A Comparison of Physical Activity and Dietary Behaviours of British Pakistani and White British Girls Aged 9 to 11 Years Living on Teesside

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by

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Abstract

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Introduction

South Asian minority groups in the UK are at greater risk of heart disease and diabetes than the general White population. Physical activity and diet may play an important role in the onset of these diseases. Previous studies suggest levels of physical activity may be particularly low in British Pakistani girls. This mixed-method study aimed to test hypotheses that British Pakistani girls would be less active and more sedentary and would consume a greater proportion of energy from fat than White British girls. It also explored activity and dietary behaviours in the two groups.

Methods

Eighty-two British Pakistani and 82 White British girls, aged 9 to 11 years, were recruited from seven primary schools on Teesside, North-east England. Accelerometry was used to collect objective measurements of physical activity and sedentary time for four days. Three previous day physical activity recalls were used to determine participation in sport and exercise, outdoor play, screen-time and active modes of school transport. Food records and three previous day multiple-pass diet recalls were used to determine intake of energy and macro-nutrients and to characterise dietary habits. Parental interviews explored familial influences on children's physical activity and dietary behaviour.

Results

British Pakistani girls accumulated: 148 (95% CI: 95, 201) fewer counts per minute per day; 19 (95% CI: 11, 26) fewer minutes in moderate-to vigorous physical activity and 5% (95% CI: 3, 7) more sedentary time, compared with White British girls. According to activity recalls British Pakistani girls accumulated: 14 (95% CI: 0.4, 28) fewer minutes per day in sport and exercise; 24 (95% CI: 13, 37) fewer minutes in outdoor play and 4 (95% CI: 0.1, 8.3) fewer minutes in active modes of school transport. There was no significant difference in screen time. British Pakistani girls gained an additional 1.7 (95% CI: 0.4, 3.3) per cent of their overall energy intake from fat, compared with White British girls. According to dietary recalls a greater proportion of British Pakistani girls consumed fast-food as an evening meal ($p=0.034$) and were more likely to consume food that had been deep fried ($p=0.04$) or shallow fried ($p<0.001$) during cooking.

Conclusion

The lower levels of physical activity and higher amounts of sedentary time, coupled with the higher intake of total fat found in British Pakistani compared with White British girls, may be associated with the increased cardiometabolic risk found in these populations, both in childhood and later in life.

Table of Contents

Declaration .... **I**
Statement of Copyright .... **I**
Acknowledgements .... **II**
Preface .... **III**

Chapter One: Introduction and Literature Review **1**
1.1 Introduction **1**
1.2 Cardiometabolic Risk **4**
1.2.1 South Asians and Cardiometabolic Risk 4
1.2.2 Physical Activity and Cardiometabolic Risk 4
1.2.3 Sedentary Behaviour and Cardiometabolic Risk 5
1.3 An Ethnic Group Comparison of Physical Activity and Sedentary Behaviour in the UK . **5**
1.3.1 Physical Activity of South Asian and White European Adults 5
1.3.2 Physical Activity of South Asian and White European Children 7
1.3.3 Sedentary Behaviour of South Asian and White European Adults 9
1.3.4 Sedentary Behaviour of South Asian and White European Children 9
1.3.5 Physical Activity Behaviours of British South Asian compared with White European Adults 10
1.3.6 Physical Activity Behaviour of British South Asian compared with White European Children 11
1.4 Determinants of Physical Activity and Sedentary Behaviour in Children **14**
1.4.1 Demographic and Socioeconomic Factors 14
1.4.2 Environmental and Social Factors 15
1.4.3 Conclusion 16
1.5 Physical Activity in British Muslim Women and Girls **17**
1.5.1 Avoidance of the Opposite Sex 18
1.5.2 Islamic Dress Code 19
1.5.3 Home/Family Responsibilities 19
1.5.4 Organised Physical Activity of Females from Predominantly Muslim Countries 21
1.5.5 Physical Activity Levels of Girls Living in Pakistan 22
1.5.6 Conclusion 23
1.6 Energy Intake and Cardiometabolic Risk **25**
1.7 Macronutrients and Cardiometabolic Risk **25**
1.7.1 Total Fat and Saturated Fat 25
1.7.2 Total Carbohydrates and Sugar 26
1.7.3 Fibre 26
1.7.4 Conclusion 27
1.8 Dietary Behaviour and Cardiometabolic Risk **27**

1.8.1 Fruit and Vegetable Intake 27
1.8.2 Sugar-sweetened Beverages 27
1.8.3 Breakfast Consumption 28
1.8.4 Fried Food and Fast-food Consumption 28
1.8.5 Conclusion 29
1.9 An Ethnic Group Comparison of Dietary Intake in the UK 29
1.9.1 Energy Intake of South Asian and White Europeans 29
1.9.2 Fat and Saturated Fat Intake of South Asian and White Europeans 30
1.9.3 Carbohydrate Intake of South Asian and White Europeans 32
1.9.4 Fibre Intake of South Asian and White Europeans 33
1.9.5 Conclusion 34
1.10 Ethnic Group Comparisons of Dietary Behaviour of British Children 34
1.10.1 Fruit and Vegetable Intake of British South Asians compared with White Europeans 34
1.10.2 Sugar-sweetened Beverage Intake of British South Asians compared with White Europeans 35
1.10.3 Breakfast Consumption of British South Asian compared with White European 35
1.10.4 Fast-food Consumption of British South Asians 36
1.10.5 Dietary Behaviour of Children Living in Pakistan 37
1.10.6 Conclusion 38
1.11 Determinants of Dietary Practices of Muslim South Asians 39
1.12 Conclusion 40
1.13 Study Aims 41
1.14 Hypotheses 41

Chapter Two: Methodological Literature Review 42
2.1 Physical Activity Assessment 42
2.1.1 Assessing Children's Physical Activity 42
2.2 Subjective Methods for Assessing Children's Physical Activity 43
2.2.1 Physical Activity Questionnaires (PAQs) 43
2.2.2 Physical Activity Recall (PAR) 44
2.2.3 Physical Activity Diary or Log 45
2.2.4 Validity of Self-Report Methods for Assessing Children's Physical Activity 45
2.2.5 Misreporting Issues Associated with Self-Reported Physical Activity 46
2.2.6 Self-Report Methods for Assessing Physical Activity of Different Ethnic Populations 47
2.2.7 Conclusion 47
2.3 Objective Methods for Assessing Children's Physical Activity 48
2.3.1 Pedometry 48
2.3.2 Heart Rate Monitoring 49
2.3.3 Accelerometry 50
2.3.4 Reliability and Validity of Objective Tools for Assessing Children's Physical Activity . 53

2.3.5 Objective Tools for Assessing Physical Activity of Ethnic Minority Groups 54
2.3.6 Conclusion: Using Objective Methods for Assessing Children's Physical Activity 54
2.4 Methods for Assessing Children's Sedentary Time 55
2.4.1 Self-Report 55
2.4.2 Objective Tools...56
2.4.3 Conclusion 57
2.5 Methodological Decisions for Data Collection by Accelerometry.............................. 57
2.5.1 Epoch Review 58
2.5.2 Defining the Duration of Measurement 60
2.5.3 Defining the Minimum Wear Criteria 60
3.5.4 Omitting Spurious Data..61
2.5.5 Threshold Review..62
2.6 Dietary Intake Assessment 68
2.6.1 Food Records...68
2.6.2 Diet Recall 68
2.6.3 Multiple Pass Recall (MPR) 69
2.6.4 Food Frequency Questionnaire (FFQ)..70
2.6.5 Validity of Self-report Dietary Assessment Methods for use with Children...............70
2.6.6 Examining Dietary Intake of Different Ethnic Populations 72
2.6.7 Reliability and Validity of Methods of Self-Report for Dietary Assessment...............73
2.6.8 Portion Size Estimates...74
2.6.9 Misreporting..75
2.6.10 Conclusion...75

Chapter Three: Methods, Data Processing and Analysis 76
3.1 Study Design... 76
3.2 Study Setting and Participants.. 76
3.2.1 Background of Study Population 76
3.2.2 Sample Size 77
3.2.3 Ethical Approval 77
3.2.4 Data Protection 77
3.2.5 Feedback to Schools..78
3.2.6 Funding Sources 78
3.3 Data Collection and Recruitment.. 79
3.3.1 Recruitment of Schools 79
3.3.2 Recruitment of Girls 80
3.4 Study Protocol 83
3.4.1 Parent Meetings...83
3.4.2 Study Induction 83
3.4.3 The Study Booklet 83
3.4.4 Parent/Guardian Questionnaire 84

3.4.5 Parent/Guardian Cover/Interview Recruitment Letter 84
3.4.6 Poster 85
3.4.7 Actigraph Activity Monitoring 85
3.4.8 Food Record 87
3.4.9 Previous Day Multiple Pass Diet Recall (PD-MPDR) 87
3.4.10 Previous Day Physical Activity Recall (PD-PAR) 89
3.4.11 Physical Activity Questionnaire 90
3.4.12 Parent Interviews 91
3.5 Data Processing 93
3.5.1 Parent Questionnaire 93
3.5.2 Weight and Height 95
3.5.3 Accelerometry 95
3.5.4 Multiple Pass Diet Recall 97
3.5.5 Previous Day - Physical Activity Recall (PD-PAR) 108
3.5.6 Physical Activity Questionnaire 109
3.5.7 Parent Interview 111
3.6 Sample Statistics 112
3.6.1 PD-MPDR Sub-Sample for Analysis 112
3.6.2 Physical Activity Sub-Sample for Analysis 113
3.6.3 Parent Interview Sample for Analysis 115
3.7 Statistical Analysis 116
3.7.1 Sample Statistics 116
3.7.2 Background Information 116
3.7.3 Weekend and School Day; Out-of-School and During-School Variation 116
3.7.4 Controlling for Environmental and Socio-Demographic Determinants of Objectively Measured Physical Activity and Energy and Macro-Nutrient Intake 116
3.7.5 Multilevel Modelling 117
3.7.6 Ethnic Group Comparisons of Objectively Measured Physical Activity and MPDR Energy and Macro-Nutrient Intake 117
3.7.7 Ethnic Group Comparison of Objectively Measured Physical Activity during School Break-time 118
3.7.8 Ethnic Group Comparisons of Meal Time Dietary Behaviour 118
3.7.9 Ethnic Group Comparison of the Consumption of Food and Beverages Related to Excess Weight Gain 118
3.7.10 Previous Day Physical Activity Recall (PD-PAR) and Physical Activity Questionnaire (PAQ-C) 118
3.7.11 Qualitative Data Analysis – Interviews 119

Chapter Four: Characterising Physical Activity of White British and British Pakistani Girls 120
4.1 Background 120

4.2 Aims **120**
4.3 Hypotheses **120**
4.4 Results **121**
4.4.1 Description of the Study Sample 121
4.4.2 Physical Activity Level of All Girls 127
4.4.3 Environmental and Socio-Demographic Factors Association with Physical Activity .131
4.4.4 Ethnic Group Comparison of Overall Mean Objectively Measured Physical Activity 135
4.4.5 Ethnic Group Comparison of Weekend and School Day Patterns of Objectively Measured Physical Activity 135
4.4.6 Ethnic Group Comparison of Hourly Patterns of Total Physical Activity and Sedentary time for Weekend and School Days 136
4.4.7 Ethnic Group Comparison of Out-of-School and During-School Objectively Measured Physical Activity 141
4.4.8 Ethnic Group Comparison of Objectively Measured School Break-time Physical Activity 145
4.5 Discussion **146**
4.5.1 Ethnic Group Comparisons of Overall Objectively Measured Physical Activity 146
4.5.2 Ethnic Group Comparisons of Weekend and School Day Patterns of Objectively Measured Physical Activity 149
4.5.3 Ethnic Group Comparisons of Out-of-School and During-School Patterns of Objectively Measured Physical Activity 153
4.5.4 Ethnic Group Comparison of School Break-time Physical Activity 157
4.6 Conclusion **158**

Chapter Five: Ethnic Group Comparison of Physical Activity and Sedentary Behaviour of White British and British Pakistani Girls 159
5.1 Background **159**
5.2 Aims **159**
5.3 Results **160**
5.3.1 Description of Study Sample 160
5.3.2 Ethnic Group Comparison of Overall Self-Reported Activities 161
5.3.3 Ethnic Group Comparison of Self-Reported Activities on Weekend Days................165
5.3.4 Ethnic Group Comparison of Self-Reported Activities on School Days 170
5.4 Discussion **183**
5.4.1 Ethnic Group Comparison of Overall Physical Activity and Sedentary Behaviour.....183
5.4.2 Ethnic Group Comparisons of Weekend Physical Activity and Sedentary Behaviour 186
5.4.3 Ethnic Group Comparison of School Day Physical Activity and Sedentary Behaviour 190
5.5 Conclusion **195**

Chapter Six: Characterising Ethnic Differences in Dietary Intake of White British and British Pakistani Girls 196
6.1 Background........ 196
6.2 Aims 196
6.3 Hypothesis........ 196
6.4 Results........ 196
6.4.1 Description of the Study Sample........ 196
6.4.2 Overall Mean Daily Dietary Intake and Patterns of Mean Dietary Intake of all Girls in this Study........ 201
6.4.3 Environmental and Socio-Demographic Factors Association with Dietary Intake 206
6.4.4 Ethnic Group Comparisons of Mean Dietary Intake 211
6.5 Discussion........ 218
6.5.1 Ethnic Group Comparison of Overall Mean Daily Energy Intake........ 218
6.5.2 Ethnic Group Comparison of Overall Mean Daily Intake of Macronutrients 219
6.6 Conclusion 223

Chapter Seven: Ethnic Group Comparison of Dietary Behaviour of White British and British Pakistani Girls 225
7.1 Background........ 225
7.2 Aims 225
7.3 Results........ 225
7.3.1 Ethnic Group Comparison of Meal Time Dietary Practices and Consumption Habits 225
7.3.2 Traditional South Asian Cooking Practices........ 237
7.3.3 Ethnic Group Comparison of the Frying of Food during Cooking 238
7.3.4 Ethnic Group Comparison of Food and Beverage Group Intake Associated with Excess Weight Gain and Cardiometabolic Risk 240
7.4 Discussion........ 245
7.4.1 Meal Time Dietary Practices 245
7.4.2 Cooking Practices 249
7.4.3 Ethnic Group Comparisons of Food and Beverage Group Intake Associated with Excess Weight Gain and Cardiometabolic Risk 251
7.5 Conclusion 253

Chapter Eight: Conclusion 254
8.1 Summary of Study Aims 254
8.2 Study Strengths and Limitations 255
8.2.1 Sample........ 255
8.2.2 Methods 255
8.3 Summary of the Main Study Findings 260
8.4 Areas for Future Research 265

Bibliography 268
Appendices 294

A. School recruitment letter
B. Parent/guardian study information letter
C. Staff study information letter
D. Study consent form (child)
E. Study booklet
F. Parent/guardian cover/interview recruitment letter
G. Parent /guardian questionnaire
H. Multiple Pass Diet Recall Protocol
I. Data collection sheets (diet)
J. Data collection sheets (physical activity)
K. Physical Activity Questionnaire for Children

Declaration

I declare that this thesis is my own work and that, to the best of my knowledge and belief it contains no material previously publishes or written by another person except where due acknowledgement has been made in the text.

The word count of this thesis is 85'846, excluding the bibliography and appendices.

Statement of Copyright

Signed:

Date: 31 October 2012

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Preface

This thesis examines lifestyle behaviours associated with cardiometabolic risk in 9 to 11 year old girls of White British and British Pakistani ethnicity. The main aims of this study are to make ethnic group comparisons of objectively measured physical activity and sedentary time and self-reported physical activity and dietary behaviours.

Chapter one describes the health inequalities related to cardiometabolic risk between White British and British South Asians. It outlines the links between physical activity, sedentary behaviour, dietary intake and cardiometabolic risk and reviews past research on these behaviours in British South Asian ethnic groups (adults and children), with a focus on British Pakistanis, and where possible comparing them with their White British counterparts. In addition, this chapter discusses the determinants of physical activity in children, including moral codes and associated practices relating to British Muslim women and girls. Finally, chapter one outlines the detailed aims of the study and the hypotheses to be tested.

