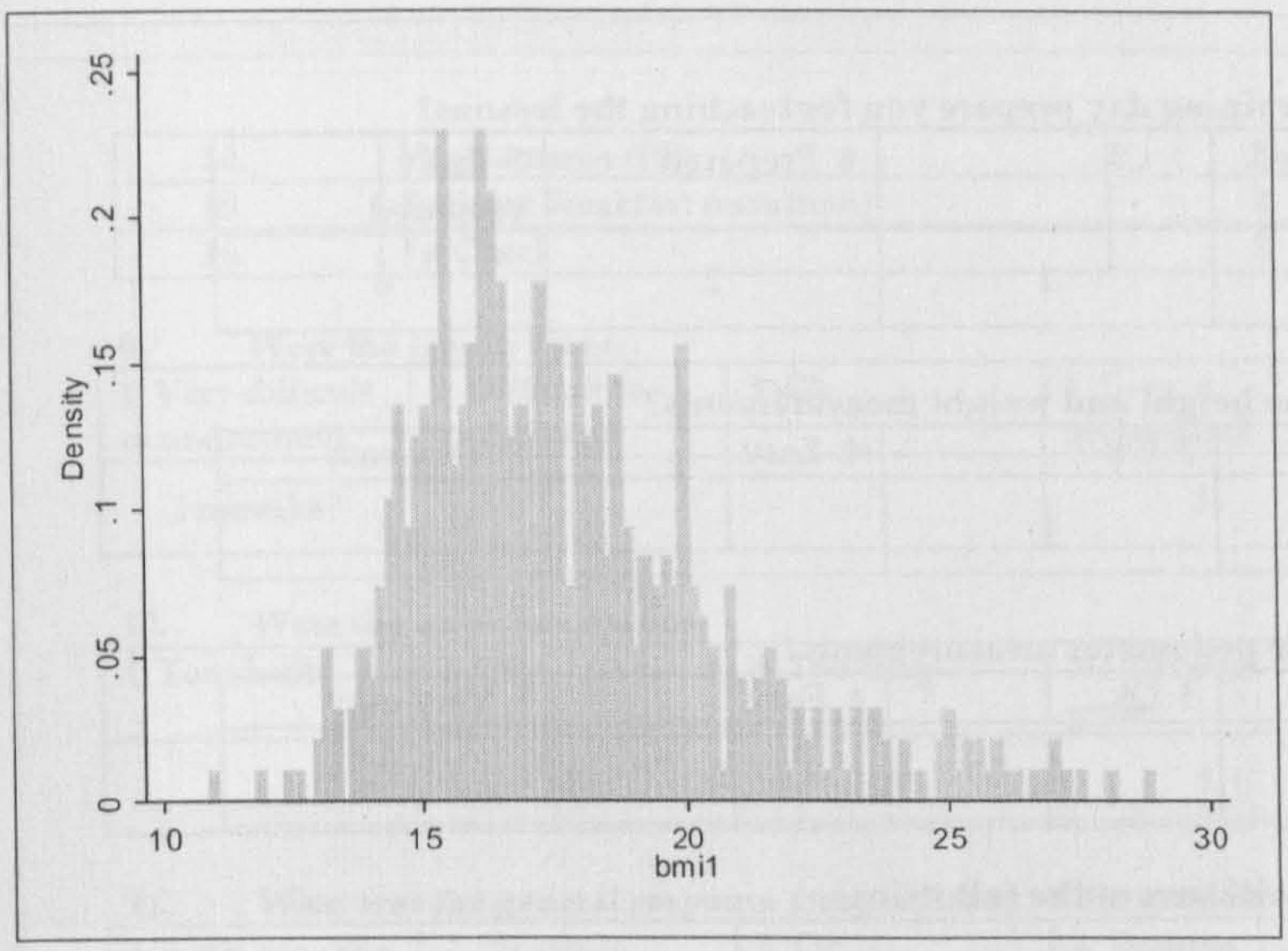


Figure 5.1 AFLY5 Phase I teacher questionnaire results n=9

1. To what extent did the training day prepare you for teaching the lessons?

1 Not at all prepared	2 Not prepared	3 Ok	4 Prepared	5 Fully prepared
		1	2	6

2. How easy was it to do the height and weight measurements?

1 Very difficult	2 Difficult	3 Ok	4 Easy	5 Very easy
		1		8

3. How easy was it to do the pedometer measurements?

1 Very difficult	2 Difficult	3 Ok	4 Easy	5 Very easy
3	2	2	2	

4. Did you have problems with any of the following:

Pedometers resetting	9
Lost pedometers	6
Pedometers left at home	7
Broken pedometers	9

5. How easy was it to do the 'A day in the life' questionnaire?

1 Very difficult	2 Difficult	3 Ok	4 Easy	5 Very easy
		1	3	5

6. How easy was it to do the 'TV questionnaire'?

1 Very difficult	2 Difficult	3 Ok	4 Easy	5 Very easy
	1	2	3	3

7. How easy or difficult was it to fit the lessons into the curriculum?

1 Very difficult	2 Difficult	3 Ok	4 Easy	5 Very easy
1	2	2	4	

8. What were the lessons like to teach: please indicate any lessons you did not teach; and any which were particularly good or poor.

Lesson	Title	Did not teach	Good	Poor
1.	Fit Check 1		6	
2.	Fit Check 2		6	
3.	Safe workout: PE Introduction (theory)	2	4	1
4.	Balance of Good Health (nutrition)		6	1
5.	Five foods countdown (PE)	2	5	
6.	Five food groups (nutrition)		7	1
7.	Musical Fare (PE)	2	5	
8.	Keeping the balance (nutrition)		7	
9.	Three kinds of fitness (PE)	3	4	
10.	Freeze my TV	1	6	
11.	Snack attack (nutrition)	1	5	
12.	Bowling for snacks (PE)	4	2	
13.	Chain Five (nutrition)	3	3	

Figure 5.1 continued

14.	Veggiemania (PE)	3	4	
15.	Brilliant Breakfast (nutrition)	2	5	
16.	Fit Check	2	4	

9. Were the lesson plans:

1 Very difficult to understand	2 Difficult to understand	3 Ok	4 Easy to understand	5 Very easy to understand
1 mistake?		1	3	4

10. Were the nutrition lessons:

1 Too short	2 OK	3 Too long	No answer given
	5	3	1

11. What was the general response from children to the nutrition lessons?

1 Very negative	2 Negative	3 Ok	4 Positive	5 Very positive
		3	1	5

12. Were the PE lessons:

1 Too short	2 OK	3 Too long	No answer given
	6		4

13. What was the general response from children to the physical activity lessons?

1 Very negative	2 Negative	3 Ok	4 Positive	5 Very positive
		2	3	4

14. What was the general response from children to the Fit check?

1 Very negative	2 Negative	3 Ok	4 Positive	5 Very positive
		3	3	4

15. What was the overall response from the children to Freeze My TV?

1 Very negative	2 Negative	3 Ok	4 Positive	5 Very positive
	1	3	3	3

16. What type of feedback did you receive from parents?

1 Many negative comments	2 Some negative comments	3 No comments	4 Some positive comments	5 Many positive comments
		7	2	

17. Would you want to continue using the materials?

No	May be	Yes
	2	7

Figure 5.1 continued

18. Did you use the photos of food?

No	Yes	NA
1	8	1

19. Where the photos the right size?

No	Yes	NA
1	7	1

20. Did you use the CD rom with the lessons?

No	Yes	NA
7	2	1

21. Did you need to prepare any further materials?

No	Yes	NA
5	4	1

AFLY5 phase I process evaluation coding

In Table 5.2 the detail of the Nvivo coding is given for the interviews with teachers. In Table 5.3 the main and sub-codes are given.

Table 5.2 Interviews with teachers about AFLY5 by number of teachers, duration, number of codes and references

School ID	Number of codes	Number of references
12	11	12
23	33	48
19	28	36
14	29	44
26	28	41
18	32	40
16	26	32
28	9	10

Table 5.3 Tree and child nodes for teacher interviews about AFLY5 Phase I

Main code	Sub-code
A day in the life questionnaire	
CD	
Continuing to use materials	
Curriculum	
Fit check	Changes to Fit Check
	Children's responses
Freeze My TV	Changes to Freeze My TV
	Children's response to Freeze My TV
Additional materials	
Height and weight measurements	Consent
	Ease of doing measurements
	Response from children
Lessons	Lesson plans
	Changes to lessons
	Children's response
	Quality
	Using resources
Lessons not taught	
Nutrition lessons	Changes to nutrition lessons
	Children's response
	Length
Parents	
PE lessons	
Pedometers	Broken
	Children's response
	Data quality
	Ease of measurement
	Lost
	Missing or left at home
	Non-measurement use
	Resetting
Photos	
Response from children	Enjoyment
Results	
School extra activities	
Training	
TV questionnaire	
Type of interview	Face to face
	Telephone

APPENDIX 6. AFLY5 PHASE II: DEVELOPING PARENT INVOLVEMENT

This appendix relates to chapter 5.

Letter 6.1 Letter inviting parents to take part in interview about parent involvement

South Gloucestershire Council

Healthy Schools

Active for Life South Gloucestershire

University of BRISTOL

South Gloucestershire NHS
Primary Care Trust

Monarch Court
Emerald Park
Emerson's Green
South Gloucestershire
BS16 7FH

Telephone: 0117 330 2400
Fax: 0117 330 2401

Date: May 2008

Dear Parent/Guardian

Invitation to take part in a telephone interview

Levels of obesity are steadily increasing and both the NHS and Local Authority have been set the target to halt the year on year rise in obesity in under 11 year olds. In 2006 we piloted an obesity prevention project in 19 schools in South Gloucestershire, which was based on lessons developed in the USA. Whilst they were well received by the children and teachers there was very little parental involvement.

We know how important parents are in influencing what children eat and what they do. We also know that in society today there are lots of pressures which make it difficult to eat a healthy diet and do physical activity. Therefore we would like to invite you to take part in a telephone interview to give your views about how we can appropriately involve parents in the project.

The interview will be facilitated by researchers from the University of Bristol. Each interview will last up to 30 minutes and will be made at a time which suits you. During the interview you will be asked your ideas about involving parents in school based work to increase children's eating of healthy food, increase physical activity and decrease inactive activities. We want you to discus what works well and what doesn't. The information gathered will be used to design material for use in the schools during 2008/9. Everything you say will be confidential.

If you would like to take part please return the response form by **13 June 2008** to indicate your availability. We will contact you to confirm the date and time.

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

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Page 2

If you have any questions about the interviews please do not hesitate to contact Ruth Kipping: 0117 928 7279.

Yours sincerely,

C. Payne	Jane C. Spouse
Dr Chris Payne Director of Public Health South Gloucestershire Primary Care Trust	Dr Jane Spouse Assistant Director of Children and Young People South Gloucestershire Council

www.sglos-pct.nhs.uk

Chairman: Brian Goodson CB OBE
Chief Executive: Penny Harris

South Gloucestershire Council

South Gloucestershire NHS
Primary Care Trust

Active for Life South Gloucestershire

Healthy Schools

University of BRISTOL

Active for Life Year 5

Consent Form and availability for telephone interview about involving parents

☐ I have read the letter and I agree to take part in the telephone interview. I understand that what I say will be confidential and not attributed directly to me.

I am available on the following times (please tick all available times).

Monday 16 June	Morning 9-12	Afternoon 12-5	Evening 6-8
Tuesday 17 June	Morning 9-12	Afternoon 12-5	Evening 6-8
Wednesday 18 June			Evening 6-8
Thursday 19 June			Evening 6-8
Monday 23 June			Evening 6-8
Tuesday 24 June			Evening 6-8
Wednesday 25 June			Evening 6-8
Thursday 26 June			Evening 6-8
Tuesday 15 July	Morning 9-12	Afternoon 12-5	Evening 6-8
Wednesday 16 July	Morning 9-12	Afternoon 12-5	Evening 6-8
Thursday 17 July	Morning 9-12	Afternoon 12-5	Evening 6-8
Friday 18 July	Morning 9-12	Afternoon 12-5	Evening 6-8

Name of your child's school: ....

Your name: ....

Your telephone number (where you want to be phoned): ....

Your email address (if you regularly check it): ....

Please return this form to the University of Bristol in the prepaid envelope **by 13 June 2008** or post it to: Ruth Kipping, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol, BS8 2PR

Interview schedule 6.1 AFLY5 Phase II Interview schedule with parents about parent involvement

Active for Life Year 5: Semi-structured Interview Schedule on Parental Involvement

1. Introduction (4 minutes)

Explain purpose of interview

- This interview is about a new project called "Active for Life Year 5" which your child's school will be doing next year
- We are seeking views about involving parents to promote healthy eating, physical activity and reducing sedentary behaviours with year 5 children
- Check name of their year 5 child (to refer to in the interview)

Confidentiality

- The interview will be tape recorded, transcribed and the information analysed to identify how to involve parents
- Nothing you say will be attributed directly to you or the school
- If you change your mind about taking part we can stop at any point. If you decide after the interview that you don't want me to include what you said, please contact me and I will remove it.

2. **We will start by thinking about ways in which parents are involved in their child's education (6 minutes)**

In what ways does your child's school involve you in your year 5 child's education? *e.g. letters by post or via the child, email, newsletters, homework planner open evenings, meetings, workshops, assemblies, family days, parent groups.*

- Do you think that this level of involvement is about right, too little or too much?
- Why did you say that?
- How would you like to get more involved?
- What are the barriers to greater involvement?
- Is there anything that the school could do to help parents to be more involved?
- Can you tell me about any other ways that you are involved in your year 5 child's education?

June 2008

3. **What do you think about the following methods of involving** parents (8 minutes): what is good about them, what are the draw backs, are the methods better for some groups of parents and not for others?

- Newsletter about a topic e.g. physical activity
- Assemblies about a topic
- Home work based on eating, physical activity and sedentary activity lessons
- Home work which involves parents and children doing something with food or physical activity and eating healthy food, which will be used to make a calendar to take home
- Parents being invited to go into school for one afternoon to do activities with their child on eating and physical activity
- Family early evening fun topic events e.g. about food or physical activity
- Workshops

4. Health eating (5 minutes)

In the project year we will ask the schools to teach year 5 children about healthy eating.

Do you think this is a good or bad idea?

- Why?

Thinking about your Year 5 child, what aspects of healthy eating does he or she find easy and difficult?

- Why?

Are there ways that you can suggest that parents could help their children to reinforce what they learn at school?

- types of home work
- activities at home
- cooking
- shopping
- growing food at home
- workshops for parents.

June 2008

5. Physical activity (5 minutes)

In the project next year we will ask the schools to teach Year 5 children about being physically active and reducing sedentary time such as the time spent watching TV and playing computer games?

Do you think this is a good or bad idea?

- Why?

What aspects of physical activity do 9-10 year old children enjoy?

- Why?

What aspects of sedentary activity do 9-10 year old children enjoy?

- Why?

Can you suggest ways that parents can help their children to apply lessons to being physically active?

- types of home work
- activities at home
- getting to school
- activities after school and at weekends
- workshops for parents.

Closing (2 minutes)

That's all the questions we have for you today. You have helped us a lot and we will use your input to understand more about ways that we can help children to be more active and eat a healthy diet.

Is there anything else you'd like to tell us about the things we talked about today?

Do you have any questions for me?

Thank you very much for your time and attention. We appreciate you sharing your thoughts and opinions with us!

June 2008

Table 6.1 Parent interviews about parental involvement in Active for Life Year 5 by school

School ID	Parent number	Length of interview (minutes)	Number of codes	Number of references
33	1	20	28	30
34	1	21	36	40
34	2	20	31	35
34	3	17	25	26
37	1	36	37	41
37	2	19	27	41
37	3	15	27	31
38	1	30	34	40
38	2	26	29	31

Table 6.2 Main and sub codes for parent interviews about homeworks and AFLY5 project

Main code	Sub code
Child information	Gender of year 5 child
	Child's school
	Child's weight
Family initiated activities	Healthy eating activities
	Physical activity
Healthy eating	Barriers to healthy eating
	Children's attitude to healthy eating
	Cooking
	Cross-curricula
	Dieting
	Food activities at home
	Growing food
	International food
	Moderation
	School policy
	Shopping
	Trips
	Views of teaching about diet
Homework	Activity based homework
	Compulsory
	Current homework
	Parent involvement
	Problems
	Stickers
Mother information	Age
	Other children
	Mother's weight
	PTA involvement
	Work
Physical activities	Barriers
	Competitive sports
	Involving parents
	Lunchtime sport
	Non-school activities
	PA enjoyed by children
	PA not enjoyed
	School bike racks
	Views of promoting PA
	Walking to school

Table 6.2 continued

Main code	Sub code
Current school involvement of parents	Assemblies
	Help in classroom
	Letters
	Level of involvement
	Newsletter
	Parents' evening
	Problems with involvement
	PTA
	School food
	School trips
	Special events
Sedentary activities	Amount of time spent screen viewing
	Playing outside
	Sedentary activities
	Time to relax
	Views of reducing sedentary activities
	What children enjoy
Views of ideas for involving parents	Assemblies
	Barriers
	Classroom activity
	Early evening event
	Newsletter
	Parents' response
	Workshops

APPENDIX 7. AFLY5 PHASE II: METHODS

This appendix relates to chapter 6.

Figure 7.1 Example of AFLY5 homework

Homework: Snack attack

In class we have been looking at the importance of selecting healthy snacks. We have looked at food labels to find information on nutrient and fat content.

For your homework, work with your parent or carer and find two packets of snacks that you eat at home, for example cake, biscuits, crisps, sweets. You may have fruit and vegetables for snacks, which is good, but you won't be able to use them because they don't have a food label unless they are dried, tinned or frozen. You are going to compare what is in the two snacks. If you don't have any snacks at home, use the two examples below.

Examples

Packet of raisins

	Per 100g
Protein	2.6
Carbohydrate	70g
of which sugars	70g
Fat	0.4g
Fibre	5.3g

Sultana and current cake

	Per 100g
Protein	4.1g
Carbohydrate	55.7g
of which sugars	19.1g
Fat	13.9g
Fibre	3.2g

Figure 7.1 continued

  

Your name: ....

In the table below write the name of the snacks and the amount of protein, carbohydrate, sugars, fat and fibre per 100g. If the label is per 25g or another amount, use that and write in the table.

Name of snack 1:.....................

	Per ....g
Protein	
Carbohydrate	
of which sugars	
Fat	
Fibre	

Name of snack 2:.......................

	Per ....g
Protein	
Carbohydrate	
of which sugars	
Fat	
Fibre	

Questions

1. Which snack had the most sugar? ....
2. Which snack had the most fat? ....
3. Which of the 5 food groups is snack 1 in? ....
4. What healthier snacks could you have eaten instead of the two on this sheet (if your 2 snacks are healthy, think of two more healthy snacks)? ....
5. Think of what you and your parent / carer can do to help you eat these healthier snacks next week? ....

The information on this form will be analysed by University of Bristol researchers as part of the Active for Life Year 5 Research Project. All data will be kept confidential.

Parent/carer: If you do **NOT** want this homework sheet to be included in the Active for Life Year 5 Research Project please tick here. ☐

South Gloucestershire Council

Healthy Schools

Active for Life

University of BRISTOL

South Gloucestershire NHS
Primary Care Trust

Monarch Court
Emerald Park
Emerson's Green
South Gloucestershire
BS16 7FH

Telephone: 0117 330 2400
Fax: 0117 330 2401

Address of school

Date: May 2008
Ref:

Dear *Name of head teacher*

Invitation to take part in '*Active for Life Year 5*' - *school obesity prevention project*

We are writing to invite your school to take part in an exciting new project to help prevent and reduce obesity in children.

Levels of obesity are steadily increasing and both the NHS and Local Authority have been set the target to halt the year on year rise in obesity in under 11 year olds. Childhood obesity is one of the priorities identified in the Local Area Agreement. We have been successful in bidding for money from the Department of Health to run an obesity prevention programme for year 5 classes in South Gloucestershire. The attached summary provides information about the project, what it will involve and the benefits to children and schools.

The project is based on a programme developed in the USA. Sixteen lesson plans which cover a range of subject areas (maths, language, PHSE and PE) have been adapted by British primary school teachers. The lessons cover topics about healthy eating, physical activity and reducing TV viewing. The University of Bristol will be evaluating the project to help us to understand whether the intervention is effective. They will ask parents whether they object to their child having the following measurements taken:

- Height
- Weight
- Waist circumference
- Diet and daily activities questionnaire
- Measurement of sedentary activities questionnaire

If you need this letter in a different format, please telephone the number under the signature

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We are inviting primary schools in the Yate locality of South Gloucestershire to take part in the project. All schools which respond to say that they would like to take part will be included in the project and receive one day of training for the year 5 teacher in September 2008 (with supply teacher costs covered) and 16 lesson plans. In addition, of those schools which take part, four schools will be selected to take part in further work to increase parental involvement. This will involve the University of Bristol inviting parents to take part in interviews, the teachers using some additional materials (to be developed following the interviews). The children in these schools will also be asked to wear accelerometers for 5 days (match-box sized activity monitors which look like pedometers) to measure their physical and sedentary activity.

Please complete the response form and return it by 30 May 2008 to Ruth Kipping: Research Fellow, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol BS8 2PR. If you have any questions about the project please do not hesitate to contact Ruth Kipping: 0117 928 7279 or ruth.kipping@bristol.ac.uk

Yours sincerely,

C Payne   Jane C. Spouse

Dr Chris Payne
Director of Public Health
South Gloucestershire
Primary Care Trust
Tel 0117 330 2400

Dr Jane Spouse
Assistant Director of Children and Young People
South Gloucestershire Council

cc Chair of Governors

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

Chairman: Brian Goodson CB OBE
Chief Executive: Penny Harris

South Gloucestershire Council

South Gloucestershire NHS
Primary Care Trust

Active for Life

Healthy Schools

University of BRISTOL

Active for Life Year 5 - school obesity prevention project

Response Form

Name of Headteacher: ....

Name of school: ....

☐ No, we would not like to take part in the project

Please tell us why: ....

....

☐ Yes, we would like to take part in the project

If known, please give the following information about the person(s) who will be teaching year 5 from September 2008 if known. If you do not know who will be teaching year 5, please give the contact details for someone with regard to taking part in this project.

Name of the year 5 teacher: ....

Telephone number of the year 5 teacher: ....

Email address of the year 5 teacher: ....

Please give the number of children who will be year 5 in September 2008:..........................

Please return this form by 30th May 2008 to:

Ruth Kipping: Research Fellow, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol BS8 2PR.
Tel: 0117 928 7279
Email: ruth.kipping@bristol.ac.uk

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

Chairman: Brian Goodson CB OBE
Chief Executive: Penny Harris

Letter 7.2 Letter of ethics approval for AFLY5 phase II study

University of BRISTOL

Dr Ruth Kipping
University of Bristol

2nd May, 2008

**Faculty of Medicine and Dentistry
Committee for Ethics (FCE)**

c/- 69 St Michael's Hill
Bristol
BS2 8DZ

Email Sylvia.Elliott@bristol ac uk

Dear Ruth.

Application number: 070820

Title: Active for Life Year 5: Parental Involvement Study

Your application has been granted **full approval** and you may commence your study.

The FCE expects to be notified of any significant deviations from this research proposal. The FCE also expects to be notified of any unforeseen ethical events which may arise during the course of this study.

Yours faithfully,
David Jessop
Chair, Faculty of Medicine and Dentistry Committee for Ethics

South Gloucestershire Council

Healthy Schools

Active for Life South Gloucestershire

University of BRISTOL

South Gloucestershire NHS
Primary Care Trust

1 Monarch Court
Emerald Park
Emerson's Green
South Gloucestershire
BS16 7FH

Telephone: 0117 330 2400
Fax: 0117 330 2401

Date: September 2008
Ref:

Dear Parent/Guardian

Taking measurements from your child

Your child's Year 5 class is taking part in a project organised by the National Health Service and the Local Authority. The project is called *Active for Life Year 5*. The class will be taught lessons about healthy eating, increasing physical activity and decreasing inactive behaviours, like watching TV. The lessons will be taught by the children's usual teacher during year 5. The project is based on a project developed in the USA, which was effective at improving children's health and reducing levels of obesity and we have adapted it for use locally.

We want to find out whether the lessons help the children to make healthy choices about food and physical activity. To do this we need to take measurements from the children at the beginning and end of the project. This will help us to know whether the project is successful locally and whether we should continue to use it. All children in year 5 will be invited to take part in the measurements. Your child has not been singled out or selected because of their weight.

We are writing to ask whether you object to your child having the following measurements taken in term 1 and repeated in term 6. The measurements are:

- Your child's height, weight and waist circumference
- Your child to complete two questionnaires in the classroom about their diet, physical activity and the amount of time they spend doing sedentary activities like watching TV or using computer/video games.

All measurements will be taken in the school by researchers from the University of Bristol who have enhanced Criminal Records Bureau clearance. The height, weight and waist measurements will be done in a private area away from other pupils and staff. Children

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Page 2

who take part will be asked to remove their shoes and any heavy outdoor clothing. They will be weighed in normal, light, indoor clothing.

Staff and other children at the school will not see the measurements. The information collected about your child will be kept confidential and will only be used by the University of Bristol to assess whether the lessons are effective. The name and date of birth of your child will be requested to allow us to identify all the data for each child. When the data is analysed the information will be anonymous, so that it will not be possible to identify an individual child.

The school is giving full support to this project. However, if you do not wish your child to take part in the measurements, please complete the refusal of consent form enclosed with this letter and post using the pre-paid envelope. **Please only complete and return the form if you DO NOT want your child to take part in the measurements.** If you do not return the refusal of consent form within two weeks of receiving this letter, we will include your child in the research project. <u>If you are happy for your child to take part in all the measurements you do not need to return this form</u>. Children will not be made to participate if they don't want to.

If you have any questions about the project please do not hesitate to contact Ruth Kipping: 0117 928 7279.

Yours sincerely,

Jane C. Spouse

Dr Chris Payne
Director of Public Health
South Gloucestershire
Primary Care Trust
Tel 0117 330 2400

Dr Jane Spouse
Assistant Director of Children and Young People
South Gloucestershire Council

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South Gloucestershire Council

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Primary Care Trust

Active for Life South Gloucestershire

Healthy Schools

University of BRISTOL

Active for Life Year 5

Refusing Consent For Measurements

Only return this form if you DO NOT want you child to participate in some or all of the measurements. Please put a cross in the box of any measurements you DO NOT wish your child to take part in.

☐ Height ☐ Weight ☐ Waist

☐ Questionnaire about their diet and activities the previous day

☐ Questionnaire about the amount of time spent doing sedentary activities like watching TV

Child's name: ____________________ Child's Date of Birth: ______________

Child's School: ____

Year: _____ Class: _____

Parent's / Carer's name: _________________________________

Parent's / Carer's signature: ______________________________

Please return this form to the University of Bristol in the prepaid envelope or post it to: Ruth Kipping, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol, BS8 2PR

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

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Figure 7.2 Assent form for children to complete

ASSENT FORM FOR STUDENTS

Title of project: Active for Life Year 5

Active
For Life

The researcher has explained the project to me. I understand what she said, and I have been given the chance to discuss any questions or concerns.

Please put a tick against the measurements you are happy to do.

1. I am happy to fill in the **Day in the Life** questionnaire ☐
2. I am happy to fill in the **questionnaire about activities** ☐
3. I am happy to have my **height** measured ☐
4. I am happy to have my **weight** measured ☐
5. I am happy to have my **waist** measured ☐
6. I am happy to wear an **accelerometer** ☐

I understand that I am volunteering to take part and that I am free to change my mind at any time and not take part.

Name of student ....

Date ....

Signature ....

Name of researcher ....

Date ....

Signature ....

Questionnaire 7.1 Child sedentary behaviour questionnaire

Child's Questionnaire: about your activities

Your full name:...

Your date of birth: ....

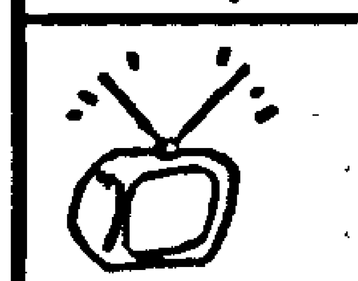
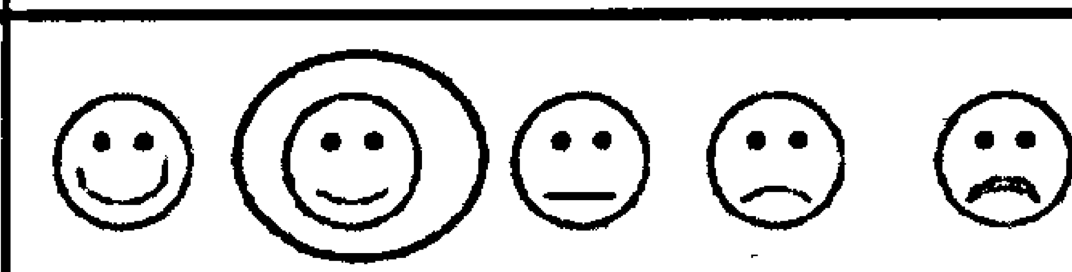
Name of your school: ....

Please tick here if yesterday wasn't a normal day (e.g. you were ill) ☐

Please tick here if last Saturday wasn't a normal day (e.g. you were ill) ☐

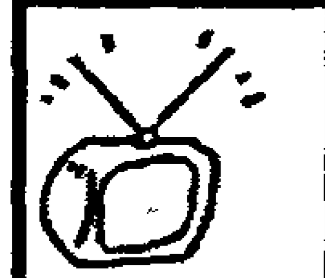
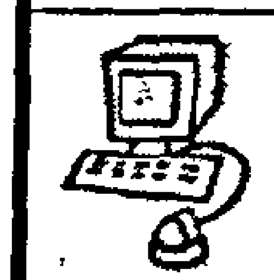
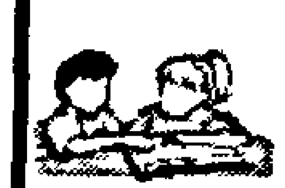
- Write the number of hours and minutes you did the activity for.
- Write a 'O' by the hours and minutes if you didn't do it.
- Draw a circle round the **smiley face** that shows how much you usually **enjoy** doing it.

Example: Someone who watched no TV before school, 2 hours and 10 minutes after school and 3 hours last Saturday and they enjoyed it.

EXAMPLE Activity		**Column 1** Yesterday before school	**Column 2** Yesterday after school	**Column 3** Last Saturday	**How much do you enjoy doing this?** (circle a face even if you <u>didn't</u> do it)
	**Watching TV, DVDs or Videos**	0 Hours 0 Minutes	2 Hours 10 Minutes	3 Hours 0 Minutes	

For researcher to complete	School ID:	Participant ID:	Day:

Questionnaire 7.1 continued

Activity		Column 1 Yesterday before school	Column 2 Yesterday after school	Column 3 Last Saturday	How much do you enjoy doing this? (circle a face even if you <u>didn't</u> do it)
	Watching TV, DVDs or Videos	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Playing Playstation, Nintendo, XBOX, or computer games (not Wii or Dance Dance Revolution)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Using the computer or Internet but not for games	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Doing homework	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Playing indoors with toys or games (eg. Lego, dolls, board games)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Sitting and talking (but not including the phone)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	

For researcher to complete	School ID:	Participant ID:	Day:

Questionnaire 7.1 continued

Activity		Column 1 Yesterday before school	Column 2 Yesterday after school	Column 3 Last Saturday	How much do you enjoy doing this? (circle a face even if you <u>didn't</u> do it)
	Talking on the phone or texting	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Sitting and listening to music	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Playing a musical instrument	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Reading a book or magazine	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Doing art & craft (eg. models, beads, sewing, drawing, painting)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
?	Another activity. Write here what it was:	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	

For researcher to complete	School ID:	Participant ID:	Day:

Questionnaire 7.2 Parent completed questionnaire about child's sedentary behaviours

Parent Questionnaire: about **your year 5 child's** activities

This questionnaire is part of the "Active for Life Year 5" study. Your answers will be confidential.

Please return the questionnaire in the pre-paid envelope to Ruth Kipping at the University of Bristol. Department of Social Medicine, Canynge Hall, Whiteladies Road, Bristol. BS8 2PR.

Your name: ....

Full name of your year 5 child:..

Name of your child's school: ....

Your child's date of birth: ....

Please tick to indicate your relationship with your child: mother ☐ father ☐ other ☐

On which day of the week are you completing this questionnaire: ....

Please tick here if yesterday or last Saturday wasn't a normal day (e.g. your child was ill): Yesterday ☐ Last Saturday ☐

The answer to the following question is optional. If you choose to complete it we will provide the answer to South Gloucestershire Council for their measurement of physical activity levels.

Please tick which of the following best describes how much physical activity your child does per week at the moment (outside of school):

Fewer than 30mins per week ☐ 1 x 30mins per week ☐ 2 x 30mins per week ☐

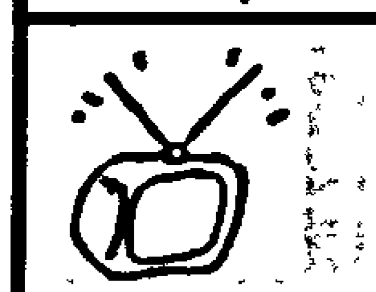
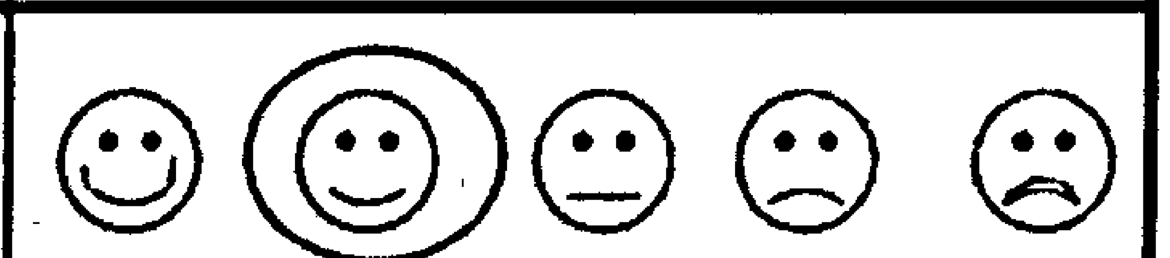
If other, please state:...

For researcher to complete	School ID:	Participant ID:	Day:

On the next two pages think about how long your child spent on the different activities yesterday before and after school, and last Saturday. The activities we are asking you about don't use a lot of energy, e.g. watching television. We are not asking about activities which involve exercise, e.g. cycling. There are not right or wrong answers – just tell us what you remember and whether your child usually enjoys the activity.

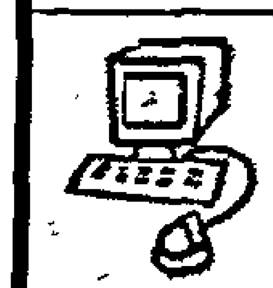
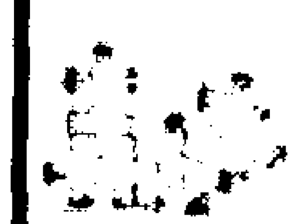
- In column 1 write the number of hours and minutes your child did the activity for yesterday **before school.**
- In column 2 write the number hours and minutes your child did the activity for yesterday **after school.**
- In column 3 write the number of hours and minutes your child did the activity **last Saturday.**
- If your child didn't do the activity put a '**O**' by the hours and minutes.
- For each activity put a circle round the smiley face that shows how much your child usually **enjoys** doing it. If your child didn't do the activity please indicate how much they usually enjoy it. If you don't know how much they enjoy it please leave it blank.

Example: Someone who watched no TV before school, 2 hours and 10 minutes after school and 3 hours last Saturday and they enjoyed it.

EXAMPLE Activity		**Column 1** Yesterday before school	**Column 2** Yesterday after school	**Column 3** Last Saturday	**How much do you enjoy doing this?** (circle a face even if you <u>didn't</u> do it)
	**Watching TV, DVDs or Videos**	0 Hours 0 Minutes	2 Hours 10 Minutes	3 Hours 0 Minutes	

For researcher to complete	School ID:	Participant ID:	Day:

Questionnaire 7.2 continued

Activity		Column 1 Yesterday before school	Column 2 Yesterday after school	Column 3 Last Saturday	How much do you enjoy doing this? (circle a face even if you <u>didn't</u> do it)
	Watching TV, DVDs or Videos	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Playing Playstation, Nintendo, XBOX, or computer games (not Wii or Dance Dance Revolution)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Using the computer or Internet but not for games	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Doing homework	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Playing indoors with toys or games (eg. Lego, dolls, board games)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Sitting and talking (but not including the phone)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	

For researcher to complete School ID: Participant ID: Day:

Questionnaire 7.2 continued

Activity		Column 1 Yesterday before school	Column 1 Yesterday after school	Column 2 Last Saturday	Column 3 Last Saturday
	Talking on the phone or texting	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Sitting and listening to music	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Playing a musical instrument	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Reading a book or magazine	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Doing art & craft (eg. models, beads, sewing, drawing, painting)	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	
	Another activity. Write here what it was:	...... Hours ...... Minutes	...... Hours ...... Minutes	...... Hours ...... Minutes	

For researcher to complete School ID: Participant ID: Day:

University of BRISTOL

DEPARTMENT OF SOCIAL MEDICINE
Canynge Hall, Whately Road, Bristol, BS8 2PS

Ruth Kipping
Research Fellow
T +44 (0)117 9287239
ruth.kipping@bristol.ac.uk
http://www.epi.bris.ac.uk

October 2008

Dear Parent/Carer

Your child's Year 5 class is taking part in the Active for Life Year 5. You have given your consent for your child to wear an activity monitor called an 'accelerometer' for five days (during the day). Accelerometers are small match-boxed sized activity monitors which provide accurate measures of physical activity.

We would like you to remind your child to wear the activity monitor all day on Thursday, Friday, Saturday, Sunday and Monday. The teacher will take the accelerometer from the child on Monday at school. The accelerometers will be given to me and I will analyse the data. The analysis will be confidential.

The activity monitor should be worn on the belt around the waist, either over or under a jumper, with the red monitor just below the hip. Make sure the yellow dot on the activity monitor is at the TOP. It should be worn all the time from when your child wakes up in the morning, until they go to bed at night. It should be taken off if your child goes into water (swim/bath/shower) or if they play a sport like full-contact rugby. It is not a problem if a light on the monitor flashes. Your child will be given a certificate when it is returned.

We are also enclosing two questionnaires which we would like you to complete about your child and return in the pre paid envelope. Completing the questionnaires is voluntary. The analysis will be confidential. The questionnaires will help us to know whether the project is successful locally and whether we should continue to use it.

If you need to contact me about the Active for Life project please phone me on 0117 928 7239. Many thanks for your assistance.

Yours sincerely,

Ruth Kipping
Department of Social Medicine
ruth.kipping@bristol.ac.uk

Figure 7.3 Accelerometer information sheet

Things to Remember about your Activity Belt!

- Wear the belt round your waist, either over or under your jumper, with the red monitor just below your hip
- Make sure the yellow dot on the activity monitor is at the TOP
- The monitor will flash for the rest of today and then stop flashing tomorrow - this is normal!
- Wear it all the time from when you wake up in the morning, until when you go to bed at night BUT…
- Take it off if you go into water (swim/bath/shower) or if you play full-contact rugby
- If you are worried about wearing it for a particular sport, check with your club coach/teacher first
- Wear it back into school on **MONDAY**
- We will give a small prize to all the children who wear the activity monitor for 5 days
- If you have any questions, give Ruth Kipping a call on 0117 928 7239

☺THANK YOU FOR TAKING PART☺

Parent Questionnaire: supporting children to be physically active

This questionnaire is part of the Active for Life Year 5 study. Your answers will be confidential. The questionnaire is about what you do to support your child to be physically active. On the other side of this page there are 12 statements. Please circle a response to indicate how much you agree or disagree with each statement. First, please fill in the information below so that we can compare your answers to other information we are collecting during the study. Please circle the 'not relevant' option if you do not have a TV or computer games.

Full name of your year 5 child: ....

Your child's date of birth: ....

Name of your child's school: ....

Your name: ....

Please tick to indicate your relationship with your child:

mother ☐ father ☐ other (please explain) ....

Thank you for your time. Please return the questionnaire in the pre-paid envelope to:

Ruth Kipping
Research Fellow
Department of Social Medicine
University of Bristol
Canynge Hall
Whiteladies Road
Bristol
BS8 2PR

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I enjoy exercise and physical activity.	1	2	3	4	5
2. I limit how long my child plays video or computer games (including Gameboy).	1	2	3	4	5
3. I often organise family outings that involve physical activity (e.g. going for a walk, a bike ride, or swimming).	1	2	3	4	5
4. I frequently exercise or do something active with my child.	1	2	3	4	5
5. I go out of my way to book my child into sports and other activities that are physically active (e.g. after school clubs, swimming lessons).	1	2	3	4	5
6. I exercise or am physically active on a regular basis.	1	2	3	4	5
7. I often take my child to places where he/she can be active (e.g. parks, playgrounds, sport games or practices)	1	2	3	4	5
8. My child can only watch a few programmes on TV each day	1	2	3	4	5
9. I often watch my child participate in sporting activities (e.g. watch your child perform at a football match or a dance performance).	1	2	3	4	5
10. I tell my child to go outside and do something active if he/she has been doing indoor activities for a long time.	1	2	3	4	5
11. I use my behavior to encourage my child to be physically active.	1	2	3	4	5
12. I limit how long my child can use the computer for things other than homework.	1	2	3	4	5

Table 7.1 Date of measurements before and after the intervention

School ID	Before intervention day of measurement	After intervention day of measurement	Same day of the week
30*	Wednesday 19 November 2008	Wednesday 1 July 2009	Yes*
31*	Tuesday 11 November 2008	Tuesday 02 June 2009	Yes*
32	Friday 28 November 2008	Thursday 16 July 2009	No
33*	Wednesday 8 October 2008	Tuesday 16 June 2009	No
34*	Wednesday 1 October 2008	Wednesday 24 June 2009	Yes*
35	Tuesday 14 October 2008	Tuesday 30 June 2009	Yes
36	Thursday 13 November 2008	Wednesday 2 July 2009	No
37*	Wednesday 5 November 2008	Wednesday 10 June 2009	Yes*
38*	Wednesday 15 October 2008	Wednesday 15 July 2009	Yes*
39	Monday 13 October 2008	Friday 3 July 2009	No
40	Thursday 9 October 2008	Tuesday 14 July 2009	No
41	Friday 10 October 2008	Friday 3 July 2009	Yes
42	Tuesday 14 October 2008	Thursday 11 June 2009	No
43	Wednesday 22 October 2008	Thursday 2 July 2009	No
44	Friday 24 October 2008	Thursday 25 June 2009	No
45	Friday 7 November2008	Friday 12 June2009	Yes

*6 schools using accelerometers

Letter 7.5 Invitation to parents for children to take part in focus group about AFLY5 Phase II

South Gloucestershire Council

Healthy Schools

Active for Life

University of BRISTOL

South Gloucestershire NHS
Primary Care Trust

Building 8
Brook Office Park
Folly Brook Lane
Emerson's Green
Bristol BS16 7FL

Telephone: 0117 300 2400
Fax: 0117 330 4101

Date: May 2009

Dear Parent/Carer

Invitation for your child to take part in a focus group

This year your child's class are taking part in a project organised by the National Health Service and the Local Authority. The project is called *Active for Life Year 5.* The class are being taught lessons about healthy eating, increasing physical activity and decreasing inactive behaviours, like watching TV. Some parents worked with us in June 2008 to develop materials to involve parents in the project.

We would like to invite your child to take part in a focus group to give their views about the project. A focus group is a group discussion with questions facilitated by a researcher. Two researchers from the University of Bristol with enhanced Criminal Record Bureau clearance will facilitate the focus group. The focus group will be held during a school day in June or July 2009 and will last for up to 60 minutes. We are looking for 6-8 children to attend the focus group.