Chapter two is a methodological literature review. It discusses a wide range of methods available for assessing physical activity, sedentary time and dietary intake in children. This includes both objective assessment methods, as well as more traditional self-report methods. It focuses on the use of these methods to examine ethnic group differences in physical activity and dietary intake and related behaviour, and problems associated with using each method with children. Each section concludes by defining the methods selected for use within this current study. This chapter also discusses key methodological decisions associated with using accelerometry to assess physical activity and sedentary time in children, before outlining the standard practice adopted within this study. Chapter three of this thesis reports the study methodology. More specifically it outlines the study design and describes the study setting and recruitment procedure. It discusses the study protocol, presents the sample statistics and the data processing and analysis techniques.

Chapters' four to seven present the study findings and the discussion of these findings. Chapter four investigates ethnic group differences in objectively measure physical activity and sedentary time. This chapter also investigates ethnic group differences in patterns of objectively measured physical activity and sedentary time by weekend and school (week) days and during-school and out-of-school and school break-time. Chapter five investigates self-reported physical activity and sedentary behaviours in an effort to explain the ethnic group differences found in objectively measured physical activity and sedentary time. It does this by examining, by ethnic group, participation in sport and exercise; outdoor play; screen time; after-school sport and exercise and active modes of school transport.

Chapter six compares, by ethnic group, energy and macronutrient (fat; saturated fat; carbohydrates; sugar and fiber) intakes. This chapter also examines patterns of energy and macronutrient intakes for Sunday (representing weekend days); school days; during-school and out-of-school. Chapter seven investigates dietary behaviour, to provide an explanation for the ethnic group differences and similarities found in energy and macronutrient intakes in chapter six, and examines dietary practices and consumption habits associated with excess weight gain and cardiometabolic risk.

Finally, to conclude, chapter eight discusses the main strengths and limitations of this study, summarises the key findings and discusses them in relation to the increased cardiometabolic risk found in British South Asians, compared with White British populations, and identifies potential areas for future research.

Chapter One: Introduction and Literature Review

1.1 Introduction

South Asian populations in the UK are at greater risk of type 2 diabetes and cardiovascular disease than the general population (Simmons et al., 1992; Erens and Primatesta, 2001; Sproston and Mindell, 2006; Feltbower et al., 2002; McKeigue et al., 2003). Prevalence of type 2 diabetes is also markedly higher in British South Asian children, when compared with White European children (Feltbower et al., 2002, 2003), with precursors already presenting themselves in British children within the first 10 years of life (Whincup et al., 2002, 2011). Higher rates of type 2 diabetes, and risk factors for cardiovascular disease were observed in British South Asians of Pakistani and Bangladeshi origin, compared to those of Indian origin (Bhopal et al., 1999: Erens and Primatesta, 2001; Sproston and Mindell, 2006). Although South Asians may be more genetically predisposed to the development of these cardiometabolic diseases, it is believed that low levels of physical activity and a poor diet may contribute to elevated risk in British South Asians.

Low levels of physical activity (Helmrich et al., 1991; Hu et al., 1999; Sigal et al., 2004, 2006; LaMonte et al., 2005; Laaksonen et al., 2005; Warburton et al., 2006; Jeon et al., 2007) and high levels of sedentary behaviour (Hu et al., 2003; Hamilton et al., 2004, 2007, 2008; Hamburg et al., 2007; Bauman and Spungen 2008; Healy et al., 2008; Tremblay et al., 2010) are associated with raised cardiometabolic risk in adult populations. There is also increasing evidence to suggest that low levels of physical activity (Brage et al., 2004: Gidding et al., 2006; Sardinha et al., 2008; Owen et al., 2010) and extended periods of sedentary behaviour (Tremblay et al., 2011) are having adverse effects on obesity rates and cardiometabolic profile of children.

A review study by Fischbacher et al. (2004) found that British South Asians were, consistently, less physically active than White Europeans living in the UK. There is also evidence to suggest variation between South Asian subgroups, with those of Pakistani and Bangladeshi origin, showing lower levels of physical activity, when compared with those of Indian origin, with particularly low levels reported for women and girls of these ethnic groups (Erens and Primatesta, 2001; Sproston and Mindell, 2006; Hayes et al., 2002; Fischbacher et al., 2004; Owen et al., 2009; Williams et al., 2011).

Given the links between physical activity and sedentary behaviour and cardiometabolic risk, there is a great need to expand on the current body of self-report data, with more reliable objective data, for South Asian populations most at risk. To my knowledge there are currently no data available on objectively measured physical activity and sedentary time in British Pakistani girls. Since cardiometabolic risk is high and self-reported physical activity is low in this population, this information is of public health importance.

Identifying differences in physical activity behaviours is potentially the key to understanding ethnic group differences in levels of physical activity and sedentary time. Previous UK based studies have shown that White European and Indian women participated in a wider range of activities of moderate to vigorous intensity compared to Pakistani and Bangladeshi women (Pomerleau et al., 1999; Hayes et al., 2002; Sproston and Mindell, 2006). The Health Survey for England (2004) investigated ethnic group differences in activity behaviour of children aged 2 to 15 years, and found that Pakistani and Bangladeshi girls spent less time in sport and exercise activities and active play compared with White European and Indian girls. Participation in physical activities is likely to vary with age, particularly in Pakistani and Bangladeshi girls, where issues of modesty come into practice around puberty. Therefore there is a need for more age specific information on physical activity and sedentary related behaviours within these populations.

Excess energy intake is also associated with overweight and obesity (Prentice and Jebb, 1995; Hill and Peters, 1998), which are closely linked to cardiometabolic risk (Despres 2006; Despres and Lemieux, 2006; Despres et al., 2008; Ferrannini et al., 2008; Klein et al., 2012). Previous studies have found adverse associations between intake of specific macronutrients (Jenkins et al., 1981; Sevak et al., 1994; Marshall et al., 1994; Daly et al., 1997; Salmeron et al., 1997; Meyer, 2000; Hu et al., 2001a, 2001b; McKeown, 2004), consumption of sugar-sweetened beverages (Malik et al., 2006; Hu and Malik, 2010), fast-foods (French et al., 2000; Bowman et al., 2004[a], 2004b; Pereira et al., 2005), skipping breakfast (Cho et al., 2003; Farshchi et al., 2005; Niemeier et al., 2006; Raynor et al., 2008; Szajewska and Ruszczyński, 2010) and cardiometabolic risk. Inverse associations have also been found between fibre (Anderson et al., 2004) and fruit and vegetable intake (Carter et al., 2010; Ness and Powels, 1997; Dauchet et al., 2006) and cardiometabolic risk.

Previous studies, investigating ethnic group differences in energy and macronutrient intake between White European and South Asian adult populations, are inconsistent in their findings. Differences in dietary practices, including religious and regional variations, may play a role in these discrepancies. Therefore South Asians should not be treated as one homogeneous group and should instead be recognised by their religious orientation or country of origin. Donin et al. (2010) report on ethnic group differences in dietary intake of British children. They found that South Asian children had a greater energy and fat intake, but lower carbohydrate, sugar and saturated fat intake, when measured as a proportion of daily energy intake, compared with White Europeans. There was also evidence to suggest a slight variation of macronutrient intake between South Asian subgroups. However, additional evidence of ethnic group differences in dietary intake of British children is limited and therefore warrants further investigation.

Since key determinants of adiposity and cardiometabolic disease are already displaying themselves in childhood, identifying at risk populations is essential for early prevention. There is a need to identify whether British Pakistani girls compensate for low levels of physical activity and high periods of sedentary time with lower energy intake. Furthermore, identifying dietary practices of White British and British Pakistani girls may provide evidence key to understanding the variation in disease risk between these populations.

This study takes a medical anthropological perspective to investigate physical activity, sedentary time and dietary intake of White British and British Pakistani girls, aged 9 to 11 years, living on Teesside, North-east England. A mixed method approach is employed to collect data on objectively measured physical activity and sedentary time; self-reported physical activity and sedentary related behaviour; self-reported dietary intake and dietary behaviour, as well as semi-structured interviews to investigate parental perceptions of physical activity and dietary practices within the household.

1.2 Cardiometabolic Risk

1.2.1 South Asians and Cardiometabolic Risk

Adults of South Asian ethnicity in the UK are at increased risk of developing type 2 diabetes and coronary heart disease, compared to the White British population (Riste et al., 2001; Kuppuswamy and Gupta, 2005). Type 2 diabetes and cardiovascular risk is greater in British South Asians of Pakistani and Bangladeshi origin, compared with those of Indian origin (Bhopal et al., 1999). In addition, there is evidence to suggest that childhood diabetes is on the increase in the UK, with rates found to be noticeably higher in children of South Asian ethnicity (Feltbower et al., 2002, 2003). Furthermore, studies (Whincup et al., 2002; 2011) have found higher levels of insulin and insulin resistance in British South Asian children, compared with White British children within the first decade of life.

1.2.2 Physical Activity and Cardiometabolic Risk

The health benefits of physical activity in relation to morbidity and premature mortality from cardiometabolic disease have been well documented (Helmrich et al., 1991; Hu et al., 1999; Sigal et al., 2004; 2006; Warburton et al., 2006; Laaksonen et al., 2005 ; LaMonte et al., 2005; Jeon et al., 2007). Physical activity of moderate to vigorous intensity is beneficial for the prevention of lifestyle related disease in adults (Sigal et al., 2006; Jeon et al., 2007). Therefore, UK public health guidelines recommend that adults should participate in a minimum of 150 minutes of moderate to vigorous physical activity per week, or 30 minutes per day, on at least five days of the week (Department of Health, 2011).

There is increasing evidence to suggest that low levels of physical activity are also having adverse effects on the health of young children, in terms of obesity and cardiometabolic profile (Brage et al., 2004; Gidding et al., 2006; Sardinha et al., 2008; Owen et al., 2010), and physical activity in childhood has a protective effect on fatness in adulthood (Parsons and Power et al., 1999). Current UK public health guidelines therefore recommend that children, aged 5 to 18 years, should participate in a minimum of 60 minutes of moderate to vigorous physical activity every day (Department of Health, 2011). However, evidence suggests that a high proportion of children are failing to meet these levels (Owen et al., 2009). Since key determinants of adiposity and cardiometabolic disease are already displaying themselves in childhood, identifying at risk populations is essential for early prevention.

1.2.3 Sedentary Behaviour and Cardiometabolic Risk

In recent years there has been an increased interest in the relationship between sedentary behaviour and health, with growing evidence to suggest that spending long periods of time in sedentary behaviour is adversely associated with obesity and poor cardiometabolic profile (Hu et al., 2003; Hamilton et al., 2004; 2007; 2008; Hamburg et al., 2007; Healy et al., 2008; Bauman and Spungen, 2008; Tremblay et al., 2010) independently of physical activity and whether guidelines for moderate to vigorous physical activity are being met (Healy et al., 2007; Hamilton et al., 2008). Recent health guidelines suggest that adults should minimise the amount of time they spend sitting. This can be achieved by reducing the amount of time spent watching TV or on the computer, taking regular breaks from sitting at work and using active modes of transport such as walking or cycling (Department of Health, 2011).

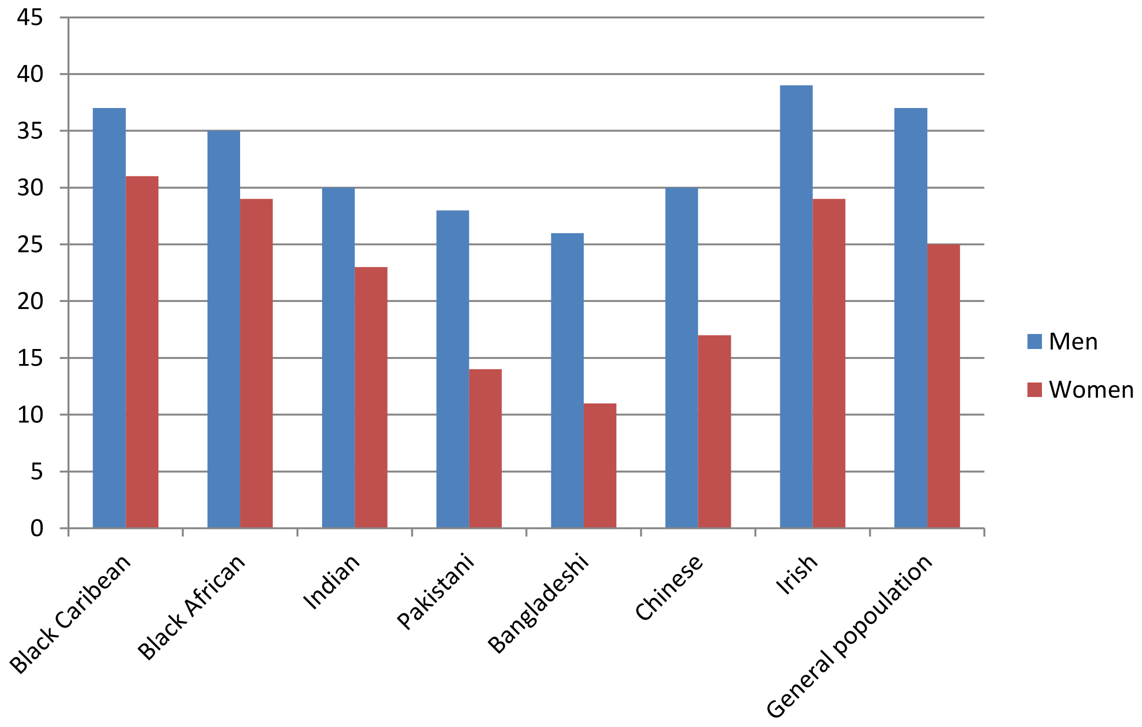
Evidence suggests that an increased amount of sedentary behaviour in children has unfavourable effects on their body composition (Tremblay et al., 2011) and cardiometabolic profile (Ekelund et al., 2006; Sardinha et al., 2008). Recent Canadian guidelines stipulate that children should minimise the amount of time they spend sedentary each day, by limiting recreational screen time (TV viewing, computer use and video gaming) to no more than two hours per day; break up extended periods of sitting; reduce the amount of time spent indoors throughout the day and participate in more active forms of transport (Tremblay et al., 2011).

1.3 An Ethnic Group Comparison of Physical Activity and Sedentary Behaviour in the UK

1.3.1 Physical Activity of South Asian and White European Adults

It has been well documented that adult South Asians, in the UK, are less physically active than their White British counterparts (Williams and Shams, 1998; Erens and Primatesta, 2001; Sproston and Mindell, 2006; Lean et al., 2001; Hayes et al., 2002; Fischbacher et al., 2004; Yates, 2010; Williams et al., 2011). A review study by Fischbacher et al. (2004) found that adult South Asians were consistently less physically active than the general white population. The 1999 and 2004 *Health Survey for England* were the first large scale surveys to examine the health of minority ethnic groups in England and reported ethnic group differences in self-reported physical activity levels of adults. Findings from the 2004 survey suggested that more men than women (graph 1.3.1.1) met physical activity guidelines (30 minutes or more of moderate intensity activity on at least five days a week) in all ethnic groups. Asian ethnic groups, in particular Pakistani and Bangladeshi were the least likely to meet physical activity guidelines. Furthermore, only a small proportion of South Asian women, particularly those of Pakistani and Bangladeshi origin, were meeting guidelines.