During the focus group the children will be asked to discuss what they remember about the project, what they thought about the lessons and activities and whether any of the materials helped them to eat healthy food, increase physical activity and decrease sedentary activities. We want to discus what worked well and what didn't. The information gathered in the focus groups will be used to evaluate the project.

If your child would like to take part and you are happy for them to do so, please return the response form by 20 May 2009. We will fill the focus groups on a first come, first served basis. We will inform the school teacher who will be in the focus group.

On the day of the focus group we will ask the children to say if they are happy to take part in the focus group. Any child is free to change their mind and not take part.

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

Chairman: Sir Chris Clarke OBE
Chief Executive: Penny Harris

Page 2

If you have any questions about the focus groups please do not hesitate to contact Ruth Kipping: 0117 928 7239.

Yours sincerely,

C Payne

Jane C. Spouse

Dr Chris Payne
Director of Public Health
South Gloucestershire
Primary Care Trust
Tel 0117 330 2400

Dr Jane Spouse
Assistant Director of Children and Young People
South Gloucestershire Council

If you need this letter in a different format, please telephone the number under the signature

www.sglos-pct.nhs.uk

Chairman: Sir Chris Clarke OBE
Chief Executive: Penny Harris

South Gloucestershire Council

South Gloucestershire NHS Primary Care Trust

Active for Life

Healthy Schools

University of BRISTOL

Active for Life Year 5

Consent for child to attend focus group about project

Please tick if you are in agreement.

☐ I give agreement for my child to take part in a focus group about the project and my child is happy to take part.

Child's name: ______________________ Child's Date of Birth: __________

Name of child's school: ______________________________

Year: ______ Class: _____

Parent's / Carer's name: ______________________________

Parent's / Carer's signature: ______________________________

Please return this form to the University of Bristol in the prepaid envelope by 20 May 2009 or post it to: Ruth Kipping, Department of Social Medicine, University of Bristol, Canynge Hall, Whatley Road, Bristol, BS8 2PS

If you need this letter in a different format, please telephone the number under the signature

Chairman: Sir Chris Clarke OBE
Chief Executive: Penny Harris

www.sglos-pct.nhs.uk

Figure 7.4 Guide for focus groups with children about ALFY5 Phase II

Active for Life Year 5: Focus Group With Children

1. Introduction

Researchers to introduce themselves

Hello, my name is Ruth and this is Byron. We work at the University of Bristol and we have helped your teacher run the Active for Life Year 5 project this year. Today, we want to find out what you thought about the lessons and the homework activities. We are doing what is called a focus group, which is like a discussion. There are no right or wrong answers and it isn't a test. We just want to hear what you think. It is important that you are honest and give answers that you think are right even if they are different from what the other children are saying.

Confidentiality and ground rules:

Your parents/carers have said that they are happy for you to do this. Please can you also write your name on this form to say that you are happy to take part.

If it is ok with everyone I am going to record the discussion so that I can remember what we have said but no one else will hear the recording. We are doing this in 3 other schools and we will listen to what all the children are saying. We will use this information to help us change the project. We won't use your names but will say that 'a child' or 'children' said this.

We're going to have a discussion, so you don't need to raise your hand, but please try to wait until someone else has finished talking to that I can hear what everyone has to say. We want all of you to take part. Some children may say something you don't agree with and we need to respect each other's views. Please keep private what the other children say.

Are there any questions?

Group introductions

Here is a sticky label. Please write on it your name and put it on your jumper.

We will then go round the group and I would like you to say your name and what your favourite subject or activity is at school.

Figure 7.4 continued

2. Themes for discussion

Area	Questions/Prompts
1. Awareness of Active for Life lessons	Your school took part in the Active for Life year 5 project do you remember anything that you learnt about physical activity using the Fit Check Journal (show a copy) or the games using the photos of food (show the photos)? • What did you enjoy about these lessons? • How could the lessons be made better? What about the diet lessons, do you remember anything about those lessons (prompt with the 'Eat Well Plate' picture)? • Thinking back what did you enjoy those lessons? • Is there anything that would have been more fun?
2. Parental involvement	Do you remember doing this homework (Ruth to show each homework sheet in turn followed the questions – move onto next homework if the children didn't do it). Did you do this homework with anyone at home? Who? Please put down the smiley to show how much you liked doing this activity at home. Put the cross down if you didn't do it. Why did you put down that face? What could we do to make this homework more enjoyable? Have you continued doing this activity at home, but not as homework?
3. Health eating	Did anything in the project make you change what you eat? • What helped and why? • If not, why not – what are the barriers?
4. Physical activity	Did anything in the project make you change what physical activities you do – more/less physical activity? • What helped and why? • If not, why not – what are the barriers? Did anything in the project make you change the amount of time you spend doing activities like playing on the computer or watching TV? • What helped and why? • If not, why not – what are the barriers?

June 2009

Figure 7.4 continued

Ending

That's all the questions we have for you today. You have helped us a lot.

I'm just going to summarise what we've talked about....

Is there anything else you'd like to tell us about the things we talked about today?

Do you have any questions for me?

Thank you very much for your time and attention. We appreciate you sharing your thoughts and opinions with us!

June 2009

South Gloucestershire Council

Healthy Schools

Active For Life

University of BRISTOL

South Gloucestershire NHS
Primary Care Trust

Building 8
Brook Office Park
Folly Brook Lane
Emerson's Green
Bristol BS16 7FL

Telephone: 0117 300 2400
Fax: 0117 330 4101

Date: May 2009

Dear Parent/Carer

Invitation to take part in a telephone interview school project

This year your child's class have taken part in a project organised by the National Health Service and the Local Authority. The project is called *Active for Life Year 5*. The class were taught lessons about healthy eating, increasing physical activity and decreasing inactive behaviours, like watching TV. Some parents worked with us in June 2008 to develop materials to involve parents in the project.

We would like to invite you to take part in a telephone interview to give your views about the homework materials used in the project. The interview will be facilitated by researchers from the University of Bristol. Each interview will last up to 30 minutes and will be made at a time which suits you. During the interview you will be asked to discuss your knowledge of the project, whether you remember any of the homework topics and whether any of the materials helped you to support your child to eat healthy food, increase physical activity and decrease sedentary activities. We want you to discuss what worked well and what didn't. The information gathered in the interviews will be used to evaluate the project.

If you would like to take part, please return the response form **by 2 June 2009** to indicate you agree to take part and your availability. We will contact you to confirm the date and time.

If you need this letter in a different format, please telephone the number under the signature

---

www.sglos-pct.nhs.uk

Chairman: Sir Chris Clarke OBE
Chief Executive: Penny Harris

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If you have any questions about the interview please do not hesitate to contact Ruth Kipping at the University of Bristol: 0117 928 7239.

Yours sincerely,

C Payne

Jane C. Spouse

Dr Chris Payne
Director of Public Health
South Gloucestershire
Primary Care Trust
Tel 0117 330 2400

Dr Jane Spouse
Assistant Director of Children and Young People
South Gloucestershire Council

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South Gloucestershire Council

South Gloucestershire NHS
Primary Care Trust

Active For Life

Healthy Schools

University of BRISTOL

Active for Life Year 5
Consent form and availability for telephone interview about involving parents

☐ I have read the letter and I agree to take part in the telephone interview. I understand that what I say will be confidential and not attributed directly to me.

I am available on the following times (please tick all available times).

Wednesday 10 June		Afternoon 12-6	Evening 6-8
Thursday 11 June		Afternoon 12-6	Evening 6-8
Monday 15 June		Afternoon 12-6	Evening 6-8
Monday 22 June	Morning 9-12	Afternoon 12-6	Evening 6-8
Tuesday 23 June		Afternoon 12-6	Evening 6-8
Monday 29 June	Morning 9-12	Afternoon 12-6	Evening 6-8
Thursday 2 July	Morning 9-12	Afternoon 12-6	Evening 6-8
Friday 3 July	Morning 9-12	Afternoon 12-6	
Monday 6 July		Afternoon 5-6	Evening 6-8
Tuesday 7 July		Afternoon 5-6	Evening 6-8
Thursday 9 July		Afternoon 5-6	Evening 6-8
Monday 13 July	Morning 9-12	Afternoon 12-6	Evening 6-8
Tuesday 14 July	Morning 9-12	Afternoon 12-6	Evening 6-8
Wednesday 15 July	Morning 9-12	Afternoon 12-6	Evening 6-8

Name of your child's school: ....

Your name: ....

Your telephone number (where you want to be phoned): ....

Your email address (if you regularly check it): ....

Please return this form to the University of Bristol in the prepaid envelope by 2 June 2009 or post it to:
Ruth Kipping, Department of Social Medicine, University of Bristol, Canynge Hall, Whatley Rd, Bristol BS

Interview schedule 7.1 Semi-structured interview guide for interviews with parents about AFLY5 Phase II

Active for Life Year 5: Semi-structured Interview Schedule on Parental Involvement

1. Introduction (3 minutes)

Explain purpose of interview

- This interview is about a project called "Active for Life Year 5" which your child's school did this year
- Last year we talked to parents about their views of how to involve parents to promote healthy eating, physical activity and reducing sedentary behaviours
- The purpose of the interview is to find out what you remember about the project, whether you have been involved in any of the activities with your child, what you thought about them, whether they have led to any behaviour changes and if you have any suggested changes.
- Check name of their year 5 child (to refer to in the interview)

Confidentiality

- The interview will be tape recorded, transcribed and the information analysed to identify how to involve parents
- Nothing will be attributed directly to you or the school
- If you change your mind about taking part we can stop at any point. If you decide after the interview that you don't want me to include what you said, please contact me and I will remove it.

2. **Your child's year 5 class have been doing a series of lessons called 'Active for Life Year 5'.** (5 minutes)

Can you tell me what you know about the project

- how do you know about that – was it from your child talking about it, something you read or something else?

Do you know what topics were covered in the lessons?

- do you remember how you know about that?

Do you remember seeing the Eat Well Plate? Do you remember what the plate taught the child about food?

- do you remember how you know about that?

Do you remember seeing the Fit Check or Freeze My TV journal?

- do you remember how you know about that?

June 2009 1

3. **Do you remember if any of these methods were used to involve you in the Active for Life project (8 minutes):**

- Home works:
- Scavenger hunt
- Cooking at home
- Blank Eat Well Plate
- Bingo challenge card
- Freeze My TV leaflet for parent and Family Freeze My TV
- Snack worksheet
- Top Grub cards and worksheet
- Measuring sugar in drinks worksheet
- 5 A Day chart worksheet
- Breakfast chart

Newsletter about a topic e.g. physical activity

What was good about them, what are the draw backs, are there some groups of parents they are good or less good for?

4. **Health eating (5 minutes)**

In the project year 5 children were encouraged to eat balanced diet.

Can you think of any examples of how the project helped your child to change what they eat?

Are there other activities which would have helped you to be involved in healthy eating at home:

- food activities at home
- shopping
- growing food at home

5. **Physical activity (5 minutes)**

In the project year 5 children were encouraged to be physically active and reducing sedentary time such as the time spent watching TV and playing computer games?

Can you think of any examples of how the project helped your child to change their physical activity or sedentary activity?

Are there other activities which would have helped you to be involved in healthy eating at home:

- activities at home
- getting to school
- activities after school and at weekends

6. **Finally, can you think of any ways we could have involved parents more in the project?** (3 minutes)

Closing (2 minutes)

That's all the questions we have for you today. You have helped us a lot and we will use your input to understand more about ways that we can help children to be more active and eat a healthy diet.

Is there anything else you'd like to tell us about the things we talked about today?

Do you have any questions for me?

Thank you very much for your time and attention. We appreciate you sharing your thoughts and opinions with us!

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University of BRISTOL
DEPARTMENT OF SOCIAL MEDICINE
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June 2009

Dear Parent/Carer

Questionnaire about Active for Life Year 5

This year your child's class have taken part in a project called Active for Life Year 5. The project has been about healthy eating and being physically active.

We wrote to you earlier in the term inviting you to take part in a telephone interview to give your views about the project. Very few parents have opted to do an interview, but your views are important to us. Therefore we are sending you a questionnaire and inviting you to give us your views about the project. The information you give in the questionnaire will be confidential. We will use the information gathered in the questionnaires from all parents to evaluate the project. Please return the questionnaire to me in the enclosed envelope.

If you would prefer to do a telephone interview please contact me on 0117 928 7239 and we can arrange a time for me to phone you.

Thank you for your help with the previous questionnaires.

Yours sincerely,

Ruth Kipping

Ruth Kipping
ruth.kipping@bristol.ac.uk

Active For Life

Active for Life Year 5

Parent/Carer Questionnaire About Active for Life Year 5

This questionnaire is about your views of the Active for Life Year 5 project. The information you give will be used by the University of Bristol to evaluate the project.

1. Please tick the name of the school where your Year 5 child is at school:

a) Frampton Cotterell Primary School ☐

b) King's Court Primary School ☐

c) Fromebank Primary School ☐

d) Manor Primary School ☐

2. Are you the child's:

a) Mother ☐

b) Father ☐

c) Carer ☐

d) Other ☐

3. What topics do you remember have been covered in the Active for Life project?

4. How do you know about the project?

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4. Please give us your views on whether you remember the Active for Life Year 5 homeworks and any comments you have:

Homeworks	Do you remember this homework?			Comments: what was good, what was less good, what could be improved?
	Yes	No	Don't know	
1. Setting goals to be active with example of a Scavenger hunt				
2. Cooking at home (smoothie and pizza recipe)				
3. Blank Eat Well Plate (fill in the gaps on the plate to show what you ate)				
4. Bingo challenge card (10 activities from a choice of 30)				
5. Freeze My TV leaflet for parent and Family Freeze My TV				
6. Snack worksheet (comparing labels of a healthy and less healthy snack)				
7. Top Grub cards and worksheet (playing Top Trump cards about food)				
8. Measuring sugar in drinks				
9. Five A Day chart worksheet (setting goals to eat fruit and vegetables)				
10. Breakfast chart (a weekly record of what you ate for breakfast)				

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5. Do you remember reading about the project in a school newsletter?

Yes ☐ No ☐ Don't know ☐

6. Do you think the project has changed what your child eats?

Yes ☐ No ☐ Don't know ☐

7. If the project has helped your child to change what they eat please give examples:

8. Do you have other ideas for homework activities which could encourage healthy eating at home?

9. Do you think the project has changed your child's physical activity?

Yes ☐ No ☐ Don't know ☐

10. If the project has helped your child to be more physically active please give examples:

11. Do you have other ideas for homework activities which could encourage children to be more physically active?

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12. Are there other ways we can involve parents/carers to be involved with this project?

Thank you very much for your time.

Please return this form to the University of Bristol in the prepaid envelope or post it to: Ruth Kipping, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol, BS8 2PR

Interview schedule 7.2 Semi-structured interview guide for interviews with teachers about AFLY5 Phase II

Interview schedule for Active for Life Year 5 Teachers

Name of teacher: **Name of school:**

Training day: *Please think about the training day (3 minutes)*

1. To what extent did you feel prepared to teach the lessons?

    - What was good / useful?
    - What could have been improved?

Lessons: *Please think about the lessons (10 minutes)*

2. Did you think that the lessons fitted well with the curriculum?
    - What could be done to improve them?
        a. Format / length

3. Do you have any comments about a particular lesson(s) that could be improved?
    - What could be changed

4. How many of the lessons did you teach?
    - If not all lessons were taught, what were the reasons?

Homeworks: *Please think about the homeworks (10 minutes)*

5. Can you tell me about your experience using the homeworks?
    - Did you give out all the homeworks?
    - How many were completed and returned?
    - How well did the homeworks engage the parents in the project?
    - Were there any homeworks which could be improved?
    - Were there any homeworks which were popular?

6. Did you put anything about the project in the school newsletter?
    - If yes – example
    - If no – where there reasons why not

7. Do you think that parents were involved in the program?
    - How could parents be more involved?

General impression: *Thinking generally about the program (8 minutes)*

8. Do you think the project had any effect on either the children's eating or physical activity?
    - Why do you say that? Can you give me an example?

Future: *Thinking about next year and beyond (2 minutes)*

9. Will you continue to use the materials in their current or modified form?
    - How would you modify them?

Other school activities *(3 minutes)*

10. Were there other projects or events taking place during the academic year that promoted healthy eating and physical activity?

11. Any other areas you wanted to comment on?

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Questionnaire for Teachers in the Active for Life Year 5 Project

Please complete this questionnaire to give us feedback about your views of the Active For Life Year 5 Project. The name of your school will be used to identify the responses from schools with increased parental involvement. Your answers will be treated in confidence.

Name of School: ....

Name of teacher completing questionnaire: ....

1. To what extent did the training day prepare you for teaching the lessons?

Not at all prepared	Not prepared	Ok	Prepared	Fully prepared

2. What was your experience of the researchers doing the measurements

Very disruptive	Disruptive	Ok	Not disruptive	Not at all disruptive

3. How easy or difficult was it to fit the lessons into the curriculum?

Very difficult	Difficult	Ok	Easy	Very easy

4. Please indicate any lessons you did not teach; and any which were particularly good or poor

Lesson	Title	Did not teach	Good	Poor	Comments
1.	Fit Check 1				
2.	Fit Check 2				
3.	Safe workout: PE Introduction (theory)				
4.	Eat Well Plate (nutrition)				
5.	Five foods countdown (PE)				
6.	Five food groups (nutrition)				
7.	Musical Fare (PE)				
8.	Keeping the balance (nutrition)				
9.	Three kinds of fitness (PE)				
10.	Freeze my TV				

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11.	Snack attack (nutrition)				
12.	Bowling for snacks (PE)				
13.	Think about your drink (nutrition)				
14.	Veggiemania (PE)				
15.	Brilliant Breakfast (nutrition)				
16.	Fit Check				

5. **If some year 5 children are in another class, please comment on the teaching of the project in the other class(es):**

Not applicable	None of the lessons were taught in the other class(es)	Some of the lessons were taught in the other class(es)	All the lessons were taught in the other class(es)	Other:

6. **Were the lesson plans:**

Very difficult to understand	Difficult to understand	Ok	Easy to understand	Very easy to understand

7. **In your opinion did the "Fit Check" help children to make behaviour changes**

Don't know	No	Maybe	Yes

8. **In your opinion did the "Freeze My TV" help children to make behaviour changes**

Don't know	No	Maybe	Yes

9. **What type of feedback did you receive from parents?**

Many negative comments	Some negative comments	No comments	Some positive comments	Many positive comments

10. **Will you continue using the materials?**

No	May be	Yes

Thank you. Please return to: Ruth Kipping, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol BS8 2PR.

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APPENDIX 8. AFLY5 PHASE II: RESULTS

This appendix relates to chapter 6.

Data quality assessment

Table 8.1 shows the response for parent completed questionnaires before the AFLY5 intervention by school. Table 8.2 and Table 8.3 present the number of children without parent consent or child assent for the measurements by intervention group. Table 8.4 and Table 8.5 present the data by school.

Table 8.1 Response rate for parent completed sedentary behaviour questionnaire and parent support for activities scale

		Sedentary behaviour questionnaire			Parent support for activities scale		
School ID	No. in Year 5	Number returned	Number returned after reminder	Total number (%) returned	Number returned	Number returned after reminder	Total number (%) returned
33[1]	41	21	5	26 (63.4)	19	5	24 (58.5)
34[1]	44	11	4	15 (34.1)	11	4	15 (34.1)
37[1]	36	13	6	19 (52.8)	15	6	21 (58.3)
38[1]	29	9	4	13 (44.8)	9	4	13 (44.8)
30	34	14	4	18 (52.9)	14	5	19 (55.9)
31	50	32	5	37 (74.0)	30	4	34 (68.0)

[1] Parent involvement schools

Table 8.2 Parent opt out of measurements by intervention group

								Parent Opt Out n (%)			
Intervention	Time	No. in Year 5	Left	Joined	Absent	Sed qu[2]	Diet qu[3]	Height	Weight	Waist	Accel[4]
All schools	Before	529			22 (4.2)	12 (2.3)	11 (2.1)	14 (2.6)	17 (3.2)	17 (3.2)	2 (0.4)
	After	530	13 (2.5)	1 (0.2)	38 (7.2)	11 (2.1)	10 (1.9)	13 (2.5)	16 (3.0)	16 (3.0)	1 (0.2)
Parent involvement schools	Before	150			4 (2.7)	1 (0.7)	1 (0.7)	1 (0.7)	1 (0.7)	2 (1.3)	1 (0.7)
	After	151	5 (3.3)	1 (0.7)	8 (5.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)	0 (0.0)
No parent involvement schools	Before	379			18 (4.7)	11 (2.9)	10 (2.6)	13 (3.4)	16 (4.2)	15 (4.0)	1 (0.3)
	After	379	8 (2.1)	0 (0.0)	30 (7.9)	11 (2.9)	10 (2.6)	13 (3.4)	16 (4.2)	15 (4.0)	1 (0.3)

[1] Denominator is all children in year 5. [2] Sedentary behaviour questionnaire. [3] Diet (Day in the life) questionnaire. [4] Accelerometers given to 2 schools (84 children) in no parent involvement schools, therefore percentage calculated with denominator of 84. [5]

Table 8.3 Child opt out of measurements (by not giving 'assent') by intervention group

			Child opt out[1] n (%)								
Intervention	Time	No. in Year 5	Left	Joined	Absent	Sed[2]	Diet[3]	Height	Weight	Waist	Accel[4]
All schools	Before	529			22 (4.2)	11 (2.1)	8 (1.5)	9 (1.7)	43 (8.1)	43 (8.1)	3 (1.3)
	After	530	13 (2.5)	1 (0.2)	38 (7.2)	7 (1.3)	16 (3.0)	3 (0.6)	37 (7.0)	25 (4.7)	3 (1.3)
Parent involvement schools	Before	150			4 (2.7)	6 (4.0)	6 (4.0)	4 (2.7)	17 (11.3)	12 (8.0)	3 (2.0)
	After	151	5 (3.3)	1 (0.7)	8 (5.3)	2 (1.3)	3 (2.0)	0 (0.0)	7 (4.6)	7 (4.6)	3 (2.0)
No parent involvement schools	Before	379			18 (4.7)	5 (1.3)	2 (0.5)	5 (1.3)	26 (6.9)	31 (8.2)	0 (0.0)
	After	379	8 (2.1)	0 (0.0)	30 (7.9)	5 (1.3)	13 (3.4)	3 (0.8)	30 (7.9)	18 (4.7)	0 (0.0)

[1] Denominator is all children in year 5. [2] Sedentary behaviour questionnaire. [3] Diet (Day in the life) questionnaire. [4] Accelerometers given to 2 schools (84 children) in no parent involvement schools, therefore percentage calculated with denominator of 84 for these schools and denominator of 234 for all schools using accelerometers.

Table 8.4 Number of children without parent consent or without child assent for measurements before AFLY5 intervention

School ID	No. in Year 5	Absent	No parental consent						No child assent					
			Sed qu[2]	Diet qu[3]	Height	Weight	Waist	Accel[4]	Sed qu[2]	Diet qu[3]	Height	Weight	Waist	Accel[4]
33[5]	41	2	0	0	0	0	0	0	0	0	0	5	1	1
34[5]	44	1	0	0	0	0	1	0	0	0	1	3	3	1
37[5]	36	1	0	0	0	0	0	0	6	6	3	6	7	1
38[5]	29	0	1	1	1	1	1	1	0	0	0	3	1	1*
30	34	1	1	1	1	1	1	1	1	0	0	1	1	0
31	50	4	0	0	1	1	1	0	0	0	0	0	0	0
32	45	2	1	1	1	1	1		0	0	0	1	1	
35	29	0	0	0	1	1	1		0	0	2	3	4	
36	7	0	0	0	0	0	0		1	0	0	1	1	
39	12	0	1	1	1	1	1		0	0	0	2	0	
40	58	0	2	2	2	3	2		2	1	0	6	8	
41	23	0	2	1	1	2	2		0	0	0	1	0	
42	7	0	0	0	0	0	0		0	0	0	0	0	
43	42	6	2	2	3	4	4		1	0	0	3	4	
44	42	4	2	2	2	2	2		0	1	3	7	11	
45	30	1	0	0	0	0	0		0	0	0	1	1	

[1] Denominator is all children in year 5. [2] Sedentary behaviour questionnaire. [3] Diet (Day in the life) questionnaire. [4] Accelerometers given to 2 schools (84 children) in no parent involvement schools, therefore percentage calculated with denominator of 84. [5] Parent involvement schools.

Table 8.5 Number of children without parent consent or without child assent for measurements after AFLY5 intervention

School ID	No. in Year 5	Left	Joined	Absent	No parental consent						No child assent					
					Sed qu[2]	Diet qu[3]	Height	Weight	Waist	Accel[4]	Sed qu[2]	Diet qu[3]	Height	Weight	Waist	Accel[4]
33[5]	42	0	1	1	0	0	0	0	0	0	2	3	0	0	2	0
34[5]	44	2	0	6	0	0	0	0	1	0	0	0	0	0	0	1
37[5]	36	2	0	1	0	0	0	0	0	0	0	0	0	5	3	1
38[5]	29	1	0	0	0	0	0	0	0	0	0	0	0	2	2	1
30	34	0	0	3	1	1	1	1	1	1	0	1	0	6	1	0
31	50	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0
32	45	1	0	2	1	1	1	1	1		0	0	0	2	0	
35	29	0	0	1	0	0	1	1	1		1	2	2	4	3	
36	7	0	0	0	0	0	0	0	0		0	0	0	0	0	
39	12	1	0	2	1	1	1	1	1		0	1	0	1	0	
40	58	0	0	8	2	2	2	3	2		4	5	0	6	3	
41	23	1	0	5	2	1	1	2	2		0	0	0	0	0	
42	7	0	0	1	0	0	0	0	0		0	0	0	0	1	
43	42	1	0	6	2	2	3	4	4		0	0	0	3	4	
44	42	3	0	0	2	2	2	2	2		0	2	1	4	5	
45	30	1	0	2	0	0	0	0	0		0	1	0	4	1	

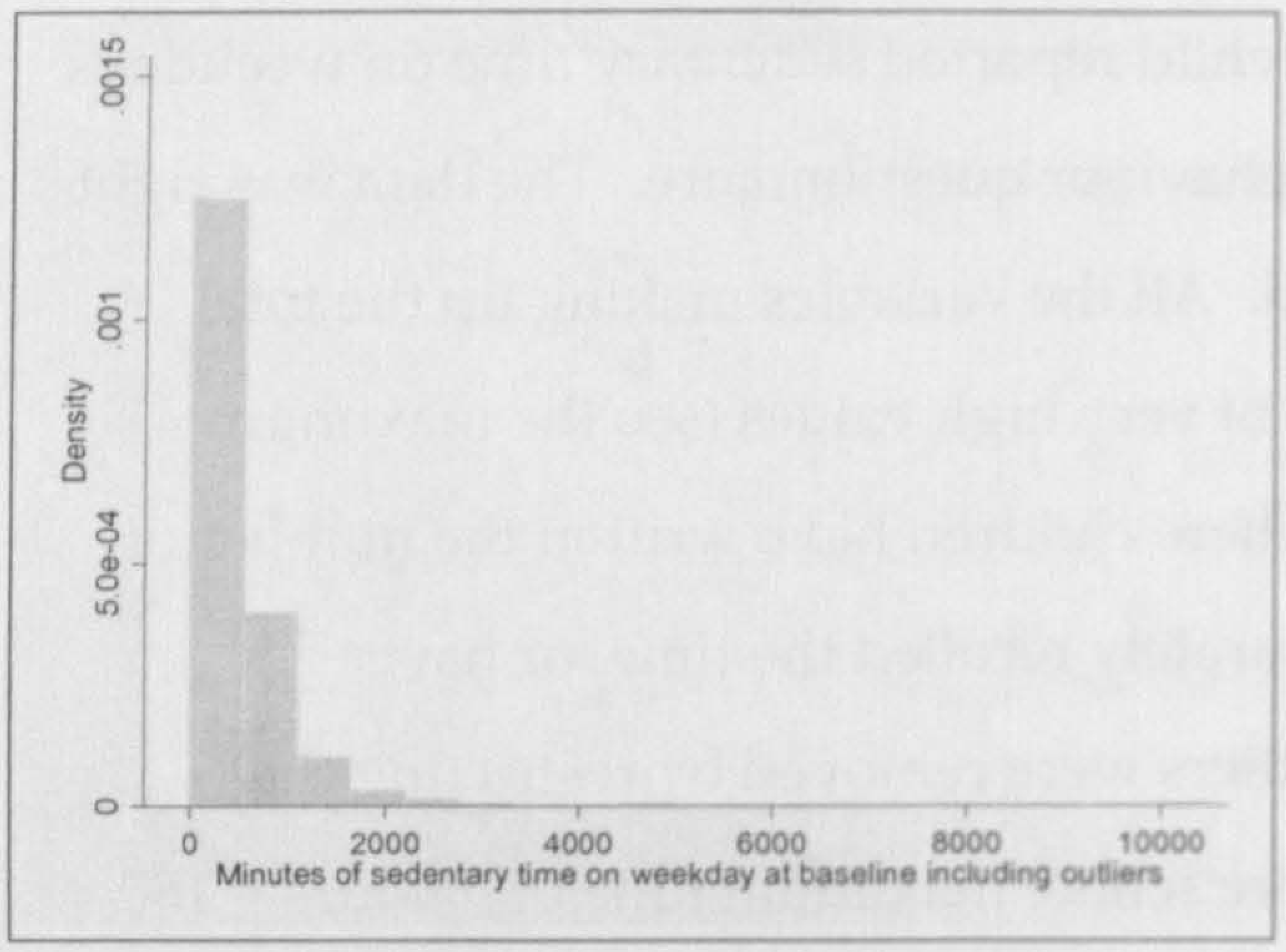
[1] Denominator is all children in year 5. [2] Sedentary behaviour questionnaire. [3] Diet (Day in the life) questionnaire. [4] Accelerometers given to 2 schools (84 children) in no parent involvement schools, therefore percentage calculated with denominator of 84. [5] Parent involvement schools.

Sedentary behaviours measured by sedentary behaviour questionnaire

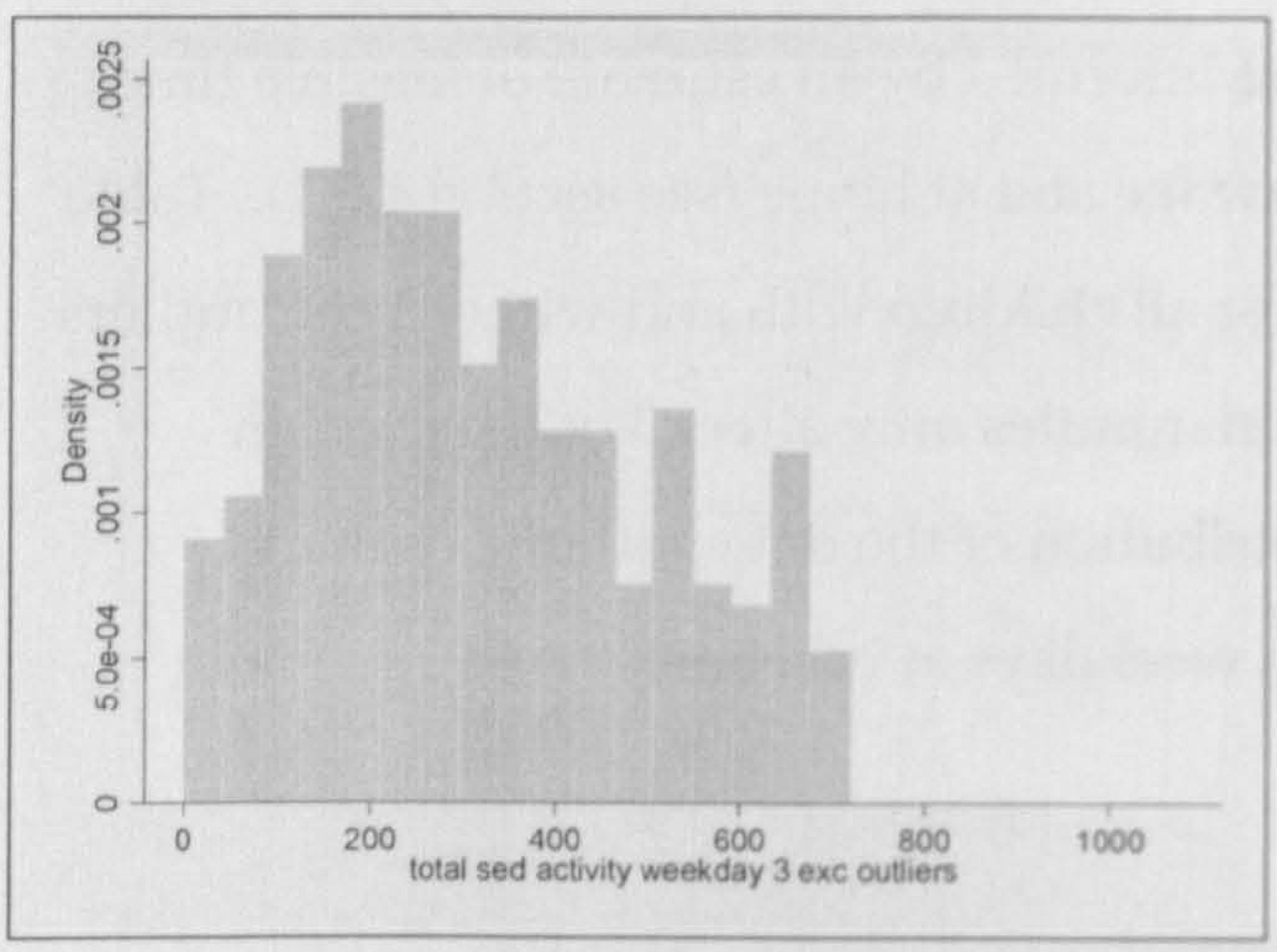
Graph 8.1 shows the distribution for child reported sedentary time on weekdays at baseline measured by sedentary behaviour questionnaire. The data was right skewed and not normally distributed. All the variables making up the total sedentary time have a small number of very high values (see the maximum values in Table 8.6), which may be where children have written the number of minutes instead of hours, have inaccurately recalled the time, or have deliberately fabricated the time. Outliers were removed by restricting the possible time for each period to: before school maximum time of 3 hours = 180 minutes; after school maximum time of 9 hours = 540 minutes; Saturday maximum time of 18 hours = 1080 minutes. These times were based on those used in phase one of AFLY5 and were informed by an estimate of feasible times when children of this age would be awake and at home (see section 1.5.1). Table 8.7 shows the baseline median time for all children with and without the outliers removed. The restriction of maximum minutes only alters 3 of the median values. Graph 8.2 shows that the distribution of the data with the outliers removed is still positively skewed on weekdays at baseline.

The Stata 'ladder' and 'gladder' commands were used to generate transformations to convert the child reported sedentary time into a normally distributed variable. The square root transformation converts the sedentary time variable into a normally distributed variable (see Graph 8.3 to Graph 8.8). However, the square root transformation is difficult to interpret. Therefore on balance I have decided not to transform the data for further analysis and the median and IQR of sedentary behaviour are used in simple descriptive analyses. The distributions on Saturdays and for screen time are shown in Graph 8.4 to Graph 8.10. The data for screen time is more positively skewed than sedentary time.

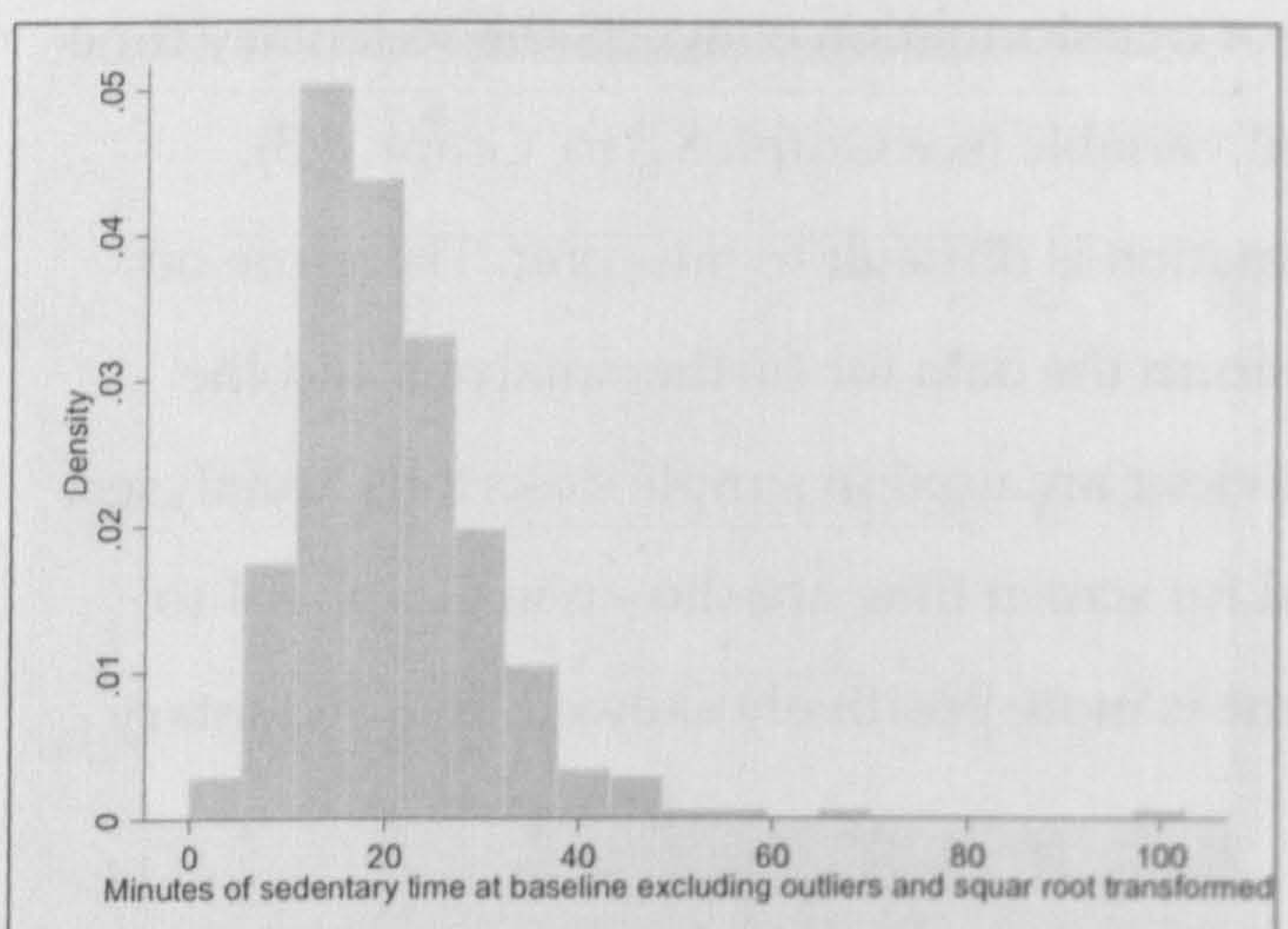
Graph 8.1 Minutes of child reported sedentary time on weekday before AFLY5 intervention including outliers



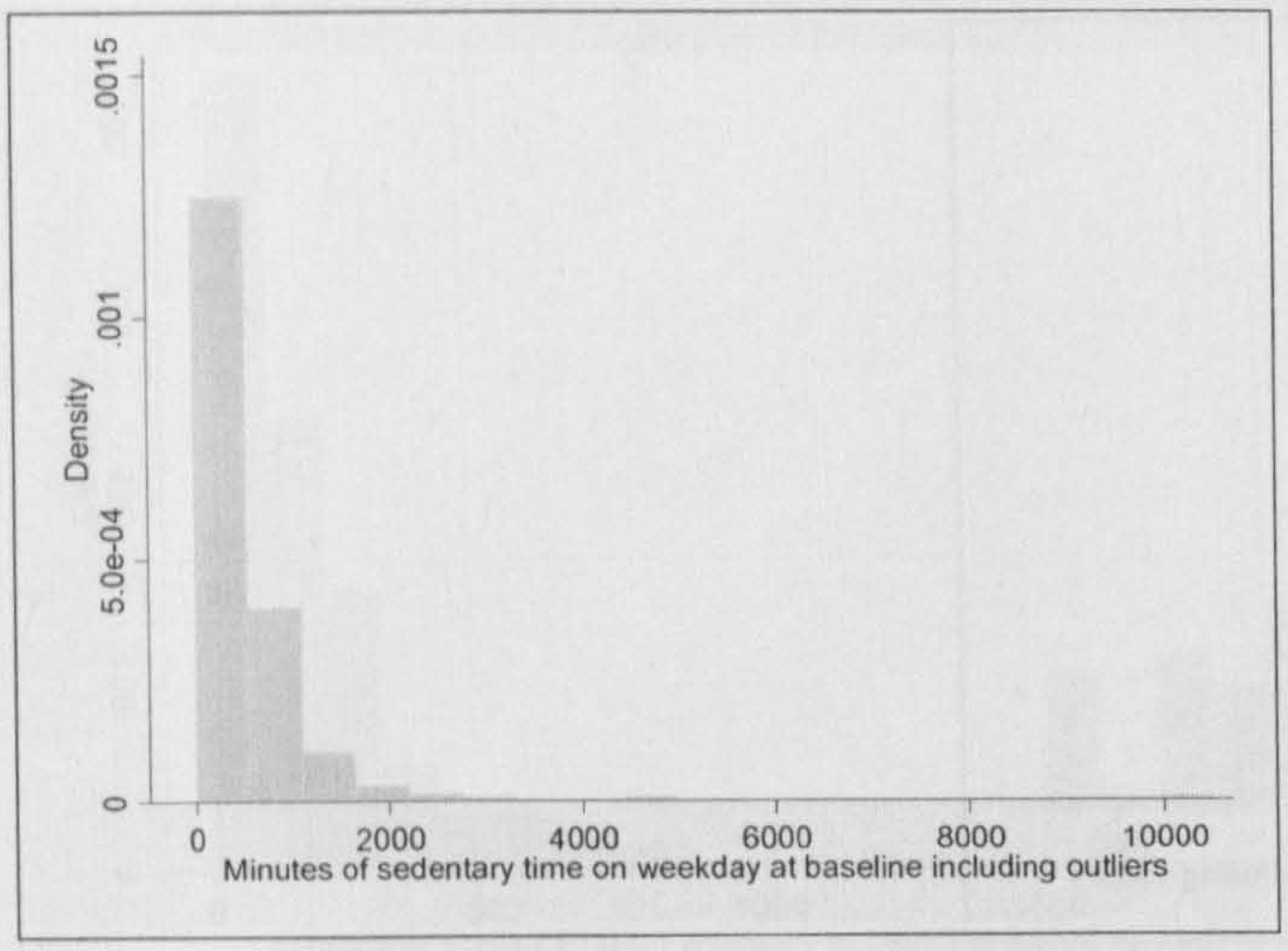
Graph 8.2 Minutes of child reported sedentary time on weekday before AFLY5 intervention excluding outliers



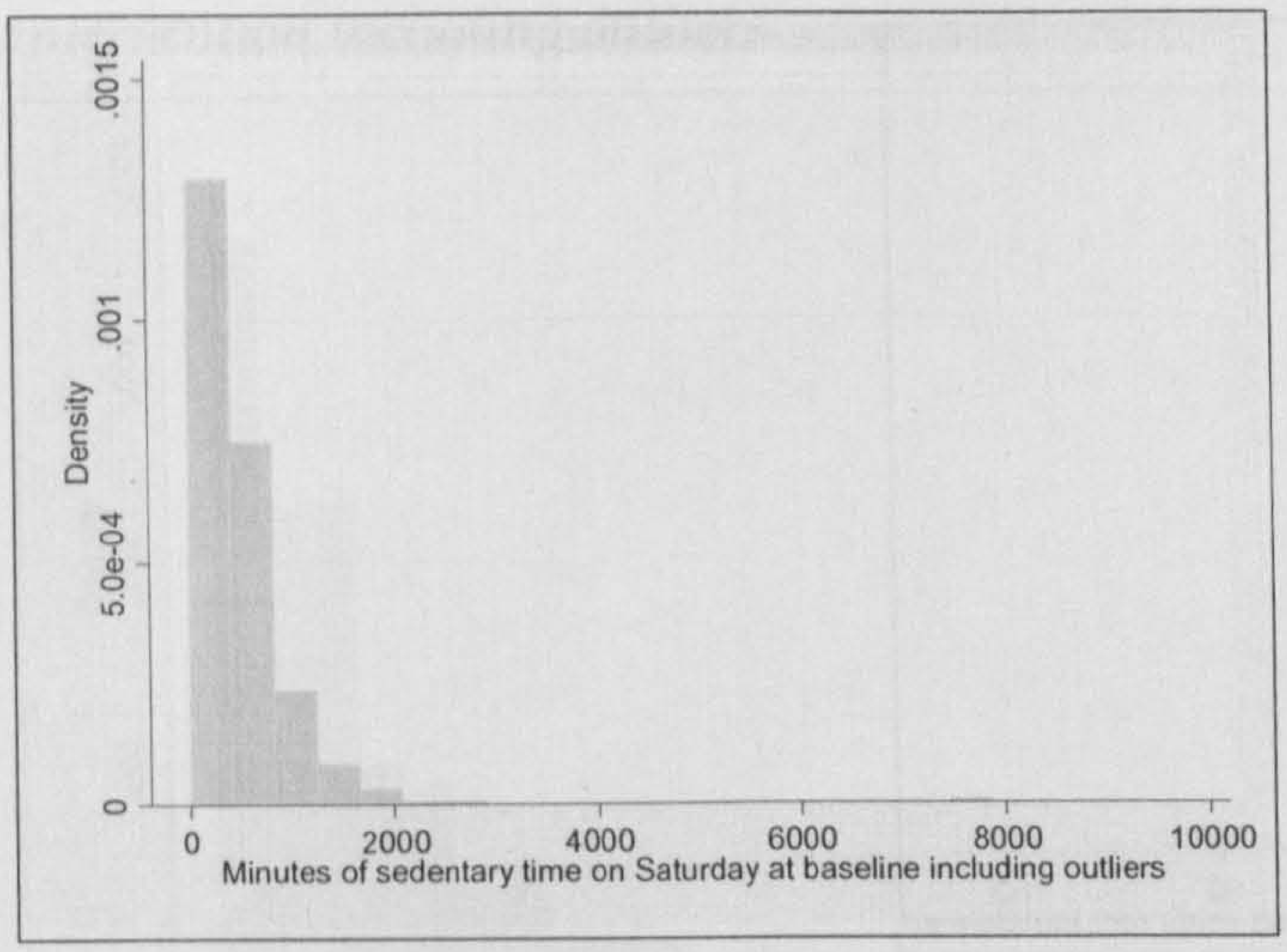
Graph 8.3 Minutes of child reported sedentary time on weekday before AFLY5 intervention excluding outliers and square root transformed



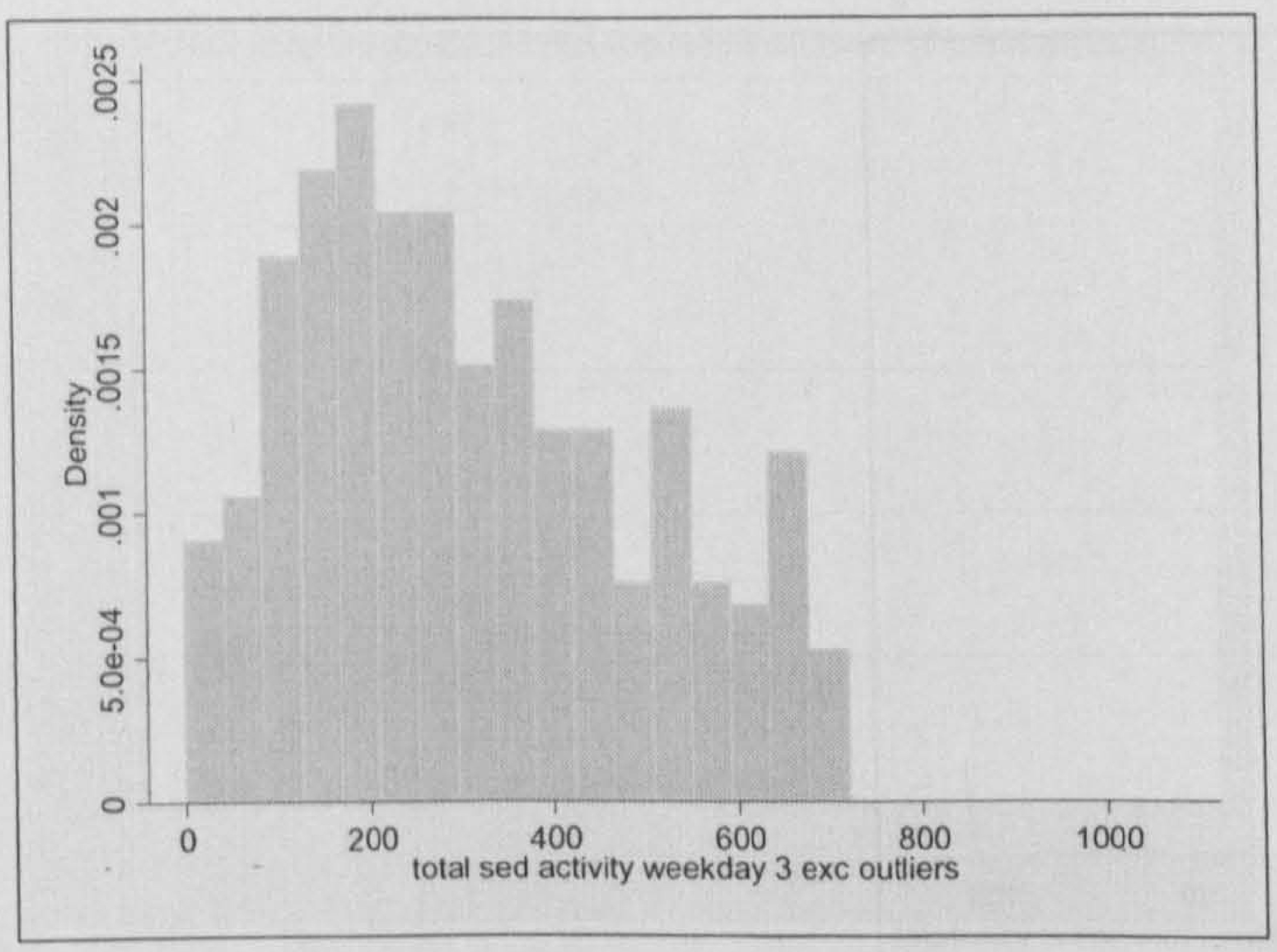
Graph 8.4 Minutes of child reported sedentary time on weekday before AFLY5 intervention including outliers



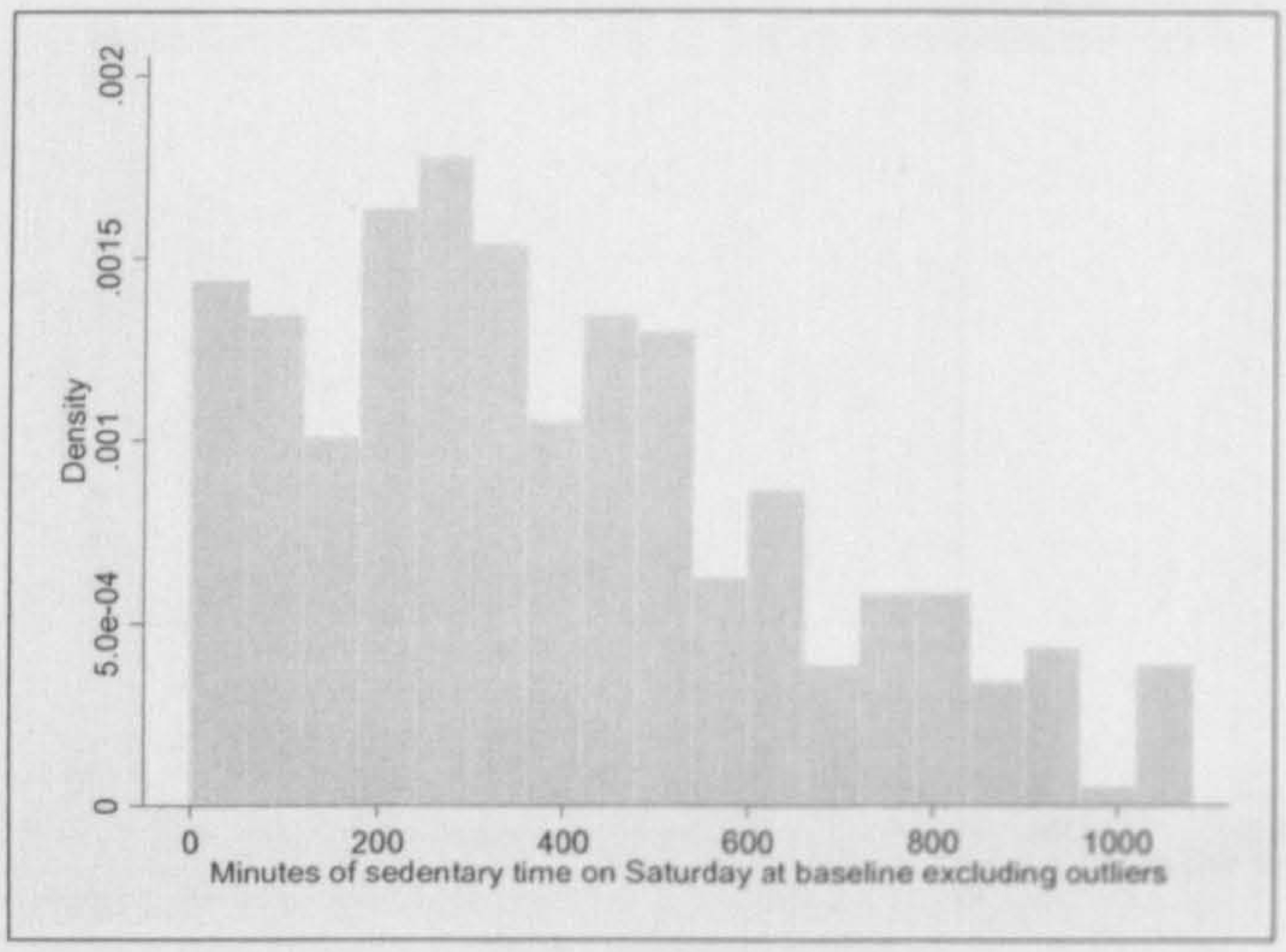
Graph 8.5 Minutes of child reported sedentary time on Saturday before AFLY5 intervention including outliers



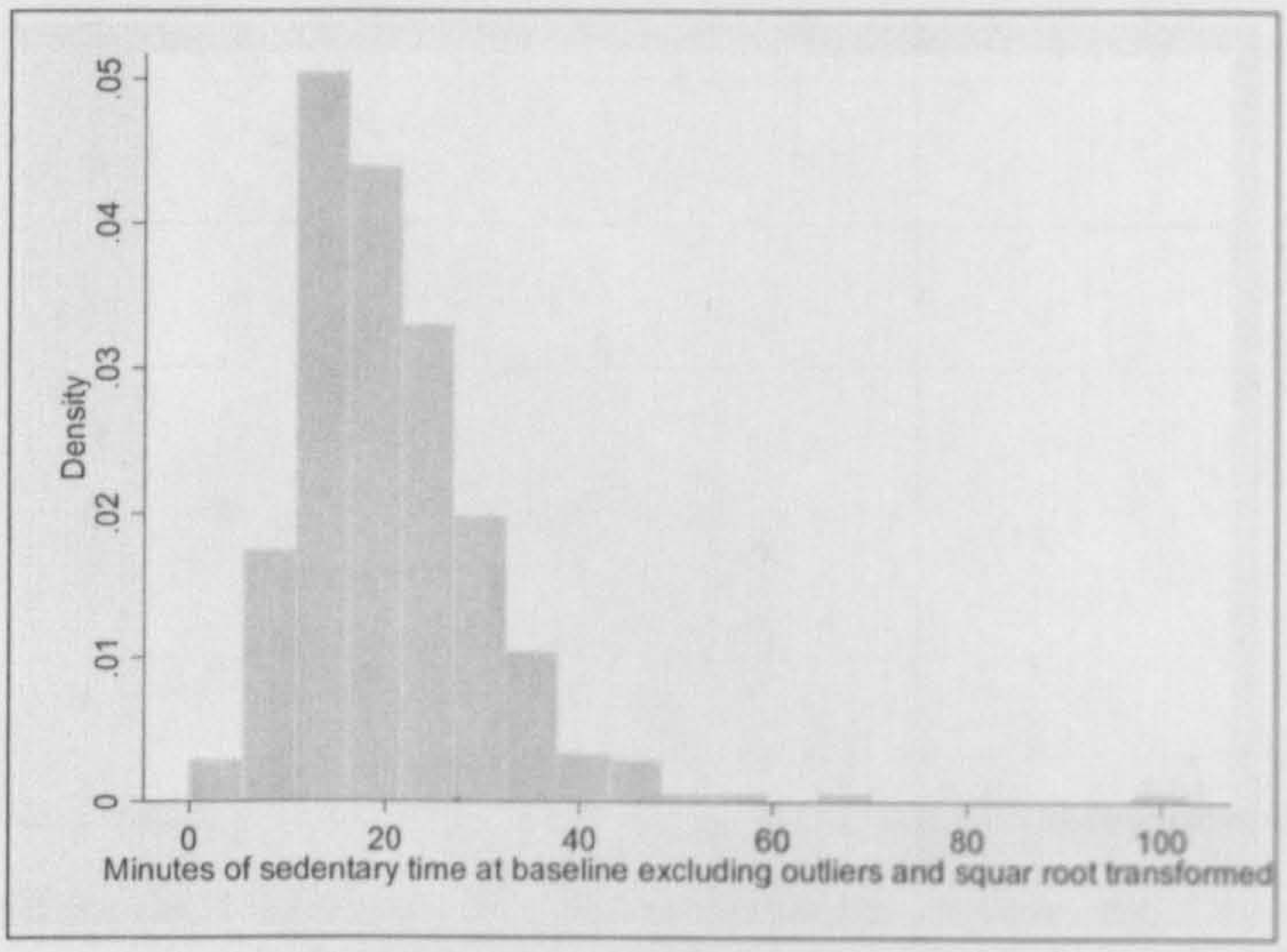
Graph 8.6 Minutes of child reported sedentary time on weekday before AFLY5 intervention excluding outliers



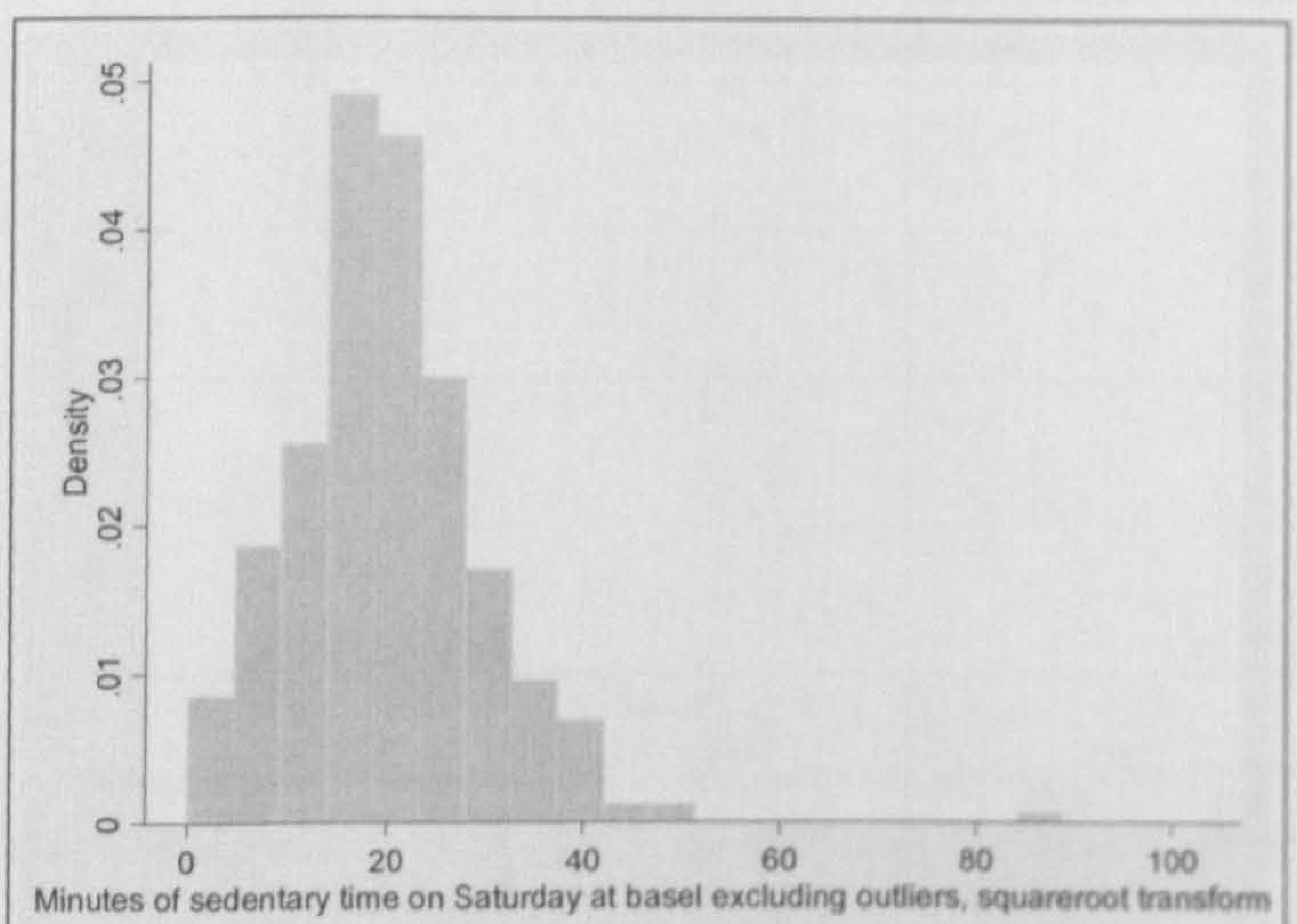
Graph 8.7 Minutes of child reported sedentary time on Saturday before AFLY5 intervention excluding outliers



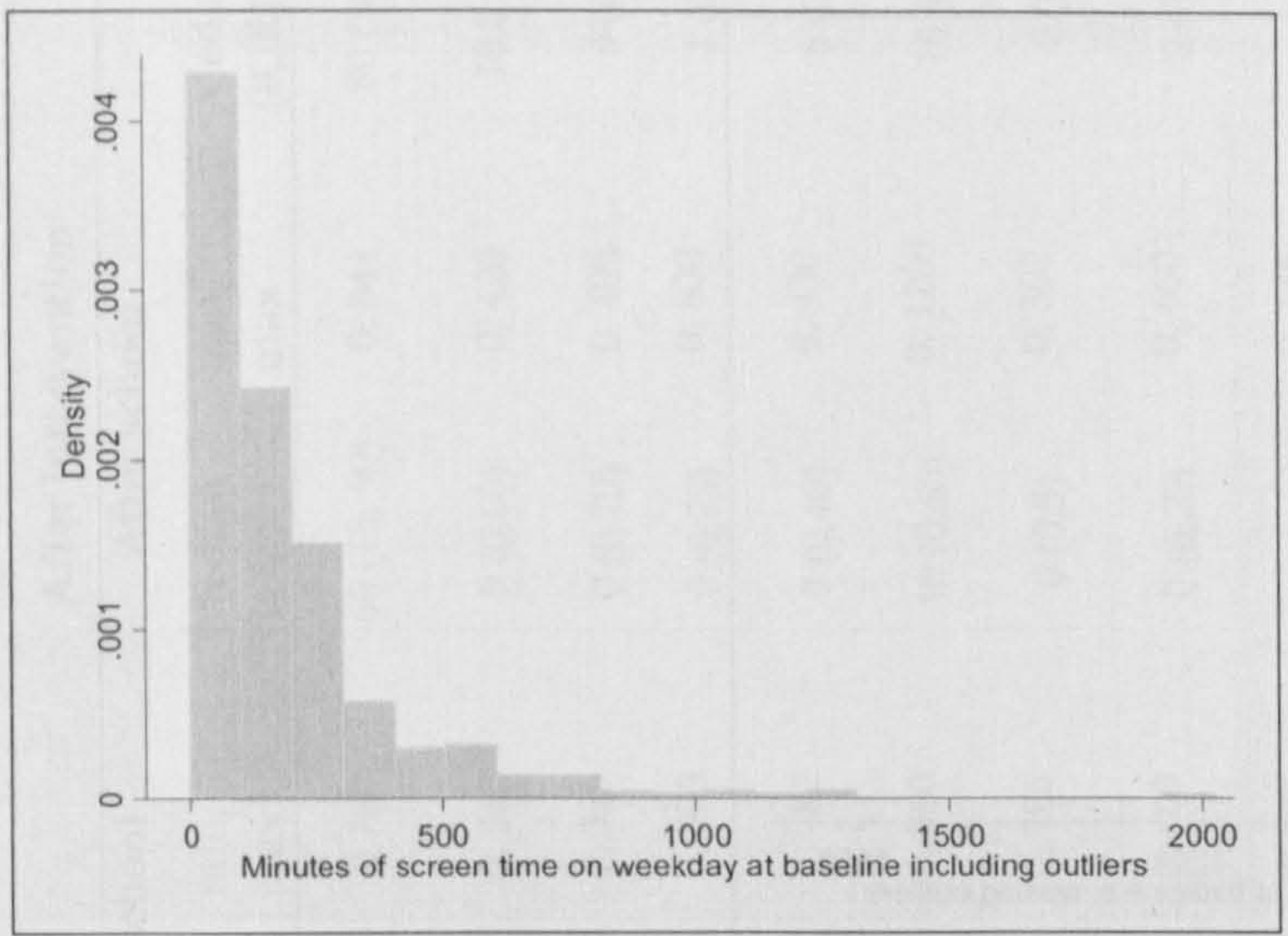
Graph 8.8 Minutes of child reported sedentary time on weekday before AFLY5 intervention excluding outliers and square root transformed



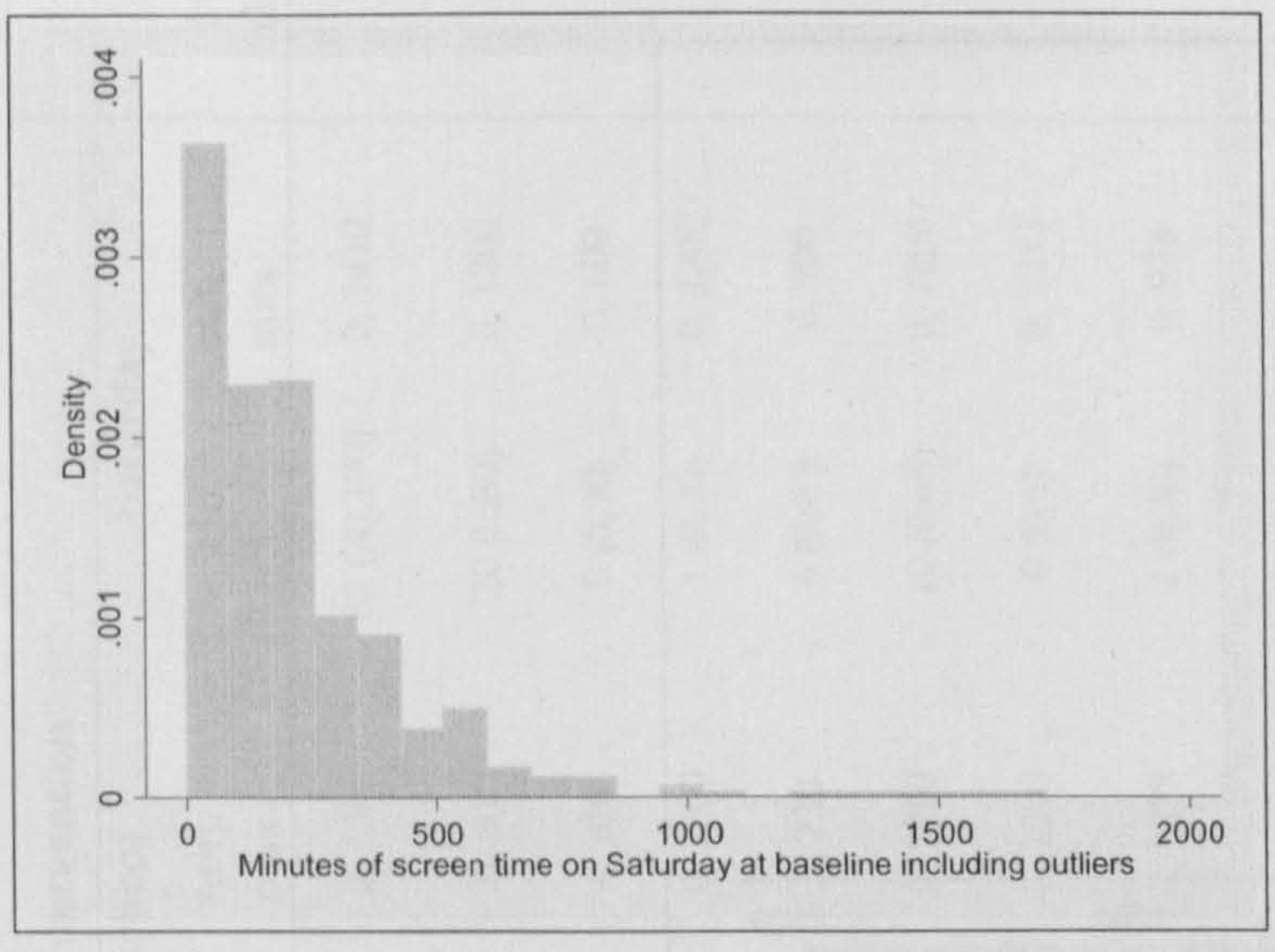
Graph 8.9 Minutes of child reported sedentary time on Saturday before AFLY5 intervention excluding outliers and square root transformed



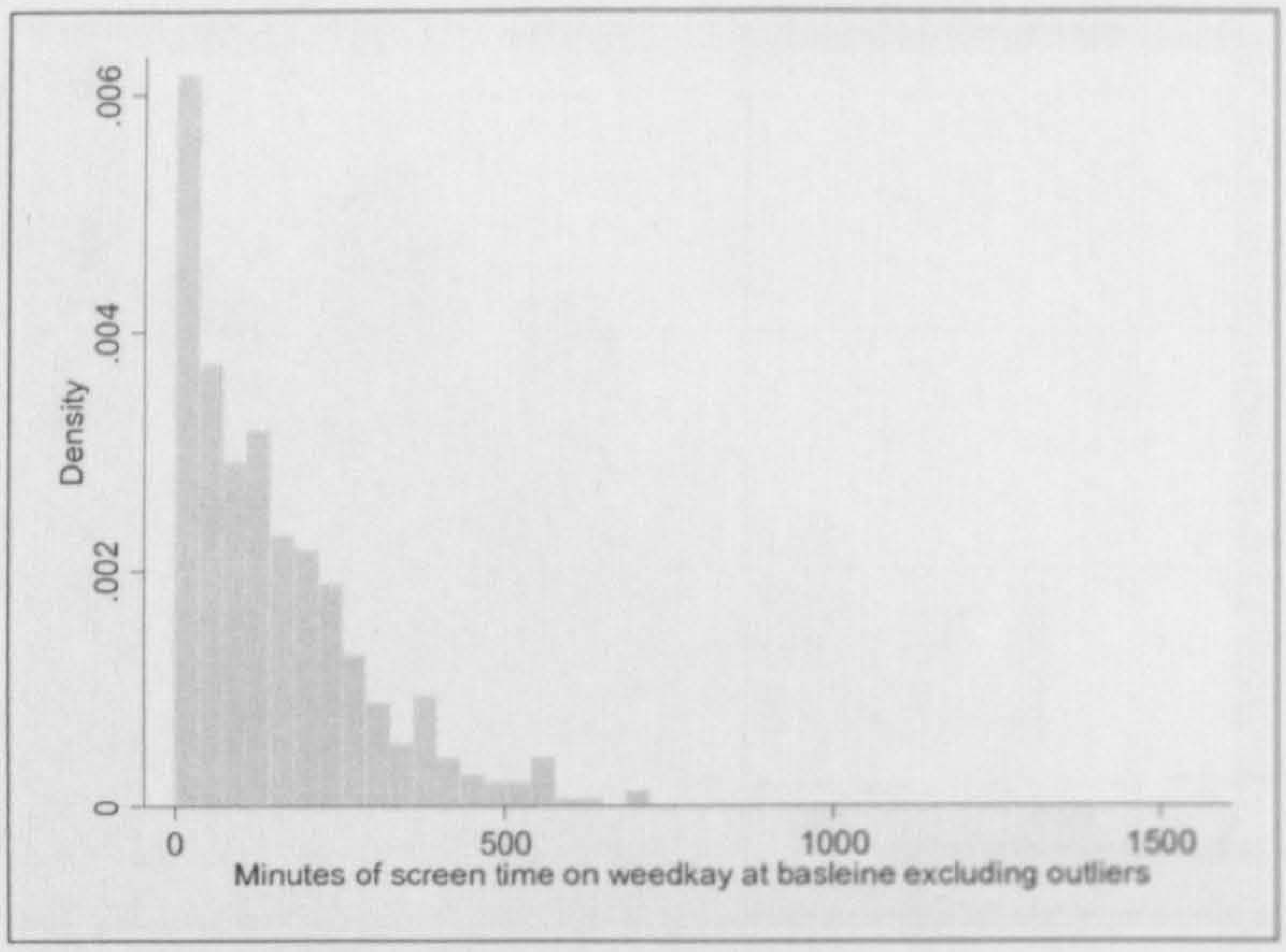
Graph 8.10 Minutes of child reported screen time on weekday before AFLY5 intervention including outliers



Graph 8.11 Minutes of child reported screen time on Saturday before AFLY5 intervention including outliers



Graph 8.12 Minutes of child reported screen time on weekday before AFLY5 intervention excluding outliers



Graph 8.13 Minutes of child reported screen time on Saturday before AFLY5 intervention excluding outliers

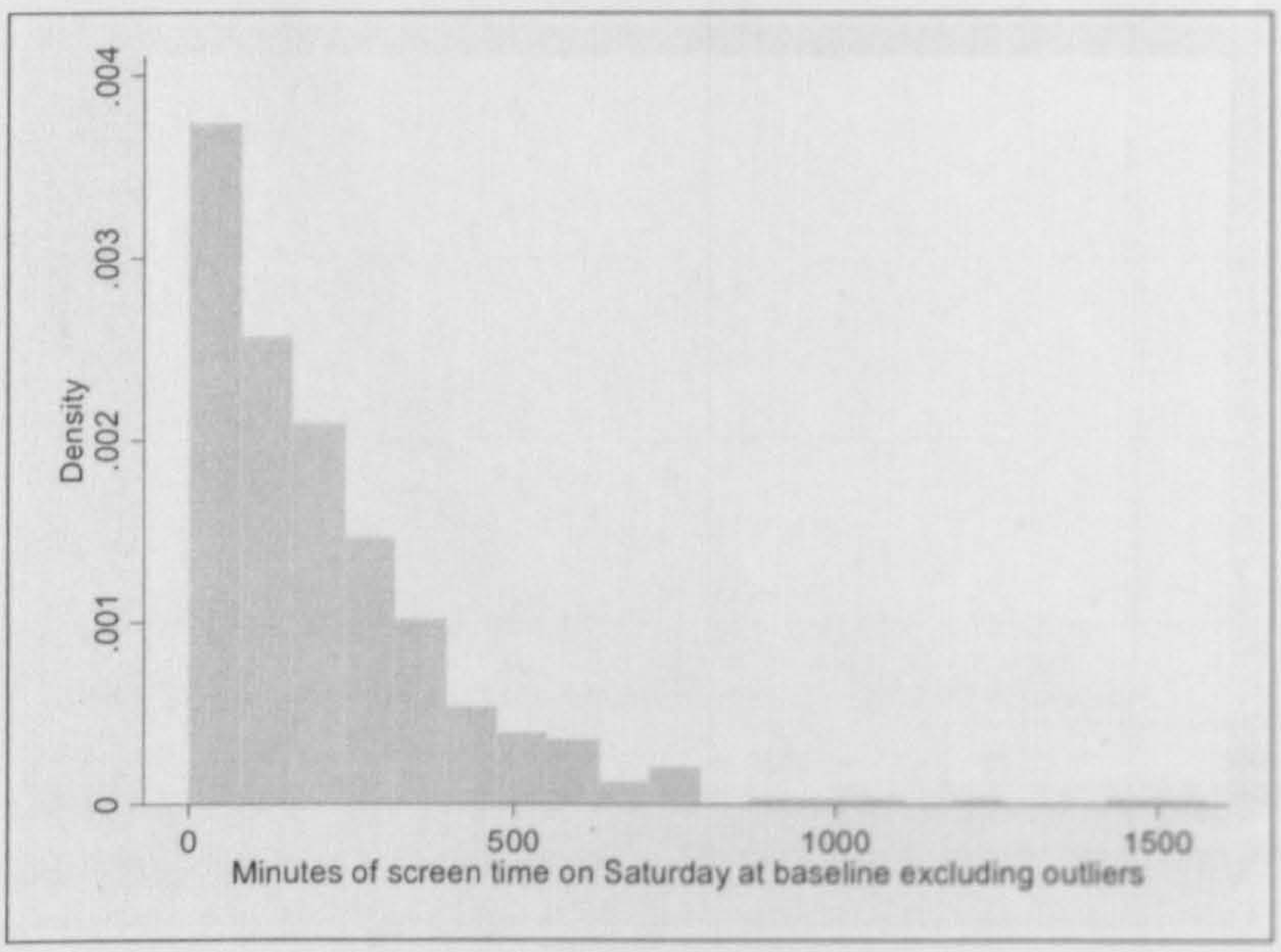


Table 8.6 Child reported times spent in sedentary behaviours: before AFLY5 intervention medians, IQR and range (including outliers) n=461

	Before intervention						After intervention					
	Before school		After school		Saturday		Before school		After school		Saturday	
	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max
TV, DVDs or Videos	10 (0,30)	0 , 420	60 (15,105)	0, 1200	82 (30,170)	0, 1410	10 (0,30)	0,760	60 (15, 90)	0, 844	80 (30, 170)	0, 1250
Computer games	0 (0,2)	0, 610	5 (0,60)	0, 601	20 (0,80)	0, 1200	0 (0,1)	0, 360	5 (0,60)	0, 420	18.5 (0,80)	0, 1054
Computer	0 (0,20)	0, 600	0 (0,20)	0, 601	0 (0,30)	0, 600	0 (0,0)	0, 320	0 (0,20)	0, 405	0 (0,30)	0, 390
Homework	0 (0,2)	0, 1200	0 (0,27.5)	0, 1200	1 (0,30)	0, 1200	0 (0,2)	0, 600	0 (0,25)	0, 600	1 (0,30)	0, 610
Indoor games	0 (0,10)	0, 720	0 (0,40)	0, 720	6 (0,60)	0, 900	0 (0,5)	0, 482	0 (0,40)	0, 430	6 (0,60)	0, 1200
Talking	3 (0,20)	0, 900	10 (0,60)	0, 1200	10 (0,69)	0, 1200	2 (0, 20)	0, 360	10 (0,60)	0, 1200	10 (0,65)	0, 1050
Phone or text	0 (0,0)	0, 720	0 (0,5)	0, 1200	0 (0,6)	0, 1213	0 (0,0)	0, 186	0 (0,5)	0, 362	0 (0,6)	0, 840
Listening to music	0 (0,10)	0, 900	0 (0,25)	0, 1213	2 (0,30)	0, 978	0 (0,10)	0, 600	0 (0,20)	0, 660	2 (0,30)	0, 705
Playing music	0 (0,0)	0, 210	0 (0,10)	0, 252	0 (0,10)	0, 600	0 (0,0)	0, 126	0 (0,10)	0, 645	0 (0,10)	0, 366
Reading	0 (0,10)	0, 1213	10 (0,30)	0, 918	0 (0,10)	0, 1220	0 (0,10)	0, 367	10 (0,30)	0, 1200	10 (0,40)	0, 540
Art and craft	0 (0,0)	0, 610	0 (0,12)	0, 1213	0 (0,30)	0, 978	0 (0,0)	0, 420	0 (0,10)	0, 300	0 (0,30)	0, 420
Other	0 (0,5)	0, 665	30 (0,90)	0, 1096	60 (0,120)	0, 977	0 (0,5)	0, 720	30 (0,90)	0, 1200	60 (0,120)	0, 1205

Table 8.7 Child reported times spent in sedentary behaviours: before AFLY5 intervention medians, IQR and range with and without outliers (n=461 for all data)

	Before intervention all data						Before intervention with outliers removed[a]					
	Before school		After school		Saturday		Before school		After school		Saturday	
	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max
TV, DVDs or Videos	10 (0,30)	0, 420	60 (15,105)	0, 1200	82 (30,170)	0, 1410	10 (0,30)	0, 150	60 (15, 90)	0, 322	80 (30, 170)	0, 723
Computer games	0 (0,2)	0, 610	5 (0,60)	0, 601	20 (0,80)	0, 1200	0 (0,1)	0, 180	5 (0,60)	0, 370	18.5 (0,80)	0, 620
Computer	0 (0,20)	0, 600	0 (0,20)	0, 601	0 (0,30)	0, 600	0 (0,0)	0, 180	0 (0,20)	0, 320	0 (0,30)	0, 600
Homework	0 (0,2)	0, 1200	0 (0,27.5)	0, 1200	1 (0,30)	0, 1200	0 (0,2)	0, 135	0 (0,25)	0, 430	1 (0,30)	0, 720
Indoor games	0 (0,10)	0, 720	0 (0,40)	0, 720	6 (0,60)	0, 900	0 (0,5)	0, 175	0 (0,40)	0, 360	6 (0,60)	0, 900
Talking	3 (0,20)	0, 900	10 (0,60)	0, 1200	10 (0,69)	0, 1200	2 (0, 20)	0, 180	10 (0,60)	0, 480	10 (0,65)	0,900
Phone or text	0 (0,0)	0, 720	0 (0,5)	0, 1200	0 (0,6)	0, 1213	0 (0,0)	0, 124	0 (0,5)	0, 380	0 (0,6)	0, 600
Listening to music	0 (0,10)	0, 900	0 (0,25)	0, 1213	2 (0,30)	0, 978	0 (0,10)	0, 150	0 (0,20)	0, 480	2 (0,30)	0, 978
Playing music	0 (0,0)	0, 210	0 (0,10)	0, 252	0 (0,10)	0, 600	0 (0,0)	0, 180	0 (0,10)	0, 252	0 (0,10)	0, 600
Reading	0 (0,10)	0, 1213	10 (0,30)	0, 918	0 (0,10)	0, 1220	0 (0,10)	0, 180	10 (0,30)	0, 450	10 (0,40)	0, 600
Art and craft	0 (0,0)	0, 610	0 (0,12)	0, 1213	0 (0,30)	0, 978	0 (0,0)	0, 180	0 (0,10)	0, 480	0 (0,30)	0, 978
Other	0 (0,5)	0, 665	30 (0,90)	0, 1096	60 (0,120)	0, 977	0 (0,5)	0, 180	30 (0,90)	0, 480	60 (0,120)	0, 977

[a] Before school max time is 3 hours = 180 minutes; after school max time is 9 hours = 540 minutes; Saturday maximum time is 18 hours = 1080 minutes)

Assessment of test-retest reliability

To assess the test-retest reliability of the sedentary behaviour questionnaire children in one school completed the questionnaire a second time 2 weeks later. Twenty-four children completed the questionnaire on the two occasions; after excluding outliers for total sedentary time adequate data were available for 16 children on weekdays (see Table 8.8). There were 23 children with baseline and repeated baseline screen activities because fewer children were excluded for screen time.

Table 8.8 Total time in minutes spent in sedentary activities for baseline and baseline repeated excluding outliers (child reported)

	Baseline 1			Baseline 2		
Activity	**Obs**	**Median (IQR)**	**Range min, max**	**Obs**	**Median (IQR)**	**Range min, max**
Total sedentary weekday[a]	16	279.5 (174, 362.5)	55, 709	16	241 (143,5, 378)	20, 500
Total sedentary Saturday[a]	16	382 (207.5, 632)	15, 780	16	256.5 (145, 465)	0, 720
Total screen weekday	23	140 (60, 279)	0, 566	23	122 (61, 210)	20, 350
Total screen Saturday	22	240 (150, 423)	0,946	22	181 (100, 360)	0,690

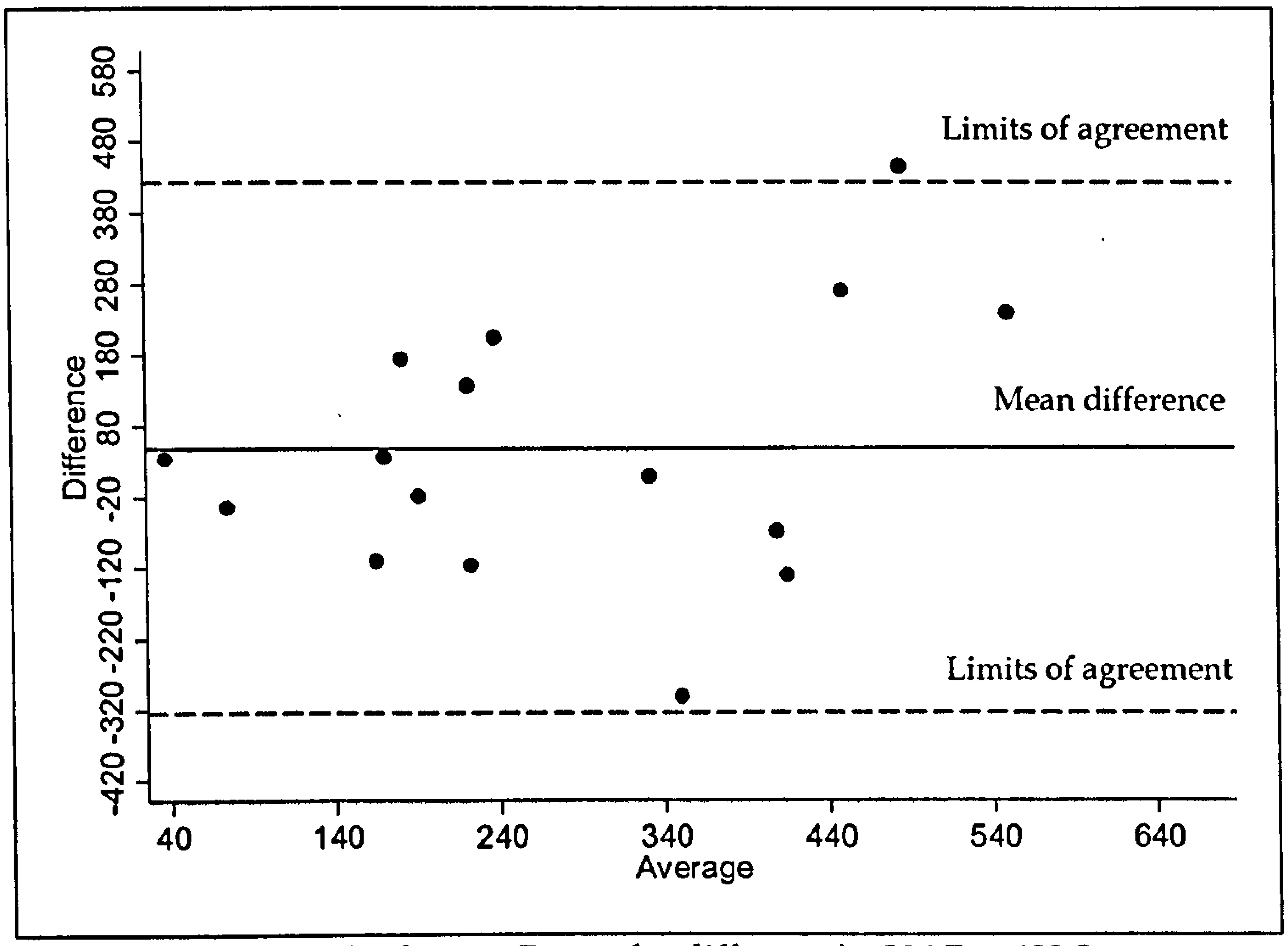
[a] weekday total times restricted to: weekday <=720, Saturday <=1080

The difference between the baseline 1 and baseline 2 measurements were compared for total sedentary and screen time using a Bland-Altman plot, which plots the mean minutes of sedentary activities at baseline 1 and 2 against the difference between the two values, with dotted horizontal lines showing the 95% limits of agreement (the mean difference plus or minus twice the standard deviation of the differences).[39] Graph 8.14 shows that on a weekday the average mean difference of total sedentary time was 49.1 minutes (95% CI -50.5 to 178.7 minutes) and 95% of the sample had a difference in values of between -325 and 423 minutes. This indicates a lot of variation between the measurements at the two time points. The graph also suggests that this variation is not random, with some suggestion that it increases with higher mean time (though the small number of data points make this difficult to ascertain). The Bland-Altman plots for sedentary time on Saturdays and for screen time on weekdays and Saturdays are shown in Graph 8.15 to Graph 8.17 and summarised in Table 8.9. The plots show a similar pattern of large differences between the two time points and evidence that the difference increased with increasing mean time.