Graph 1.3.1.1 Comparison of the Percentage of Adults Meeting Physical Activity Recommendations by Ethnic Group, as Reported in the *Health Survey For England* 2004



A study reported by Hayes et al. (2002) assessed physical activity levels of White European and South Asian ethnic groups in North-east England, UK. It was found that Bangladeshi and Pakistani women were less likely to participate in moderate to vigorous intensity physical activity than White European and Indian women. Just nine per cent of Bangladeshi and 19% of Pakistani women were meeting physical activity recommendations, compared to 37% of the general population. The evidence from both studies is consistent in suggesting that

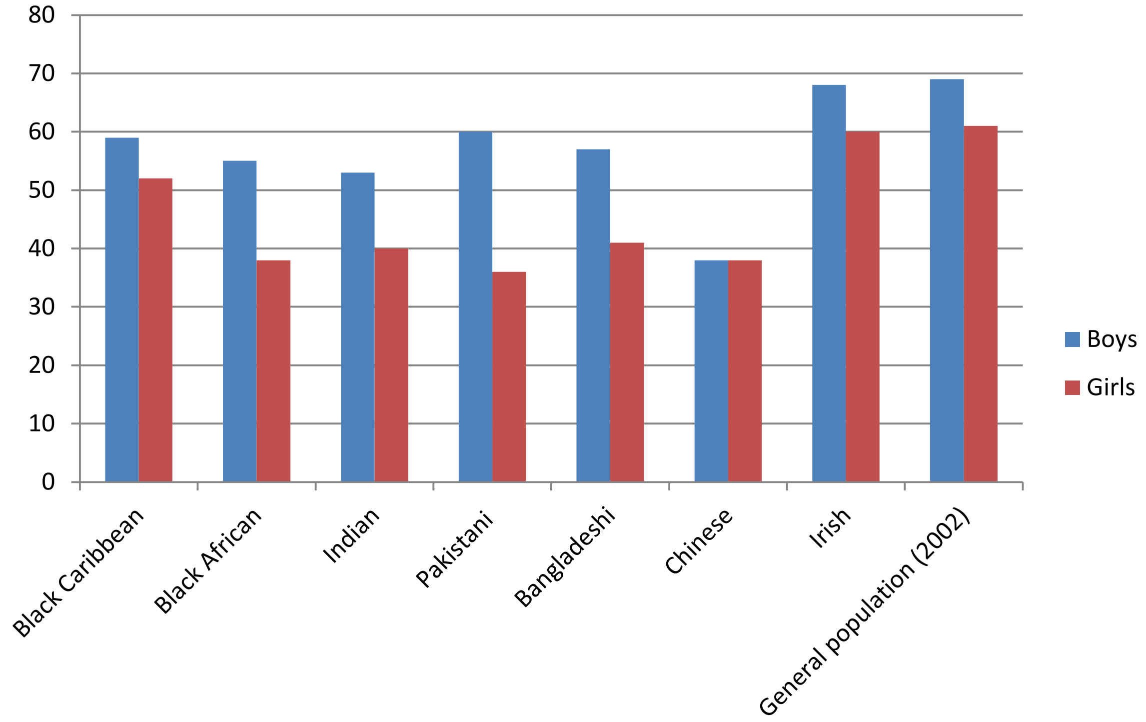
British South Asian adults are less physically active than their White European counterparts, particularly regarding physical activity of a higher intensity that is most beneficial to health. Low levels of physical activity, like those identified in adult South Asians, are likely to be a significant aetiological cause associated with the increased risk of cardiometabolic disease within these populations.

1.3.2 Physical Activity of South Asian and White European Children

Studies reported by both Woodfield et al. (2002) and Duncan et al. (2008) used a self-report, four by one day, recall questionnaire to assess physical activity levels of ethnically diverse samples of secondary school children from Birmingham, UK. Woodfield et al measured differences in energy expenditure and physical activity. They identified that children of South Asian ethnicity had lower average daily energy expenditure and were more likely to be classified as 'inactive' than their White counterparts. Duncan et al reported on activity intensity, finding that South Asian children were less likely to participate in higher intensity physical activity, averaging 20 minutes less moderate to vigorous physical activity per day, compared with white children. A further study by Brodersen et al. (2007) reports trends from a five year longitudinal study of 11 to 16 year old children based in South London. Participants were asked annually, from year 7 to 11, to report the amount of vigorous physical activity they participated in during the last seven days. Again findings suggest that South Asians were consistently less active than their white counterparts in both gender groups and boys reported more physical activity than girls. Furthermore, physical activity was found to decline in both ethnic and gender groups over time, although a steeper decline was witnessed in girls.

The *Health Survey for England* 2004 also investigated ethnic group differences in physical activity levels of children, aged 4 to 15 years (graph 1.3.2.1). Findings suggest that South Asian boys and girls were less likely to meet physical activity recommendations (60 minutes or more of moderate to vigorous physical activity on every day of the week) than the general population boys and girls. There was also considerable variation in physical activity between the different South Asian minority groups, with findings suggesting that the proportion of boys meeting physical activity recommendations was lowest in Indians, compared with Pakistani and Bangladeshis, all of which were lower than the general population boys. Ethnic group differences were more marked in girls, with much lower proportions of Indian, Pakistani and Bangladeshis meeting physical activity recommendations, compared with the general population girls. Pakistani girls were the least likely to meet recommended physical activity guidelines, compared with all other ethnic groups. Gender differences were also evident, with a greater proportion of boys from each ethnic group meeting physical activity guidelines, compared with girls.

Graph 1.3.2.1 Comparison of The Percentage of Children Aged 2 to 15 Years Meeting Physical Activity Recommendations by Ethnic and Gender Group, as Reported by the *Health Survey For England* 2004



In recent years it has become popular to assess physical activity using more accurate, objective methods, rather than previous less reliable methods of self-report. Owen et al. (2009) was the first published study to investigate ethnic and gender differences in objectively measured physical activity by accelerometry. They studied 9 to 10 year old children, in the UK and found that, despite accumulating similar amounts of moderate to vigorous physical activity, South Asian boys accumulated significantly fewer Counts Per Minute (CPM) and steps, compared with White European boys. Ethnic variations in physical activity levels were again more marked in girls and despite recording more registered time, South Asian girls accumulated significantly fewer total counts, CPM, steps and spent less time in moderate to vigorous physical activity, compared with White European girls. These findings therefore imply that South Asian boys and girls were less physically active compared to White European boys and girls. A more recent study by Duncan et al. (2011) assessed physical activity, in terms of steps, in White British and South Asian children, aged nine years. They found that children of South Asian ethnicity accumulated, on average, significantly fewer steps, suggesting that they were less physically active than White British children.

All other published studies available have used methods of self-report to determine that South Asian adolescents are less physically active than White European adolescents. Therefore, evidence suggests that ethnic variations in physical activity levels are present between White European and South Asian children, in boys, but more so girls from an early age. The *Health Survey for England* is the only study to identify ethnic variation in children's physical activity levels between the different South Asian subgroups and suggested that the proportion of Pakistani girls meeting current physical activity guidelines are particularly low in comparison to the general population of girls. However, objective measures of physical activity are required to confirm these findings.

1.3.3 Sedentary Behaviour of South Asian and White European Adults

The current interest in sedentary time in relation to health outcomes is a relatively recent trend; therefore literature on ethnic group differences within this area is limited. Hayes et al. (2002), however, examined ethnic group differences in the proportion of men and women who spent large parts of their day inactive, which referred to sitting, with limited amounts of walking. They found that a greater proportion of South Asian men and women reported spending their days inactive compared with their White European counterparts. Furthermore, significant differences were also reported between the different South Asian ethnic groups, with findings to suggest that a greater proportion of Pakistani and Bangladeshi women spent their day inactive, when compared with Indian and White European women. To my knowledge there are no further published studies examining sedentary behaviour in adult South Asians here in the UK.

1.3.4 Sedentary Behaviour of South Asian and White European Children

Khunti et al. (2007) and Brodersen et al. (2007) have both explored ethnic group differences in self-reported sedentary time of adolescent children, by measuring screen time, which was described as watching TV and playing on computer games. Khunti et al identified no significant differences in screen time between ethnic groups. In their longitudinal study, Brodersen et al identified that self-reported screen time increased with age in both British South Asian and White adolescents. However, they found a more rapid incline in South Asian girls, when compared with White European girls, with this difference becoming increasingly significant over time.

Objective measurements of ethnic group differences in sedentary behaviour of younger children were reported by Owen et al. (2009). It was identified that South Asian boys and girls spent more time sedentary, compared with their White European counterparts. The greatest difference, however, was found in girls, with South Asians accumulating, on average, an additional 48 minutes of sedentary time, per day, compared to White European girls.

Owen et al. (2009) do not distinguish between the different South Asian minority groups. Therefore it is not possible to determine whether sedentary time differs between South Asian minority groups and whether the particularly high levels of inactivity found in Pakistani women are present in Pakistani girls during childhood. Gaining accurate measures of sedentary time within these populations may help provide important evidence surrounding the less favourable cardiometabolic profile evident in South Asian children.

1.3.5 Physical Activity Behaviours of British South Asian compared with White European Adults

Differences in physical activity related behaviours, and the amount of time spent in them, is potentially the key to understanding ethnic group differences in physical activity and sedentary levels. Hayes et al. (2002) identified that adult South Asians were less likely, than White Europeans, to walk long distances. A further study reported by Pomerleau et al. (1999) examined ethnic group differences in behavioural correlates associated with BMI of women in the UK, and also found that South Asian women participated in less walking activity than the general population women. Pomerleau et al further reports that British South Asian women were also less likely to cycle and participate in sports activities than White European women. Similar findings were again reported by Hayes et al, who distinguished between the different South Asian minority groups, identifying that Pakistani and Bangladeshi women were less likely, than Indian and women of the general population, to participate in cycling and swimming activities. Ethnic group differences were also evident in men, with a smaller proportion of South Asians participating in activities compared to White Europeans.

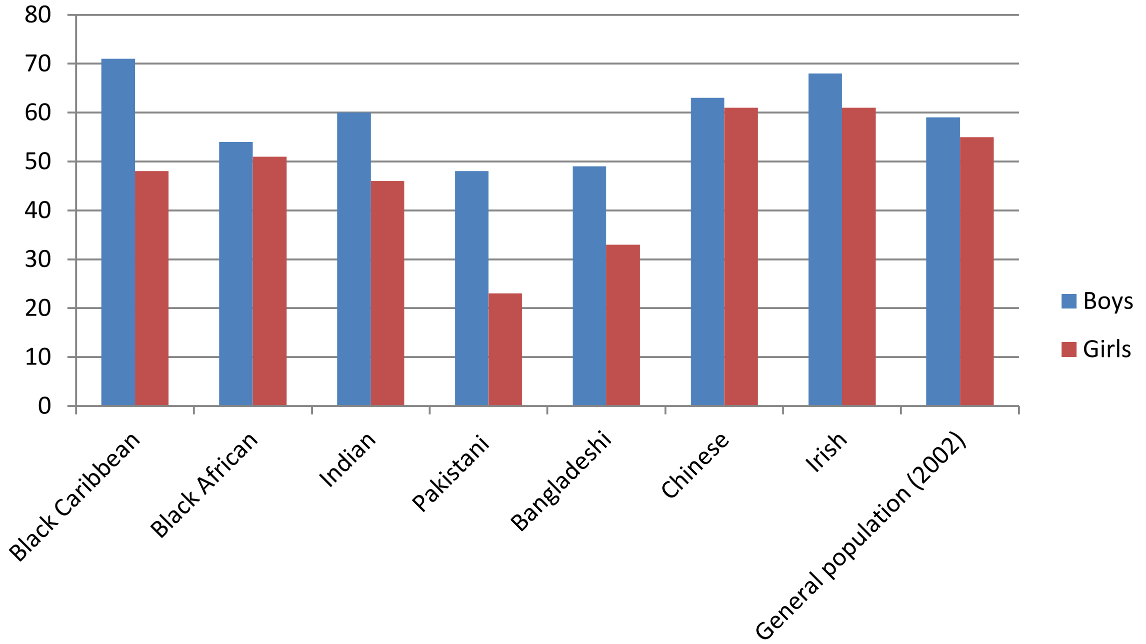
The *Health Survey for England* 2004 also report on ethnic group differences in activity behaviour of adults. In line with previous findings, self-reported participation in sports and exercise and brisk walking activity were low in Pakistani and Bangladeshi women, compared with the general population. Ethnic group differences were also found in men, with South Asians reporting participating in less sports and exercise on a weekly basis compared with White European men.

It is possible that the physical activity behaviour of adults may predict that of the children from the same population. A number of review studies (Sallis and Prochaska et al., 2000, Van Der Horst et al., 2007; Hinkley et al., 2008) have found evidence to support a significant association between parent and child physical activity levels. Such evidence may suggest that the low levels of physical activity found in British South Asian adults, may be a potential predictor for low levels of physical activity of children from these populations.

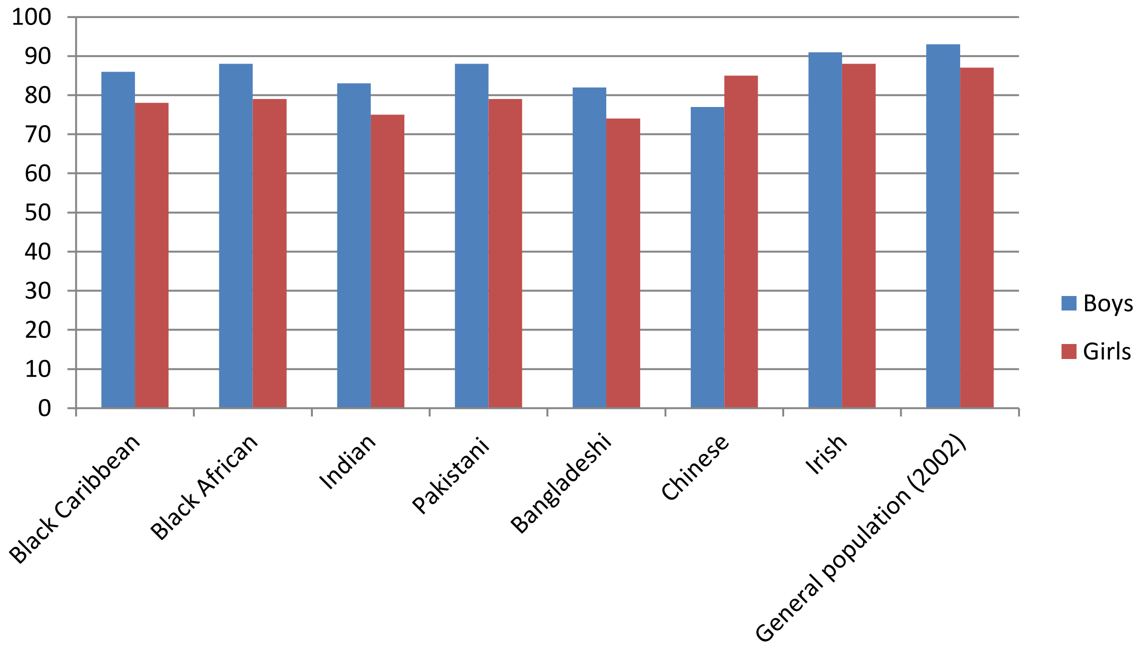
1.3.6 Physical Activity Behaviour of British South Asian compared with White European Children

The *Health Survey for England,* 2004, reported on ethnic group differences in the proportion of children participating in sports and exercise (graph 1.3.6.1). Participation in sport and exercise activities was lower in South Asian girls, compared with those of the general population, with participation rates particularly low in Pakistani and Bangladeshi girls. Participation in sport and exercise was low in Pakistanis and Bangladeshi boys, when compared with the general population and Indian boys. Gender differences were also apparent, with girls of all ethnic groups consistently displaying lower participation rates in sport and exercise activities compared with boys.

Graph 1.3.6.1 The Proportion of Children, Aged 2 to 15 Years, Self-Reporting Participation in Sport and Exercise Activities, by Ethnic and Gender Group, as Reported by the *Health Survey For England* 2004



Graph 1.3.6.2 The Proportion of Children, Aged 2 to 15 Years, Self-Reporting Participation in Active Play, by Ethnic and Gender Group, as Reported by the *Health Survey For England* 2004



The average time spent in sport and exercise activity by ethnic group was also reported (data not presented) with girls of South Asian ethnicity reporting spending the least, and girls from the general population spending the most amount of time in sport and exercise activities. Indian and Pakistani boys reported spending similar amounts of time in sport and exercise activities compared with the general population boys, whereas the lowest amount of time spent in sport and exercise activities were reported by Bangladeshi boys.