Table 8.9 Analysis of mean difference before AFLY5 measured and repeated two weeks later for child reported sedentary and screen time measured by the sedentary behaviour questionnaire on weekdays and Saturdays

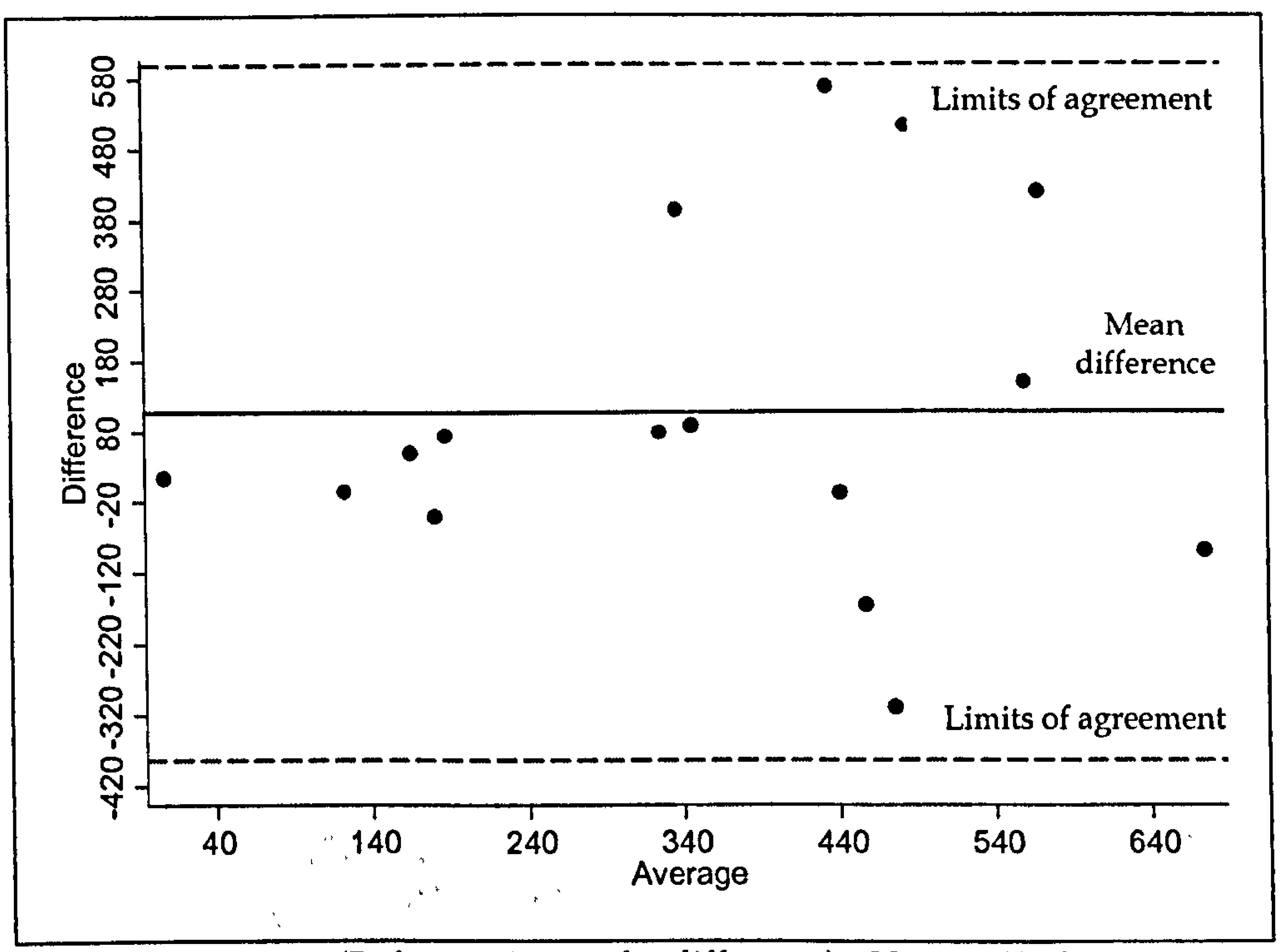
	Mean difference of minutes at baseline 1 and 2 (95% CI)	**95 % limits of agreement (minutes)**	**Range (minutes)**
Sedentary time weekday	49.1 (-50.5 to 148.7)	-324.7 to 422.9	37.5 to 550.0
Sedentary time Saturday	108.6 (-22.7 to 239.8)	-384.2 to 601.3	7.5 to 675.0
Screen time weekday	34.0 (-38.7 to 106.6)	-302.2 to 370.1	15.0 to 418.0
Screen time Saturday	77.9 (-14.8 to 170.5)	-339.9 to 495.7	0.0 to 660.0

Graph 8.14 Bland-Altman Plot of total child reported sedentary time on weekday before AFLY5 intervention and repeated two weeks later



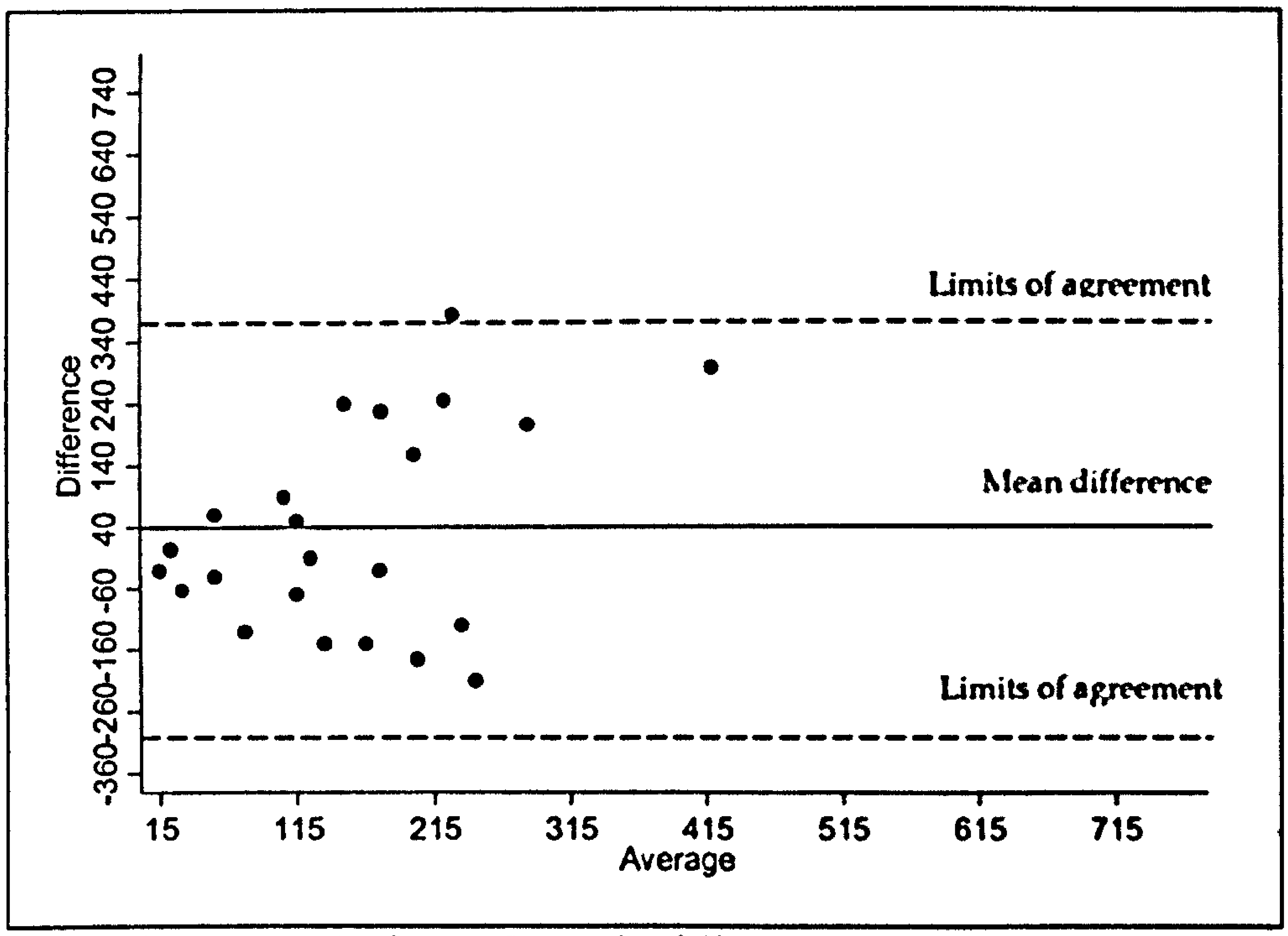
Limits of agreement (Reference Range for difference): -324.7 to 422.9
Mean difference: 49.1 (CI -50.5 to 148.7) Range : 37.5 to 550.0

Graph 8.15 Bland-Altman Plot of total child reported sedentary time the previous Saturday before AFLY5 intervention and repeated two weeks later



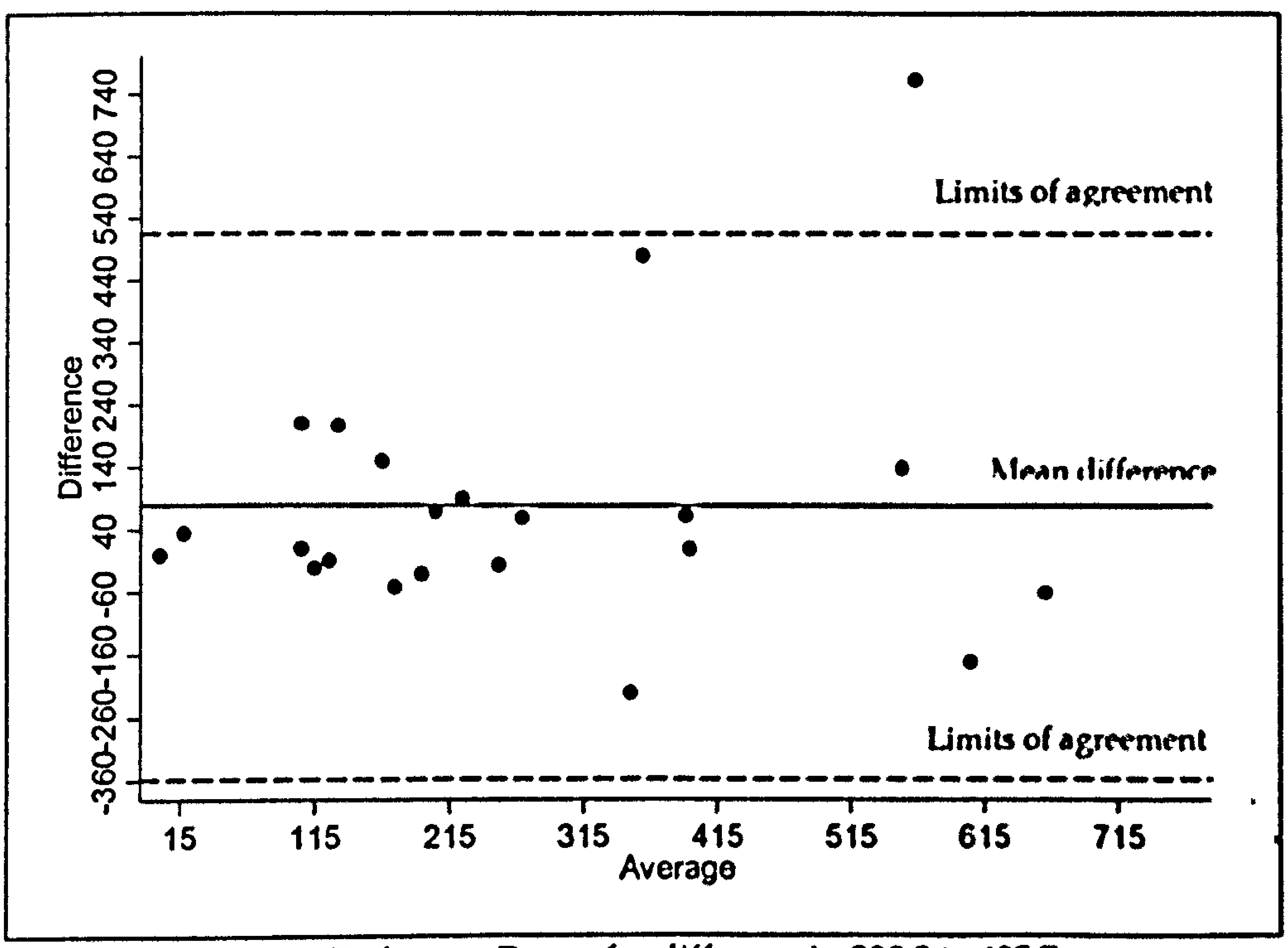
Limits of agreement (Reference Range for difference): -384.2 to 601.3
Mean difference: 108.6 (CI -22.7 to 239.8) Range : 7.5 to 675.0

Graph 8.16 Bland-Altman Plot of total child reported screen time the previous weekday before AFLY5 intervention and repeated two weeks later



Limits of agreement (Reference Range for difference): -302.2 to 370.1
Mean difference: 34.0 (CI -38.7 to 106.6) Range : 15.0 to 418.0

Graph 8.17 Bland-Altman Plot of total child reported screen time the previous Saturday before AFLY5 intervention and repeated two weeks later



Limits of agreement (Reference Range for difference): -339.9 to 495.7
Mean difference: 77.9 (CI -14.8 to 170.5 Range : 0.0 to 660.0

Categories of time spent screen viewing were created. Cross tabulations of the categories of time spent screen viewing at baseline 1 and 2 are shown for weekdays in Table 8.10 and for Saturdays in Table 8.11. Overall 34.8% of categories at the second measurement agreed with those at the first measurement on weekdays and 77% on Saturdays. Most children at both time points were categorised as watching 2+ hours with levels of agreement being 53.8% on weekdays and 83.3% for this category on Saturdays. The kappa statistic was calculated to test the reproducibility of agreement between replicate measurements taken at different points in time.[39] The kappa statistic for the measurements on a weekday was very low at -0.05, which shows no agreement. The kappa statistic for the measurements on a Saturday was 0.41, which shows a fair level of agreement, however this is at the lower limit of 'fair agreement'.[39]

Table 8.10 Hours of child reported screen viewing (TV and computer) before AFLY5 intervention and repeated two weeks later on weekdays (n=23)

		Before AFLY5 intervention measurement 1				
		0 hour	>0 <1 hour	>=1 <2 hours	2+ hours	Total
Before AFLY5 intervention measurement 2	0 hour	0	1	1	0	2
	>0 <1 hour	0	1	1	1	3
	>=1 <2 hours	0	1	0	4	5
	2+ hours	0	2	4	7	13
	Total	0	5	6	12	23

Table 8.11 Hours of child reported screen viewing (TV and computer) before AFLY5 intervention and repeated two weeks later on Saturdays (n=22)

		Before AFLY5 intervention measurement 1				
		0 hour	>0 <1 hour	>=1 <2 hours	2+ hours	Total
Before AFLY5 intervention measurement 2	0 hour	1	1	0	1	3
	>0 <1 hour	0	0	0	1	1
	>=1 <2 hours	0	0	1	1	2
	2+ hours	0	0	1	15	16
	Total	1	1	2	18	22

Assessment of inter-rater reliability of the sedentary activity questionnaire

In six schools both parents (proxy report) and children were asked to complete the sedentary behaviour questionnaire to assess inter-rater reliability. 127 parents completed the questionnaire at baseline and 97 at follow-up. Table 8.12 shows the number of parents and children by school with completed questionnaires at baseline and follow-up.

Table 8.12 Number of parents and children who completed the sedentary activity questionnaire at baseline and follow-up

	Number of parents		Number of children	
School ID	Before	After	Before	After
30	17	8	30	27
31	37	36	44	50
33	26	17	34	31
34	15	14	43	33
37	19	14	34	32
38	13	8	28	9
Total	127	97	213	182

For the child reported data there were a small number of very high values and outliers were removed for each period as outlined above: before school maximum time of 3 hours = 180 minutes; after school maximum time of 9 hours = 540 minutes; Saturday maximum time of 18 hours = 1080 minutes. For the parent proxy reported data there was only one value which exceeded these maximum times and it was talking before school (one value at 190 minutes). This was excluded from analysis of the parent reported data. The reported median, minimum and maximum values for each variable are presented by parent report and child report in Table 8.14 for the 90 children before the AFLY5 intervention with a parent completed questionnaire. The total time in minutes spent in sedentary and screen activities before and after the intervention reported by the child and parent excluding outliers is shown in Table 8.13 (there were fewer children excluded for screen activities than total sedentary time). The median sedentary and screen time were higher by parent proxy report than the child reported time, particularly for screen viewing on Saturday.

Table 8.13 Total time in minutes spent in sedentary activities before AFLY5 intervention reported by the child and parent excluding outliers

	Parent reported			Child reported		
Activity	**N**	**Median (IQR)**	**Range min, max**	**N**	**Median (IQR)**	**Range min, max**
Total sedentary weekday[a]	56	290 (180, 370)	55, 685	56	200 (105, 322)	10, 670
Total sedentary Saturday[a]	68	443 (298, 585)	0, 1080	68	330 (177, 515)	3, 886
Total screen weekday	90	120 (60,180)	0, 810	90	78 (30, 150)	0, 490
Total screen Saturday	93	435 (295, 595)	0, 1080	93	150 (60, 240)	0, 721

[a] weekday total times restricted to: weekday <=720, Saturday <=1080

Table 8.14 Child and parent reported median time spent in sedentary behaviours before intervention for 90 children with parent data

	Parent reported values for child reported before intervention n=90						Child reported values for baseline before intervention n=90					
	Before school		After school		Saturday		Before school		After school		Saturday	
	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max	Median (IQR)	min, max
TV, DVDs or Videos	10 (0,30)	0,90	60 (30,120)	0,300	120 (60,180)	0,360	0 (0,30)	0 , 130	30 (3,65)	0, 300	90 (20,180)	0, 1410
Computer games	0 (0,0)	0,150	0 (0,30)	0,240	30 (0,70)	0,180	0 (0,0)	0, 180	0 (0,30)	0, 240	11 (0,60)	0, 305
Computer	0 (0,0)	0,30	0 (0,30)	0,240	0 (0,30)	0,330	0 (0,0)	0, 90	0 (0,10)	0, 130	0 (0,30)	0, 260
Homework	0 (0,0)	0,90	10 (0,30)	0,75	15 (0,45)	0,130	0 (0,2)	0, 110	0 (0,5)	0, 180	3 (0,30)	0, 290
Indoor games	0 (0,0)	0,60	30 (0,60)	0,180	60 (0,120)	0,360	0 (0,1)	0, 305	0 (0,15)	0, 299	2.5 (0,32.5)	0, 720
Talking	10 (0,30)	0,180	30 (18,60)	0,330	60 (30,120)	0,510	5 (0,20)	0, 240	10 (0,50)	0, 480	10 (0,70)	0, 480
Phone or text	0 (0,0)	0,15	0 (0,0)	0,60	0 (0,0)	0,180	0 (0,0)	0, 80	0 (0,0)	0, 230	0 (0,3)	0, 180
Listening to music	0 (0,0)	0,60	0 (0,13)	0,75	10 (0,30)	0,180	0 (0,5)	0, 900	3 (0,20)	0, 600	4 (0,30)	0, 480
Playing music	0 (0,0)	0,15	0 (0,0)	0,30	0 (0,10)	0,75	0 (0,0)	0, 60	0 (0,2)	0, 126	0 (0,10)	0, 120
Reading	0 (0,0)	0,30	30 (5,30)	0,120	20 (0,30)	0,120	0 (0,10)	0, 390	5 (0,30)	0, 360	5 (0,30)	0, 189
Art and craft	0 (0,0)	0,30	0 (0,5)	0,120	0 (0,30)	0,155	0 (0,0)	0, 180	0 (0,5)	0, 240	0 (0,20)	0, 425
Other	0 (0,0)	0,60	0 (0,30)	0,240	10 (0,90)	0,360	0 (0,10)	0, 300	60 (0,120)	0, 480	90 (0,148)	0, 977

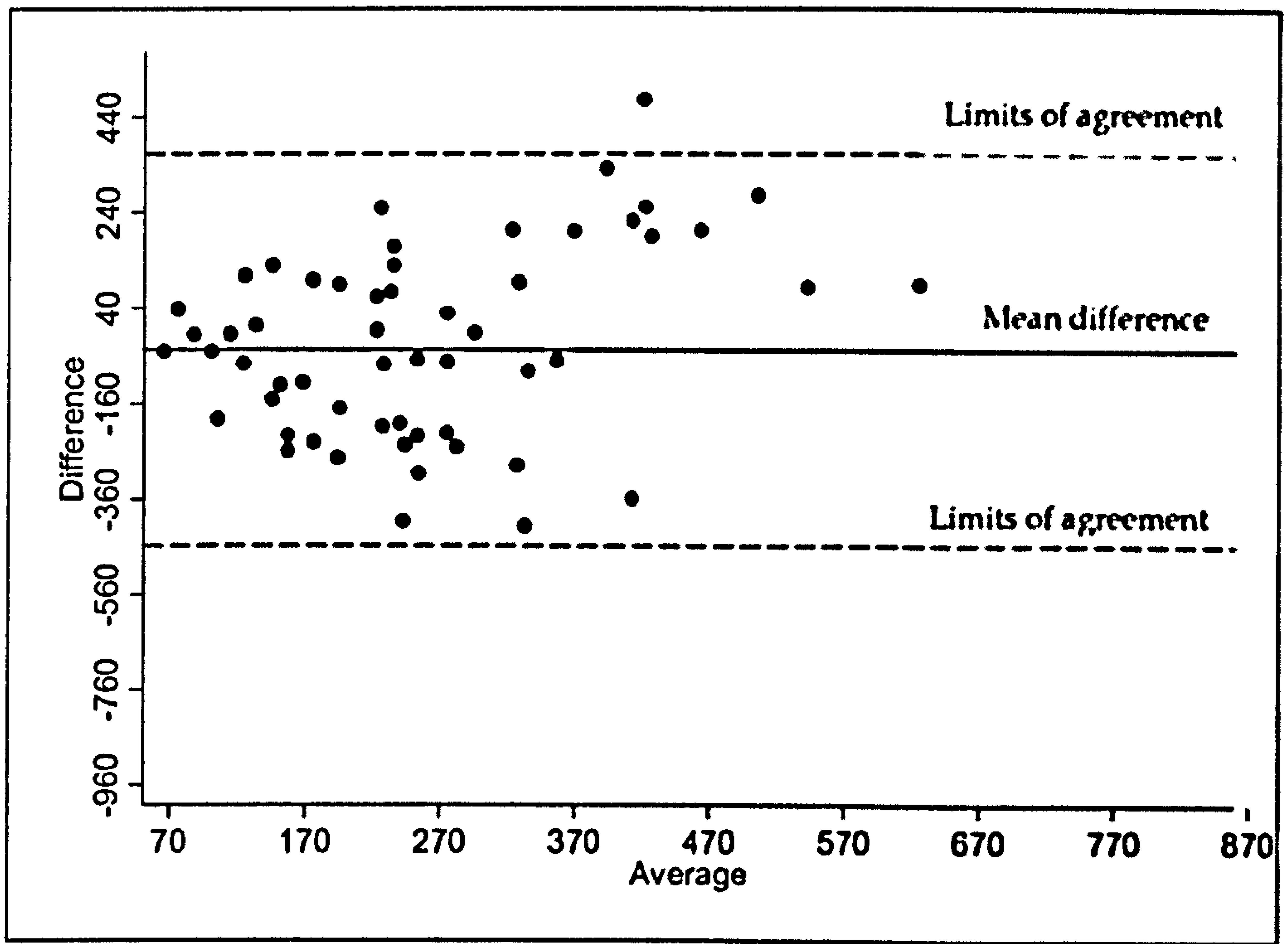
The difference between the child and parent proxy sedentary time and screen time were compared using a Bland-Altman plot, which plots the mean minutes of child and parent reported time against the difference between the two values. Graph 8.18 shows that on average the mean difference of total sedentary time reported by children and parents on weekdays was -46.8 minutes (95% CI -101.7 to 8.1 minutes) and 95% of the sample had a difference in values of between 75.0 to 632.5 minutes. The Bland-Altman plots for sedentary time on Saturdays and for screen time on weekdays and Saturdays are shown in Graph 8.19 to Graph 8.21 and summarised in Table 8.15. The plots show a similar pattern of large differences between the two time points and evidence that the difference increased with increasing mean time.

Table 8.15 Analysis of mean difference by child report and parent proxy report for sedentary and screen time measured by the sedentary behaviour questionnaire on weekdays and Saturdays

	Mean difference of minutes child-parent (95% CI)	**95 % limits of agreement (minutes)**	**Range (minutes)**
Sedentary time weekday	-46.8 (-101.7 to 8.1)	-456.7 to 363.1	75.0 to 632.5
Sedentary time Saturday	-104.0 (-180.9 to -27.2)	-739.0 to 530.9	92.5 to 845.0
Screen time weekday	-23.867 (-54.2 to 6.4)	-313.2 to 265.5	0.0 to 465.0
Screen time Saturday	-286.0 (-341.8 to -230.1)	-828.2 to 256.3	20.0 to 645.0

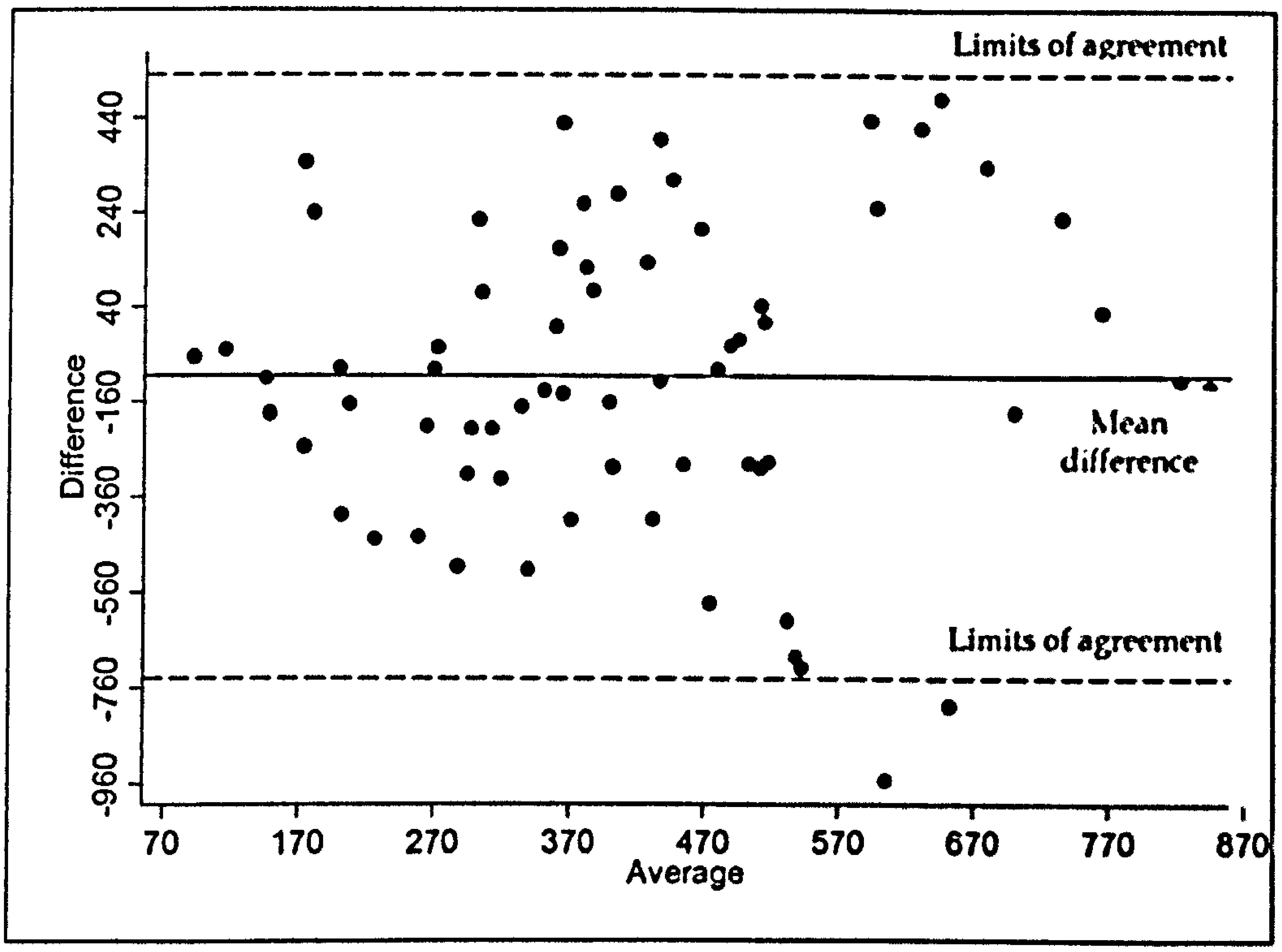
Table 8.16 shows the child free text answers to 'other activities' on the sedentary behaviour questionnaire, and Graph 8.22 to Graph 8.33 show the children's enjoyment of sedentary activities.

Graph 8.18 Bland-Altman plot of parent and child reported total sedentary time on weekday before AFLY5 intervention



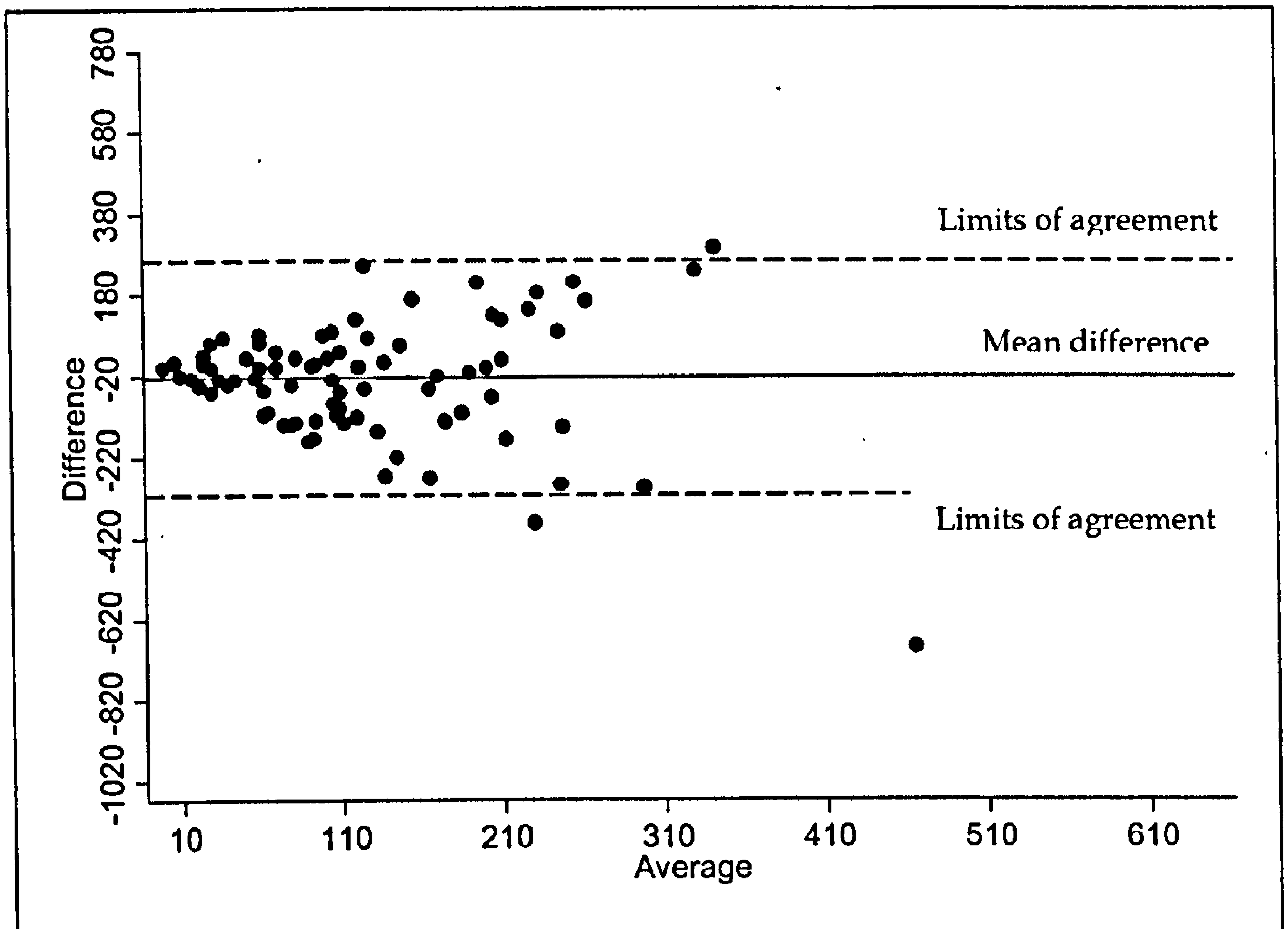
Limits of agreement (Reference Range for difference): -456.7 to 363.1
Mean difference: -46.8 (CI -101.7 to 8.1) Range : 75.0 to 632.5

Graph 8.19 Bland-Altman plot of parent and child reported sedentary time on Saturday before AFLY5 intervention



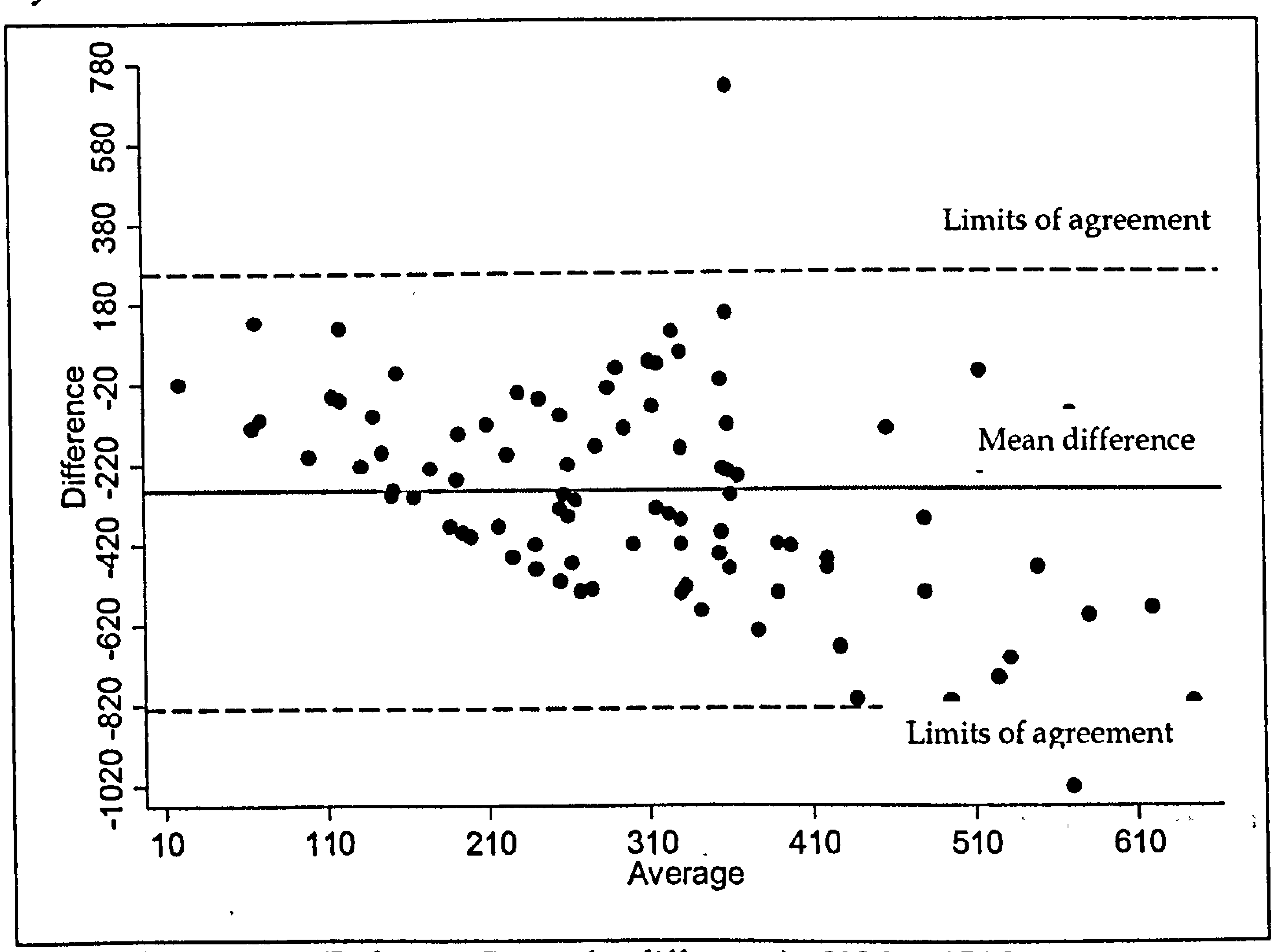
Limits of agreement (Reference Range for difference): -739.0 to 530.9
Mean difference: -104.0 (CI -180.9 to -27.199) Range : 92.5 to 845.0

Graph 8.20 Bland-Altman plot of parent and child report of total weekday screen time before AFLY5 intervention



Limits of agreement (Reference Range for difference): -313.2to 265.5
Mean difference: -23.9 (CI -54.2 to 6.4) Range : 0.000 to 465.0

Graph 8.21 Bland-Altman plot of parent and child reported screen time on Saturday before AFLY5 intervention



Limits of agreement (Reference Range for difference): -828.2 to 256.3
Mean difference: -286.0 (CI -341.8 to -230.1) Range : 20.000 to 645.0

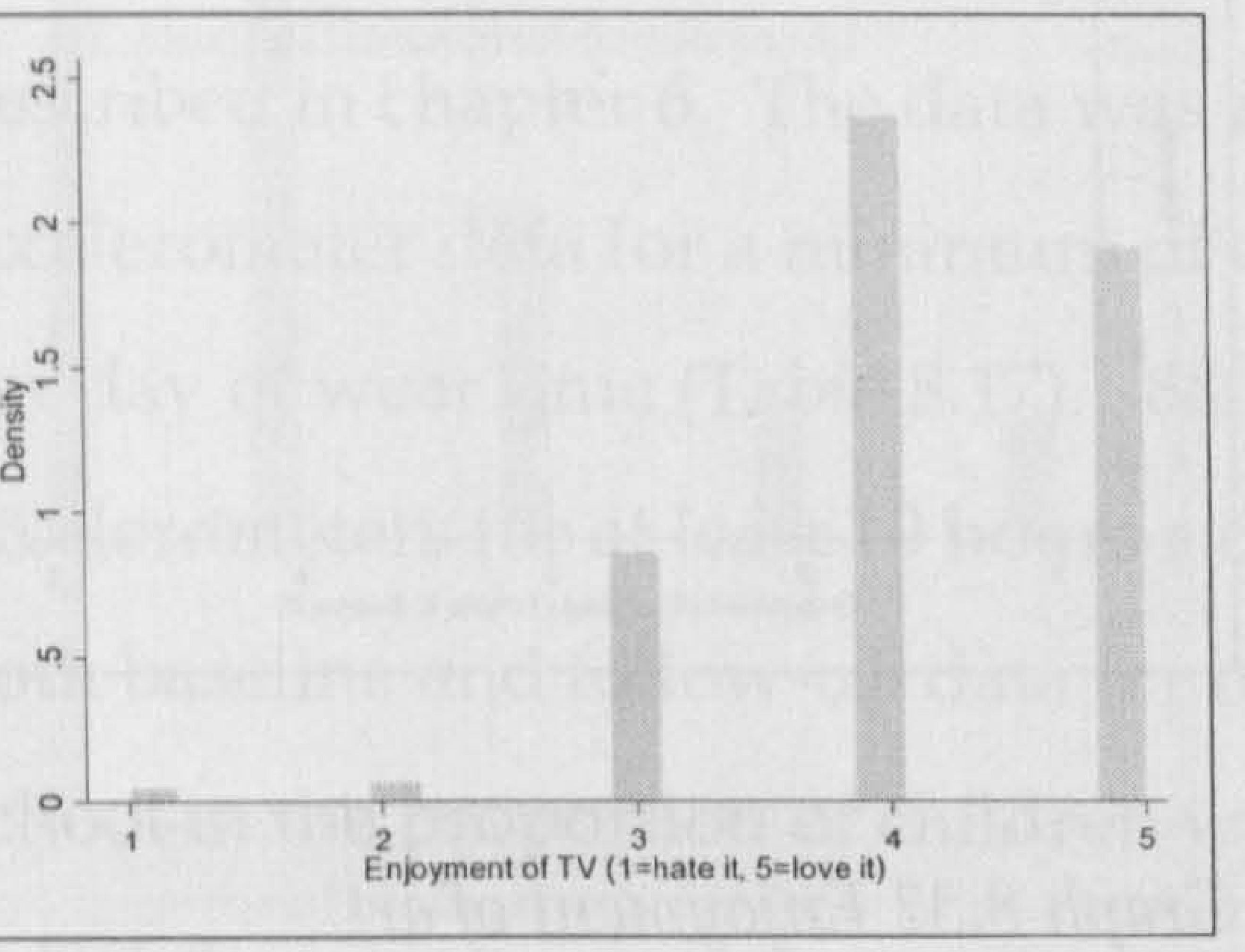
Table 8.16 Frequency of free text data about 'other activities' measured using the sedentary behaviours questionnaire