The *Health Survey for England,* 2004, also reported on ethnic and gender variations in active play (graph 1.3.6.2). A high proportion of girls from each ethnic group reported participation in some active play. South Asian and Black African girls, and Chinese, Bangladeshi and Indian boys, were the least likely to participate in active play. Whereas, Irish and the general population girls and boys were the most likely to participate in active play. With the exception of the Chinese, girls consistently reported lower participation rates in active play compared with boys. However, ethnic and gender differences in active play were not as marked as those reported for participation in sport and exercise. The poor uptake of sport and exercise activities and low levels of physical activity, however, are not isolated to British South Asian children alone and is generally a common feature in Muslim girls and women. Participation in physical activity and organised sport by Muslim women and girls is discussed in more detail in section 1.5.

A further study, reported by Khunti et al. (2007), explored ethnic group differences in school break-time and evening activity in adolescent White European and South Asian children. Break-time activities included football, ball games, chasing games and organised sport activities. Evening activities included, brisk walking or jogging, household chores, cycling, sports and dancing, plus others. Similar proportions of White European and South Asian girls reported active behaviour at school, during morning and lunch time break, however the proportion of girls reporting active behaviour was very low; eight per cent and seven per cent, respectively. No ethnic group differences were identified in the active behaviour of boys, who consistently reported more active behaviour than girls. Furthermore, Khunti et al found no significant difference, by ethnic or gender groups, in active behaviour during the evening.

In summary, evidence suggests that girls show the greatest variation in activity behaviour between ethnic groups. The low participation in self-reported activities by South Asians, particularly Pakistani and Bangladeshis, are in line with the low levels of physical activity also found in these groups. Since low levels of objectively measured physical activity have been found in South Asian girls, aged 9 to 10 years, this suggests that ethnic group differences in activities, such as those examined by the *Health Survey for England,* and their behavioural determinants are already beginning to display themselves at this early age. It is possible that these variations in activity behaviours are not simply related to preference, but are associated with deeper underlying issues related to differences in religious and social values and practices between South Asian ethnic groups (section 1.5). There is a great need for additional evidence examining physical activity and activity behaviour of young children of different ethnicities in the UK. Furthermore, public health knowledge would benefit from understanding how and why, in relation to physical activity behaviour and religious and social values and practices, differences in physical activity levels occur.

1.4 Determinants of Physical Activity and Sedentary Behaviour in Children

Habitual physical activity and sedentary behaviour of children can be influenced by a wide range of demographic, socioeconomic and environmental determinants. This section, when possible, examines the evidence from published systematic reviews to determine the factors within each of these categories that have proven to consistently influence children's physical activity. Furthermore, an additional number of environmental factors are examined that were not covered by the review studies, but are of interest to this present study.

1.4.1 Demographic and Socioeconomic Factors

Sallis and Prochaska et al. (2000) conducted a review of 108 studies to investigate factors associated with physical activity of children and adolescents, aged 3 to 18 years. They found that age was consistently associated with the physical activity levels of adolescents, but not children. Van der Horst et al. (2007) also conducted a review; 57 papers were examined to investigate associations with physical activity and sedentary behaviour of youth, aged 4 to 18 years. They concluded by suggesting that age was not associated with children's physical activity, and the evidence for associations between age and the physical activity levels of adolescents was inconclusive. Positive associations were found between age and sedentary behaviour, however this evidence was from only two studies, therefore Van der Horst et al suggests that, due to insufficient evidence, no definite conclusions regarding age and sedentary behaviour can be made.

The findings regarding physical activity, however, may suggest that in children age may have little influence, but in adolescence it may begin to play a more significant role.

Sallis and Prochaska et al. (2000) and Van der Horst et al. (2007) also explored associations between gender and physical activity. Both studies found evidence to suggest that boys were consistently more physically active than girls. Van der Horst et al also explored associations between gender and sedentary behaviour; however this was limited to a single study with adolescents, which found that boys were more sedentary than girls. Further evidence would, therefore, be required before definite conclusions can be made.

A number of review studies have investigated the effect of socio-economic status on children's physical activity and sedentary behaviour. Sallis and Prochaska et al. (2000) investigated a range of socio-economic indicators; however they concluded that none was related to children's or adolescent physical activity. Van der Horst et al. (2007), however, found positive associations between physical activity of adolescents and the socioeconomic variable mother's education. An additional review by Ferreria et al. (2006), examined 150 studies for environmental association with physical activity of youth. They found that mother's education level and family income were the socioeconomic variables that were most consistently associated with physical activity of youth. Such evidence suggests that there is a range of socio-economic variables that may be associated with physical activity and sedentary behaviour in children, and although further evidence within this area is warranted, all socio-economic variables may need to be considered when making assessments of physical activity and sedentary behaviour of children and adolescents.

1.4.2 Environmental and Social Factors

A review study by Tucker and Gilliland (2007) examined 37 studies, from eight different countries, to determine the effects of season and the weather on levels of moderate intensity physical activity. They conclude that physical activity levels varied by season and poor or extreme weather was found to be a significant barrier to children's physical activity. School is believed to be an important environment for children to participate in physical activity. Differences between schools, perhaps in policies relating to physical activity, may lead to children from one school being more active than those from another. A study by Griew et al. (2010) investigated the effects of school and found that physical activity levels varied significantly by the school attended, with the economic deprivation of the school neighbourhood found to be significantly associated with school-time physical activity. Furthermore, Ferreira et al. (2006) identified that the time allowed for free play, time spent outdoors and the number of field trips, also showed a positive association with physical activity levels of children. Findings from these studies therefore suggest the important role school plays in children's physical activity output.

Review articles have also concluded that the amount of time children spend outdoors is consistently associated with increased physical activity levels (Sallis et al., 1999; Sallis and Prochaska et al., 2000; Ferreira et al., 2006; Hinkley et al., 2008).

In addition, parental physical activity may also have a positive influence on the child's physical activity levels (Sallis and Prochaska et al., 2000; Van Der Horst et al., 2007; Hinkley et al., 2008), with findings indicating that children with active parents are more likely to be active themselves.

1.4.3 Conclusion

Findings from studies investigating determinants of physical activity of children suggest that age, gender, season, school and socioeconomic status may each play a significant role in determining their physical activity levels. Furthermore, the time a child spends outdoors, participation in school and community based sport and exercise, and using active modes of school transport, as well as parental activity are all positive predictors of children's physical activity.

1.5 Physical Activity in British Muslim Women and Girls

The term Muslim includes those who have committed themselves to the Islamic faith. Countries in which Islam is the majority religion include the South Asian countries of Pakistan and Bangladesh, but not India or Nepal. For many Muslims, Islam is a part of their identity, in which a shared set of beliefs and values are practiced and influence their day to day life. For Muslims, family honour (*izzat*) is of great importance and depends, to a large extent, on the behaviour of its women, especially daughters. Respectable female behaviour is linked with the observance of *purdah* and its associated moral values. These moral values are outlined by Shaw (2000) as follows:

- From puberty onwards females should avoid contact with unrelated men and must be virgins when they marry
- Females should dress modestly, wearing loose garments, such as the *shalwat-qamis* (loose trousers and a long blouse covering the hips), to conceal the arms and legs and the shape of the breasts, a *chadar* (shawl) or *dupatta* (headscarf) may also be worn over the head
- The females' main responsibilities are within the home, managing the household, cooking and caring for children
- Females should only leave the house when necessary and in doing so behave with proper modesty.

It is important to note that Muslim women are not homogeneous and there will be considerable variation in how *purdah* is observed and practiced. However, for many Muslim women, participating in physical activity, such as sport and exercise, or even walking in the streets, may be considered problematic, due to its potential conflict with moral values.

This section continues by discussing these moral values in relation to the physical activity behaviour of British South Asian women and children. Some of the literature, however, refers specifically to British Muslim (predominantly Pakistani and Bangladeshi) women and children, in whom physical activity levels are understood to be particularly low, whilst some refers to British South Asians as one homogeneous group, which may also include people that are not of Islamic faith (predominantly Indian).

Following on, this section aims to put into context the behaviour of British Muslims, by discussing attitudes towards female participation in organised physical activity in predominantly Muslim countries in the Middle East and South Asia. Additionally, adding further context to the previously discussed literature relating to the physical activity levels of British South Asians, in particular British Pakistani girls, this section also looks at the physical activity levels of girls living in Pakistan.

1.5.1 Avoidance of the Opposite Sex

For Muslim British South Asians, the avoidance of contact with unrelated men and women after puberty introduces a number of issues relating to female participation in physical activity. This is highlighted in a study reported by Lawton et al. (2006) that investigated physical activity barriers in adult British South Asians. It was found that South Asian women (mainly of Pakistani origin) often felt unable to participate in physical activity, including swimming or gym based activities, due to cultural taboos regarding exposing their body to the opposite sex. Single sex facilities and women only sport and exercise classes would enable Muslim women to take part in physical activity comfortably whilst also being able to maintain purdah. However, a lack of such facilities is an issue commonly reported by studies investigating physical activity barriers for South Asians (Farooqi et al., 2000; Johnson, 2000; Wray, 2002; Sriskantharajah and Kai, 2006; Farooq and Griggs, 2008; Johnson et al., 2011). A qualitative study by Wray (2002), investigated ethnic and feminine identities of Muslim Pakistani women in the UK and found that whilst providing single sex sports activities was essential, further ensuring that no males were able to enter the sports setting whilst the women's activities were taking place, was also of major importance.

For younger Muslim females the development of social relationships with boys can be damaging to their reputation, their marriage prospects and is bad for the family honour. This can lead to parents being protective and restrictive with respect to their daughters and their behaviour, which can have a negative effect on girls' participation in physical activity. This is highlighted by findings reported by Carroll and Hollinshead (1993), whose study investigated conflict in relation to British South Asian girls' participation in secondary school physical education. They report that parental concern regarding girls being out alone may restrict participation in what parents perceived as unnecessary physical activities. Parents, who did not like their daughters travelling to and from school or community based activities alone, may place restrictions on their participation in after-school sports and leisure activities. High levels of protection by Muslim parents in Scotland have also been reported by Williams and Shams (1998). These restrictions on behaviour may also affect participation in other forms of active behaviour, including active modes of transport and unsupervised outdoor play.

1.5.2 Islamic Dress Code

The *shalwat-qamis* (Islamic dress) meets the expectations of *purdah* by keeping the body, arms and legs covered. Sports however, often involve adhering to a specific dress code, which may conflict with these expectations, thus deterring many women from participating. A recent study by Dagkas et al. (2011) investigated the participation of Muslim girls in physical education classes and school sport activities. They found that schools need to be more flexible and improve their recognition of religious requirements, particularly in relation to Muslim dress code. Carroll and Hollinshead (1993) found that Muslim girls made to wear more 'suitable' clothing for P.E participation expressed feelings of guilt and shame about exposing their body and legs during sport/exercise sessions at school. Girls were often made to participate in school sport session by non-Muslims, who were not understanding of their dress code and their moral values. The Islamic dress code however, is often only practiced by females upon reaching puberty and thereafter, and may therefore be less likely to affect younger girls' participation in sports.

1.5.3 Home and Family Responsibilities

As previously highlighted by Shaw (2000), *purdah* implies that the main role of women rests with maintaining the home and caring for children. It was further highlighted by Shaw that women should only leave the house when necessary and in doing so should behave with proper modesty. Such a statement may suggest that physical activity, for many Muslim women, may not be viewed as priority, particularly in comparison to household tasks and family commitments. Sriskantharajah and Kai (2006) investigated influences and attitudes towards physical activity in South Asian women and found evidence to suggest that exercise beyond daily work was viewed as selfish activity. Furthermore they found that women were generally viewed as the home makers, whose primary role was in caring for children and other family members. Sriskantharajah and Kai also imply that participating in physical activity, other than that undertaken by maintaining the home may evoke disapproval from other family members and perhaps the community. Lawton et al. (2006) in his study of adult British South Asians also found evidence that as well as barriers such as a lack of time and opportunity to participate in physical activity, women reported obligations towards conforming to social rules and cultural expectations. This involved prioritising kin and having restrictions placed upon them regarding leaving the home, therefore hindering participation in physical activity.

A review by Johnson et al. (2000) examined the evidence to determine the barriers of primary prevention of type 2 diabetes in black and minority ethnic groups, in the UK. They found that social rules and restriction were expressed as barriers by British South Asian women and whilst in some cases family and friends were supportive of their participation in physical activity, others could be opposed to such behaviour that conflicted with social norms. These issues are further supported by Farooqi et al. (2000), who examined attitudes to lifestyle risk among South Asians in Leicester, and found that women often feared what other people might think or say about them, particularly if they were to participate in sport and exercise activities. Furthermore, Farooq and Grigg (2008) state that women are often reluctant to participate in physical activity due to the fear it will jeopardise their own cultural identity, including their customs and their cultural heritage. However, whilst these attitudes are likely to restrict women's participation in physical activity, Farooqi et al. (2000) argues that attitudes are undergoing change, particularly in the younger generations of British South Asians.

Lawton et al. (2006) imply that South Asian women experience a lack of socialisation into sporting and other outdoor activities, which would have a negative effect on uptake within this population. To further support this notion Sriskantharajah and Kai (2006) found that South Asian women believe that sport and exercise is a western practice, which is not recognised as part of their culture, particularly in previous generations. An article by Williams et al. (2011) examined the findings from the *Health Survey for England.* They found evidence to support intergenerational differences in physical activity levels, with British born South Asians accumulating higher measures of physical activity compared with migrant South Asians. Such findings perhaps imply social change, towards the adoption of more positive attitudes supporting participation in physical activity, by British born South Asians. Farooq and Grigg (2008) report that whilst attitudes are changing in younger generations, with participation in physical activity by South Asian females on the increase, parental attitudes may still cause conflict, when their disapproval of participation in physical activities clash with those of their daughters who favour physical activity. Positive parental attitudes and increased physical activity of parents have been associated with increased physical activity in children (Sallis and Prochaska et al., 2000; Van Der Horst et al., 2007; Hinkley et al., 2008). Therefore, negative attitudes, in addition to perhaps a lack of exercise culture in South Asian women, especially in Muslim groups, are likely to have negative effects on the physical activity levels of their children.

Dagkas et al. (2011) report on evidence from the case studies of adolescent Muslim females' regarding their involvement in physical education within the school environment. They found that schools which supported cultural diversity, by working with parents to adopt practices that preserved religious and cultural identities, encouraged parents to support the girl's physical education. The school, however, that was unable to address these requirements encountered tensions that resulted in some Muslim parents withdrawing their daughters from their physical education classes. It is possible, as suggested by Dagkas et al. (2011), that the school environment, for many Muslim girls, is likely to be the main, if not the only, environment in which they experience physical activity and learn about its value to health. Therefore the support of the parents and the school is critical to the girls' physical activity participation.

1.5.4 Organised Physical Activity of Females from Predominantly Muslim Countries

A briefing paper for the United Nations, Educational, Scientific and Cultural Organisation (UNESCO), by Kirk (2012), states that all children should have the basic human right to participate in physical activity, yet the religious and cultural practices of some Middle Eastern and Asian Muslim countries, in particular Egypt and Qatar, discourage or even forbid female participation, resulting in little or no participation in sport or physical activity by these population groups.

Sfeir (1985) examined data on sports participation of Muslim women, from 29 predominantly Islamic countries, and found evidence to suggest that whilst providing physical education classes was compulsory for schools, traditional attitudes and the lack of single sex facilities meant that they were often neglected in practice. However, Sfeir found evidence to suggest that sports participation varied by country, as well as by rural and urban environments, which was largely dependent on Islamic renaissance, secularism, nationalism, westernization and socialism within a country. In addition, Sfeir further suggests that the extent to which women are empowered within these countries, by means of education and participation in both the labour market and in the political and economic arenas can be highly influential on the attitudes and behaviour associated with female participation in sport.