Activity	Frequency	Percentage[a]
Sport		
Sport (gym, athletics, fishing, horse riding, kick boxing, rugby, tennis, jogging, running, trampolining)	70	19.28%
Football	64	17.63%
Bike	23	6.34%
Swimming	19	5.23%
Dance (including ballet)	13	3.58%
Playing		
Playing outside (den making, park, skateboard, skipping, garden)	44	12.12%
With friends/family (activity not described)	22	6.06%
Play with pet (rabbit, dog)	17	4.68%
Playing inside (dolls house, chess, hide and seek)	11	3.03%
Playing (not specified)	2	0.55%
Other non-sedentary activities		
Club (Brownies, drama)	11	3.03%
Shopping	7	1.93%
Car/motorbike/quad biking	5	1.38%
Cooking	5	1.38%
Singing	3	0.83%
Party	1	0.28%
Activities covered by questionnaire		
DS or Wii	9	2.48%
Playing on computer	8	2.20%
Drawing	4	1.10%
Homework (handwriting, maths)	4	1.10%
TV	3	0.83%
Playing music	3	0.83%
Film	2	0.55%
XBOX	2	0.55%
Play station	2	0.55%
On phone	1	0.28%
Sedentary activities not covered by questionnaire		
Travelling	1	0.28%
Sit silently	1	0.28%
Activities not categorised		
Match Attax	1	0.28%
Mosic	1	0.28%
Saterday band	1	0.28%
Skate levels	1	0.28%
Sleep	1	0.28%

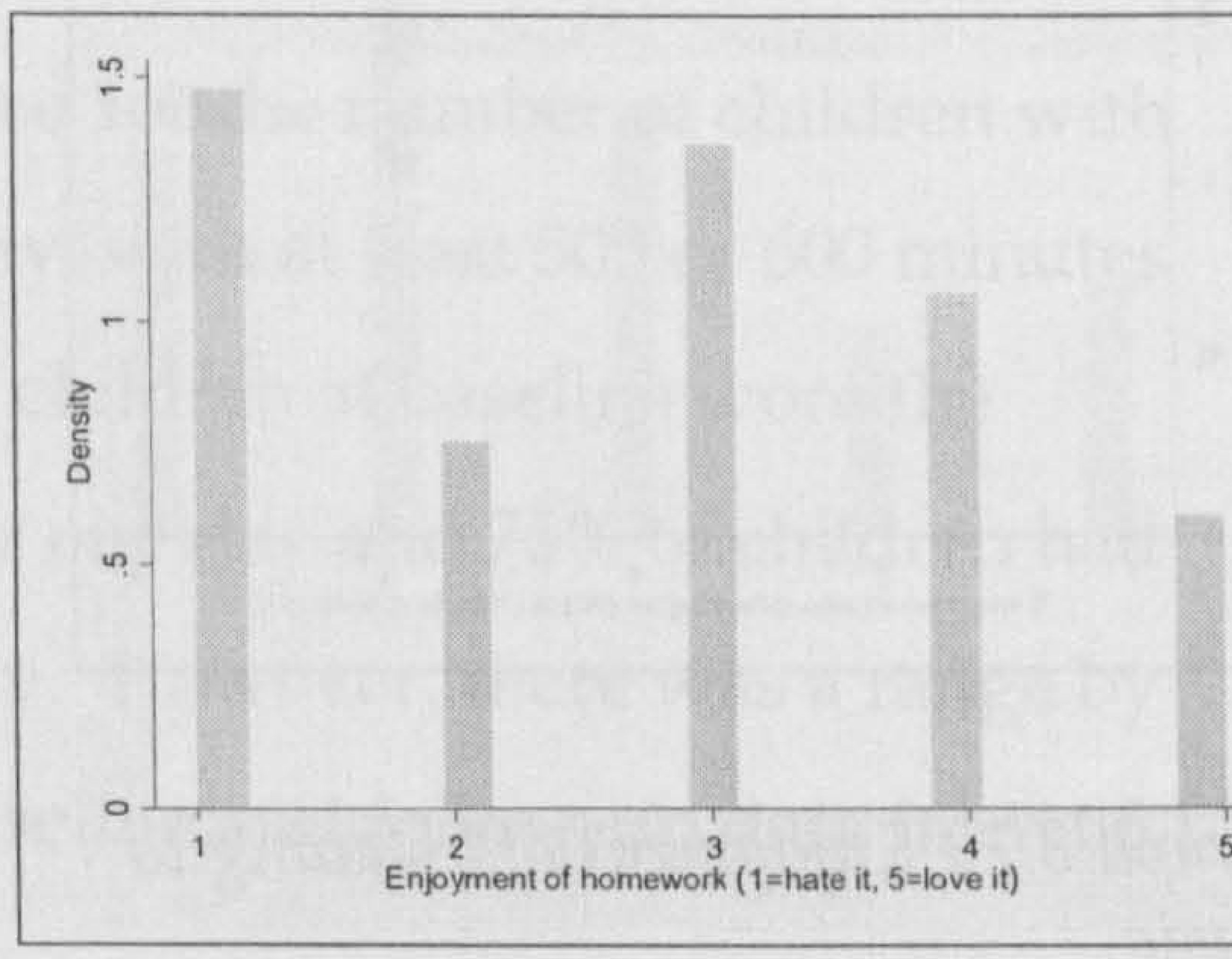
[a] Percentage of total entries for 'other activities'

Child reported enjoyment of sedentary behaviours in sedentary behaviour questionnaire before AFLY5 intervention

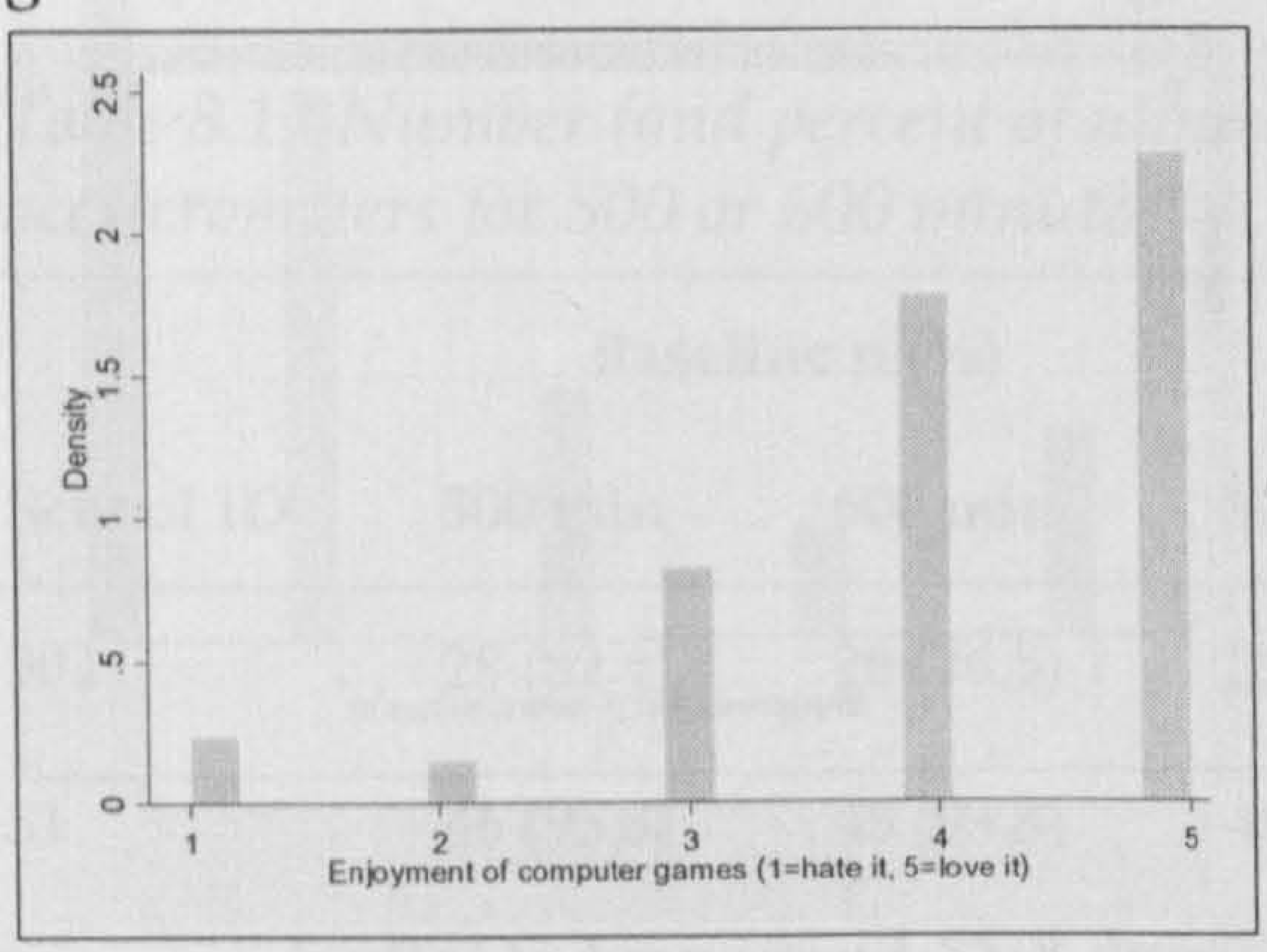
Graph 8.22 Enjoyment of TV



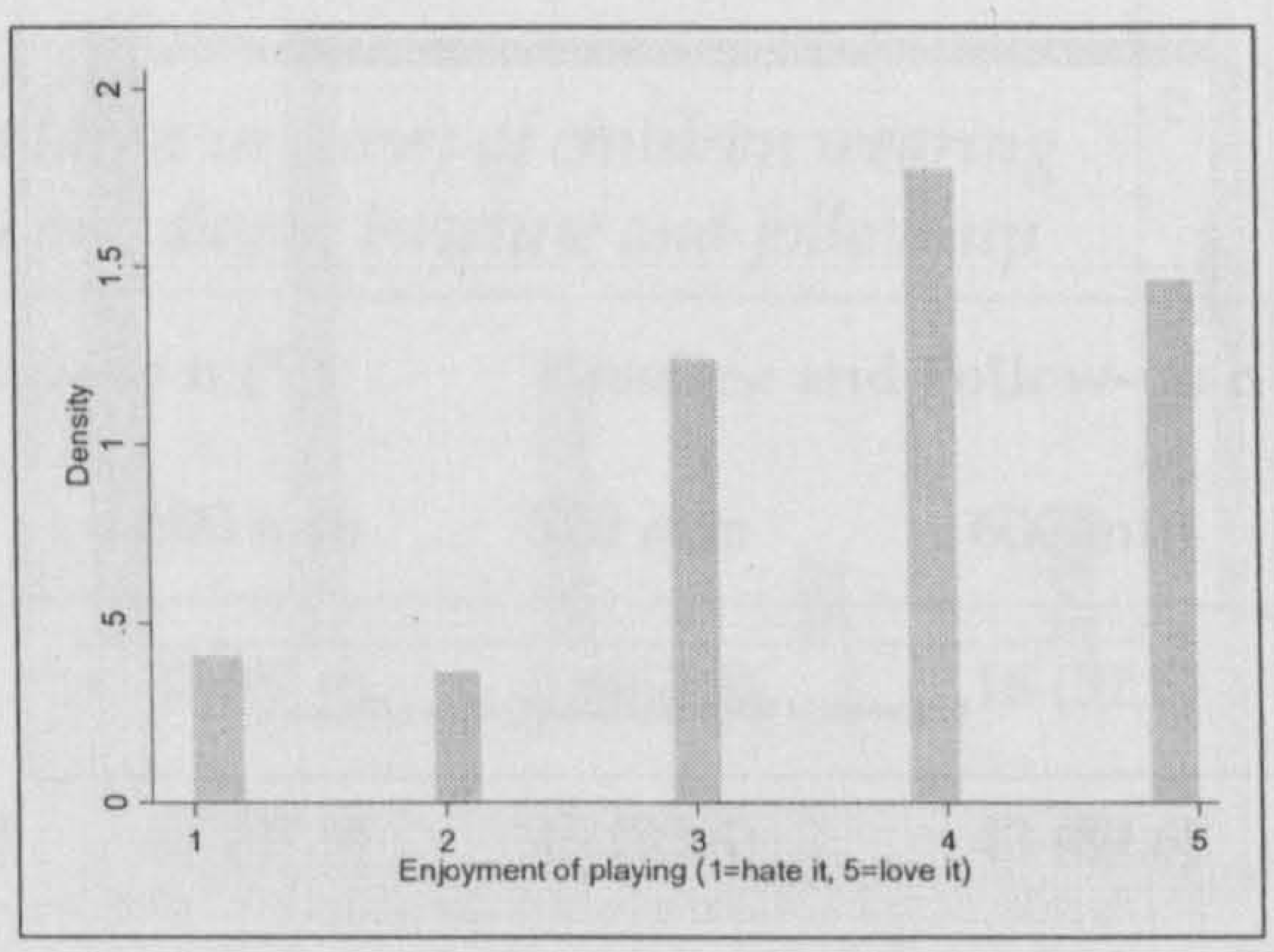
Graph 8.25 Enjoyment of homework



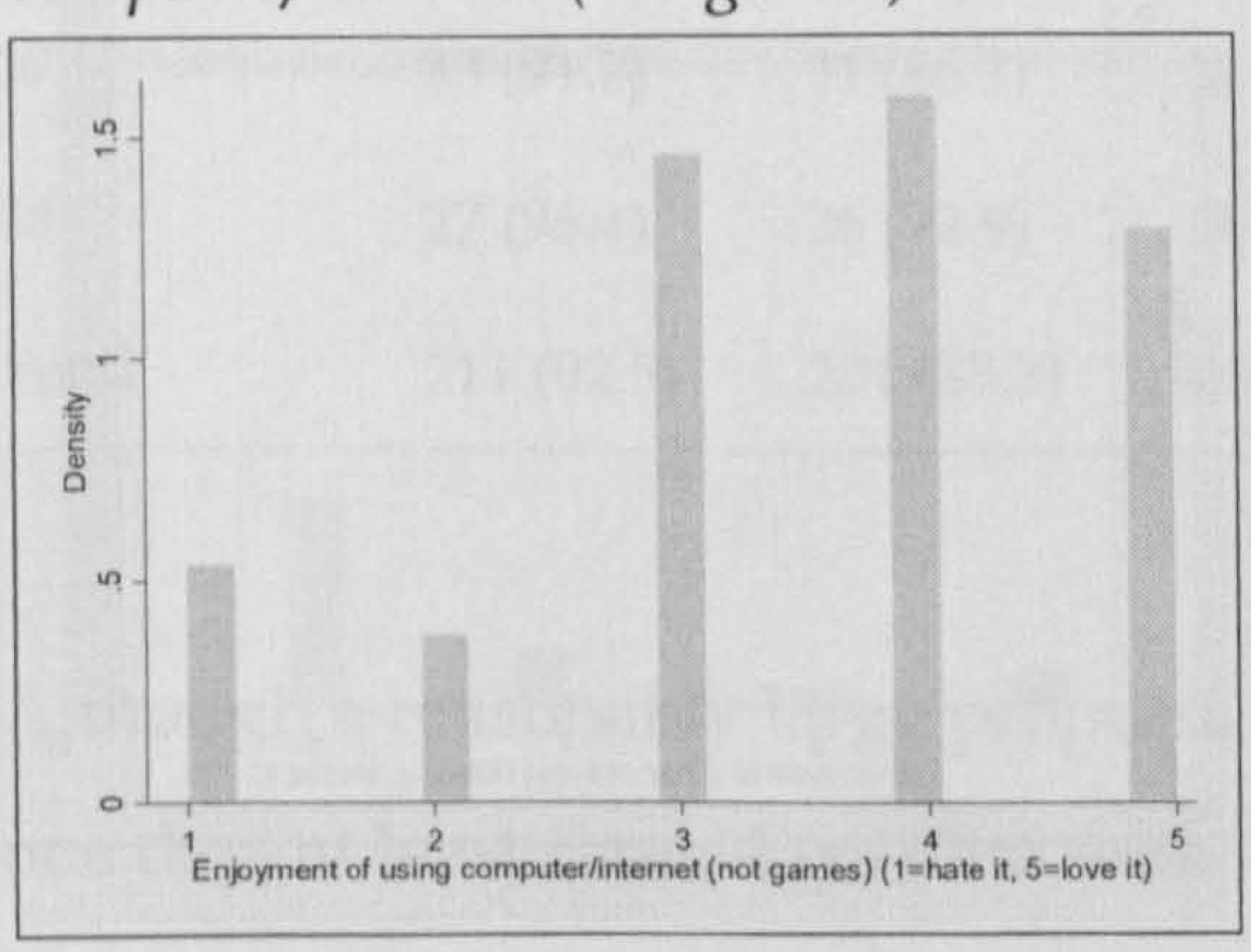
Graph 8.23 Enjoyment of computer games



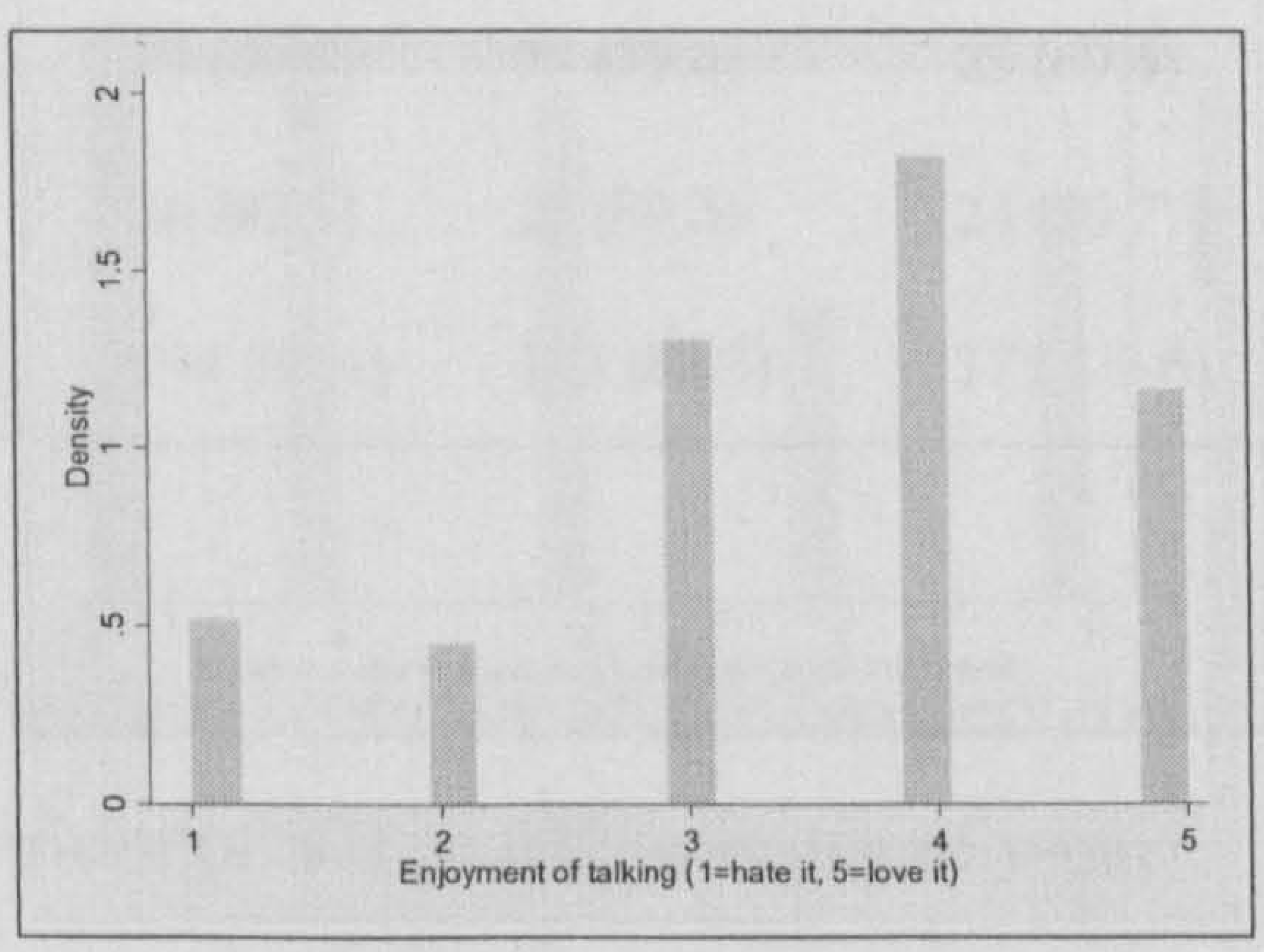
Graph 8.26 Enjoyment of playing



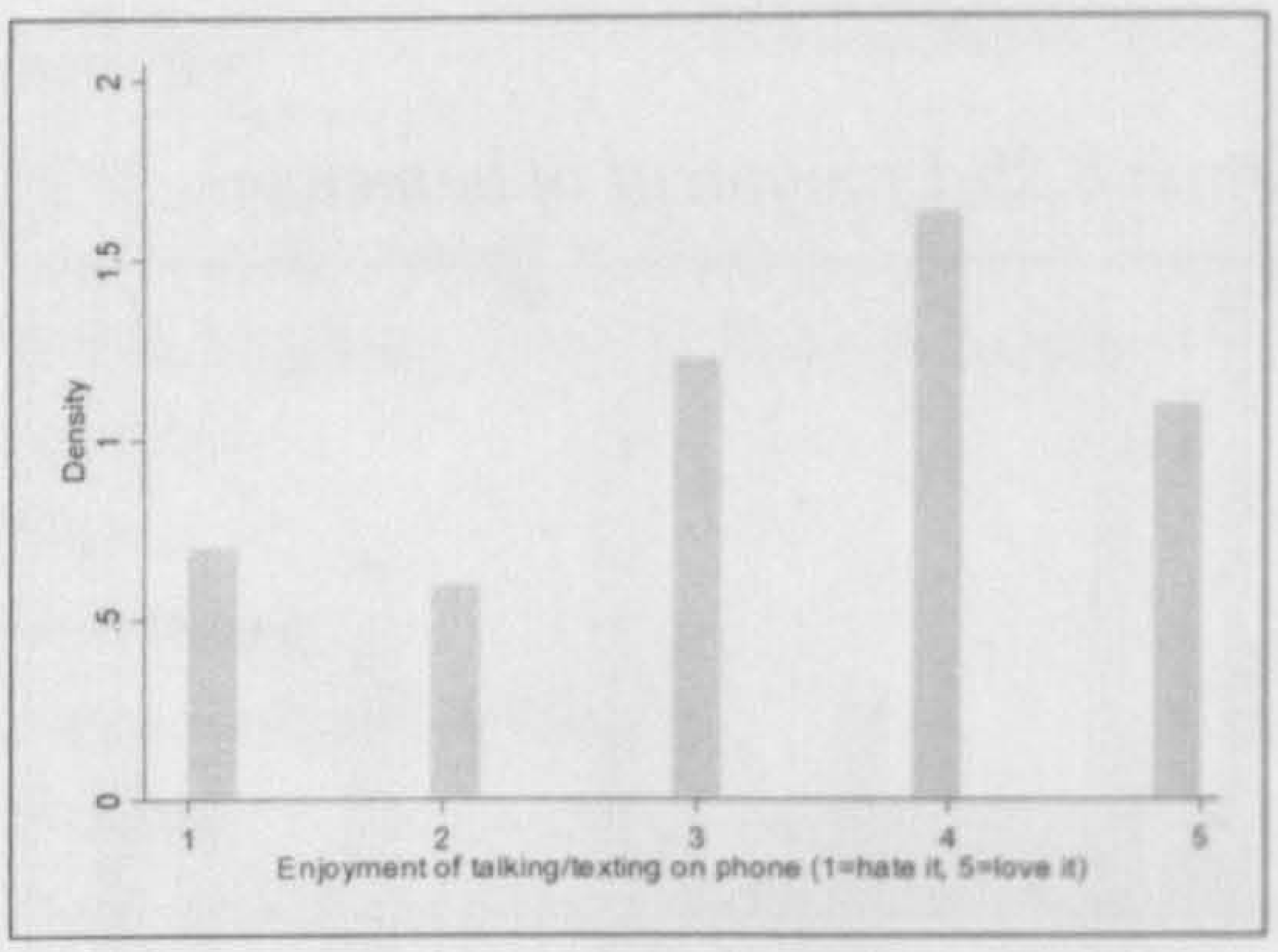
Graph 8.24 Enjoyment of computer/internet (not games)



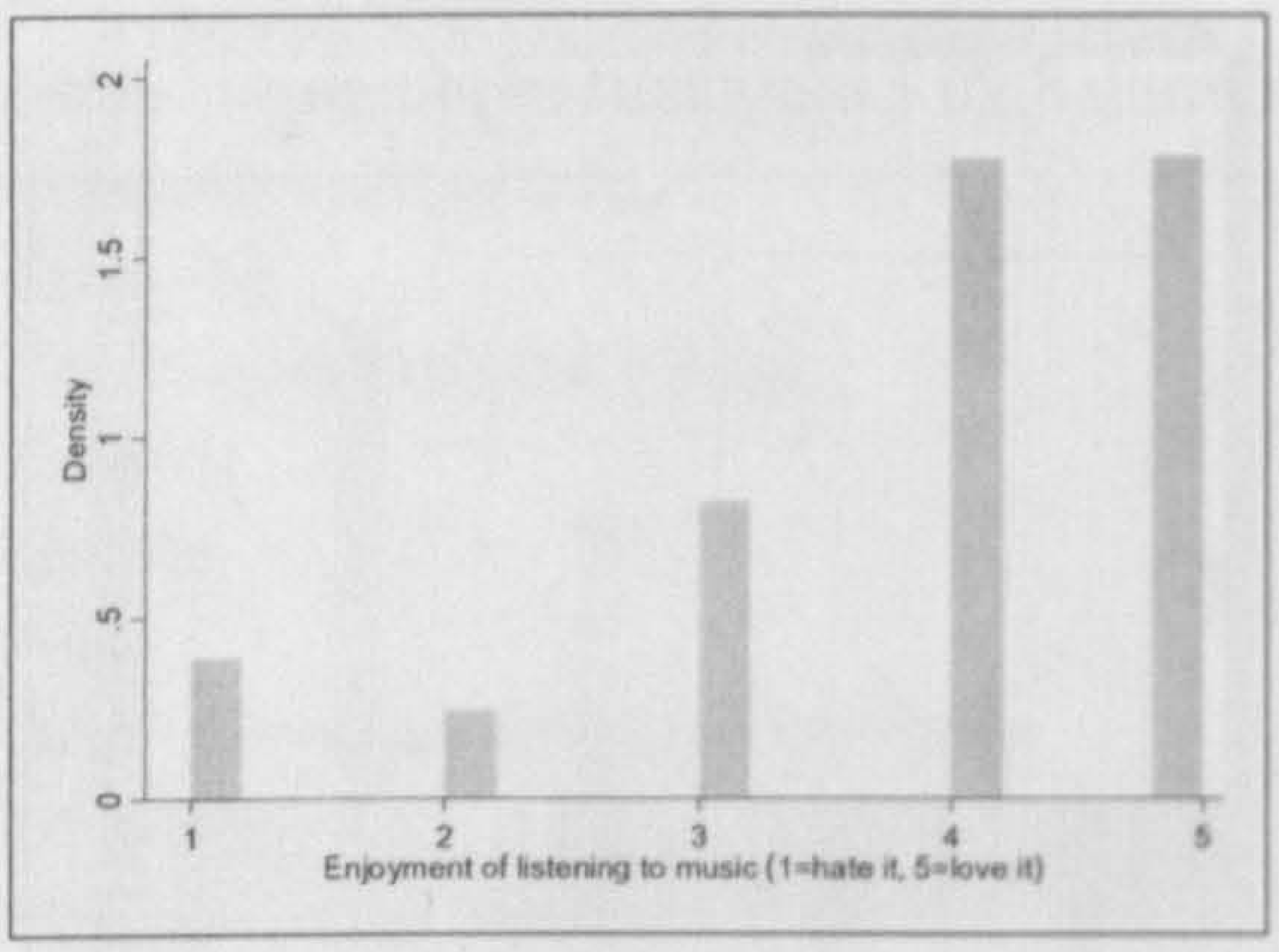
Graph 8.27 Enjoyment of talking



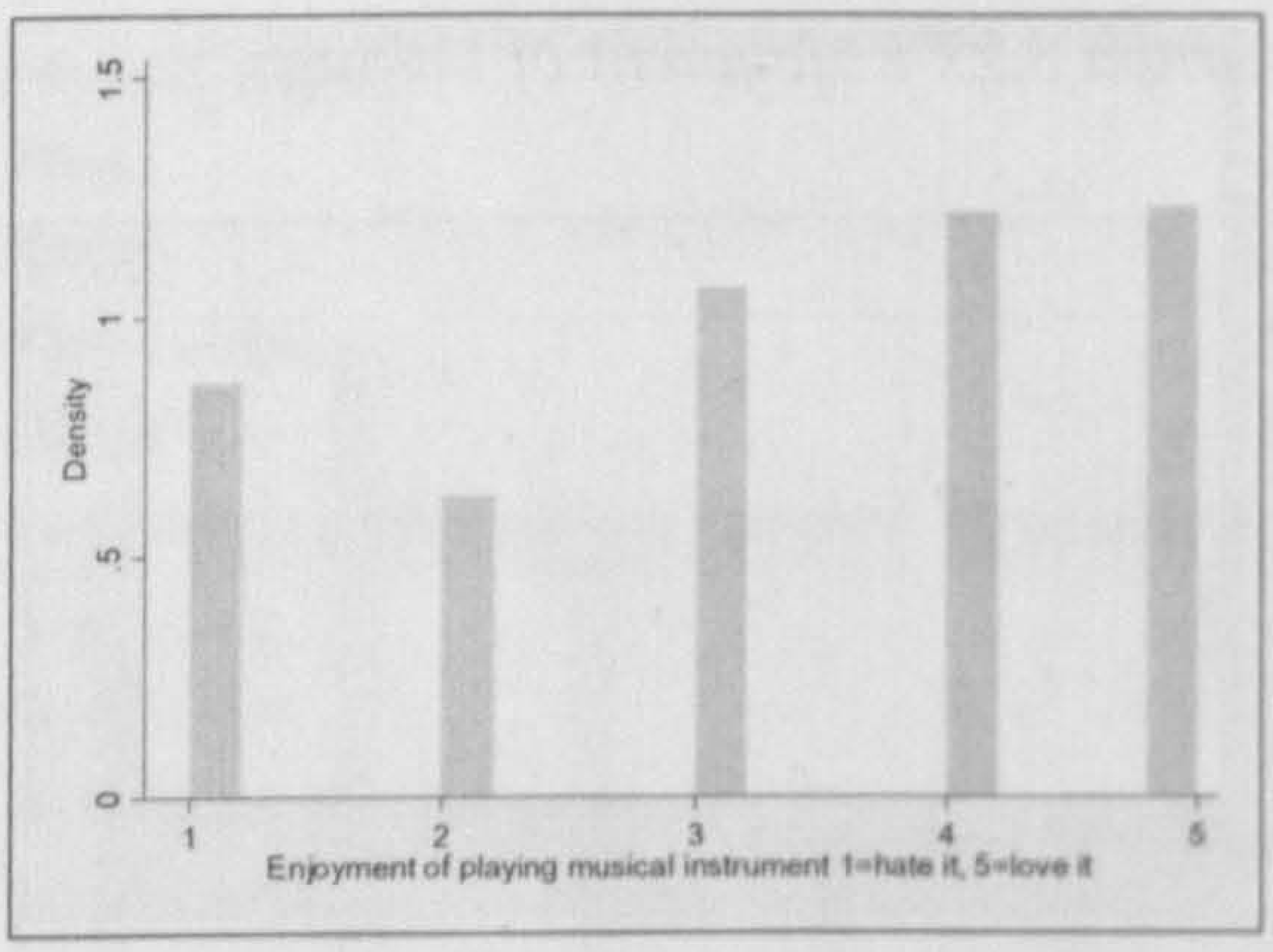
Graph 8.28 Enjoyment of talking on phone



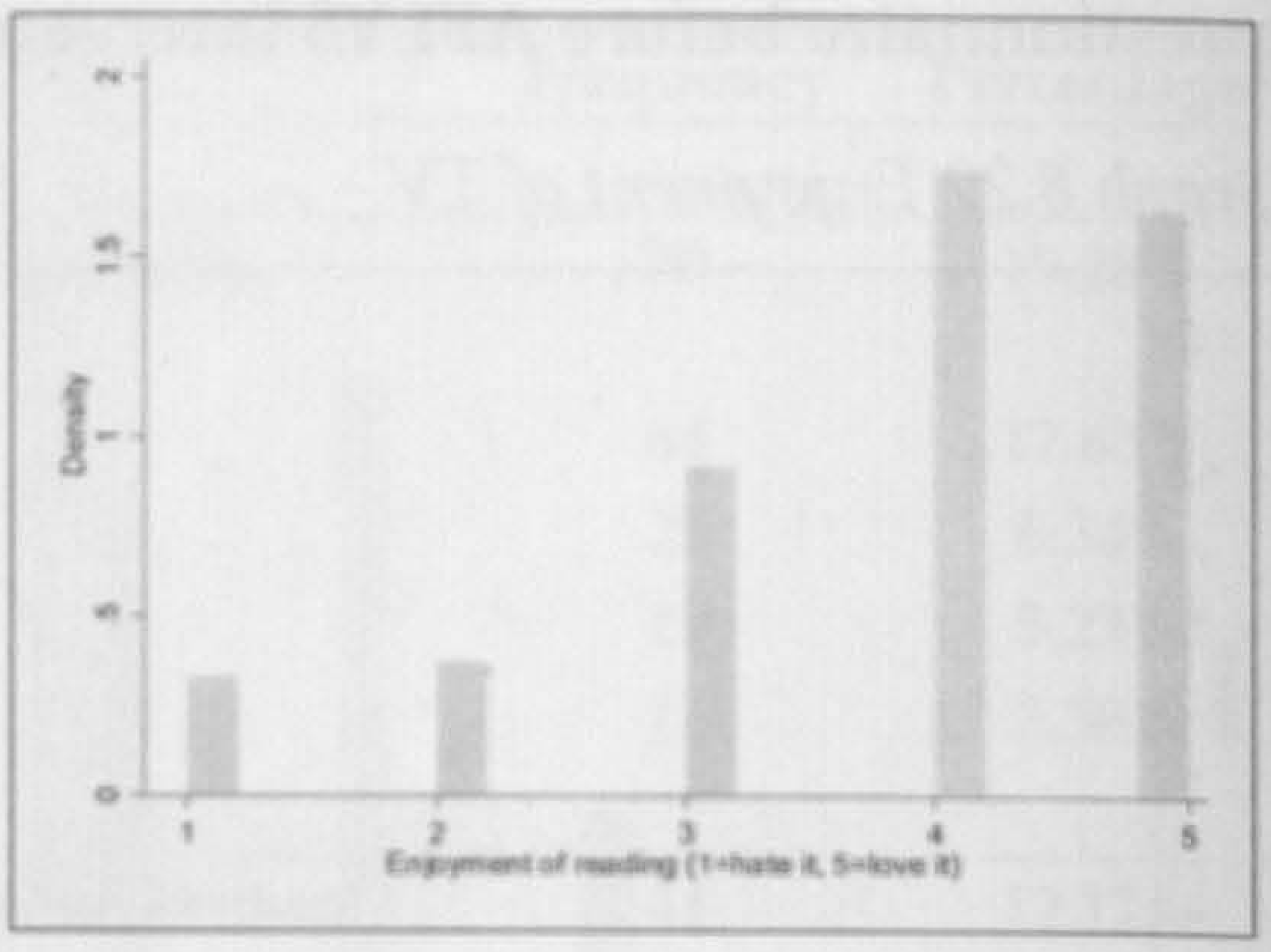
Graph 8.29 Enjoyment of listening to music



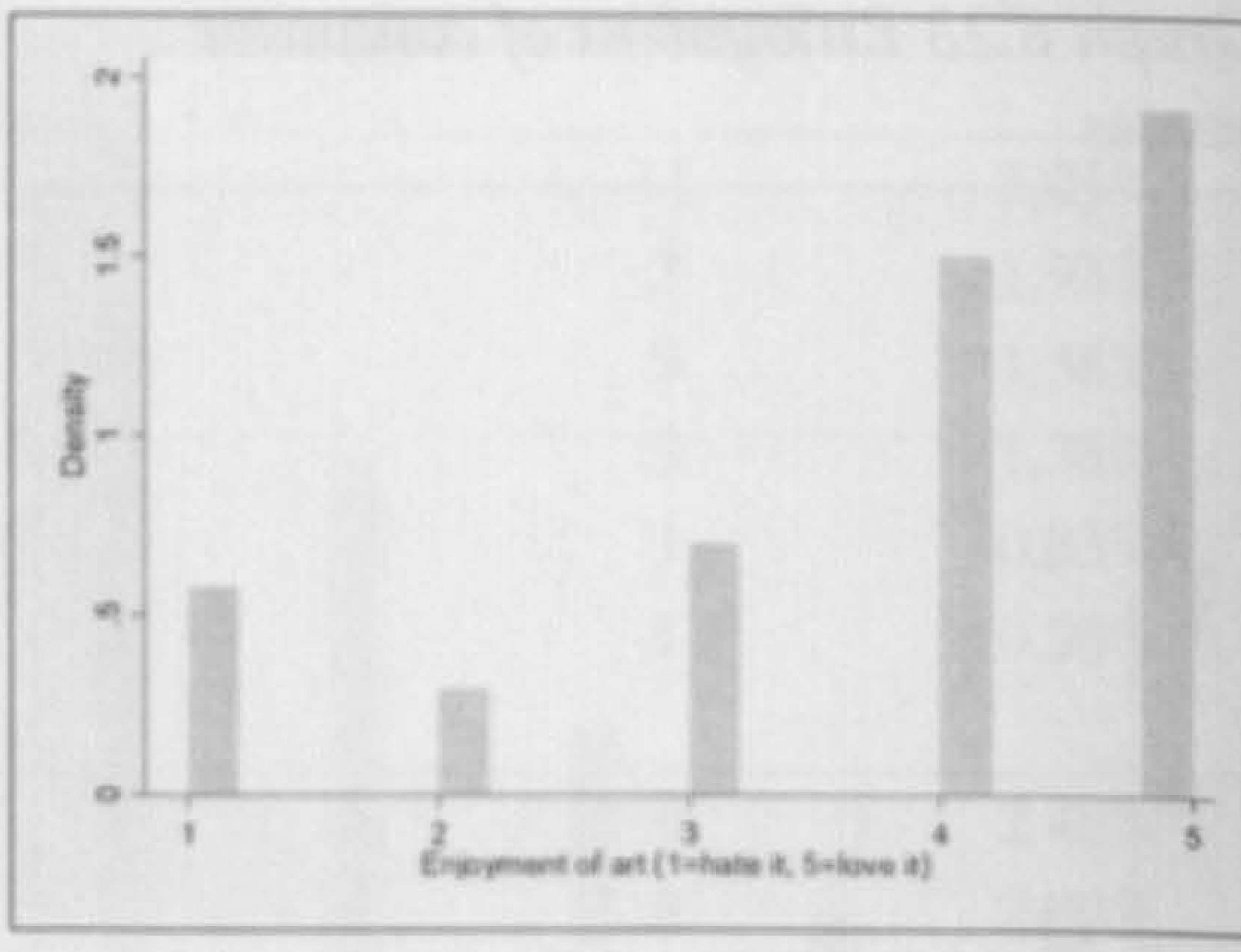
Graph 8.30 Enjoyment of playing music



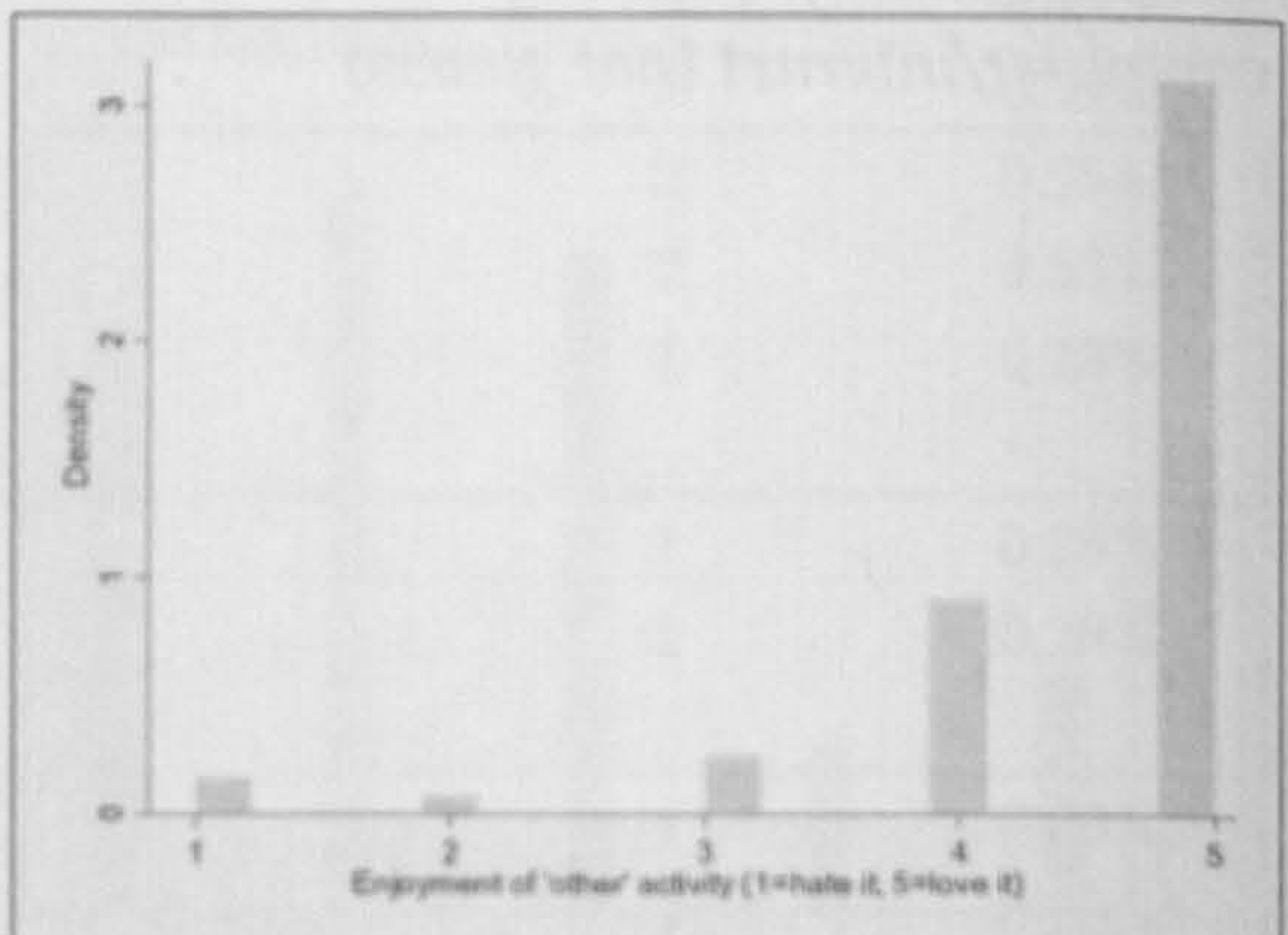
Graph 8.31 Enjoyment of reading



Graph 8.32 Enjoyment of art



Graph 8.33 Enjoyment of 'other' activity



Sedentary time measured using accelerometers

Sedentary time was also measured using accelerometers with children in six schools at baseline and follow-up. The methods used to analyse the data are described in chapter 6. The data was assessed for the number of children with accelerometer data for a minimum of one day, with at least 500 or 600 minutes per day of wear time (Table 8.17). 88.2% of children at baseline wore the accelerometers for at least 10 hours a day for one day and 75% of children had both baseline and follow-up data for one day. However, there was a range by school in the proportion of children with baseline and follow-up data from 65.1% to 89.6%.