Increasing support for participation of females in sport is suggested by the increasing involvement of female athletes in the Olympic Games within the past few decades. For instance, in 1996 26 countries did not send any women athletes to the Atlanta Games; by 2008, however, there were only three Islamic countries (Saudi Arabia, Qatar and Brunei) that did not send female athletes to the Beijing Games, and by the London 2012 Olympics these final three countries also sent at least one female athlete to the Games (Olympic.org 2012).

Until recent years government rulings in Pakistan did not allow women to participate in sports in public (ESPNcricinfo, 2005), yet they now have a successful women's national cricket team, which has come a long way since the death threats and court cases dominating its set up back in the late 1990's (ESPNcricinfo, 2005). It is necessary, however, for these women to follow a strict dress code, which involves each of them wearing *shalwar* (trousers) and long sleeved shirts; and no male spectators are allowed to watch the cricket matches (ESPNcricinfo, 2005).

In conclusion, it is apparent that the lack of involvement in organised sporting activities by females from Muslim countries would contribute to low levels of physical activity by the females within these populations.

1.5.5 Physical Activity Levels of Girls Living in Pakistan

There is very limited information on physical activity levels of girls and women living in Pakistan. A rare good quality study by Jafar et al. (2008) examined self-report data from the

Karachi survey (n=1675). This survey was conducted in the city of Karachi, Pakistan, during 2004-2005. Data on physical activity, which was described as the amount of time spent in organised and other strenuous physical activity at school and in similar activities out-of-school, over a seven day period, were collected from 1669 children, aged 5 to 14 years. Findings suggested that children spent, on average, just over half an hour in physical activity, per day. Gender differences were evident, with boys spending more time in physical activity than girls (55 minutes per day versus 25 minutes per day respectively). Furthermore, upon examining patterns of physical activity, they found that 29% of children did no exercise out-of-school, (boys 21% and girls 36%). Findings from this study suggest that girls were less physically active than boys in urban Pakistan. They also found evidence to suggest that physical activity decreased with age, particularly after nine years old for girls and 11 years old for boys.

1.5.6 Conclusion

The evidence linking low levels of physical activity and high amounts of sedentary behaviour to cardiometabolic risk is strong. It is possible that the low levels of physical activity and high amounts of sedentary behaviour displayed by British South Asians, particularly women and girls, are contributing to the poor cardiometabolic profile found in these populations. Furthermore, since the current literature suggests that British South Asian girls are displaying very low levels of physical activity and spending high amounts of time sedentary, further evidence of these behaviours within the different South Asian sub-groups is of public health importance.

Objective evidence of physical activity and sedentary time of British South Asian children, however, is limited. Furthermore, there is currently no literature specifically examining ethnic group differences in physical activity and sedentary time of White British and British Pakistani girls. This is of particular public health importance since self-reported participation in physical activity has been found to be worryingly low in British girls of Pakistani origin. Furthermore, literature examining ethnic group differences in the types of physical activities and sedentary behaviours of British girls, which would provide important understanding into how these differences may be occurring, is also limited. Therefore further investigation within these fields is warranted. Highlighting beliefs and practices associated with religion and social rules indicates why the physical activity levels of South Asian Muslims, in particular Pakistani females, are low in comparison to their White counterparts.

Identifying child populations that are displaying risk behaviours is essential to health intervention. Therefore, providing reliable objective measures of physical activity and sedentary time, in addition to investigating behaviour that relates to the accumulation of this activity are an essential part of this process.

1.6 Energy Intake and Cardiometabolic Risk

Links between excess body weight and cardiometabolic risk in adult populations have been well documented (Despres 2006; Despres and Lemieux, 2006; Despres et al., 2008; Ferrannini et al., 2008; Klein et al., 2012). Excess weight gain is caused by an energy imbalance occurring when energy intake regularly exceeds energy expenditure. Therefore, UK public health guidelines recommend that an adult's average daily energy requirements are 1,940 kcal for women and 2,554 kcal for men (Department of Health, 1991). Excess weight gain is also an increasing public health problem among children and adolescents (Lobstein et al., 2003) and has been linked to poor cardiometabolic profile in childhood (Ebbeling et al., 2002; Steinberger and Daniels, 2003). UK public health guidelines recommended that a child's average daily energy requirements are 1,740 kcal for girls and 2,970 kcal for boys aged seven to nine years of age (Department of Health, 1991).

1.7 Macronutrients and Cardiometabolic Risk

1.7.1 Total Fat and Saturated Fat

Fat is the most energy dense of dietary nutrients, therefore it is often assumed that too much fat in the diet leads to excess weight gain and increases the risk of disease (Hu, 2008). Strong associations between the proportion of energy intake from fat and prevalence of obesity have previously been identified (Bray and Popkin, 1998). Hu et al. (2001a) conducted a review to examine the relationship between dietary fat and excess weight gain. However, they conclude that the evidence to support any such relationship is unconvincing and argue that total energy intake, whether from fats or carbohydrates, relative to energy expenditure, may be more influential on body weight than fat alone.

Fat has been a strongly studied factor in relation to chronic disease, with total fat and saturated fat probably having received the most attention in terms of their negative effects on health. Individual studies examining dietary fat intake in relation to cardiometabolic risk however, are inconsistent in their findings. Therefore review studies examining dietary fat intake in relation to cardiometabolic disease have been carried out (Hu et al., 2001). The findings from these reviews suggest that the evidence supporting a relationship between total fat intake and cardiometabolic risk is weak. There was, however, much stronger evidence to suggest that a high intake of saturated fat increases cardiometabolic risk.

1.7.2 Total Carbohydrates and Sugar

Studies investigating carbohydrate intake in relation to cardiometabolic risk found limited evidence to support a relationship between the two (Salmeron et al., 1997; Meyer, 2000; Marshall et al., 1994; McKeown, 2004). Dietary guidelines for health recommend that the diet should be made up of around 50 per cent of carbohydrates, including intrinsic and milk sugar, starch and non-milk extrinsic sugar (Department of Health, 1991). Non-milk extrinsic sugar should not be consumed in excess due to the undesirable effect it can have on cardiometabolic profile (Department of Health, 1991). Hu (2008) states this is due to the understanding that high intakes of sugar are less favourable in terms of glucose response. However, studies by Jenkins et al. (1981) and Sevak et al. (1994) were unable to find an association between the sugar content of food and diabetes risk. More recent studies however, have found adverse associations between fructose consumption and cardiometabolic risk (Elliott et al., 2002; Gross et al., 2004; Havel, 2005; Johnson et al., 2007). Recent focus however has shifted to the glycaemic load of specific foods (Jenkins et al., 1981, 2000; Salmeron et al., 1997; Liese et al., 2005), which may lead to a better understanding of carbohydrate intake in relation to cardiometabolic risk.

1.7.3 Fibre

A high fibre diet is thought to play an important role in protecting against overweight, obesity and chronic disease. Previous studies reported by Appleby et al. (1998) and Slavin et al. (2005) found that a diet high in fibre was inversely associated with BMI, body weight and body fat. These findings suggest that a diet high in fibre promotes a healthy body weight. A meta-analysis by Anderson et al. (2004) found that a moderate carbohydrate, high fibre diet was linked to a more favourable metabolic risk profile. Furthermore, Estruch et al. (2009) report on findings from a dietary intervention study. They found that introducing a high fibre diet to populations already displaying a poor cardiometabolic profile, over as little as three months, was associated with a reduction in classic cardiometabolic risk factors. Evidence from these studies therefore suggests that a diet high in fibre has favourable health outcomes in relation to excessive weight gain and cardiometabolic risk.

1.7.4 Conclusion

Energy and macronutrient intake can be associated with adiposity and cardiometabolic risk, although evidence is inconclusive for most macronutrients. Therefore investigating ethnic group differences in diet, with a focus on energy and nutrient intake is important and may help explain health inequalities in relation to cardiometabolic risk found between White and South Asian adults and child populations in the UK.

1.8 Dietary Behaviour and Cardiometabolic Risk

Certain foods are thought to increase cardiometabolic risk, while others appear to provide protection. Thus it is important to investigate not only energy and nutrient intake, but also intake of particular health-enhancing or diminishing foods.

1.8.1 Fruit and Vegetable Intake

Review studies investigating total fruit and vegetable intake and metabolic risk are inconsistent in their findings (Hamer and Chida, 2007; Carter et al., 2010). However, further investigation by Carter et al. (2010) showed a significant reduction of risk in relation to specific types of fruit and vegetables consumed. Thus it was reported that consuming leafy green vegetables was associated with a reduction in the risk of developing non-insulin dependent diabetes. A number of review studies however, have found evidence to support a more positive relationship between the consumption of fruit and vegetables and cardiovascular disease (Ness and Powels, 1997; Dauchet et al., 2006). Evidence therefore suggests that fruit and vegetable consumption within the diet is protective against cardiovascular disease. Because of health related benefits associated with fruit and vegetable intake the current health recommendation in the UK suggest that children and adults should consume at least five portions of fruit and vegetables per day (National Health Service, 2012).

1.8.2 Sugar-sweetened Beverages

Sugar-sweetened beverages have been associated with increased weight gain and cardiometabolic risk. Malik et al. (2006) conducted a systematic review of thirty publications to investigate the relationship between sugar-sweetened beverage consumption and weight gain. It was found that studies with long follow up periods showed a strong association between sugar-sweetened beverage consumption and weight gain and obesity in adults and children. A more recent review by Hu and Malik (2010) found evidence to suggest that consuming as little as one portion of sugar-sweetened beverage per day was positively associated with increased risk of cardiometabolic disease in adults.

1.8.3 Breakfast Consumption

Skipping breakfast is associated with a higher energy intake (Cho et al., 2003; Farshchi et al., 2005), higher BMI and obesity rates (Cho et al., 2003; Niemeier et al.,2006; Raynor et al., 2008; Szajewska and Ruszczyński, 2010) and poor cardiometabolic risk profile (Farshchi et al., 2005) in adults and higher BMI and waist circumference in school children (Kovacs et al., 2010), compared with their breakfast consuming counterparts. Cho et al. (2003) report on data from the NHANES III, a large population-based study in the US. The consumption of the different breakfast categories were analysed in relation to BMI. Cho et al found that the type of foods consumed at breakfast influence daily energy intake and BMI. Findings suggest that those who consumed cereal or quick breads on average had a lower BMI, compared with those who reported skipping or eating meat and/or eggs for breakfast.

1.8.4 Fried Food and Fast-food Consumption

A study by Lutsey et al. (2008) investigated the role of diet in relation to the incidence of metabolic syndrome. Fried food consumption was found to be adversely associated with metabolic syndrome, therefore suggesting that regular consumption of fried food promotes the incidence of disease. Fast-food consumption has also been associated with an increase in energy intake (French et al., 2000; Bowman and Gortmaker et al., 2004; Bowman and Vinyard, 2004), BMI (Duffey et al., 2007) and cardiometabolic risk (Pereira et al., 2005; Esmaillzadeh et al., 2006; Duffey et al., 2007). A large household survey in the US, reported by Bowman and Gortmaker et al. (2004) found that fast food consumption in children was associated with a greater intake of total fat, carbohydrates, added sugar and sugar-sweetened beverages, as well as a reduction in fruit and certain types of vegetables. Evidence therefore suggests that not only does fast-food increase the risk of overweight, obesity and cardiometabolic disease it also affects overall food selection.

1.8.5 Conclusion

Dietary behaviour, including fruit and vegetable intake and the consumption of sugar-sweetened beverages, breakfast and fast-food have all been associated with adiposity and/or cardiometabolic risk. Investigating ethnic group differences in these dietary behaviours may help explain health inequalities between White and South Asian adults and child populations, in the UK, in relation to cardiometabolic risk and is therefore warranted.

1.9 An Ethnic Group Comparison of Dietary Intake in the UK

Given the links between dietary intake and cardiometabolic risk, current literature will now be reviewed in relation to the dietary intake of South Asian populations in the UK.

1.9.1 Energy Intake of South Asian and White Europeans

A number of studies have examined energy intake within different South Asian populations in the UK, however these studies can be somewhat contradictory in their findings. Smith et al. (1993) investigated ethnic group differences in dietary intake of male factory workers of South Asian and Caucasian ethnicity in Bradford, UK, using both food frequency questionnaires (FFQ) and three day dietary diaries. Comparisons of mean energy intake found no significant difference between South Asian and Caucasian ethnic groups. However, when findings were further defined by religious orientation (South Asians only), Hindu men were found to have a higher mean energy intake than Muslim men. A further study by Sevak et al. (1994) examined the diets of South Asian and European men in west London, UK, using seven day weighed intake. In contrast to Smith et al this study found that European men were averaging a significantly higher mean energy intake compared to South Asian men. However, no distinctions were made between the different South Asian subgroups.

A more recent study by Vyas et al. (2003) measured energy and nutrient intake, by food-frequency questionnaire, of both men and women of White European and Pakistani origin. This study found White European men and women had a higher energy intake compared to their Pakistani counterparts. Finally, a study by Anderson et al. (2005) used the seven day weighed diet inventory to investigate dietary intake of both the general population and a predominantly Muslim sample of South Asian women, living in Scotland. This study found women of the general population had a lower energy intake than women of South Asian origin. Results from current literature are inconsistent in their findings, which may well suggest differences in energy intake across different South Asian and White British populations. However, this may also reflect between study differences in measurement techniques.

Literature examining ethnic group differences in children's energy and nutrient intake is far more limited. This means little is known about the dietary habits of South Asian children in the UK. Donin et al. (2010) however, report on findings from the Child Heart and Health Study in England (CHASE), which is the only published study, to my knowledge, to investigate ethnic group differences in children's energy and nutrient intake. This study of nine to 10 year old children from London and the Midlands found that average energy intake was significantly lower in White European children compared to their South Asian counterparts. Comparisons were also made between White Europeans and South Asian subgroups; Indian, Pakistani and Bangladeshis. This study found that total energy intake was higher in South Asians compared with White Europeans. Pakistani children were found to average an additional 133 kcal/559 kJ more, per day, compared with White European children. The differences in total energy intake between the South Asian sub-groups were small and non-significant.

1.9.2 Fat and Saturated Fat Intake of South Asian and White Europeans

Smith et al. (1993) concluded that fat intake was similar in Caucasian and South Asian men. However, upon additional examination of fat intake between South Asian religious groups, it was found that Hindus reported a significantly higher intake of fat, compared to Muslim men. Saturated fat intake was also reported by Smith et al, where intakes were found to be similar between Caucasian and South Asian, as well as Muslim and Hindu males. Sevak et al. (1994) found a different pattern for fat intake, with European males gaining a significantly higher percentage of energy from fat compared to their South Asian counterparts. In line with findings reported by Smith et al, saturated fat intake was similar in both European and South Asian males.

In their study of men and women of European and Pakistani origin, Vyas et al. (2003) reported that fat intake, when measured as a percentage of total daily energy intake, was slightly higher in Pakistani males and females, compared to their European counterparts. Anderson et al. (2005) report similar findings for their female only sample, with South Asians again reporting higher fat intake, when measured as a percentage of total daily energy intake, compared to the general population women. This study also found that saturated fat, measured as a percentage of total daily energy intake was similar in the general population and British born South Asians.

Finally, the *Health Survey for England* 2004 investigated differences in health behaviour of ethnic minority groups. Craig et al. (2008) report on the findings for eating habits for dietary intake within the 2004 survey. However, unlike previous studies data is presented as fat scores, rather than absolute or percentage of energy intake, which were calculated from the frequency of consumption and standard portions of specific foods. Findings from the Health Survey for England suggest that both men and women from the general population had the highest fat scores compared to all other ethnic groups. Furthermore, when examining South Asian sub-groups Bangladeshi men and women were found to have the highest fat scores, followed by Pakistanis. Indians reported the lowest fat scores of the South Asian subgroups.

Reports by Donin et al. (2010) of ethnic group differences in fat intake of children, suggest that fat intake, both as absolute and as a percentage of energy intake, was significantly greater in South Asians, when compared with White Europeans. Additional examination of differences in fat intake by South Asian subgroup suggests that Pakistani and Bangladeshi children averaged the highest intakes of fat, both as absolute and as a percentage of energy intakes. However, these variations were small, as no significant difference was found between them. Saturated fat intake, when measured as a percentage of energy intakes, was significantly greater in white European children. Significant differences were also found in saturated fat intake by South Asian subgroup, suggesting both Indian and Pakistani children had higher intakes of saturated fat, when measured as a percentage of energy intake, compared with Bangladeshi children.

Current evidence surrounding ethnic group differences in dietary fat may support a higher intake in British South Asian/Pakistanis, with three of the five adult studies reporting that fat intake was significantly greater in these populations compared to their White British/European counterparts. Furthermore, the evidence supports an ethnic group difference in fat intake of children, with British South Asians consuming significantly more fat compared with their white European counterparts. However, since the evidence is extremely limited additional research to support these findings is warranted.

1.9.3 Carbohydrate Intake of South Asian and White Europeans

In the study reported by Smith et al. (1993) of male factory workers, White and South Asian men consumed similar proportions of carbohydrate. However, both total sugar and added sugar intake was significantly greater in White males, implying that South Asians consume more starchy carbohydrates. Again Smith et al further examined intake by religious background and found that Hindu males were consuming significantly more carbohydrates, compared to Muslim males though no difference was found in sugar intake. Sevak et al. (1994) suggest that their sample of South Asian men were gaining a significantly greater proportion of daily energy intake from carbohydrates, compared to European men. This higher intake of carbohydrate came from starch, as opposed to sugar which was similar between ethnic groups. Vyas et al. (2003) again report on both male and female carbohydrate consumption. Results however were variable, with Pakistani males gaining a significantly greater proportion of daily energy from carbohydrates, compared to European men. Furthermore, carbohydrate intake was significantly greater in European women compared to their Pakistani counterparts. In contrast however, findings reported by Anderson et al. (2005) suggest that, when measured as a proportion of daily energy intake, carbohydrate intake was found to be similar in South Asian and the general population women. Evidence from these studies, examining ethnic group differences of adult carbohydrate intake, are conflicting and therefore suggests a need for additional evidence within this field.

Ethnic group differences in children’s carbohydrate intake, measured in terms of absolute and as a percentage of daily energy intakes, for total carbohydrates, sugar and starch were reported by Donin et al. (2010). Absolute intake of carbohydrates was similar in White European and South Asian children, although, when measured as a percentage of energy, carbohydrate intake was lower in South Asian children. Starch intake was significantly higher and sugar intake significantly lower in South Asian children when compared to white European children.

Donin et al. (2010) further examines carbohydrate consumption by South Asian minority group and found that Indian children consumed significantly more carbohydrates, when measured as a percentage of daily energy intakes, compared with Pakistani and Bangladeshi children. Further significant variations between South Asian subgroups were apparent, with Indian and Bangladeshi children gaining a greater percentage of daily energy intake from starch compared to Pakistani children, who gained a greater proportion of their daily energy intake from sugar.

These findings suggest that White British children gain a greater proportion of carbohydrates from sugar, compared with South Asian children. However, Pakistani children also had a high intake of sugar, which was somewhat similar to that of White British children.

1.9.4 Fibre Intake of South Asian and White Europeans

An examination of fibre intake in male factory workers by Smith et al. (1993) suggests that fibre intake was significantly greater in South Asians compared to White Europeans. Furthermore, it was found that fibre intake was significantly greater in Hindu males, compared to Muslim males, which is likely associated with the vegetarian diet practiced by many Hindus. Sevak et al. (1994) again found evidence to suggest fibre intake was greater in South Asian men, compared to White European men, although no differentiation was made between South Asian subgroups. Vyas et al. (2003) report evidence suggesting that fibre intake was significantly greater in both White European males and women, when compared to Pakistani men and women. This discrepancy in findings supports a difference in dietary practices between South Asian subgroups, implying that fruit and vegetable consumption is lower in meat eating Muslims, compared to Hindus, who largely practice vegetarianism.

In their child sample, Donin et al. (2010) found evidence to support a greater intake of fibre in South Asian children, when compared to white European children. Again significant variations between South Asian subgroups were apparent, with Indians consuming the greatest amount of fibre compared to Pakistani and Bangladeshi children. Furthermore, fibre intakes of the latter two subgroups were more similar to those of White European children than fibre intake of Indian children.

1.9.5 Conclusion

Studies reporting on ethnic group differences in nutritional composition of adults' diets can be contradictory in their findings. Therefore, there is a great need for additional literature within this field that take into consideration important variations in dietary practices between the different south Asian subgroups. However, there is evidence to suggest that fat intake was higher among South Asians, in particular Pakistani women, compared with their White European counterparts. There is also some evidence to suggest that fat intake may also be high among Pakistani children. However, additional evidence is required to confirm these findings.

1.10 Ethnic Group Comparisons of Dietary Behaviour of British Children

In this section I discuss the dietary behaviour, previously associated with cardiometabolic risk, of British South Asian and White British children. For comparative purposes I then briefly highlight similar behaviour of children living in Pakistan.

1.10.1 Fruit and Vegetable Intake of British South Asians compared with White Europeans

Literature examining the fruit and vegetable intake of minority ethnic groups within the UK is limited. One of the few studies that examine this is the *Health Survey for England* 2004. This large scale survey compares fruit and vegetable intake of adult and child minority groups to the general population. Of the South Asian subgroups, both men and women of Indian and Pakistani and men of Bangladeshi origin were significantly more likely to consume five or more portions of fruit or vegetables per day, compared to the general population men and women. Fruit and vegetable intake of children followed a similar pattern, with children of South Asian ethnicity more likely than the general population children to consume five or more portions of fruit or vegetables per day. However, of the South Asian subgroup, Pakistani children were the least likely to consume five portions or more per day.

A more recent study by Harding et al. (2008) examined ethnic group differences in lifestyle factors relating to overweight and obesity in adolescent children aged 11 to 13 years. Using methods of self-report they investigated the proportion of children meeting the current UK recommendations of five portions of fruit and vegetables per day. They found that around a third of Indian and white children reported meeting these recommendations, whereas the proportion of Pakistani and Bangladeshi children meeting these recommendations was only around one-quarter. Harding et al also reported on the proportion of children consuming less than one portion of fruit or vegetables per day, which suggest that a greater proportion of White children fell into this category compared to those of South Asian ethnicity.

1.10.2 Sugar-sweetened Beverage Intake of British South Asians compared with White Europeans

The National Diet and Nutrition Survey (2000), a large UK based study, found that soft drinks were the largest contributor of added sugar to the diets of children aged four to 18 years. Despite the link between sugar-sweetened beverages and overweight, obesity and cardiometabolic risk, relatively few papers are available that have explored consumption in British minority ethnic groups, particularly in younger children. A number of studies however have investigated this type of behaviour in older children. Stone et al. (2007) explored the dietary habits of 11 to 15 year old children from secondary schools within predominantly South Asian populations in Leicester, UK. They found that over half of the sample regularly consumed fizzy drinks. Furthermore, 26% of the sample reported consuming in excess of one can of sugar-sweetened fizzy drink during the day prior to completing the questionnaire. Harding et al. (2007) also investigated fizzy drink consumption in their sample of young adolescent children. In line with Stone et al they found that 54% of white children reported consuming fizzy drinks on most days, compared with 57% of Indian and 59% of Pakistani/Bangladeshi children. Furthermore, a study by Edwards et al. (2006) investigated dietary change in Pakistani children, aged 9 to 10 years, in the UK. They found that 67% of their Bradford born Pakistani sample reported consuming fizzy drinks during the recalled day. Findings from these studies suggest that the proportion of British South Asian and White British children regularly consuming sugar-sweetened beverages is high. However additional evidence regarding this behaviour in children would be useful.

1.10.3 Breakfast Consumption of British South Asian compared with White European

Harding et al. (2008) in their sample of secondary school children found evidence to suggest that, when compared with White children, skipping breakfast was reported by a greater proportion of South Asian children, in particular Pakistani and Bangladeshi girls, with almost 50% of these girls reporting that they regularly skipped breakfast. Stone et al. (2007) also reported on breakfast consumption habits in their predominantly South Asian sample of secondary school children. They found that 24% of their sample reported that they had not consumed any beverage or food items for breakfast before leaving for school.

Additional literature examining breakfast habits, including breakfast skipping, are required for younger samples of British South Asian children to determine whether breakfast skipping is present at an early age.

1.10.4 Fast-food Consumption of British South Asians

A small number of studies have reported on dietary practices in relation to fast-food consumption habits of British South Asians. Items, such as fish and chips, pizzas and burgers were popular items consumed by British South Asian adults (Wyke and Landman, 1997) and children (Edwards et al., 2006; Lawrence et al., 2007; Parsons and Godson et al., 1999). Lawrence et al. (2007) highlight the fact that many British Pakistani and Bangladeshi Muslims abide by strict food laws, which relate to the consumption of halal meat only and can restrict the purchasing of fast-food. Lawrence et al found that such practices make take-away fish and chips and pizza more popular choices among British Muslims, in particular Pakistani and Bangladeshis.

A small number of studies have reported on the proportion of children consuming fast-food as a main meal. For instance Parsons and Godson et al. (1999), in their pre-school sample found that around 13% of Pakistani children consumed take-away fish and chips, as their main evening meal, on the day prior to recall. In their older sample of 9 to 10 year old British-born Pakistani children, Edwards et al. (2006) found that fast-food was consumed by around one quarter of their sample during the 24 hours prior to recall.

1.10.5 Dietary Behaviour of Children Living in Pakistan

A study by Hakeem et al. (2002) investigated food habits and nutrient density of the diets of children living in different rural and urban settings of Pakistan. As part of their study the diets of four groups were compared: middle income children living in urban Pakistan; high income children living in urban Pakistan; British Caucasian children living in an urban area of the UK and British Pakistani children living in an urban area of the UK. They found that energy intake was largely similar between high income children living in Pakistan and British Caucasian and British Pakistani children living in the UK. The middle income children, living in urban Pakistan, were found to have a higher daily intake of energy compared with the previous three groups. A difference in the source of energy intake between the UK and Pakistan based groups were also apparent, with children from the UK groups consuming more food from the fat and sugar groups and the Pakistan based children consuming more foods from the cereal group.

Additional evidence examining energy or nutrient intake of children living in Pakistan is limited. However a small number of studies have investigated dietary behaviour of children living in Pakistan. Jafar et al. (2008) examined the nutritional data of children, aged 5 to 14 years, from the National Health Survey of Pakistan (NHSP) (1990 – 1994) (n=2074) and the Karachi survey (2004-2005) (n=1675). Findings from the NHSP survey suggested that the fruit and vegetable intake of children from combined urban and rural areas of Pakistan was low with only 15% and 28% of children consuming fruit and vegetables, respectively, on a daily basis. The Karachi survey (based on 12 geographical clusters, with approximately 250 households per cluster, chosen at random from low to middle income areas of urban Karachi) found evidence to suggest that this sample had a higher intake of fruit and vegetables compared with the NHSP sample, with around 80% of children reporting that they consumed fruit and vegetables on a daily basis. None of these children however, reported consuming five portions per day, the recommended servings for children in the UK. The difference in findings between the two surveys is large and may possibly be associated with regional differences in dietary intake or a difference in dietary measurement technique. In addition, Hydrie et al. (2004) report on findings from a much smaller study (n=104), which investigated dietary habits of middle income children, aged 8 to 12 years, living in Karachi, Pakistan. They found that 80% of children reported low intakes of fruit and

88% reported low intake of vegetables over the measured period. Furthermore a large proportion of these children reported consuming no fruit and/or vegetables at all during this time.

There is evidence to suggest that, similar to Pakistani children living in the UK, children in Pakistan are also adopting an unhealthy lifestyle. This includes the consumption of energy dense foods, fast-food and soft drinks. Findings reported by Jafar et al. (2008) from the Karachi survey support this statement, with 71% of children consuming chocolate and/or sweets on a daily basis. Furthermore, Hydrie et al. (2004) found evidence to suggest that at least 40% of their sample were consuming soft drinks and/or fast-food on a daily basis. A more recent study by Mushtaq et al. (2011) investigated dietary behaviours of primary school children in the city of Lahore, Pakistan (n=1860). They found that the consumption of fast-food was common, with 48% of their sample reporting its consumption at least once a week. Khuwaja et al. (2003) report findings from a study of slightly older adolescent children (n=206), living in Hyderabad, Pakistan. They report that at least 31% of their sample reported unhealthy dietary habits, which involved eating junk food, high fat and/or empty calorie foods on every day of the week.

1.10.6 Conclusion

In conclusion, there is evidence to suggest possible ethnic group differences in children's dietary behaviour that is associated with excess energy intake and cardiometabolic risk. Poor dietary habits, such as the consumption of energy dense food, fast-food and sugar-sweetened beverages are not restricted to British Pakistani children, since there was also evidence of equally poor dietary habits of children living in Pakistan. Further evidence of dietary intake of British Pakistani children is warranted before definite conclusion regarding ethnic group differences in dietary habits can be made.

1.11 Determinants of Dietary Practices of Muslim South Asians

The traditional South Asian diet has been described as being composed of small amounts of meat, fish or dairy products and large amounts of chapattis, rice, pulses, fruit and vegetables (Anderson and Lean, 2005; Wyke and Landman, 1997). The diets of British South Asians however, can vary significantly depending on religion, region of origin and interaction with White British culture. A study by Kassam-Khamis et al. (1995) examined commonly consumed dishes by British South Asians. They found that there was a big difference in the common traditional diet of non-Muslims and Muslims. Religious variation in dietary practices relate to differences in dietary law, for instance many Hindus practice vegetarianism, refraining from consuming meat, poultry and fish, and for those Hindus who do not practice vegetarianism, beef is strictly prohibited. Pakistani and Bangladeshi Muslims have a number of food restrictions that prohibit the consumption of pork and alcohol, and any meat consumed must be halal. Sikhs however, do not abide by any religious restrictions regarding food, but many choose to practice vegetarianism. Previous studies investigating dietary intake of South Asians have found significant differences by religious orientation in relation to the nutritional content of the diet (Smith et al., 1993), as well as the types of foods consumed (Kassam-Khamis et al., 1995, 2000; Simmons and Williams, 1997). However, diversity has also been reported amongst South Asians sharing a common religion, which is likely to reflect regional differences in traditional recipes and cooking styles (Simmons and Williams, 1997).

Intergenerational differences in dietary practices may also exist. A study by Anderson et al. (2005) investigated dietary intake of British born and migrant South Asians. Significant differences in energy and nutrient intake were observed between the two groups, which are likely to reflect variations in dietary practices. Furthermore, a study by Anderson and Lean (2005) found evidence to suggest that, in addition to consumption of traditional items, adult South Asian women living in Glasgow also consumed many of the high fat, high sugar food of the majority culture, including items such as savoury packaged snacks, confectionary and sugar-sweetened beverages. Simmons and Williams (1997) report similar findings suggesting that many South Asians have not only adopted high-fat foods but also adopted poor cooking practices.

There is also evidence to suggest that British South Asians have adopted westernised eating practices and consumption habits at specific meal times. A number of studies examining dietary practices of British South Asian found that consumption of 'traditional' South Asian items at breakfast time was uncommon and instead more westernised food items, such as cereal, toast and eggs were consumed (Wyke and Landman, 1997; Parsons and Godson et al., 1999; Lawton et al., 2008). A large number of studies have also reported the adoption of westernised consumption habits at lunch time (Anderson and Lean, 2005; Wyke and Landman, 1997; Jamal, 1998; Parsons and Godson et al., 1999; Vyas et al., 2003; Stone et al., 2007; Lawrence et al., 2007; Lawton et al., 2008), with convenience food including; sandwiches, chips, pizza, burgers, fish fingers, crisps, biscuits, confectionary and cake being common items consumed by British South Asians at this time. Dinner, the main evening meal, is generally found to remain the most traditional of all meals in British South Asian households (Anderson and Lean, 2005; Kassam-Khamis et al., 1995; Bradby, 1997; Lawson et al., 2008). Foods consumed at this time are usually home cooked and may consist of curried meat and/or vegetable or pulse dishes, which are often accompanied by chapattis and/or rice, as well as samosa, pakora and bhajis (Anderson et al., 1995; Bradby, 1997; Lawson et al., 2008). Simmons and Williams (1997) found evidence to suggest that British South Asians generally consume their meal late in the evening compared with White British households. This may be a result of planning meal times around external commitments, such as that identified by Pallan et al. (2012), who found that meal times were planned around attendance at Mosque.