Table 8.17 Number (and percent of number of children in class) of children wearing accelerometers for 500 or 600 minutes on at least one day at baseline and follow-up

	Baseline n (%)		Follow-up n (%)		Baseline and Follow-up n (%)	
School ID	500 min	600 min	500 min	600 min	500 min	600 min
30	28 (82.4)	26 (76.5)	25 (73.5)	23 (67.6)	21 (61.8)	18 (52.9)
31	46 (95.8)	45 (93.8)	48 (100.0)	47 (97.9)	45 (93.8)	43 (89.6)
33	36 (92.3)	35 (89.7)	39 (100.0)	38 (97.4)	34 (87.2)	33 (84.6)
34	41 (95.3)	38 (88.4)	32 (74.4)	31 (72.1)	31 (72.1)	28 (65.1)
37	33 (91.7)	31 (86.1)	30 (83.3)	29 (80.6)	27 (75.0)	25 (69.4)
38	27 (96.4)	26 (92.9)	26 (92.9)	26 (92.9)	25 (89.3)	24 (85.7)
Total	211 (92.5)	201 (88.2)	200 (87.7)	194 (85.1)	183 (80.3)	171 (75.0)

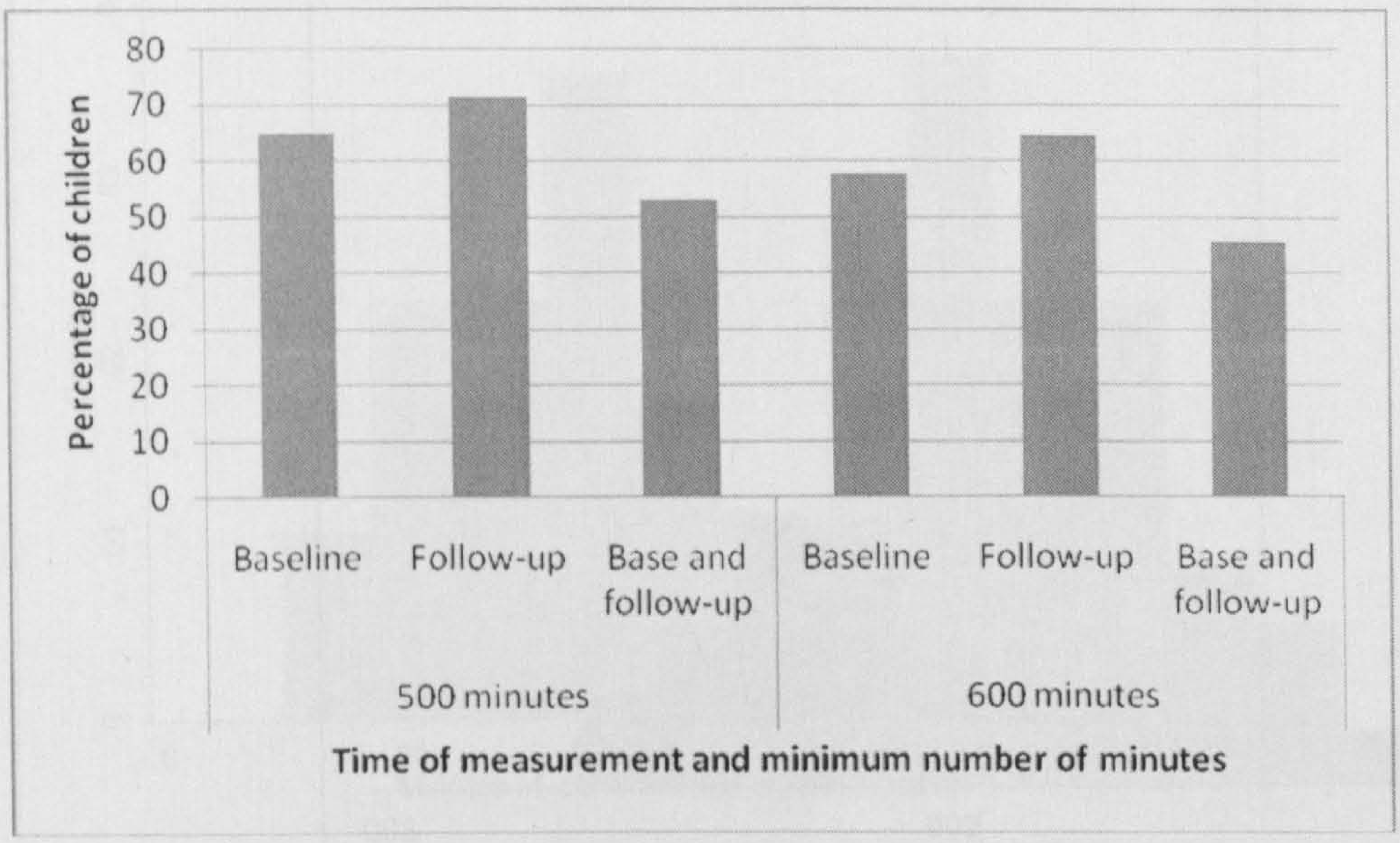
Although a reasonably large proportion of children wore the accelerometers for one day, at least three days data with a minimum of 500 or 600 minutes of wear time is required for the data to be a reliable measure of physical activity (as outlined in the methods section chapter 6). Therefore Table 8.18 shows the same data as shown in Table 8.17 but restricted to children with a minimum of three days of accelerometer data.

Graph 8.34 shows the percentage of children with baseline, follow-up and both baseline and follow-up accelerometer data. The restriction of a minimum of three days reduced the percentage of children with at least 600 minutes a day of wear time from 88.2% to 55.1% at baseline and from 75% to 43.6% for children with both baseline and follow-up data. Furthermore, there was a quite marked variation by school in the proportion of children with baseline and follow-up data (ranging from 23.5% to 62.0%).

Table 8.18 Number of children wearing accelerometers for at least 3 days and 500 or 600 minutes at baseline and follow-up by school

	Baseline		Follow-up		Baseline and Follow-up	
			n (%)			
School ID	500 min	600 min	500 min	600 min	500 min	600 min
30	16 (47.1)	13 (38.2)	14 (41.2)	11 (32.4)	11 (32.4)	8 (23.5)
31	37 (74.0)	34 (60.0)	44 (88.0)	43 (86.0)	34 (68.0)	31 (62.0)
33	23 (56.1)	21 (52.5)	33 (80.5)	28 (68.3)	20 (48.8)	15 (36.6)
34	30 (68.2)	27 (61.4)	26 (59.1)	22 (50.0)	23 (52.3)	21 (47.7)
37	20 (55.6)	15 (41.7)	24 (66.7)	22 (61.1)	15 (41.7)	11 (30.6)
38	20 (69.0)	19 (65.5)	22 (75.9)	20 (69.0)	16 (55.2)	16 (55.2)
Total	146 (62.4)	129 (55.1)	163 (69.7)	146 (62.4)	119 (50.9)	102 (43.6)

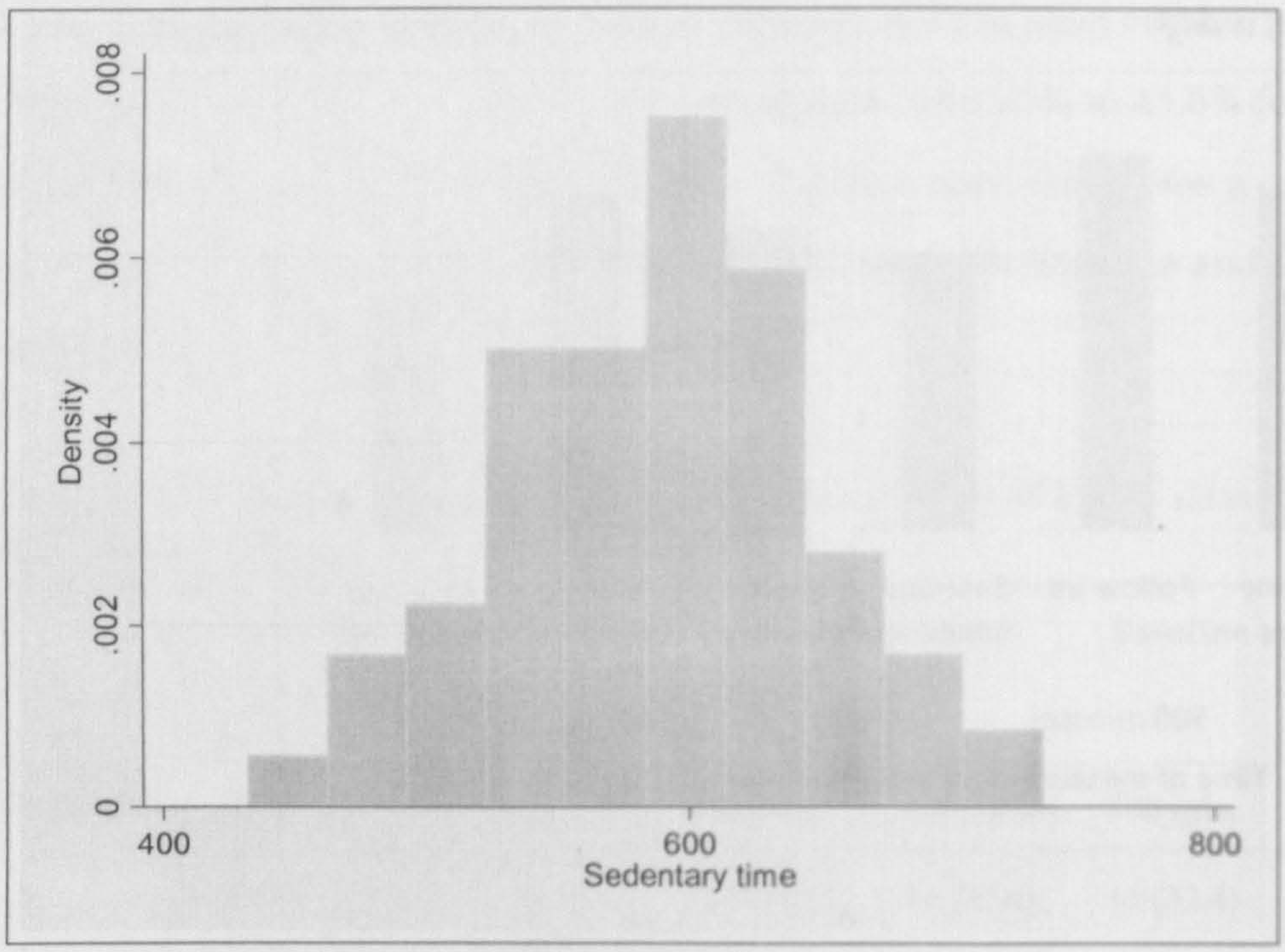
Graph 8.34 Percentage of children in all schools before and after intervention, for children with before and after accelerometer data for a minimum of 500 minutes and 600 minutes for a minimum of 3 days



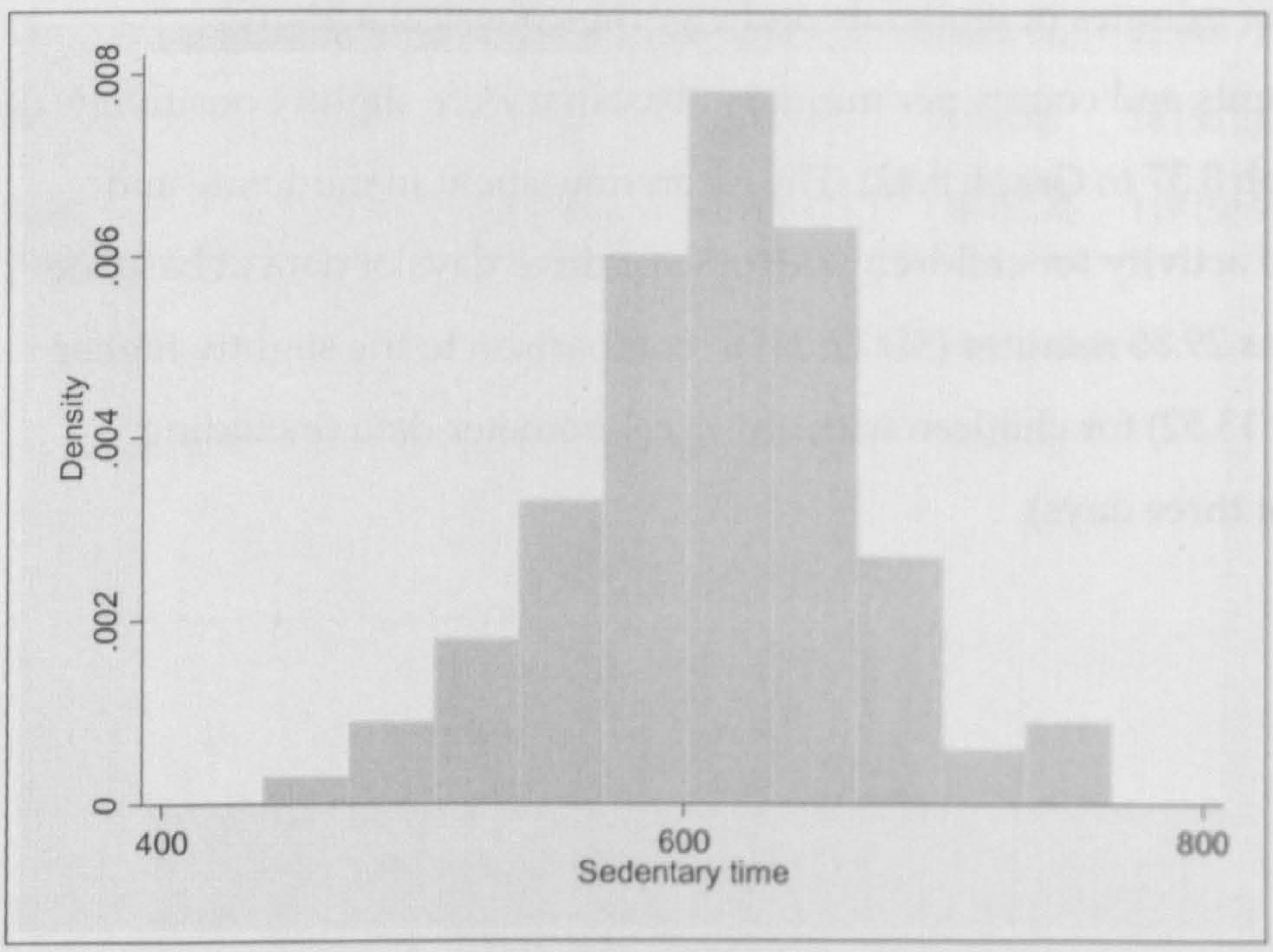
Physical activity measured by accelerometer

The distribution of minutes of moderate and vigorous physical activity, accelerometer counts and counts per minute at baseline were slightly positively skewed (see Graph 8.37 to Graph 8.42). The mean time spent in moderate and vigorous physical activity for children with at least three days of data at baseline and follow-up was 29.86 minutes (SD 12.25) in comparison to the slightly higher level of 31.02 (SD 13.52) for children with any accelerometer data (including those with at least three days).

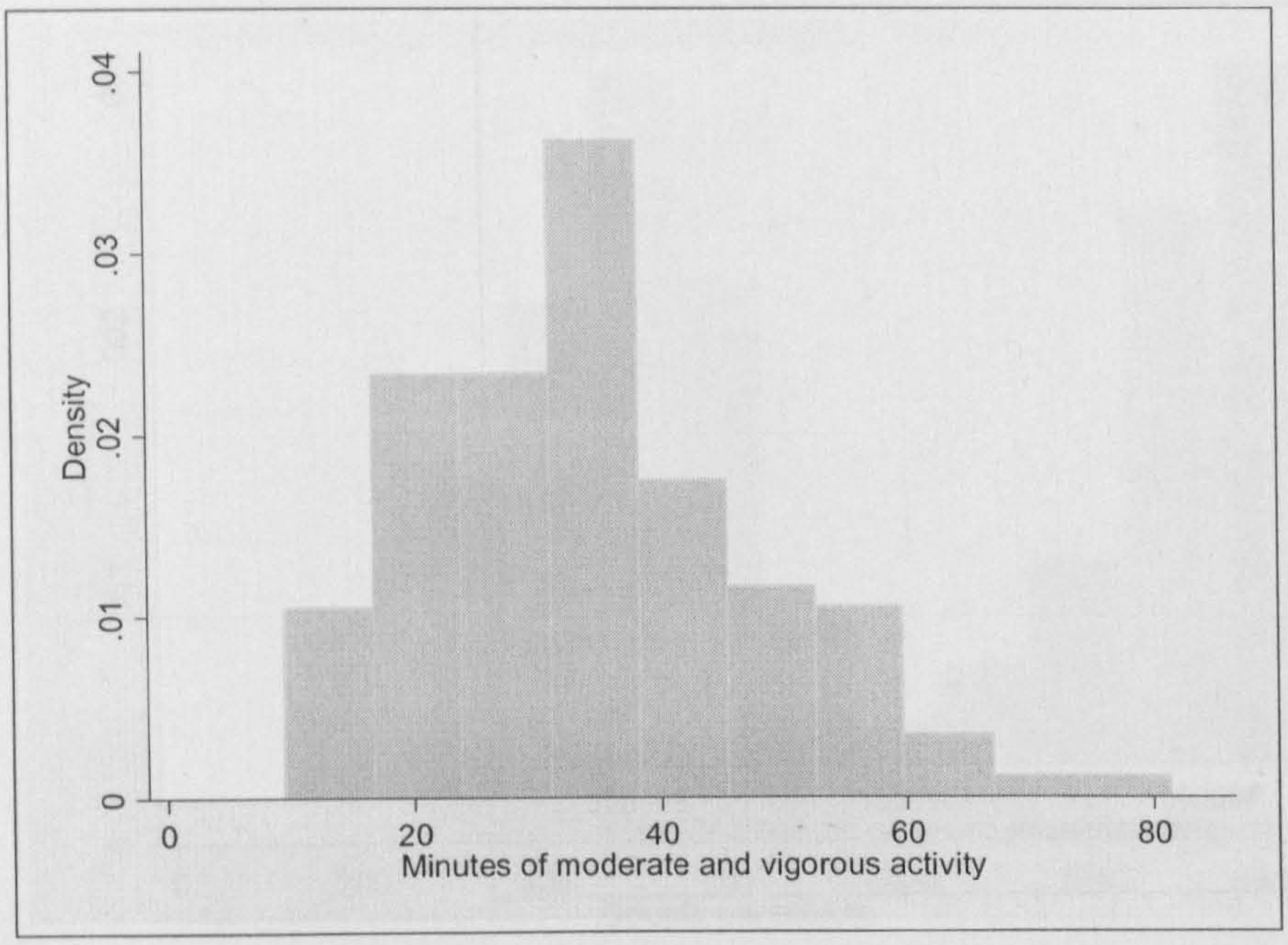
Graph 8.35 Histogram of number of minutes of sedentary time before AFLY5 intervention for children with a minimum of 500 minutes, 3 days of accelerometer wear time, and both before and after data



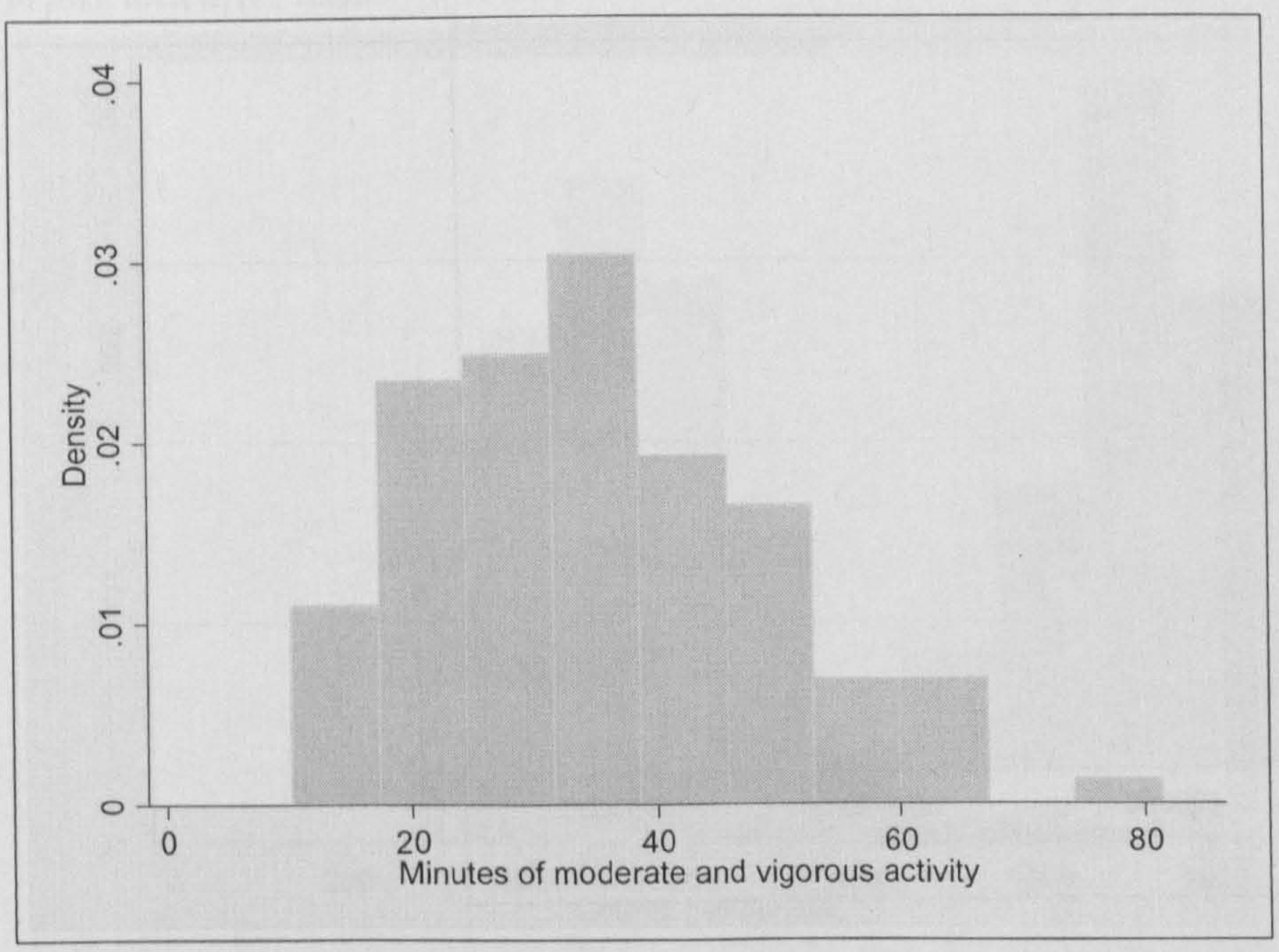
Graph 8.36 Histogram of number of minutes of sedentary time before AFLY5 intervention for children with a minimum of 600 minutes, 3 days of accelerometer wear time, and both before and after data



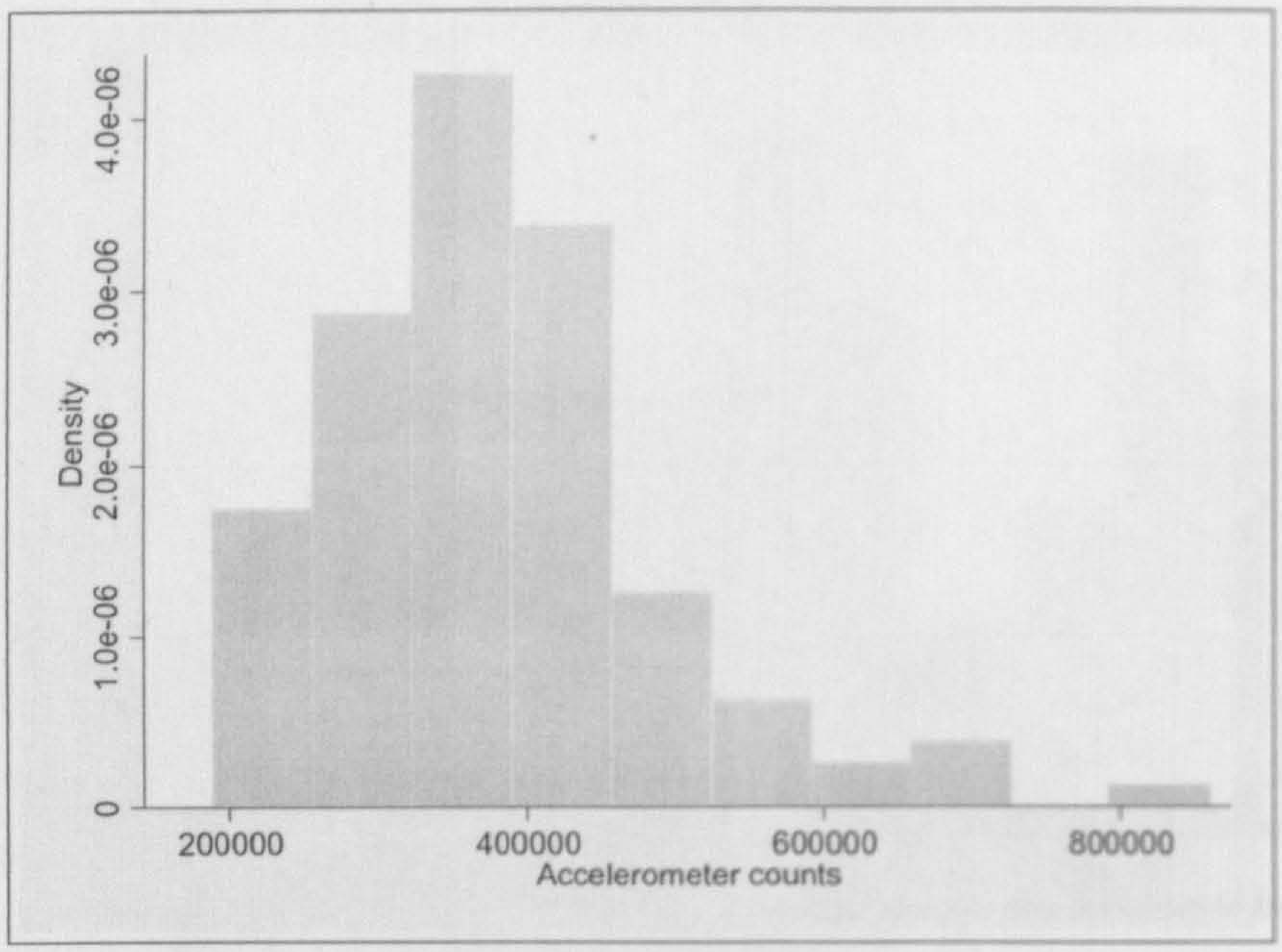
Graph 8.37 Histogram of number of minutes of moderate and vigorous physical activity before AFLY5 intervention for children with a minimum of 500 minutes, 3 days of accelerometer wear time, and both before and after data



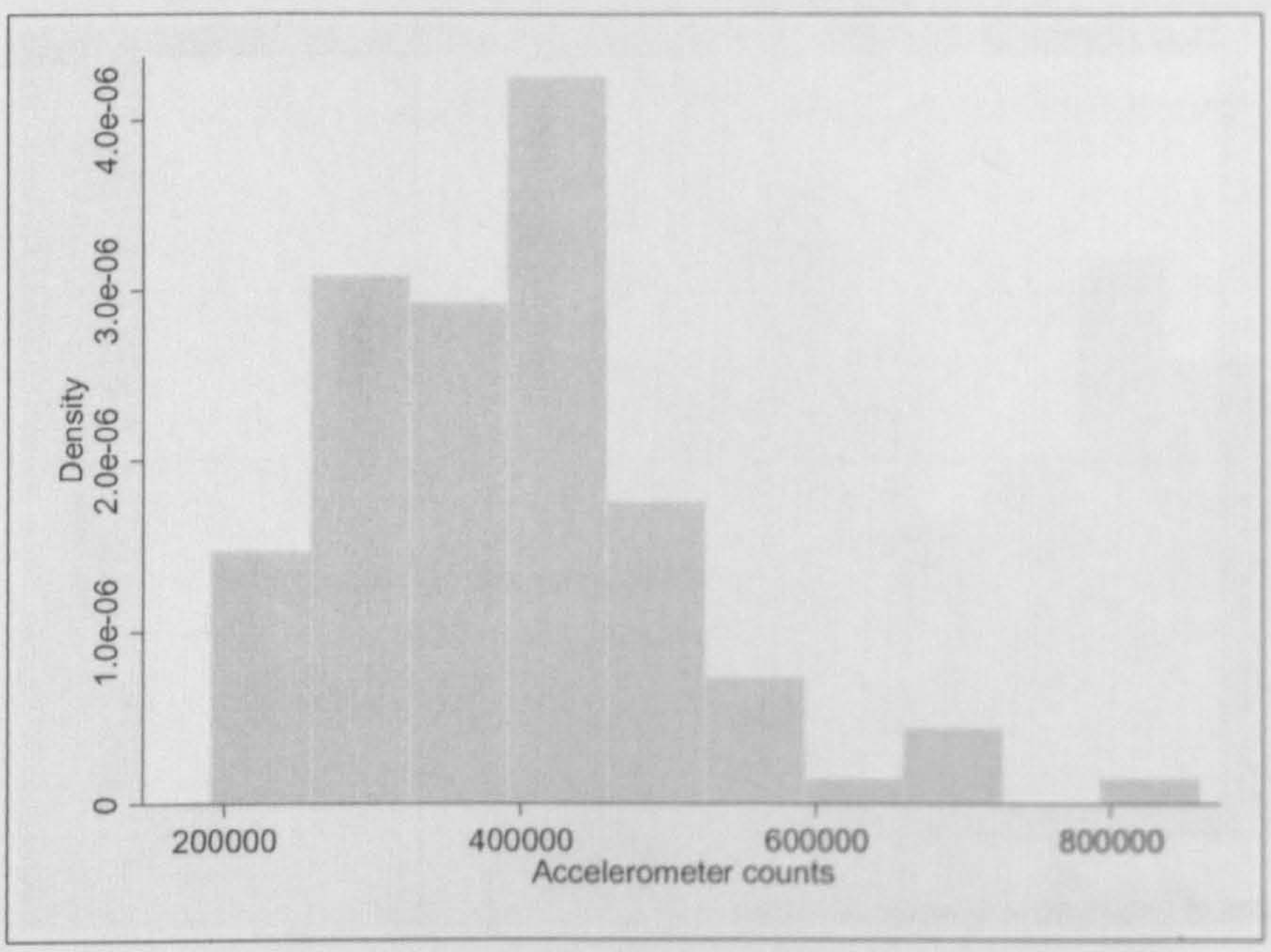
Graph 8.38 Histogram of number of minutes of moderate and vigorous physical activity before AFLY5 intervention for children with a minimum of 600 minutes, 3 days of accelerometer wear time, and both before and after data



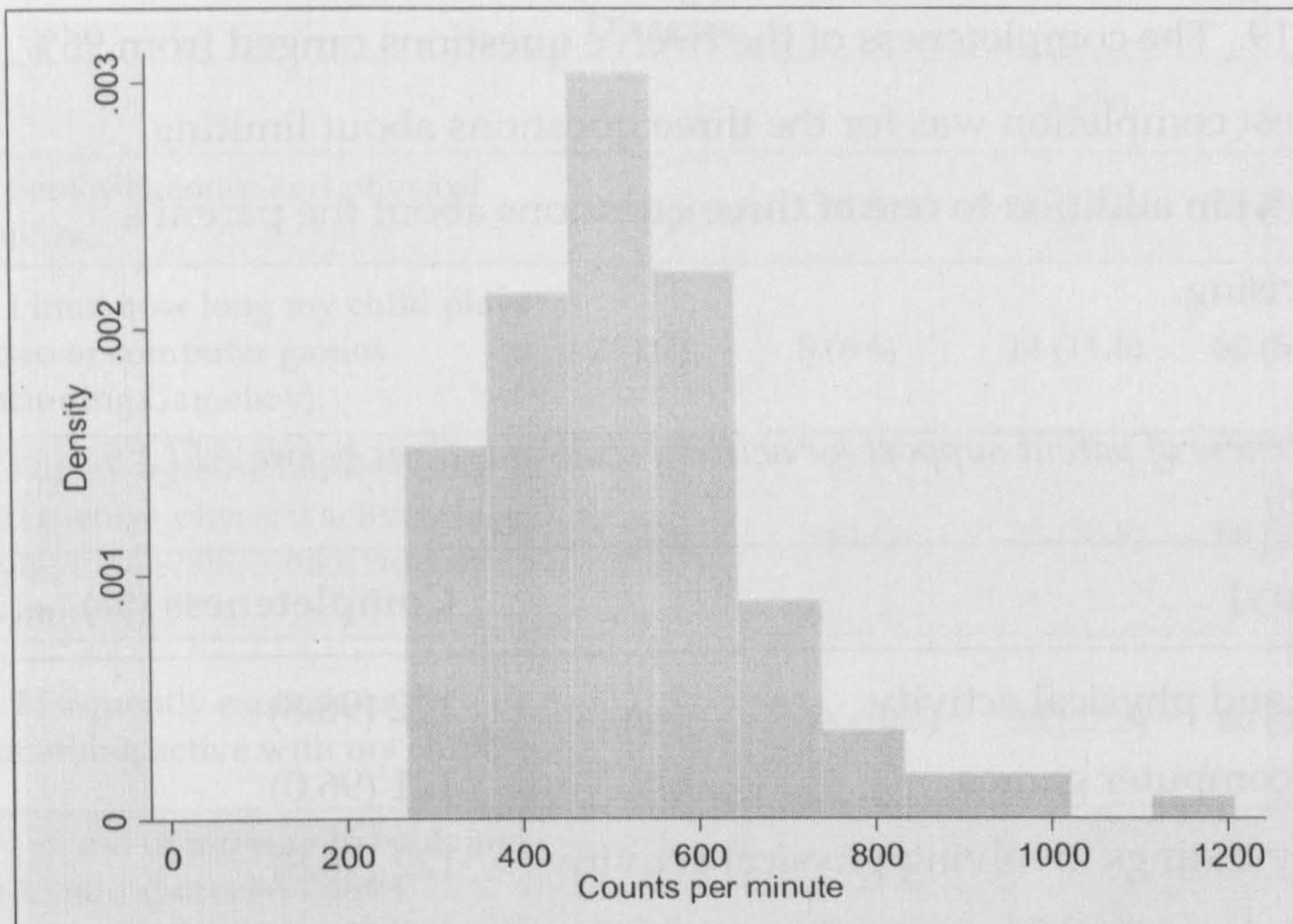
Graph 8.39 Average accelerometer counts before AFLY5 intervention for children with a minimum of 500 minutes, 3 days of accelerometer wear time, and both before and after data



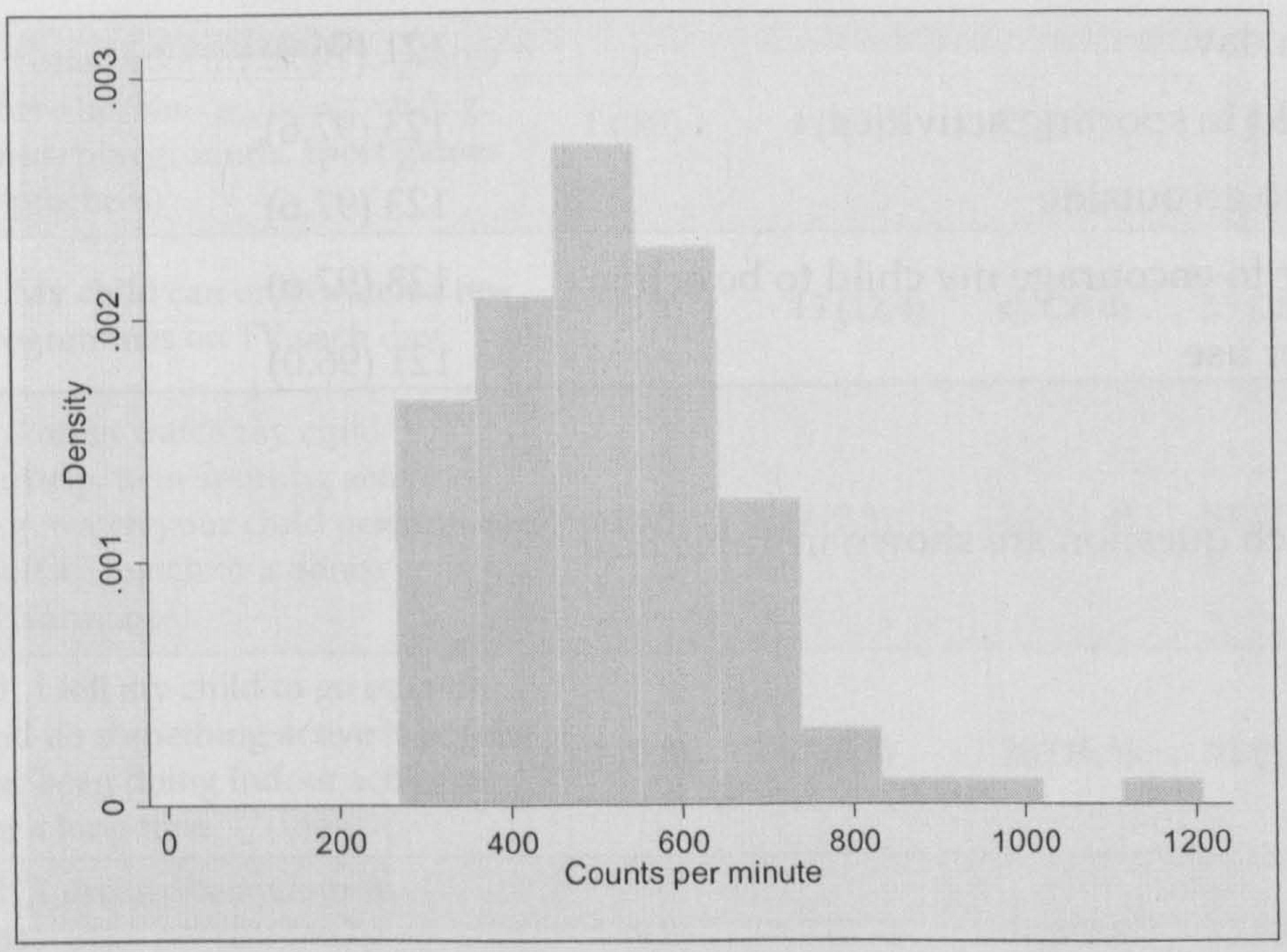
Graph 8.40 Average accelerometer counts before AFLY5 intervention for children with a minimum of 600 minutes, 3 days of accelerometer wear time, and both before and after data



Graph 8.41 Average accelerometer counts per minute before AFLY5 intervention for children with a minimum of 500 minutes, 3 days of accelerometer wear time, and both before and after data



Graph 8.42 Average accelerometer counts per minute before AFLY5 intervention for children with a minimum of 600 minutes, 3 days of accelerometer wear time, and both before and after data



Parent activity support scale

The parent activity support scale questions were assessed for completeness as shown in Table 8.19. The completeness of the twelve questions ranged from 96% to 97.6%. The lowest completion was for the three questions about limiting screen time (all 96%) in addition to one of three questions about the parent's frequency of exercising.

Table 8.19 Completeness of parent support for activity scale questions before AFLY5 intervention (n=126)

Question (summary)	Completeness (%)
1 enjoy exercise and physical activity	122 (96.8)
2. limit video or computer games	121 (96.0)
3. organise family outings involving physical activity	122 (96.8)
4. frequently exercise	121 (96.0)
5. book child into sports and other activities	122 (96.8)
6. exercise or am physically active	123 (97.6)
7. often take my child to be active	123 (97.6)
8. limit TV each day	121 (96.0)
9. watch my child in sporting activities	123 (97.6)
10. tell my child to go outside	123 (97.6)
11. use behaviour to encourage my child to be active	123 (97.6)
12. limit computer use	121 (96.0)

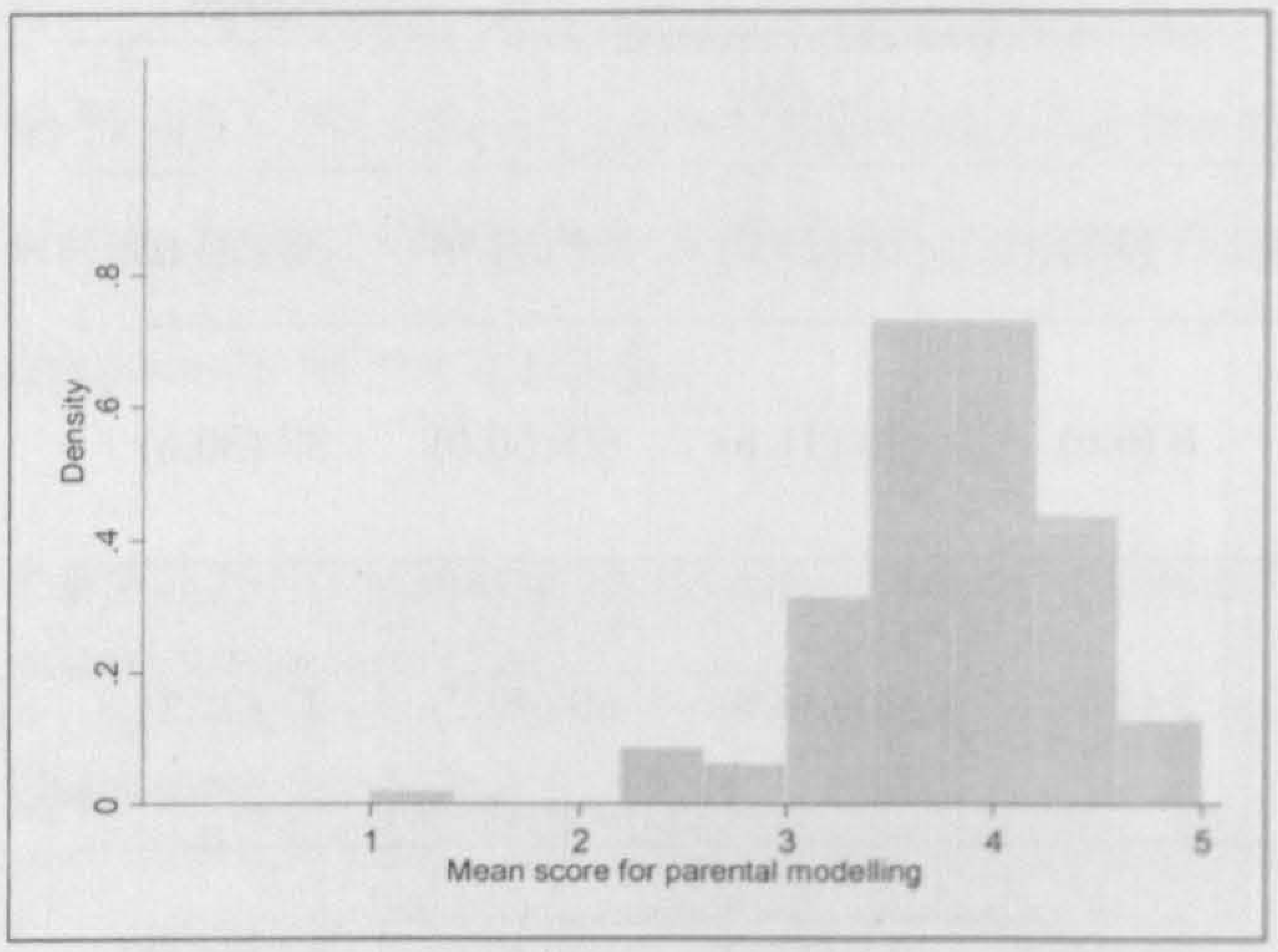
The answers to each question are shown in Table 8.20.

Table 8.20 Number and percentage of parent responses to the parent activity support scale before the intervention (n=122)

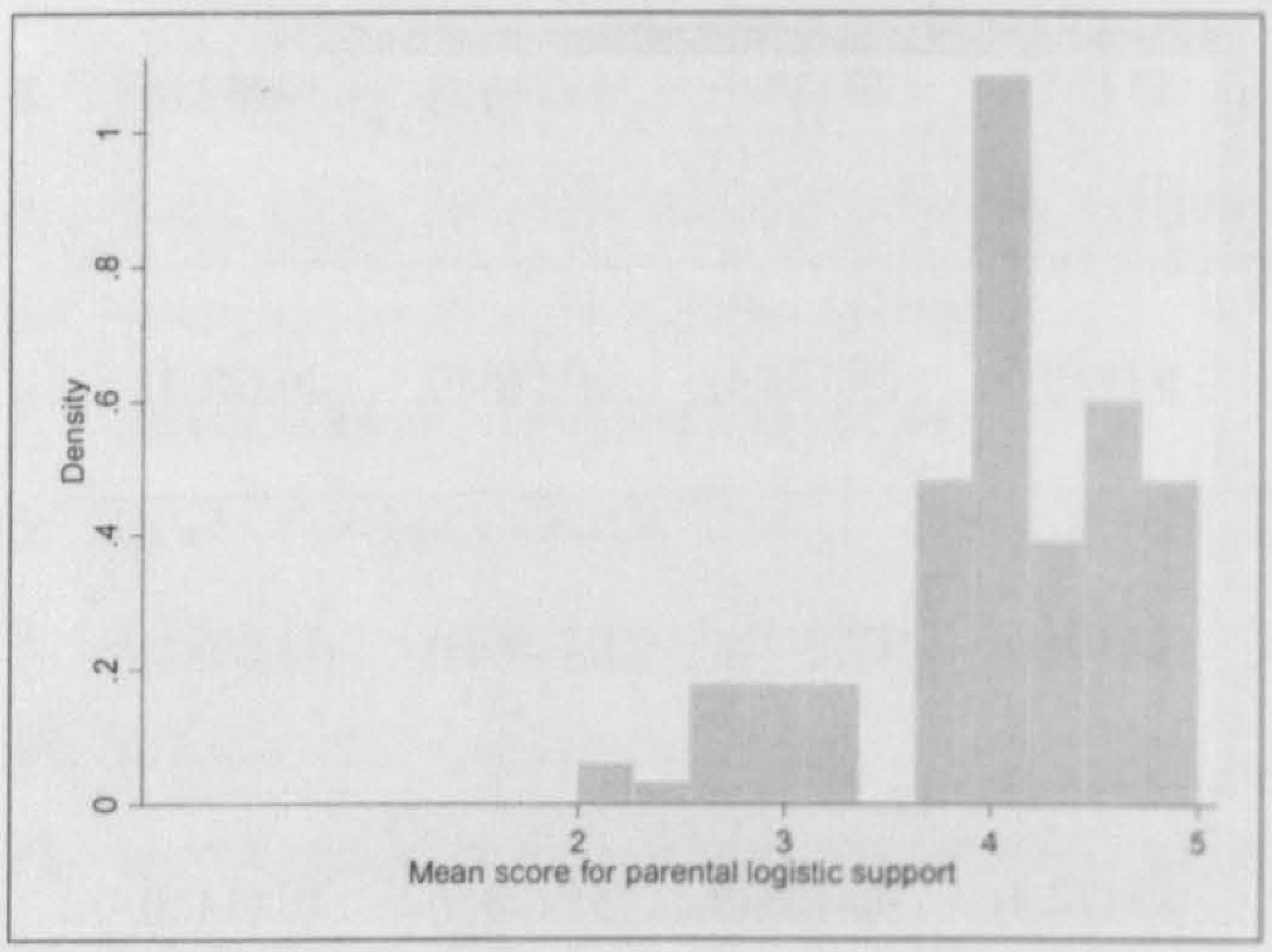
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
			n (%)		
1. I enjoy exercise and physical activity.	2 (1.6)	1 (0.8)	28 (23.0)	63 (51.6)	38 (23.0)
2. I limit how long my child plays video or computer games (including Gameboy).	2 (1.7)	8 (6.6)	14 (11.6)	60 (50.0)	37 (30.6)
3. I often organise family outings that involve physical activity (e.g. going for a walk, a bike ride, or swimming).	1 (0.8)	5 (4.1)	23 (18.9)	60 (49.2)	33 (27.1)
4. I frequently exercise or do something active with my child.	1 (0.8)	13 (10.7)	33 (27.3)	60 (49.6)	14 (11.6)
5. I go out of my way to book my child into sports and other activities that are physically active (e.g. after school clubs, swimming lessons).	3 (2.5)	13 (10.7)	23 (18.9)	44 (36.1)	39 (32.0)
6. I exercise or am physically active on a regular basis.	1 (0.8)	6 (4.9)	30 (24.4)	60 (48.8)	26 (21.1)
7. I often take my child to places where he/she can be active (e.g. parks, playgrounds, sport games or practices)	1 (0.8)	4 (3.3)	12 (9.8)	62 (50.4)	44 (35.8)
8. My child can only watch a few programmes on TV each day	7 (5.8)	15 (12.4)	46 (38.0)	35 (28.9)	18 (14.9)
9. I often watch my child participate in sporting activities (e.g. watch your child perform at a football match or a dance performance).	1 (0.8)	9 (7.3)	14 (11.4)	53 (43.1)	46 (37.4)
10. I tell my child to go outside and do something active if he/she has been doing indoor activities for a long time.	1 (0.8)	7 (5.7)	20 (16.3)	52 (42.3)	43 (35.0)
11. I use my behaviour to encourage my child to be physically active.	1 (0.8)	7 (5.7)	34 (27.6)	62 (50.4)	19 (15.5)
12. I limit how long my child can use the computer for things other than homework.	2 (1.7)	10 (8.3)	19 (15.7)	57 (47.1)	33 (27.3)

Distribution of responses to parent activity support scale before intervention

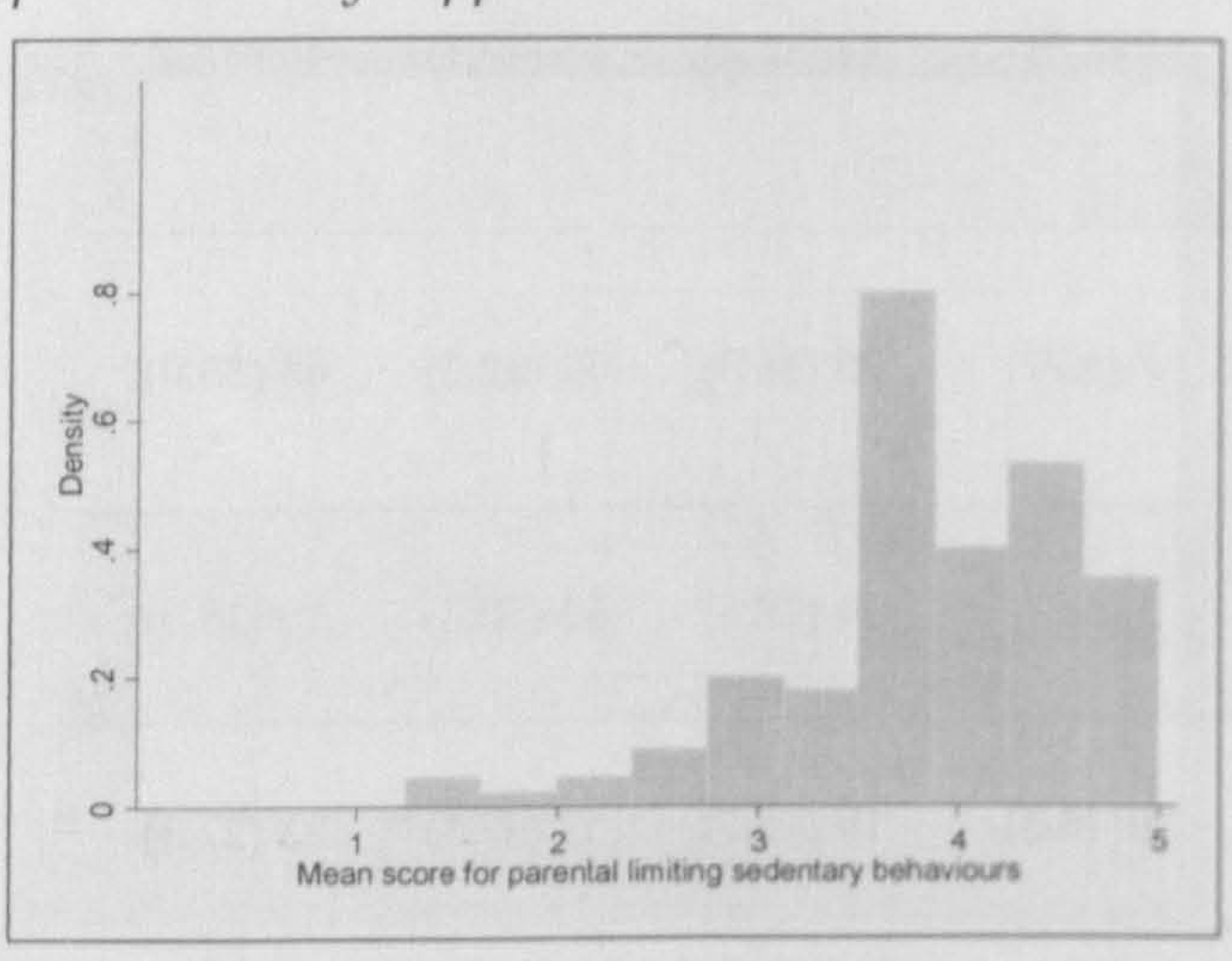
Graph 8.43 Histogram of combined modelling questions from the parent activity support scale



Graph 8.44 Histogram of combined logistic support questions from the parent activity support scale



Graph 8.45 Histogram of combined limiting sedentary behaviour questions from the parent activity support scale



Diet

The quality of the coding of the diet data was assessed by comparing the data clerk's initial coding to my coding. This resulted in 0.25% of food items being differently coded. The diet data quality was further examined by completion of the whole questionnaire.

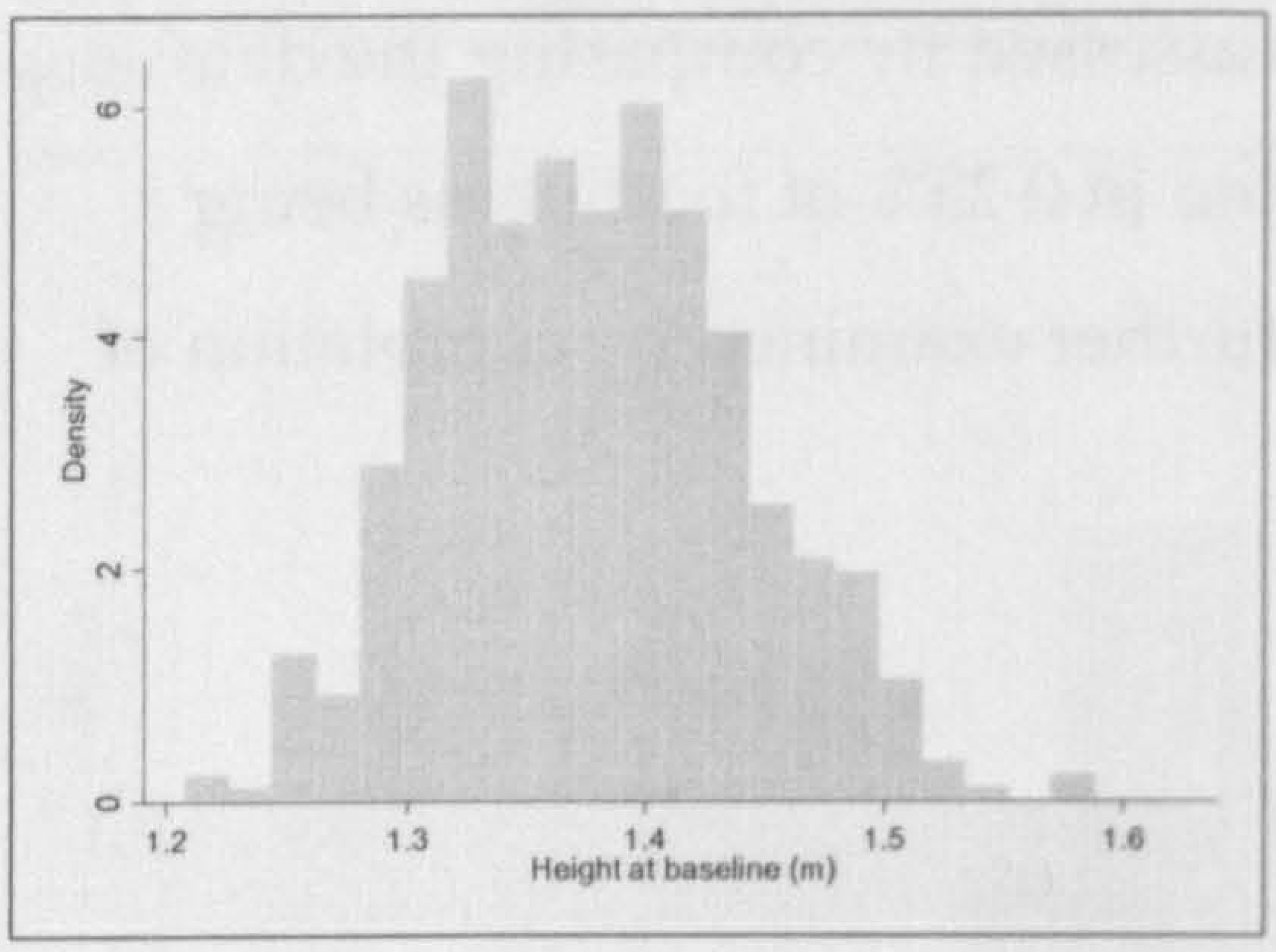
Height, weight and waist measurements

The distribution of height, weight and waist measurements at baseline and follow-up are shown in Graph 8.46 to Graph 8.51. Height has an approximate normal distribution. However, the distribution of weight is not normally distributed, but right skewed with a small number of children with very high weights for their age (>60kg). Waist circumference is also right skewed.

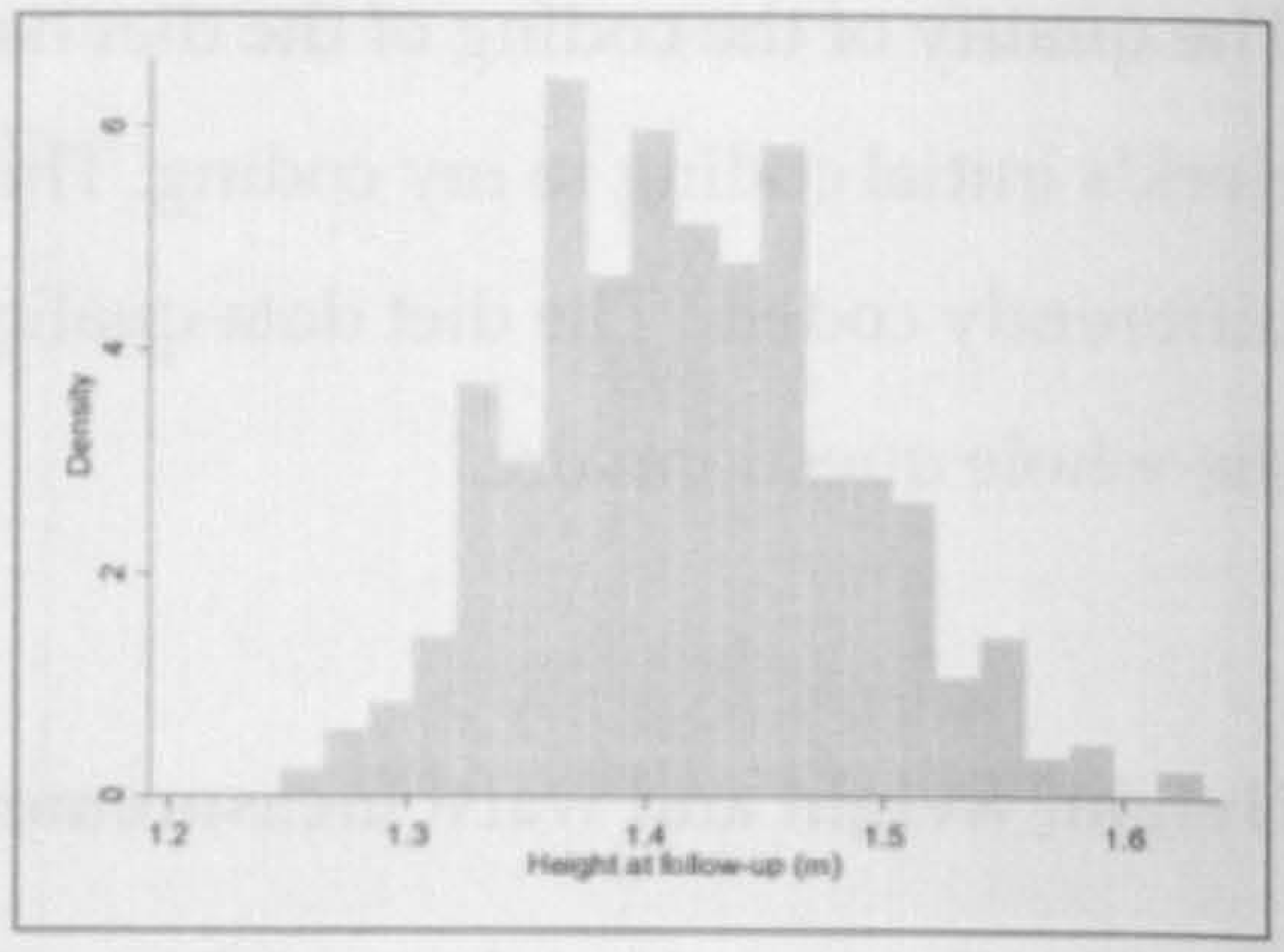
To check for outliers, waist circumference was plotted against body mass index at baseline and follow-up (see Graph 8.52 and Graph 8.53). There were no outliers at baseline but one after the AFLY5 intervention which is circled. This individual (ID 45001) had a waist circumference of 31.4 at follow-up, but at baseline the waist circumference was 59.1cm. The hand written paper copy of the measurement was checked and found to be 61.1cm at follow-up so an error had been made during data entry and this was changed in the dataset (an error rate of 0.04%). The revised scatter plot is shown in Graph 8.54.

The distribution of height, weight and waist measurements at baseline were checked for digit preference of whole and half numbers (see Graph 8.55 to Graph 8.60). At baseline there was slight digit preference for zero and five for height, digit preference of 5 for waist and no preference for weight. After the intervention there was no digit preference for height, slight digit preference of 5 for weight and 6 for waist; there was also an inverse digit preference for zero and five for waist which may be overcompensation for digit preference.

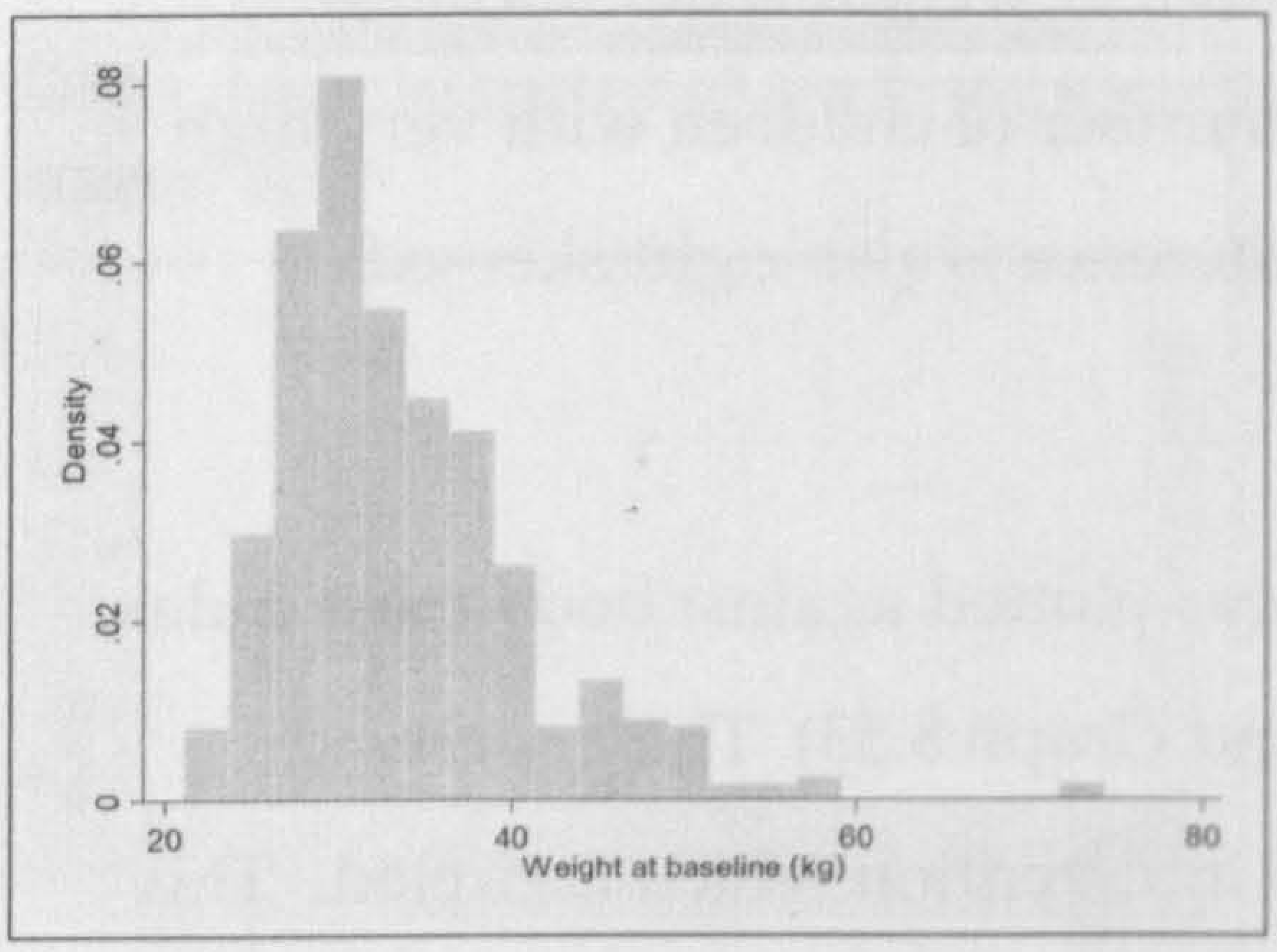
Graph 8.46 Distribution of height before intervention



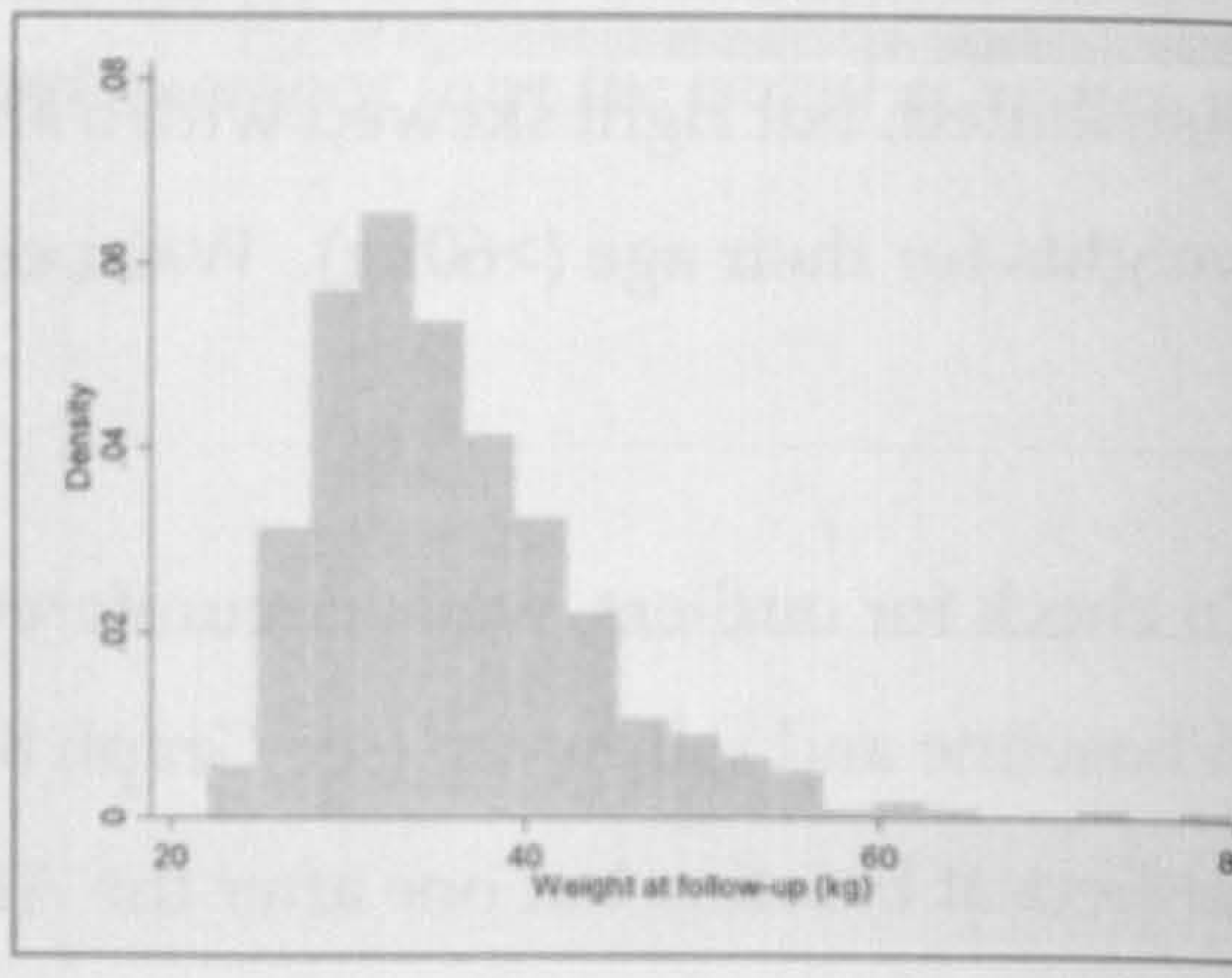
Graph 8.49 Distribution of height after intervention



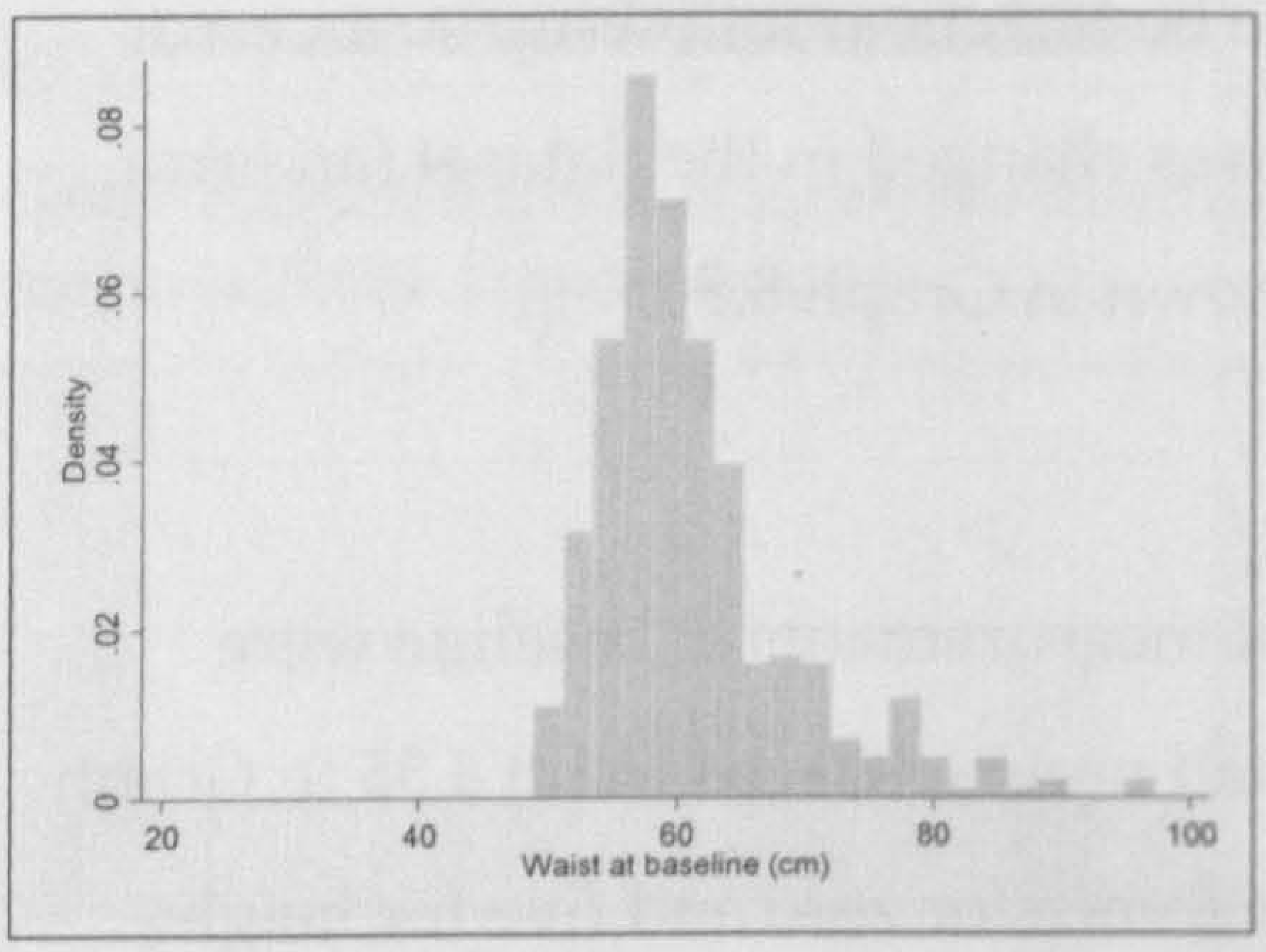
Graph 8.47 Distribution of before intervention



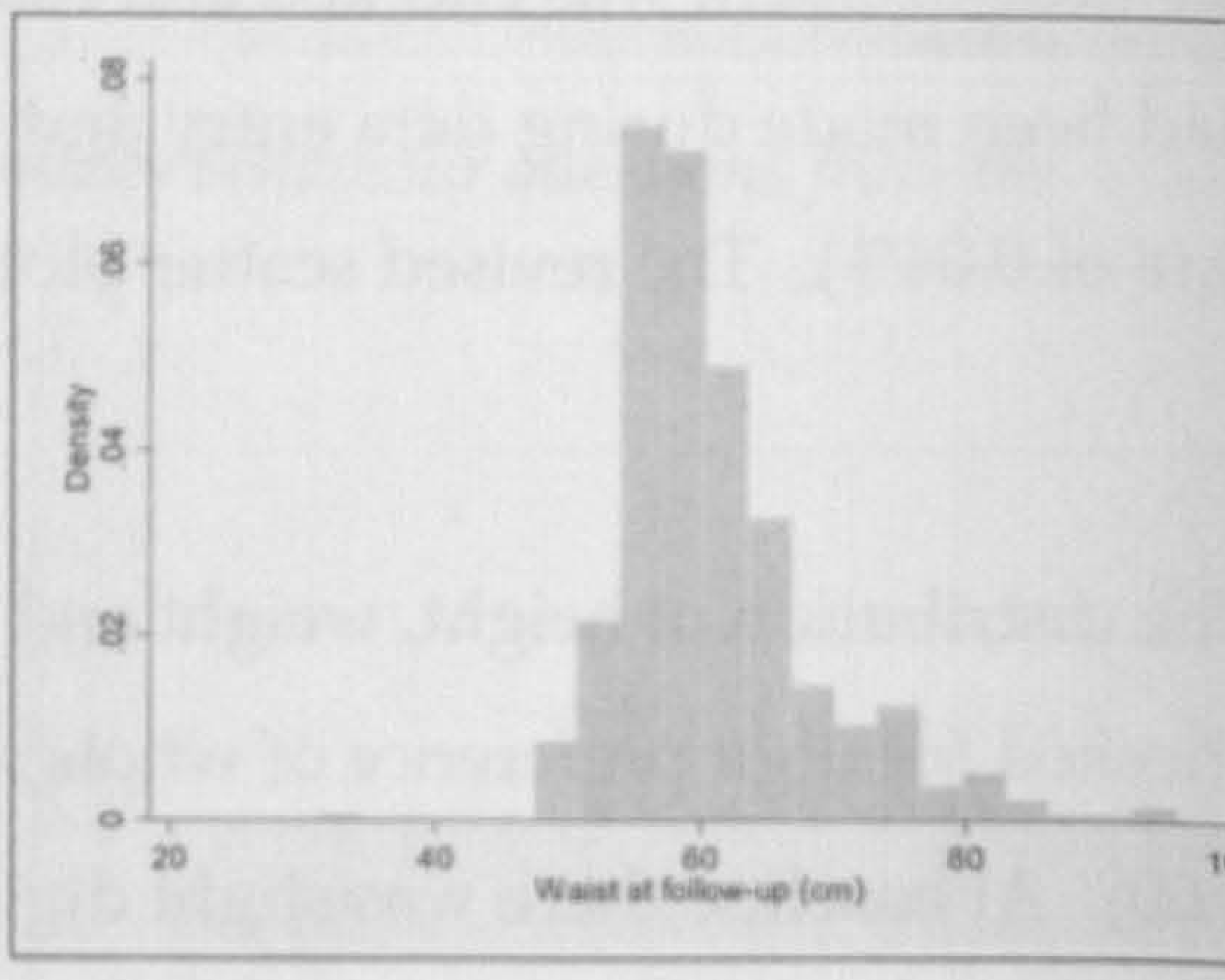
Graph 8.50 Distribution of weight after intervention



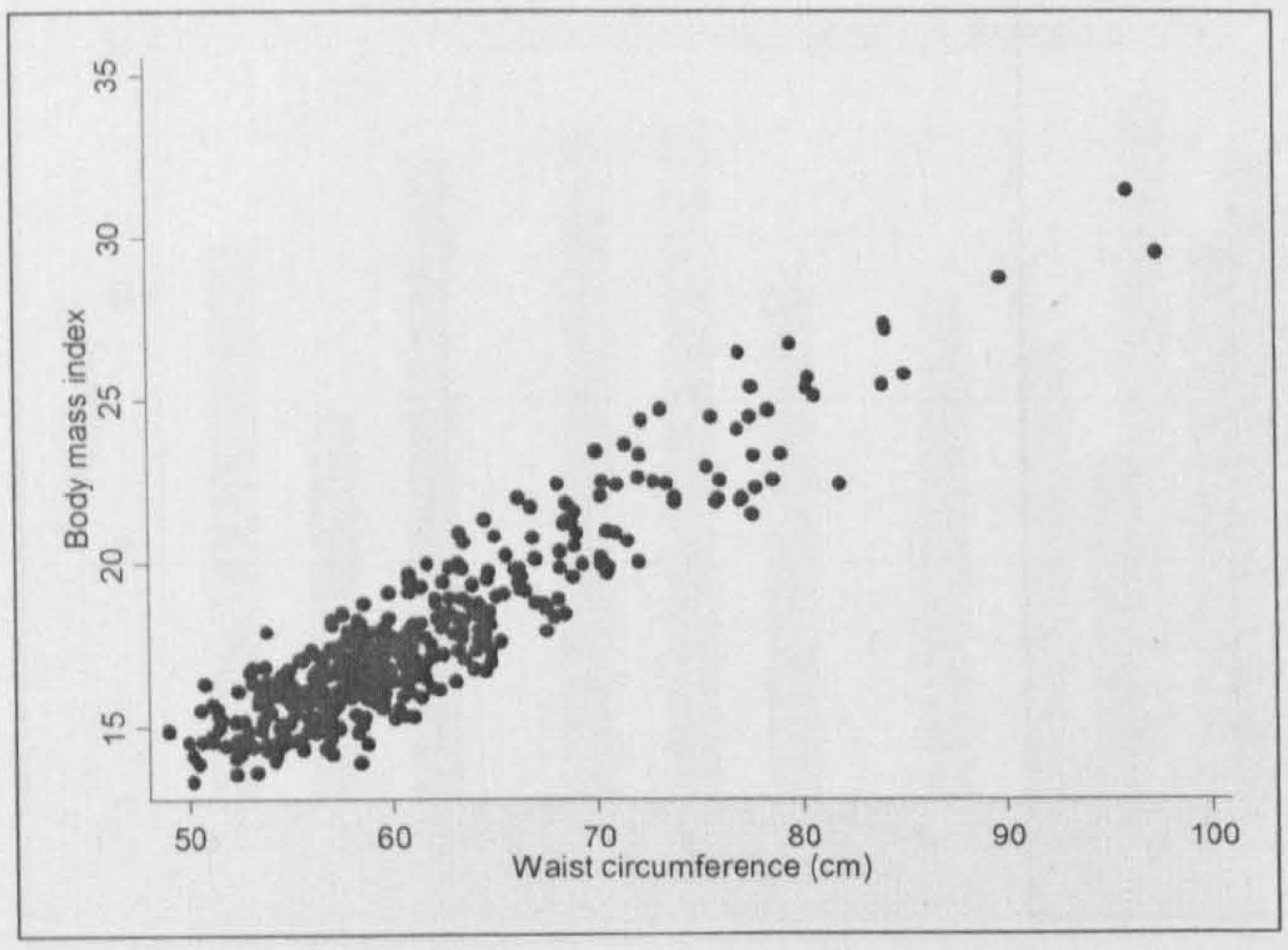
Graph 8.48 Distribution of waist before intervention



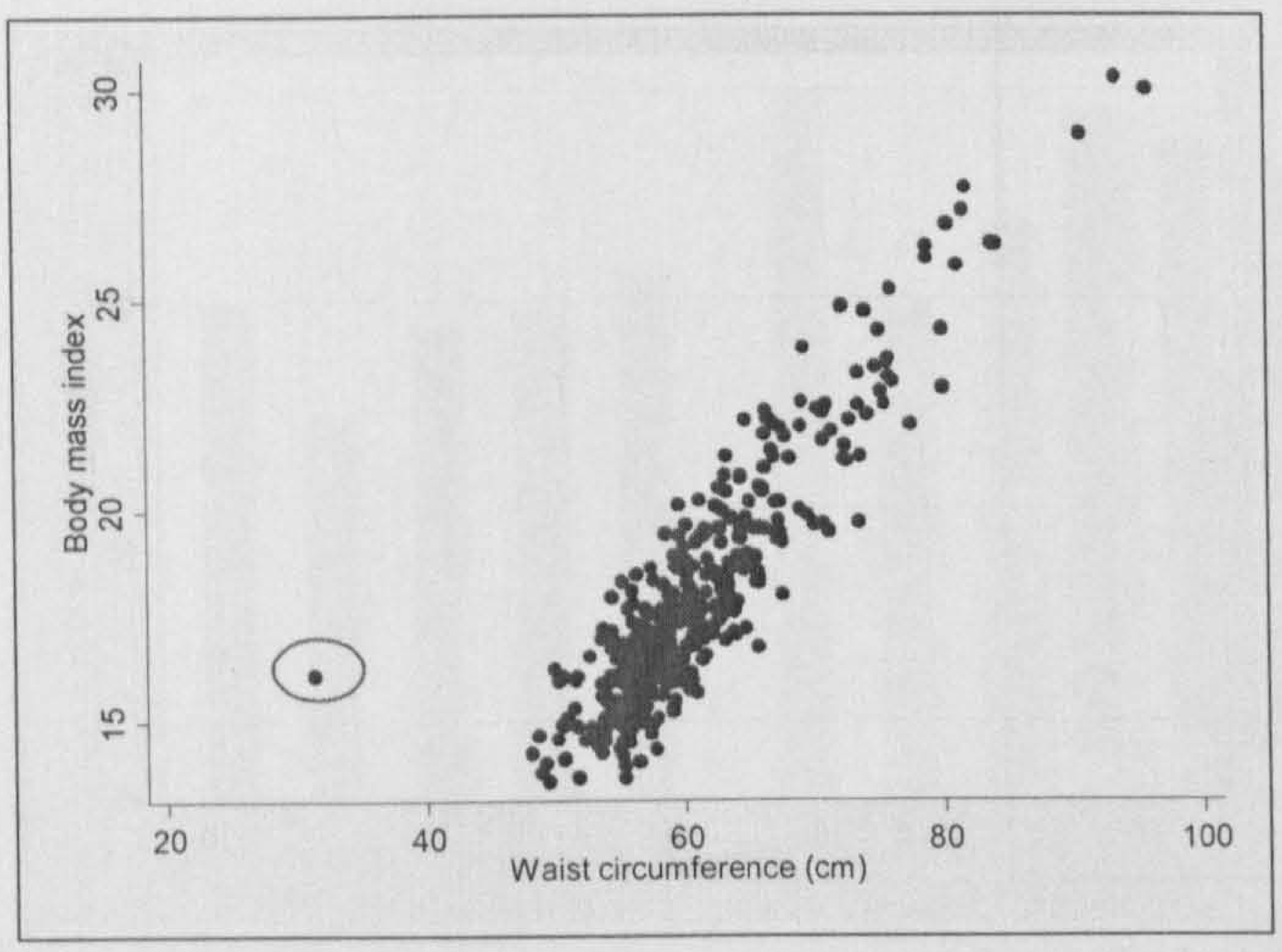
Graph 8.51 Distribution of waist after intervention



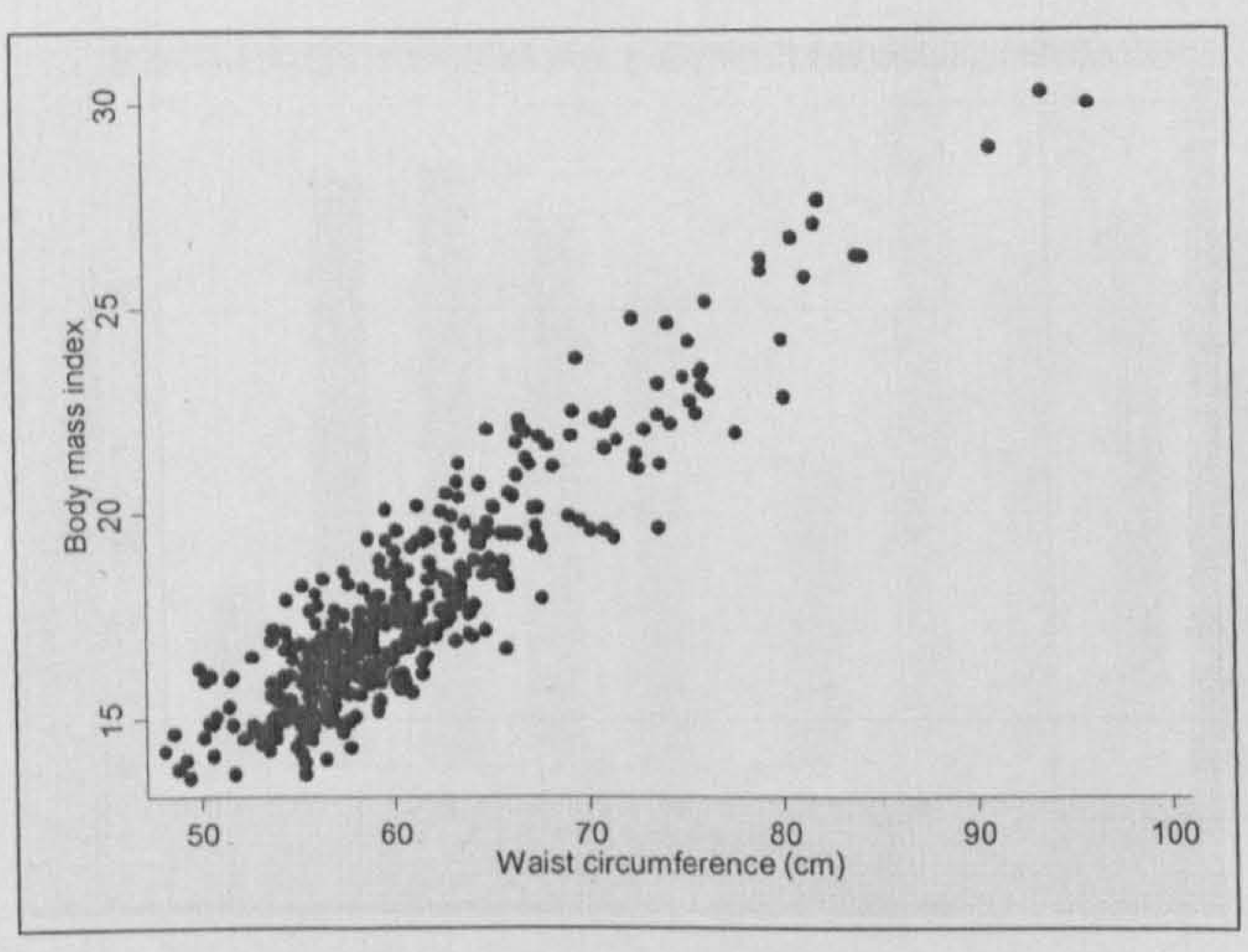
Graph 8.52 Scatterplot of waist circumference and body mass index before intervention