1.12 Conclusion

Given the evidence linking dietary intake to cardiometabolic risk, it is likely that poor dietary behaviour, particularly amongst British Pakistanis, is associated with the increased cardiometabolic risk also found in these populations. However, since data regarding dietary intake of British Pakistanis is limited, further nutritional evidence is warranted. Furthermore, given the links between dietary behaviour, including the consumption of fruit and vegetables, sugar-sweetened beverages, breakfast, fast-food and cardiometabolic risk, there is a great need to expand on the currently limited body of literature examining these behaviours in at risk populations, in particular those of South Asian origin.

1.13 Study Aims

This study sets out to compare objective measurements of physical activity and sedentary time in White British and British Pakistani girls aged 9 to 11 years. Physical activity and sedentary behaviours will be investigated to help explain any differences in time spent in physical activity and sedentary. This study will also examine how physical activity and sedentary behaviour vary across weekends and school days and during-school and out-of-school, to determine where the greatest variations in physical activity are occurring. In addition, this study aims to examine dietary intake, in relation to energy and macronutrient intake of White British and British Pakistani girls. It will investigate dietary behaviour within these two populations that might explain any observed differences in energy and nutrient intake, whilst also examining dietary behaviour that has been specifically related to cardiometabolic risk. Finally, this study aims to investigate, by means of parental interviews, familial influences on children's physical activity and dietary intake.

1.14 Hypotheses

Based on evidence from the literature review this study aims to test the following hypotheses. Other health-related aspects of physical activity and diet will also be compared, but without specific hypotheses, given lack of evidence for a prediction based on the literature reviewed.

- British Pakistani girls will have significantly lower measures of objectively measured total physical activity, compared with White British girls
- British Pakistani girls will spend significantly less time in objectively measured moderate to vigorous physical activity, compared with White British girls
- British Pakistani girls will spend significantly more time in objectively measured sedentary time, compared with White British girls
- British Pakistani girls will have a significantly higher intake of fat, measured as a proportion of daily energy intake, compared with White British girls.

Chapter Two: Methodological Literature Review

Chapter two discusses a range of methods currently available to assess diet and physical activity in children. In this chapter each method is summarised, their advantages and disadvantages are considered, as well as their reliability and validity, and the most appropriate methods to assess ethnic group differences in diet and physical activity of girls aged 9 to 11 years are identified.

2.1 Physical Activity Assessment

The aims of this study are to compare the physical activity of White British and British Pakistani girls aged 9 to 11 years. Specifically, it aims to compare levels of moderate to vigorous physical activity, as activity at this intensity is particularly beneficial to health and to reducing cardiometabolic risk. In addition, due to links between sedentary behaviour and cardiometabolic risk, this study also aims to compare levels of sedentary time. Finally, this study aims to compare participation of girls from the two ethnic groups in specific activity and sedentary behaviours. Therefore, this chapter will review the methods available to assess ethnic group differences in time spent in physical activity and sedentary time and related behaviours of children aged 9 to 11 years.

2.1.1 Assessing Children's Physical Activity

There are a wide range of methods available to assess physical activity and energy expenditure in children. These include objective methods such as indirect calorimetry, doubly labelled water, heart rate monitoring, pedometry and accelerometry. Other methods to assess physical activity include self-report, such as physical activity questionnaires (PAQs), diaries/logs and physical activity recall (PAR). Indirect calorimetry and doubly labelled water are classed as the gold standard in the assessment of physical activity and energy expenditure. However they are expensive, highly technical and unsuitable for large, field based studies. These methods are, therefore, more generally used in validation studies. Until recent years, self-report methods were the most common methods used to collect physical activity data in large field studies. However, such methods are often deemed problematic and unreliable, largely due to them being dependent on the participant's memory to report and recall as well as their ability to estimate accurately duration and intensity of specific activities (Corder et al., 2008). Self-report methods are also subject to participant bias, relying on their honesty to report true estimates of their physical activity. In more recent years, however, the introduction of objective measures means more accurate estimates of physical activity can be made. Objective measures, unlike self-report, are also able to capture more accurately sporadic physical activity characteristic of children.

Each method will now be reviewed and discussed in relation to reliability and validity for assessing physical activity in children. Their suitability for use in young children of different ethnic backgrounds will be considered. A conclusion will then be drawn as to which methods will be most suitable for achieving the study aims.

2.2 Subjective Methods for Assessing Children's Physical Activity

Subjective assessment of physical activity in children largely involves using methods of self-report, including physical activity questionnaires (PAQ), physical activity recall (PAR) and physical activity diaries/logs.

2.2.1 Physical Activity Questionnaires

PAQs are the most commonly used method for assessing physical activity in children. PAQs are used to assess physical activity, on an individual or group basis, by collecting data on the frequency, duration and intensity of activity to gain estimates of energy expenditure and time spent in activities of various intensities. Furthermore, they can provide some insight into habitual behavioural characteristics, such as leisure time activities and sport and exercise. The PAQ is a retrospective method, which is used to assess physical activity usually over a seven day period. This method may also require interviewer administration depending on the age of study population. There are many different questionnaires available for assessing physical activity in children, however, the most commonly used is the Physical Activity Questionnaire for older Children (PAQ-C) (Crocker et al., 2000; Pangrazi et al., 2003; Kowalski et al., 2004; Voorhees et al., 2005; Mhurchu et al., 2008; Burrows et al., 2009). The reliability of PAQs, in terms of producing estimates of energy expenditure and moderate to vigorous physical activity is found to vary depending on the age of respondents (Kohl et al., 2000). Furthermore, it is necessary that adaptations to questionnaires are validated for specified use, before collecting data in the desired population.

The advantages of using physical activity questionnaires include that they are suitable for use in large scale studies, relatively low cost, have low respondent burden and are unlikely to influence an individual's activity behaviour. The disadvantages include that they are subject to respondent recall and desirability bias, rely heavily on memory and the respondent's ability to recall and are subject to the individual's concept of time, therefore may be unsuitable for use with children.

2.2.2 Physical Activity Recall

The PAR is a retrospective, interviewer administered method that assesses physical activity during a defined period, usually during the previous day, the past 24 hours or a three day period. The PAR may be used to gain insight into physical activity behaviours or provide estimates of time spent in different levels of physical activity, such as moderate activity and sedentary behaviour or types of activities, such as sport and exercise, outdoor play and recreational screen time. There are numerous different ways the PAR may be carried out including: the respondent recalling, in chronological order, all activities they participated in during a specific period, including time, duration and intensity; focus solely on the reporting of activities of specific intensity or type (Simons-Morton et al., 1991; Burdette et al., 2004); a structured format, which asks the respondent to report on all activities participated in within specified time frames, such as the 30 minute blocks used by Pate et al. (2003) or similar to the seven day PAR questionnaire (Sallis et al., 1985), may involve a check list of activities, potentially with estimates of intensity and duration (Sallis et al., 1993).

Interviewer administered recalls are potentially more reliable than self-administered recalls due to the personal contact with the respondent (Biro et al., 2002) and the opportunity it provides for reviewing and probing. However, the interviewer would need to be fully trained in the procedure and knowledgeable about activity related behaviour within the study populations. A minimum of four days, including at least one weekend day (Trost et al., 2000), should be used to gain a more reliable estimate of habitual physical activity levels of children.

The advantages of using the PAR are that they are cost effective, relatively straight forward and quick to administer, low participant burden, are not thought to alter physical activity behaviour, appropriate for use in large studies within varied populations that may differ in age and ethnicity and unlike the PAQ, they can collect data on a wider range of physical activity behaviours, which can take into account variations by population (e.g. age, ethnicity and region). The disadvantages include that the physical activity recall method is subject to respondent recall and desirability bias, it relies heavily on memory and the respondent's ability to recall, it is subject to the individual's concept of time and validation studies relating to this method are limited.

2.2.3 Physical Activity Diary or Log

The physical activity diary or log provides a detailed record of the various activities participated in over the specified reporting period. This prospective method requires respondents to record time spent in activity as it occurs (Ainsworth et al., 1999) or at specific intervals i.e. every 15 minutes. Records are a good method to gain information on patterns of activity of differing types, intensity and duration (Matthews, 2002). This method has been used in numerous studies with children (Bouchard et al., 1983; Bratterby et al., 1997; Ekelund et al., 1999; Kimm et al., 2000; Rodriguez et al., 2002), but requires parental assistance with younger age groups due to them being unable to cope with the complexity of the task (Corder et al., 2008). However, due to the highly burdensome nature of this method respondents are usually only requested to complete this task over short time frames, usually one to seven days (Matthews et al., 2002).

The advantages of physical activity logs/diaries are that they are relatively inexpensive to administer, allow a detailed account of all activities undertaken within the specified time frame, are able to identify patterns of activities and they do not rely on respondent memory, as they are completed at the time of activity. Disadvantages include that they place a large amount of responsibility onto the respondent to complete the diary or log at the requested time intervals or after each activity. This degree of demand is likely to result in incomplete diaries/logs. Furthermore, this type of method may also influence respondent behaviour.

2.2.4 Validity of Self-Report Methods for Assessing Children's Physical Activity

A small number of review articles have examined the validity of various methods of self-report including interviewer administered, self-administered and parent as a proxy reporter for assessing children's physical activity (Kohl et al., 2000; Sallis and Saelens, 2000). Sallis and Saelens (2000) examined 17 self-report physical activity assessment tools, all of which were found to show some evidence of validity, however no one tool showed validity in more than one study. Furthermore, Kohl et al. (2000) examined 37 validation studies of self-report physical activity assessment tools and conclude that self-reported data is not valid when collected from children under 10 years of age. However, when used with children aged 10 years and over, most tools showed variable measures of agreement, suggesting low to moderate validity of self-reported physical activity assessments. Ward et al. (2005) investigated reporting error associated with self-report methods and found that, depending on age group, error could be as much as 35-50%. Findings from these review studies suggest that self-reported physical activity assessment tools, including the PAR, PAQ and diary/log methods are useful for providing information on specific activity behaviours but are unable to provide accurate assessments of total physical activity in young children.

2.2.5 Misreporting Issues Associated with Self-Reported Physical Activity

Fox and Riddoch (2000) suggest that using methods of self-report to assess physical activity in children may show low reliability due to varying ability to provide accurate recalls. Livingstone and Robinson (2000) suggest that until a child has an accurate concept of time, they are unable to provide frequencies and estimates. Therefore, self-report tools requiring estimation of the frequency and duration of activity are likely to produce inaccurate results when used with young children. Furthermore, it is also unlikely that many children pay attention to frequencies and duration whilst carrying out physical activities, therefore the task of estimating these factors are likely to prove problematic for them. However, it has been identified that children over the age of 10 become more familiar with the concept of time (Livingstone and Robinson, 2000), which suggests children over this age may be more likely to make reliable estimations. This notion supports previous review findings suggesting that methods of self-report are unsuitable in assessing physical activity in children less than 10 years of age (Kohl et al., 2000). As with all age groups, methods of self-report are subject to elements of social desirability responding with children who are wishing to please deliberately falsifying reports of physical activity. Furthermore, Fox and Riddoch also suggest that young children have difficulties in separating the imagined self, from the actual self, which may lead to inaccurate accounts of their physical activity.

2.2.6 Self-report Methods for Assessing Physical Activity of Different Ethnic Populations

Kriska et al. (2000) suggests that whilst the physical activity questionnaire, in general, is the most common measure of physical activity levels in adult minority subgroups, this may be an unsuitable single measure to accurately examine physical activity in these populations. This is largely due to many minority subgroups participating in physical activities of low intensity, which include the likes of walking and household chores, which unlike sport and exercise activities were found to be difficult to capture accurately through questionnaire alone (Kriska et al., 2000; Sallis et al., 1985). A recent study by Pollard and Guell (2012) assessed physical activity data quality obtained by recall questionnaire from Muslim, South Asian women in the UK. This study found that since women reported spending large amounts of their time in domestic activities, including household chores and childcare, questionnaires were unable to provide accurate estimates of their physical activity. Therefore, to accurately capture total physical activity, objective measures may be more appropriate. Furthermore, since it is unlikely that PAQs are able to accurately capture lifestyle activities specific to minority groups, choosing a self-report method, such as PAR or diary/log that is able to take into account cultural variations may be a more appropriate method to assess physical activity behaviour between different ethnic groups.

2.2.7 Conclusion

After reviewing the most commonly used methods of self-report to assess physical activity in children, it would seem that each of the reviewed tools, PAR and activity diaries/logs are limited in their reliability for estimating physical activity in children aged 9 to 11 years. Furthermore, due to the inability of self-report methods to capture children's more sporadic style physical activity, estimates of moderate to vigorous physical activity are also likely to prove inaccurate. Findings from this review also suggest that estimates of frequencies and duration made by children under the age of 10 should be used with caution. Self-report methods however, are a useful tool to gain an understanding of physical activity behaviour characteristic to the study population. Furthermore, tools such as the PAR and activity diaries/logs are appropriate for use in differing ethnic populations, due to their ability to account for variations in physical activity behaviour that are very difficult to capture using objective methods. It was found that the PAR has the least amount of respondent burden and is least likely to alter physical activity behaviour. Therefore this method may prove the most appropriate for assessing ethnic group differences in physical activity behaviour of 9 to 11 year old children.

2.3 Objective Methods for Assessing Children's Physical Activity

Objective physical activity assessment involve using tools such as pedometry, heart rate monitoring and accelerometry to measure either physiological movement or biomechanical parameters to provide real time estimations of physical activity (Corder et al., 2008).

2.3.1 Pedometry

Stepping is a common process of physical activity therefore pedometers are used as an acceptable tool to measure total physical activity by estimating the number of steps taken. Further information, by the use of prediction equations (Bassett and Strath, 2002), can be used to estimate energy expenditure (dependent on energy cost associated with walking) and the distance walked (dependent on individual stride length). Additional equations have also been formulated to estimate the intensity and the duration of activity (Tudor-Locke et al., 2005; Rowlands and Eston, 2005). However, these equations are based on stride length, determined by height, walking speed, age and gender (Bassett and Strath, 2002), therefore caution is required when using pedometers to assess physical activity of children of different height and ages (Trost, 2007).

The pedometer is a small waist worn device that measures accelerations of movement in a vertical plain and records them as steps (Bassett and Strath, 2002). There are a wide range of pedometers available, with a number of studies (Crouter et al., 2003; Schneider et al., 2003; Tudor-Locke et al., 2006) having reviewed the more popular of these models. Some electronic pedometer models use real-time data acquisition and an internal clock, which enables the storage of data over prolonged periods (Bassett and Strath, 2002). Step measurements can be visible and may involve the participant recording the number of steps taken at the end of each day or can be blinded within a concealed monitor. Using the latter is thought to reduce participant reaction. A study by Clemes and Deans (2012) investigated adult reactivity to pedometer wearing. They found mean daily step counts were higher when participants were asked to record steps into a daily diary, compared with when participant step counts were concealed. These findings confirm reactivity issues therefore to reduce bias the concealed method may be more appropriate.

Tudor-Locke et al. (2002) published a systematic review assessing the validity of pedometers. They conclude that when compared against accelerometers, pedometers were a valid tool for assessing total physical activity. An additional validation study by Crouter et al. (2003) assessed 10 different pedometers in their ability to accurately measure steps, distance and energy expenditure in adults. It was found that although accuracy for assessing steps varied by monitor and walking speed, pedometers were a reliable measure of total physical activity in terms of steps. However, the pedometer was found to be less reliable at estimating distance walked and energy expenditure.