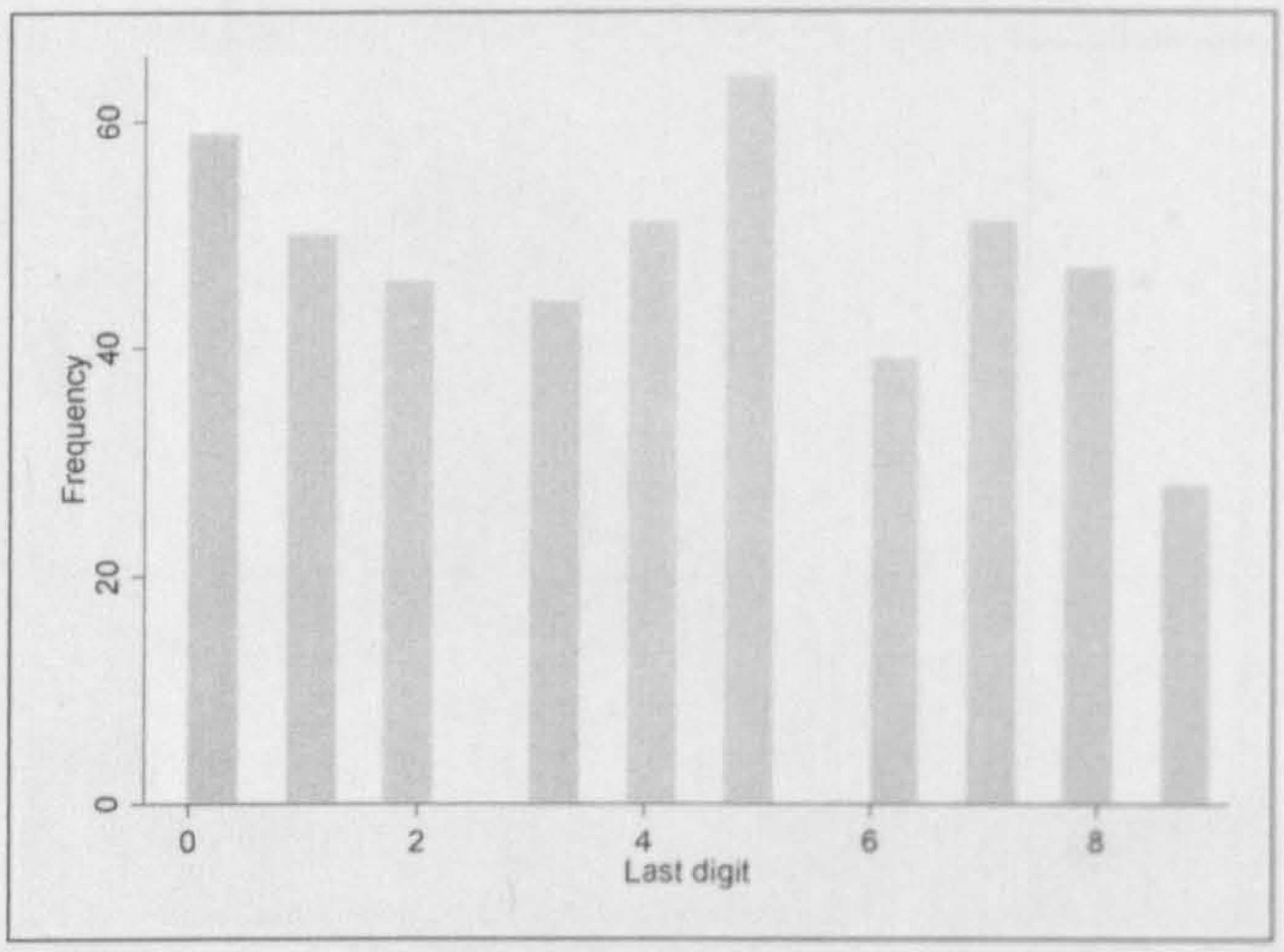
Graph 8.53 Scatterplot of waist circumference and body mass index after intervention



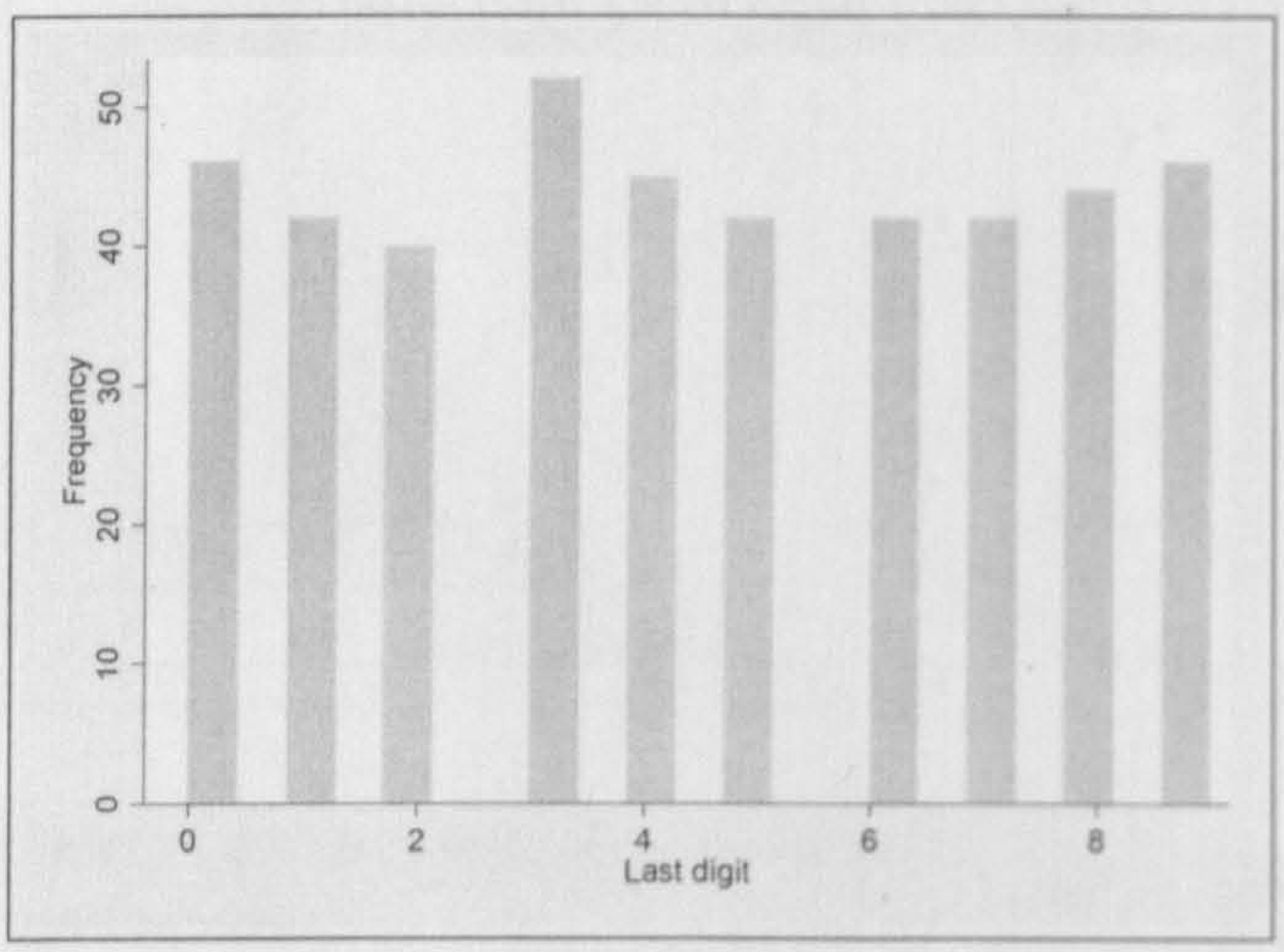
Graph 8.54 Scatterplot of waist circumference and body mass index after intervention with outlier corrected



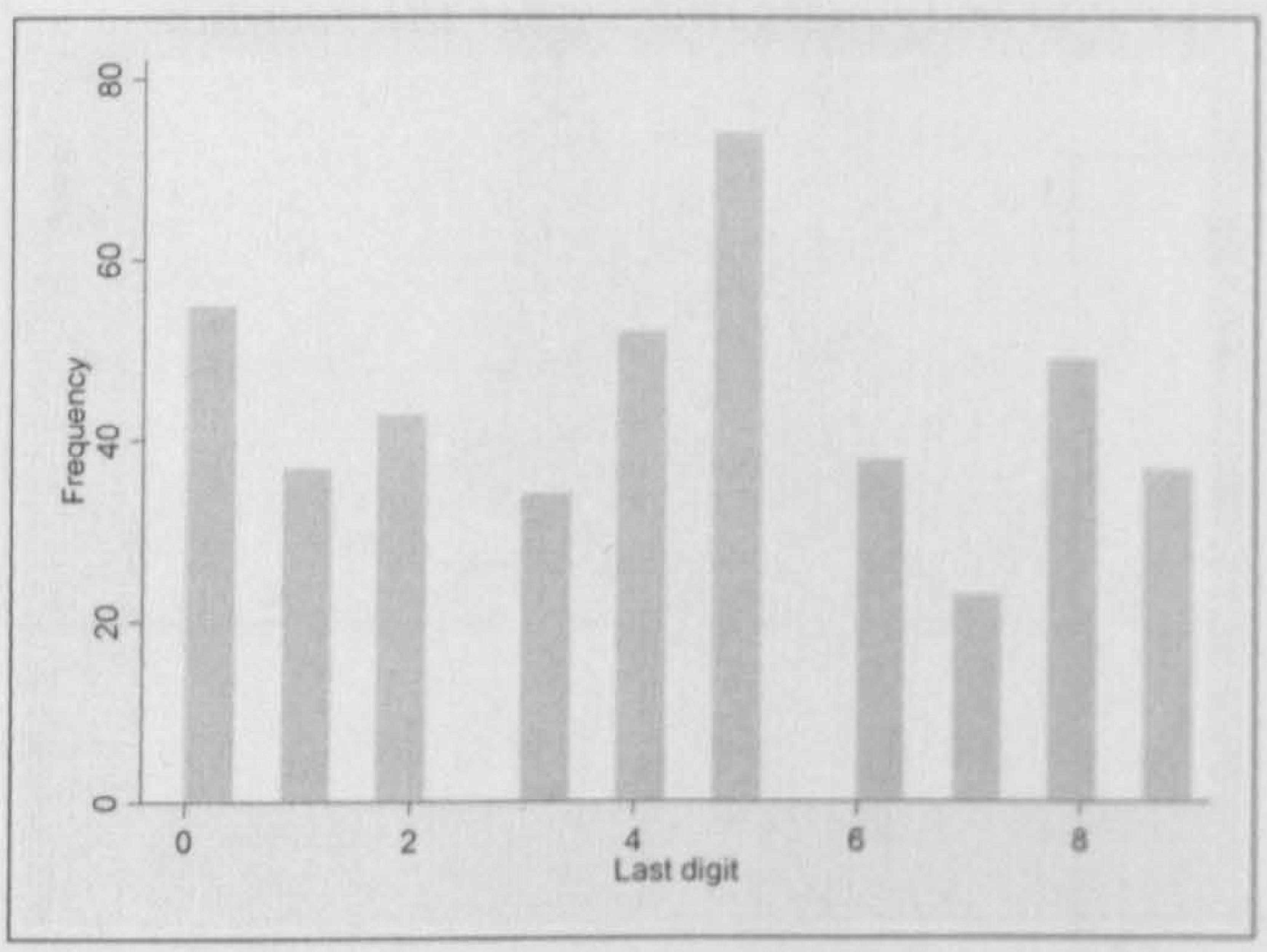
Graph 8.55 Digit preference (to three decimal places) for height measurements before intervention (n=479)



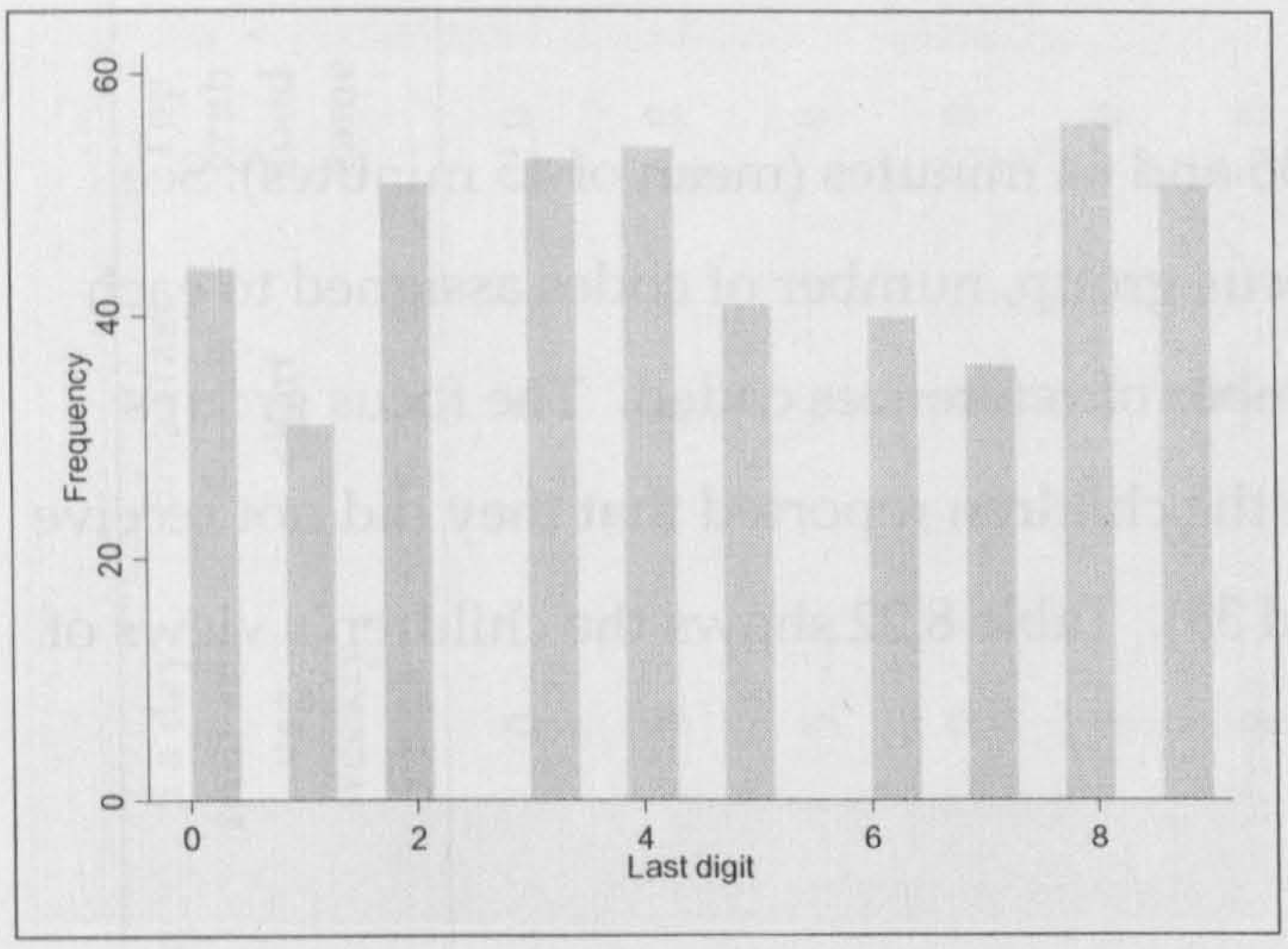
Graph 8.56 Digit preference (to one decimal place) for weight measurements before intervention (n=441)



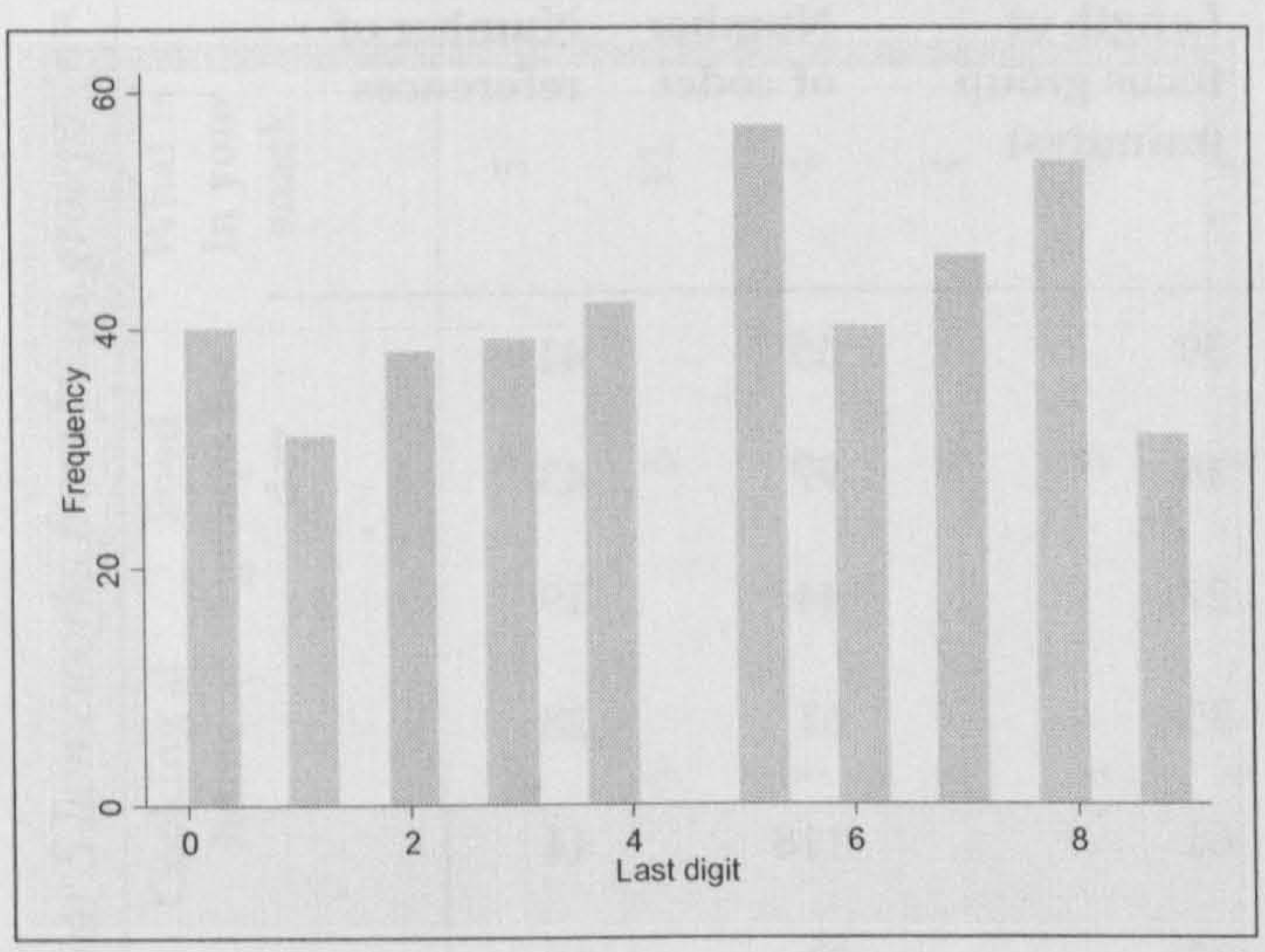
Graph 8.57 Digit preference (to one decimal place) for waist measurements before intervention (n=442)



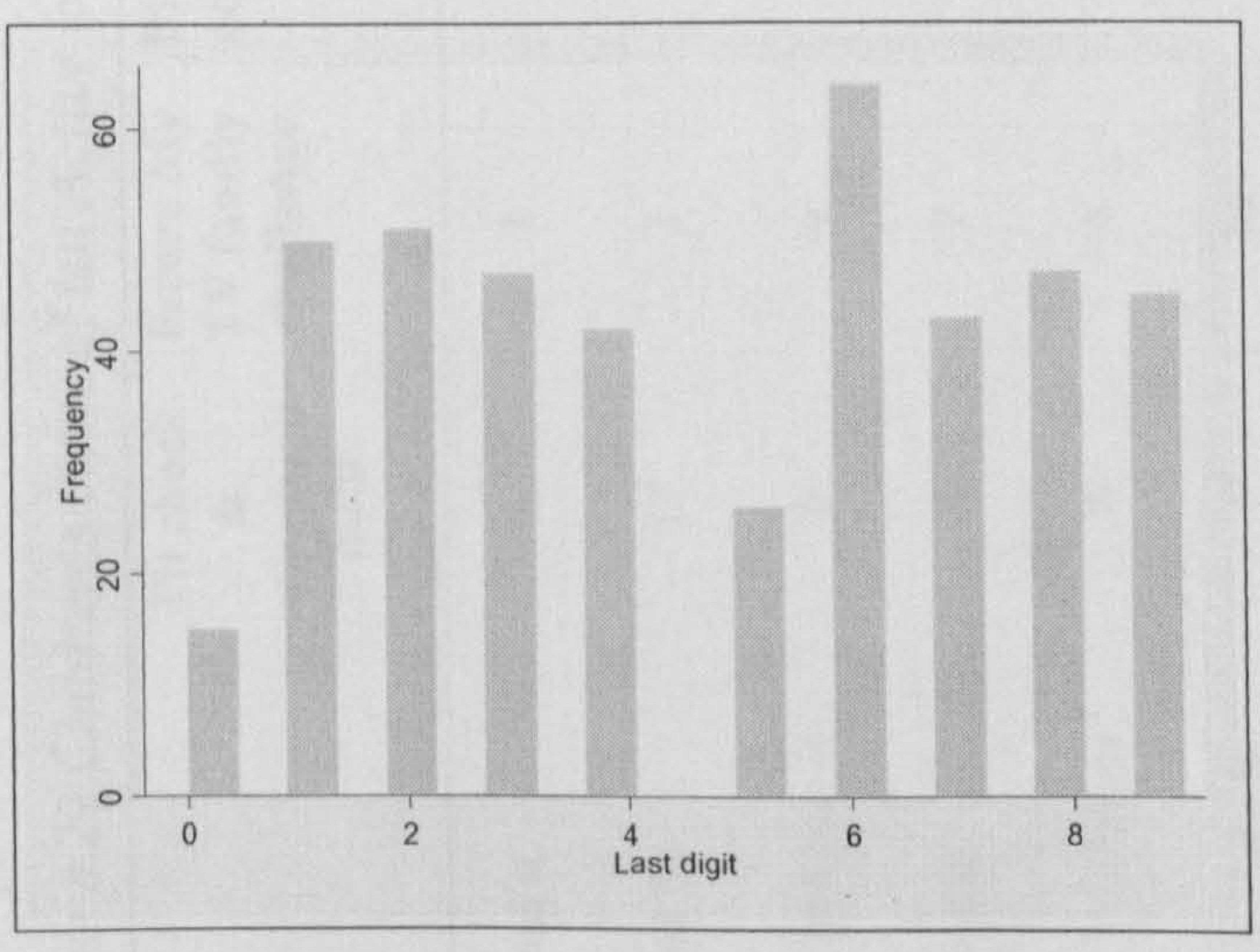
Graph 8.58 Digit preference (to three decimal places) for height measurements after intervention (n=457)



Graph 8.59 Digit preference (to one decimal place) for weight measurements after intervention (n=418)



Graph 8.60 Digit preference (to one decimal place) for waist measurements after intervention (n=430)



Process evaluation

Child Focus Groups

The focus groups lasted between 35 and 64 minutes (mean of 45 minutes). See Table 8.21 for the length of each focus group, number of codes assigned to each focus group transcript and the number of references coded. The focus groups were shortest in the schools where the children reported that they did not receive several homeworks (schools 34 and 38). Table 8.22 shows the children's views of each homework.

Table 8.21 Child focus groups about Active for Life Year 5 homeworks and parent involvement by number of children, duration, number of codes and references

School ID	Number of children in focus group	(% of year 5 in school)	Number of focus group	Length of focus group (minutes)	Number of codes	Number of references
33	6	(26.8)	1	59	65	41
33	5		2	48	97	43
34	4	(20.4)	1	27	44	19
34	5		2	35	61	28
37	8	(22.2)	1	64	118	44
38	6	(20.7)	1	37	71	33

Table 8.22 Children's views of ten Active for Life Year 5 homeworks from focus groups (n=34)

	Fit check & scavenger hunt	Freeze My TV family challenge	Bingo PA activities	Cooking at home	Food groups for day	What is in your snack	Sugar in drinks	5 a day fruit and veg weekly chart	Breakfast weekly chart	Top grub food game	Total n (%)
Loved it	1	1	7	20	3	5	1	0	6	0	44 (12.9)
Liked it	17	2	9	5	6	12	1	3	9	0	64 (18.8)
Did not like it	3	6	2	1	5	4	0	5	6	0	32 (9.4)
Hated it	0	7	0	3	4	4	7	7	5	0	37 (10.9)
Did not know	4	4	2	4	7	8	2	2	1	0	33 (9.7)
Did not do it	3	14	5	1	0	1	4	8	3	0	40 (11.8)
Homework not given out	6	0	9	0	9	0	19	9	4	34	90 (26.5)

Table 8.23 Main and sub codes for child focus groups about homeworks and AFLY5 project

Main code	Sub code
Active for Life Year 5	Diet changes
	Improve or changes
	Physical activity changes
	Remember
Bingo	Confusing
	Didn't do it or don't know
	Didn't like it
	Improve
	Like or love it
	Number of activities
Breakfast homework	Changes
	Didn't do it
	Hate or didn't like it
	Like it
Cooking homework	Didn't do it or don't know
	Didn't like it or hate it
	Like or love it
Diet lessons	Enjoy
Fit check homework	Confusing or difficult
	Didn't do it or don't know
	Didn't like it
	Improve
	Like it or love it
Food groups homework	Didn't know or didn't do it
	Didn't like it or hated
	Like it or love it
Freeze My TV homework	Didn't do it or didn't know
	Didn't like it or hate it
	Improve
	Like or love it
	Problems

Table 8.24 Main and sub codes for child focus groups about homeworks and AFLY5 project continued

Main code	Sub code
Freeze My TV lesson	Problems
	Fruit and veg homework
	Didn't do it or don't know
	Difficult planning
	Hate or didn't like it
	Like it
	Problem
Homework	Don't like
	Like
	Problems
	Remember
	Usual homework
	Improve or ideas
Number of children	
Parent involvement	How to involve
	Like
	Parent involved
	Parent not involved
	Sibling involved
Physical activity	Why changed
	Why no change
Physical activity lessons	Enjoy
School name	
Sedentary change	Why
	Why not
Snack	Don't know or didn't do it
	Hate it or didn't like it
	Like or love it
Sugar drink homework	Didn't do it
	Hate or didn't like it
	Liked it
	Not given out
Supported behaviour changes	
Top Grub	Didn't do it
	Homework
	In class
	Liked it
Weight issues	

Table 8.25 Categories assigned to children's' views of homeworks

	Theme			
	Love or liked it	**Hate or disliked it**	**Don't know**	**Didn't do it**
Categories	Liked the activity	Boring	Difficult and easy	Away
	It was fun	Repetitive	Difficult	Lost
	It was easy	Didn't like the activity	Can't remember	Didn't know what to do
	Novel homework	Found it difficult	Tired	Didn't get round to it
	Something to do	Got behind		Didn't want to do it
	Challenge or competition	Couldn't remember what they had done		Difficult
	Doing something I wouldn't normally do	Felt under pressure		Family not involved
	Choice of activity	Felt told what to do		Teacher
	Liked going outside	Family not involved		Too busy
	Doing exercise in a fun way	Passé subject		
	Learning about exercise	Not relevant		
	Learning about food	Too busy		
	Doing it with Mum			
	Family/friends were involved			
	Don't know			
	Didn't do homework at home			

Table 8.26 Example of chart for child focus group theme of diet changes made by children

ID	Category											
	Awareness	Fruit and veg	Eating in moderation	Eats less sweet foods	Specific lesson prompt	Less enjoyment of food	Cooking	Family changes	Didn't want to change	Continues eating sweet food	Already eat healthy food	Rebound
FCa1			*Eats chocolate bars in moderation now because of their health*	*Eats chocolate bars in moderation now because of their health*								
FCa2			"We need to keep what you're eating kind of (in) moderation"									
FCa4	*Aware of food inside body*	*Previously didn't eat many f&v*		"I used to be like a chocaholic...it made me umm think about what I eat now and how what are inside of me"								
FCa5			*Thinks eating other healthy food makes up for eating lots of candy floss*							On Saturday I did have two bags of candy floss		
FBa1		*Now takes vegetable for lunch and didn't before*										
FBa2		*Now likes vegetables*										
FBa3		*Now has fruit with breakfast*		"I used to have like umm chocolate cereals umm for breakfast or something like that but now I have some fruit"								

Key: hw= homework; f&v = fruit and vegetables; non-itallics with quote marks are quotes from child; itallics are my summary
ID: Capital letters are initials of school; non-capital letter is for more than one focus group in a school; number is child number

Table 8.27 Categories assigned to children's' views of changes made to diet, physical activity and sedentary behaviours

	Theme		
	Diet	**Physical activity**	**Sedentary behaviour**
Categories	Awareness	Already active	No change
	Fruit and vegetables	No change	Less TV
	Eating in moderation	More active	Less screen time
	Eats less sweet foods	Family support	
	Specific lesson prompt	Not sure if project led to change	
	Less enjoyment of food		
	Cooking		
	Family changes		
	Didn't want to change		
	Continues eating sweet food		
	Already eat healthy food		
	Rebound		

Parent interviews

Table 8.28 shows the length of each parent interview and number of codes and references from the coding. Table 8.29 shows the main and sub codes for parent interviews.

Table 8.28 Interviews with teachers in parent involvement schools about Active for Life Year 5 homeworks and parent involvement by duration, number of codes and references

School ID	Parent ID	Length of interview (minutes)	Number of codes	Number of references
33	1	18	28	36
33	2	16	23	27
34	1	37	27	36
38	1	16	23	26

Table 8.29 Main and sub codes for parent interviews about homeworks and AFLY5 project

Main code	Sub code
Awareness of AFLY5	Eat Well Plate
	Fit Check
	Freeze My TV
	From child
	Homework
	Information from school
	Media
	Research
	Topics covered by project
Healthy eating	Examples of eating changes
	Other healthy eating activities suggested
Homeworks	Bingo
	Breakfast chart
	Cooking
	Eat well plate
	Fit check/scavenger hunt
	Five a day chart
	Freeze my TV
	Homework as method of involving parents
	Snack worksheet
	Sugar in drinks
	Time
	Top Grub
Physical activity	Accelerometer
	Examples of physical activity change
	Examples of sedentary change
	Other physical activity activities suggested
Child gender	
School ID	
Questionnaire	
Newsletter	

Parent end of project questionnaire

The from parents to the parent end of AFLY5 questionnaire are shown by school in Table 8.30. The parent end of project questionnaire was assessed for completeness as shown in Table 8.31. The completeness of the closed response questions ranged from 92% to 100%. The completeness of the free text responses ranged from 20 to 100%.

Table 8.30 Characteristics of responses from parents to the parent end of AFLY5 questionnaire in parent involvement schools

School ID	Number parents completed parent questionnaires (% of children in school)	Number mothers (% of respondents)[1]
33	7 (17.1)	5 (100)
34	4 (9.1)	3 (80)
37	6 (16.7)	6 (100)
38	8 (27.6)	8 (100)

[1] Two parents in school 33 did not complete the question about whether their relationship to the child.

Table 8.31 Completeness of parent end of project questionnaire before AFLY5 intervention and homework (n=25)

Question (summary)		Completeness (%)
1.	Name of the school [1]	25 (100)
2.	Relationship with child[1]	23 (92)
3.	Topics remembered in AFLY5[2]	23 (92)
4.	How do you know about the project[2]	25 (100)
5.	Remember scavenger hunt homework[1]	23 (92)
6.	Remember cooking homework[1]	25 (100)
7.	Remember eat well plate homework[1]	25 (100)
8.	Remember bingo homework[1]	25 (100)
9.	Remember freeze my TV homework[1]	25 (100)
10.	Remember snack homework[1]	25 (100)
11.	Remember top grub homework[1]	24 (96)
12.	Remember sugar in drinks homework[1]	25 (100)
13.	Remember five fruit and vegetables chart homework[1]	25 (100)
14.	Remember breakfast chart homework[1]	25 (100)
15.	Remember project in school newsletter[1]	24 (96)
16.	Has project changed what your child eats[1]	24 (96)
17.	Examples of change of diet[2]	13 (52)
18.	Ideas for homework activities to encourage healthy eating[2]	8 (32)
19.	Has project changed what child's physical activity[1]	24 (96)
20.	Examples of change of physical activity[2]	10 (40)
21.	Ideas for homework activities to encourage physical activity[2]	5 (20)
22.	Other way to involve parents in project[2]	5 (20)

[1] Closed response [2] Free text response

Table 8.32 Parents' recall of homeworks in parent involvement schools by homework and by school

Homework	Remember homework	School n 33	34	37	38	Total n (%)[1]	p value[2]
1 Fit check	Yes	2	2	1	4	9 (39.1)	0.76
	No	3	2	5	3	13 (56.5)	
	Don't know	0	0	0	1	1 (4.3)	
2 Cooking	Yes	6	3	4	8	21 (84.0)	0.39
	No	1	1	2	0	4 (16.0)	
	Don't know	0	0	0	0	0 (0.0)	
3 Eat well plate	Yes	7	4	5	6	22 (88.0)	0.42
	No	0	0	1	1	2 (8.0)	
	Don't know	0	0	0	1	1 (4.0)	
4 Bingo	Yes	7	0	4	7	18 (72.0)	0.003
	No	0	3	2	1	6 (24.0)	
	Don't know	0	1	0	0	1 (4.0)	
5 Freeze TV	Yes	7	4	4	4	19 (76.0)	0.08
	No	0	0	2	2	4 (16.0)	
	Don't know	0	0	0	2	2 (8.0)	
6 Snacks	Yes	4	3	5	7	19 (76.0)	0.53
	No	2	0	1	1	4 (16.0)	
	Don't know	1	1	0	0	2 (8.0)	
7 Top Grub	Yes	0	0	0	1	1 (4.2)	0.16
	No	5	2	6	7	20 (83.3)	
	Don't know	2	1	0	0	3 (12.5)	
8 Sugar in drinks	Yes	4	1	4	8	17 (68.0)	0.04
	No	3	1	2	0	6 (24.0)	
	Don't know	0	2	0	0	2 (8.0)	
9 Five a day chart	Yes	7	3	4	6	20 (80.0)	0.48
	No	0	0	2	2	4 (16.0)	
	Don't know	0	1	0	0	1 (4.0)	
10 Breakfast chart	Yes	4	4	6	8	22 (88.0)	0.04
	No	3	0	0	0	3 (12.0)	
	Don't know	0	0	0	0	0 (0.0)	

[1] Not all parents answered all questions, therefore denominator varies. [2] P value tested by chi-squared with ties

Teacher interviews

Table 8.33 provides information about the interviews with teachers, by school.

Table 8.34 gives the main and sub codes for the teacher interviews.

Table 8.33 Interviews with teachers in parent involvement schools about Active for Life Year 5 homeworks and parent involvement by number of teachers, duration, number of codes and references

School ID	Teacher ID	Length of interview (minutes)	Number of codes	Number of references
33	1	23	21	31
34	1	14	23	30
37	1	18	22	25
37	2	14	19	24
38	1	9	22	24

Table 8.34 Main and sub codes for teacher interviews about homeworks and AFLY5 project

Main code	Sub code
Behaviour change	Diet changes
	Physical activity changes
Future	Continue using project
	Modifications to project
Homeworks	Experience of homeworks
	Homeworks and parent engagement
	Improvements to homeworks
	Number of homeworks returned
	Number of homeworks given out
	Popular homeworks
Lessons	Curriculum
	General experience of project
	Improvements to lessons
	Length of lessons
	Number of lessons taught
	Period over which lessons taught
	Specific lessons
	Who taught lessons
	Why lessons not taught
Newsletter	Project including in newsletter
	Project not included in newsletter
Other school activities	Food project
	Physical activity projects
Parents	Ideas of involving parents
	Parents involved in project
Training day	Attendance
	Good aspects
	Improvements

Teacher end of project questionnaires

The teacher end of project questionnaire was assessed for completeness as shown in Table 8.35. The completeness of the questions ranged from 81.8% to 100%.

Table 8.35 Completeness of teacher end of project questionnaire about AFLY5 intervention (n=11)

Question (summary)	Completeness (%)
Training day prepared for teaching the lessons	10 (90.9)
Experience of researchers doing the measurements	10 (90.9)
Ease of fitting the lessons into the curriculum	11 (100)
Lessons taught: Fit Check 1	9 (81.8)
Lessons taught: Fit Check 2	11 (100)
Lessons taught: Safe workout: PE intro	9 (81.8)
Lessons taught: Eat Well Plate	11 (100)
Lessons taught: Five foods countdown	10 (90.9)
Lessons taught: Five food groups	10 (90.9)
Lessons taught: Musical Fare	10 (90.9)
Lessons taught: Keeping the balance	10 (90.9)
Lessons taught: Three kinds of fitness	10 (90.9)
Lessons taught: Freeze my TV	11 (100)
Lessons taught: Snack attack	11 (100)
Lessons taught: Bowling for snacks	9 (81.8)
Lessons taught: Think about your drink	9 (81.8)
Lessons taught: Veggiemania	11 (100)
Lessons taught: Brilliant Breakfast	11 (100)
Lessons taught: Fit Check	11 (100)
Ease of understanding lesson plans	11 (100)
Teaching the project if some Y5 children in other classes	11 (100)
Whether the "Fit Check" helped behaviour changes	11 (100)
Whether the "Freeze My TV" helped behaviour changes	11 (100)
Comments received from parents[2]	10 (90.9)
Plans to continue using the materials[2]	10 (90.9)

Table 8.36 Teachers' reports of lessons not taught and quality of lessons taught

	Teachers n (%)		
Title of lesson	Did not teach lesson	Good	Poor
Fit Check 1	0 (0)	10 (90.9)	1 (9.1)
Fit Check 2	0 (0)	10 (90.9)	1 (9.1)
Safe workout: PE Introduction (theory)	1 (11.1)	8 (88.9)	0 (0)
Eat Well Plate (nutrition)	0 (0)	11 (100)	0 (0)
Five foods countdown (PE)	3 (27.3)	8 (72.7)	0 (0)
Five food groups (nutrition)	0 (0)	10 (100)	0 (0)
Musical Fare (PE)	6 (60.0)	4 (40.0)	0 (0)
Keeping the balance (nutrition)	1 (10.0)	7 (70.0)	2 (20.0)
Three kinds of fitness (PE)	4 (40.0)	6 (60.0)	0 (0)
Freeze my TV	0 (0)	10 (90.9)	1 (9.1)
Snack attack (nutrition)	2 (18.2)	9 (81.8)	0 (0)
Bowling for snacks (PE)	5 (50.0)	5 (50.0)	0 (0)
Think about your drink (nutrition)	3 (30.0)	7 (70.0)	0 (0)
Veggiemania (PE)	7 (77.8)	2 (22.2)	0 (0)
Brilliant Breakfast (nutrition)	2 (22.2)	7 (77.8)	0 (0)
Fit Check	0 (0)	8 (88.9)	1 (11.1)

Table 8.37 Lessons taught by teachers, reported in teacher end of project questionnaire

	School ID										
Title of lesson	31	33	34	35	38	39	40	42	43	44	45
Fit Check 1	-	-	1	1	1	1	1	1	1	1	1
Fit Check 2	1	1	1	1	1	1	1	1	1	1	1
Safe workout: PE intro	-	-	1	1	0	1	1	1	1	1	1
Eat Well Plate	1	1	1	1	1	1	1	1	1	1	1
Five foods countdown	1	1	1	0	0	1	1	1	1	0	-
Five food groups	-	1	1	1	1	1	1	1	1	1	1
Musical Fare	-	0	0	0	0	1	1	0	1	0	1
Keeping the balance	1	1	1	1	1	1	-	1	0	1	1
Three kinds of fitness	1	0	1	-	0	1	1	0	0	1	1
Freeze my TV	1	1	1	1	1	1	1	1	1	1	1
Snack attack	1	1	1	1	1	1	1	0	0	1	1
Bowling for snacks	-	1	1	0	0	1	1	0	1	0	0
Think about your drink	-	1	1	1	1	1	0	0	0	1	1
Veggiemania	-	0	0	1	0	-	1	0	0	0	0
Brilliant Breakfast	-	1	1	1	1	-	0	1	0	1	1
Fit Check	-	1	1	1	1	-	1	1	1	1	1

1= Lesson taught, 0=lesson not taught, - = not indicated

8.1.1. Studies that directly test the effects of parent involvement

Table 8.38 Summary of parental perceptions regarding healthy behaviours for preventing overweight and obesity in children from a systematic review of qualitative studies[40]

Child factors	Family dynamics	Parenting	Knowledge and beliefs	Extra familial influences	Resources and environment
• Preference for certain foods • Preference for sedentary behaviours • Child's special needs relating to illness or disability	• Parent's own behaviour influencing child's • Need to act as positive role model • Lack of time acted as barrier • Being role model difficult if undermined by other family members • Food used as a reward • Having children of different weights	• Self-efficacy about influencing their child's weight-related behaviours • Actions did not always reflect awareness • Lack of time reason for not supporting child to be physically active • Busy with work was barrier to healthy food • Tiredness was lack of motivation • Family members may sabotage decisions	• Healthy habits should begin early • Overweight and obesity seen as an issue for the future and problem affecting other people's children • Parents had greater knowledge about the need for a healthy diet than for an active lifestyle to prevent overweight • Children had lack of knowledge of consequences of eating unhealthy food and would benefit from education	• Media and marketing influences were barriers to healthy behaviours • Child's peers influenced diet and TV viewing in positive and negative ways • Wider society encouraged sedentary behaviours e.g. TV and computer games • School meals seen as barrier to healthy behaviours and schools undermined their provision of healthy diet	• Physical access and cost of resources were barriers and facilitators for healthy behaviours • Lack of local facilities was a barrier to physical activity • Parents had safety concerns about outdoor play • Cost of programmes and lack of transport was barrier • Cost of food was a barrier to a healthy diet • Poor weather was a barrier to exercise and TV was a preferred pastime during poor weather.

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