The advantages of pedometers are that they are relatively cheap, unobtrusive and appropriate for use in large studies. However, the disadvantages are that they only able measure walking or running related activity and are unable to assess weight bearing activities, bipedal activities on an incline and activities such as swimming and cycling. Critically for the purposes of this study, they are unable to provide measures of time spent in activities of different intensities. They are also unable to examine patterns of physical activity behaviour and can be liable to alter behaviour in response to wearing the monitor, particularly if step count is visible (Rowlands and Eston, 2007). Furthermore, children may be inclined to tamper with the monitor.

2.3.2 Heart Rate Monitoring

Heart rate monitoring is not a direct measure of physical activity. However, it can provide an indication of the individual response to the stress placed on the cardiorespiratory system through physical activity (Armstrong, 1998). It can therefore be used to estimate intensity, duration and frequency of physical activity and can be used to predict energy expenditure (Janz, 2002). In addition, heart rate monitoring can also be used to examine patterns of physical activity. The heart rate monitor is generally a lightweight device, which uses a transmitter attached to the chest via an elasticated strap or sticky electrodes and a small receiver watch (Valanou et al., 2006). Heart rate monitors generally have the capacity to store data for numerous days and once the assessment period is over, data from the watch can be downloaded onto a computer for analysis. However, the method chosen to analyse the data, including the thresholds selected, requires important deliberation due to the effect this can have on the interpretation of data (Rowlands and Eston, 2007).

Heart rate however, can be affected by a number of physiological factors, such as posture, emotional and environmental stresses and individual physical fitness (Strath et al., 2001). Therefore this method may not always provide a reliable estimation of physical activity, particularly at low levels (Corder et al., 2008; Valanou et al., 2006; Rowlands and Eston, 2007) and is only recommended to assess physical activity of moderate to vigorous intensity (Riddoch and Boreham, 1995).

Heart rate monitoring has the advantages of having low respondent burden over short time periods and non-wear time is easily identifiable. However, disadvantages include; electrodes or chest strap can cause some discomfort and therefore may not be suitable for use in child populations; the heart rate signal can encounter interference from household equipment or due to poor connectivity, which may result in substantial loss of data and the heart rate can be affected by physical fitness, body temperature, caffeine and emotions, which may introduce measurement error. Furthermore, the heart rate monitor cannot be worn during water based activities and is subject to being tampered with.

2.3.3 Accelerometry

Over the past decade many significant advances have been made in measuring physical activity. The most notable of these has been the accelerometer-based activity monitor, which is designed to provide real time estimates of the frequency, intensity and duration of free living physical activity (Trost et al., 2005). Accelerometer activity monitors are generally small, lightweight devices that are worn on the hip or limbs on an elasticised belt. Their small size allows subjects to wear them for long periods of time without interfering with normal movement. Furthermore this device also has a large memory capacity. The data can then be downloaded for analysis using appropriate computer software (Hendelman et al., 2000).

This device measures body movements in terms of acceleration, recorded as activity counts. These activity counts, through the use of appropriate intensity cut-points, can be used to categorise activity into sedentary, light, moderate and vigorous levels. Estimates of total energy expenditure can also be calculated using prediction equations. Unlike methods of self-report, accelerometers have been proven to provide reliable measures of physical activity in large scale free-living studies with children (Riddoch et al., 2004; Mattocks et al., 2007), and because of this they are becoming increasingly popular for use in studies of child populations. Accelerometers are also extremely effective in the assessment of activity of an incidental nature and can capture short sporadic bouts of activity, with the use of short epoch settings. This type of activity is particularly important since it is known to provide important contributions to overall energy expenditure of children (Fox and Riddoch, 2000). Accelerometers however, are unable to capture static work and movement against external forces such as pushing, lifting objects, stair climbing, cycling, rowing or resistance training (Puyau et al., 2004). Furthermore, non-waterproof models are also unable to capture water based activities, such as swimming. Each type of accelerometer has its own software to analyse data, however data are not comparable between brands (Welk et al., 2000; Sirard and Pate, 2001; Brage et al., 2003; Welk et al., 2004), which make between study comparisons problematic. It is also important to note that activity monitors manufactured by different companies have various different features. Therefore careful consideration is required to choose which type may best suit the study needs.

There are a number of different accelerometers available for use with children. The more frequently used are the Actigraph, Actiwatch and Actical, each of which differs in how they measure physical activity. The waist worn Actigraph, also known previously as the CSA, MT1 and WAM (Rowlands and Eston, 2007) is the most frequently used activity monitor in large physical activity assessment studies with children (Riddoch et al., 2004; Mattocks et al., 2007, 2008; Trost et al., 2008). It is also the most validated, particularly in free-living studies. Actigraph data can be used to provide measures of total physical activity, intensity and duration of activity and energy and caloric expenditure. There were two Actigraph models available at the time of the design of this study, which were the GT1M, a unidirectional accelerometer measuring accelerations in a vertical plane, and the GT3X, which can measure accelerations in three planes. It is thought that measuring accelerations in three planes of movement could provide more reliable estimates of children's physical activity than measuring in one or two planes, although evidence supporting this notion varies (Welk, 2005; Trost et al., 2005). The GTX3 can be also be used as a unidirectional accelerometer. The Actiwatch is an omni-directional accelerometer that usually attaches around the participant's wrist and can measure movement in all directions. As well as measuring total physical activity, intensity and duration of activity, it has the ability to monitor sleep patterns (Trost et al., 2005) and has the added advantage of being smaller than other accelerometer models and waterproof (Puyau et al., 2002). However, the Actiwatch is not as widely used in child studies as the Actigraph. The Actical is an omni-directional accelerometer, which attaches around the wrist, waist or ankle. This accelerometer was designed for measuring whole body movement and is particularly sensitive for detection of sedentary and high energy movements (Puyau et al., 2004). Actical's main functions provide measures of total physical activity; intensity and duration of activity; total energy and calorie expenditure. However, it is the least used in child studies, compared with the Actigraph and Actiwatch accelerometers.

There is a lack of standardisation regarding the use of accelerometers and analysis of data in terms of minimum wear, epoch setting, data processing and activity cut-points, which limit the ability to make between study comparisons. However, a special collection of papers were published in the journal of Medicine & Science Sports & Exercise in 2005, which discuss best practice regarding a whole range of methodological, data processing and analysis issues associated with the use of accelerometers, in the attempt to set some form of standardisation into accelerometer based studies.

Accelerometry has a number of advantages including its ability to provide objective, detailed descriptions of total physical activity and activity patterns, within a wide range of populations and age groups. It is also a well validated method for assessing physical activity in children on a group level. It has a low participant burden and its concealed data unit may suggest that it is unlikely to significantly alter physical activity behaviour. Disadvantages include that they are less accurate at detecting activities such as cycling and swimming. Data requires a good depth of understanding in relation to processing and interpreting. There is no universal standard of good practice making between study comparisons difficult. Data collection is also heavily dependent on participant memory and compliance for wearing the device over the required amount of time.

2.3.4 Reliability and Validity of Objective Tools for Assessing Children's Physical Activity

Beets et al. (2005) assessed the validity of pedometers for measuring total physical activity, measured as steps, of children. This study found a strong association between observer and pedometer assessed steps, however step count was found to vary by walking speed. Heart rate monitoring may also be problematic for measuring total physical activity, since heart rate response is known to lag following a reduction in activity intensity and can remain elevated for a substantial amount of time afterwards and therefore may misrepresent actual physical activity. Also as a result of this lag in heart rate it is possible that more sporadic bursts of physical activity, which are characteristic of children, may go unaccounted for (Rowlands and Eston, 2007). In a review article, Sirard and Pate (2001) examine the validity of accelerometer use to estimate children's physical activity. From the 17 studies assessed, they conclude that when indirect calorimetry was used as the validation criteria, a strong positive relationship with accelerometry was found ($r>0.7$), suggesting that accelerometers provide a valid measure of total physical activity in children. Of the three commonly used accelerometer models previously discussed, the Actigraph is the most widely validated for use within free living studies of children (Hendelman et al., 2000; Puyau et al., 2002; Freedson et al., 2005; Riddoch et al., 2007; Nilsson and Anderssen et al., 2009; Owen et al., 2009), and whilst the Actiwatch has also been validated in free-living settings (Puyau et al., 2004; Freedson et al., 2005) and the Actical in laboratory settings (Puyau et al., 2002, 2004; Freedson et al., 2005; Pfeiffer et al., 2006) with children, they are not as well validated or as widely used as the Actigraph.

Various equations are available to predict energy expenditure based on accelerometer data. However, due to great variation in physical activities and the amount of energy they use, determining energy expenditure from accelerometer counts can be subject to substantial error (Rowlands and Eston, 2007). Furthermore, the types of activities children participate in on a daily basis and the amount of energy expended during these activities is likely to vary by individual. Therefore, formulating a standardised equation to predict energy expenditure from activity counts for children would be extremely problematic. These findings suggest that predicting energy expenditure from accelerometry is liable to substantial error and therefore is likely to provide an invalid measure of children's physical activity.

2.3.5 Objective Tools for Assessing Physical Activity of Ethnic Minority Groups

The appropriateness of objective tools to assess physical activity in ethnic minority groups is largely unknown. Validation studies examining this issue in relation to the various physical activity assessment tools are therefore warranted. Previous studies have used the Actigraph (Owen et al., 2009, 2011) and pedometers (Duncan et al., 2012) to assess ethnic differences in total physical activity, in nine to 11 year old White European and British South Asian children, in the UK. No measurement issues relating to ethnicity were reported by either study, perhaps indicating that either of these tools may be appropriate for assessing physical activity in ethnic minority groups. The use of the heart rate monitor method, however, may be unsuitable due to issues relating to modesty in female South Asian populations, since assistance would be necessary in attaching the device to the chest. A study by Pollard and Guell (2012) assessed the suitability of the Actigraph accelerometer and the Sensewear arm band for assessing physical activity in South Asian women. It was found that the Actigraph was the preferred method of assessment of these women due to its unobtrusive nature and the fact that it could be worn outside clothing.

2.3.6 Conclusion: Using Objective Methods for Assessing Children's Physical Activity

The assessment of total physical activity and moderate to vigorous physical activity using methods of self-report may be problematic and inappropriate for children under 10 years of age. Therefore, objective tools, in particular accelerometry, which has proven to provide valid and reliable estimates of both total physical activity and moderate to vigorous physical activity in child populations, may be the most appropriate for gaining this information from this sample of 9 to 11 year old girls. In addition, accelerometry has previously been used to assess physical activity in studies of similar ethnic and age composition to this current sample of White British and British Pakistani girls. Accelerometry has also proven to be an appropriate tool for examining patterns of physical activity over time, which would also be beneficial to the investigations of this study.

Of the accelerometry tools available for commercial use, the Actigraph is by far the most widely used and validated device for physical activity assessment in children, and since data is non-comparable between tools, using the Actigraph would allow for comparisons against a much broader range of studies. Given the evidence, accelerometry in particular the

Actigraph, would seem to be the most appropriate tool for assessing total physical activity and moderate to vigorous physical activity in this sample of 9 to 11 year old White British and British Pakistani girls. Objective physical activity assessment tools are unable to provide information regarding what activities children participate in, as well as when and where. Methods of self-report, such as the physical activity recall allow the examination of physical activity behaviour, a method which is also able to account for ethnic variation, and is therefore essential to this study. However, as physical activity recall is not a tool that has been extensively used or validated in children, using an additional questionnaire maybe appropriate, as a secondary tool, to support findings in self-reported physical activity behaviour.

2.4 Methods for Assessing Children's Sedentary Time

The field of sedentary behaviour assessment is not as well developed or technologically advanced as that of physical activity assessment and therefore tools for assessing sedentary behaviour are more limited.

2.4.1 Self-Report

Methods of self-report often assess sedentary time in terms of the time spent in specific activities. For example a study by Gorley et al. (2007) examined the time adolescent girls spent in sedentary activities by self-report diary. Watching television; doing homework; using motorised transport and sitting talking were sedentary activities reported by this sample of girls. Gorley et al also found that listening to music; spending time chatting on the telephone; using a computer and reading were commonly reported sedentary activities.

A systematic review by Bryant et al. (2007) examined 98 studies to determine the reliability and validity of self-report methods (questionnaires, previous day activity recall and diaries) to assess sedentary behaviour, with a particular focus on their ability to assess children's time spent watching TV. Bryant et al conclude that the questionnaire method lacks validity as it is highly subject to measurement error related to memory and social desirability responding, furthermore the questionnaires were only able to provide crude estimates of sedentary time and were unable to accurately assess the frequency and duration of children's sedentary activities, including watching TV. Diaries were found to be more reliable in providing detailed information of the activity, activity frequency and duration. However, issues associated with this method include constant recording of sedentary behaviour resulting in high participant burden and respondent behaviour reactivity. Bryant et al found that the previous day physical activity recall, despite being highly dependent on the child's ability to estimate and recall, produced the most reliable and valid estimates of sedentary time, primarily TV viewing, in child populations.

2.4.2 Objective Tools

Sedentary behaviour has been defined as activity that does not increase energy expenditure substantially above the resting level and typically does not exceed 1.5 METs (Pate et al., 2008). These may include activities such as sleeping, sitting, lying down and watching TV. Evidence from previous studies suggest that sedentary behaviour, such as spending prolonged periods of time sitting, is harmful to health (Pate et al., 2008; Owen et al., 2010). Objective measurements of sedentary behaviour, that are able to distinguish between the different activities postures, would provide important understanding in the relationship between sedentary behaviour and poor health. There are a small number of objective tools that have previously been used to measure sedentary behaviour, these include, heart-rate monitoring, accelerometry and the ActivPAL.

The heart-rate monitor, described previously in section 2.3.2, may be used to measure time spent in sedentary behaviour, however it is particularly subject to interference from environmental conditions, such as anxiety and increased temperature, which can increase the heart rate without an associated increase in energy expenditure (Corder et al., 2008). Because of this interference this method is unlikely to provide reliable and valid reading of sedentary behaviour.

The accelerometer is a well-established method that is able to provide objective measurements of sedentary behaviour; and with the use of appropriate threshold cut-points is found to provide reliable and valid estimates of children's sedentary time (Puyau et al., 2002; Reilly et al., 2003; Treuth et al., 2004; Mattocks et al., 2007). Accelerometers, however, are not able to distinguish between sedentary time that was accumulated in different postures i.e. sitting, lying or standing position (the latter typically classed as light activity (Owen et al., 2010)). Therefore, this method is subject to the misclassification of light activity as sedentary behaviour and is unable to provide information on sitting time, which is of public health importance.

The ActivPAL (PAL technologies Ltd, Glasgow, UK) is a more recent method, designed to measure sedentary behaviour, with the ability to detect posture and distinguish between the time spent sitting, lying and standing. The ActivPAL has been validated for assessing sedentary behaviour in adult populations (Hart et al., 2011; Kozey-Keadle et al., 2011). This method is becoming increasingly popular, but the number of published studies that have used the ActivPAL in free living situations with children and adolescents is limited and there is evidence that the ActivPAL, which is worn, attached to the upper leg, is intrusive to fit (Salmon et al., 2010, 2011; Harrington et al., 2011; Martin et al., 2011).

2.4.3 Conclusion

Although the ActivPAL is able to distinguish between lying, sitting and standing, this information is not central to this study. Furthermore, the Actigraph accelerometer has previously been used to examine ethnic group differences in the sedentary time of South Asian and White European children (Owen et al., 2009). The Actigraph will therefore be used to measure sedentary time in this sample of British Pakistani and White British girls, which will allow for comparison of findings between studies.

In addition, self-report methods such as the previous day physical activity recall are a useful tool to gain insight into sedentary activities and will allow for the detection of any differences in the type of sedentary activities performed by each ethnic group. Therefore, ethnic group differences in sedentary behaviour (specifically screen time) will be assessed using the previous day physical activity recall.

2.5 Methodological Decisions for Data Collection by Accelerometry

When using accelerometry, methodological decisions are required regarding epoch setting; minimum measurement period; minimum wear period and intensity thresholds. The following section will now review the literature in relation to each of these methodological decisions.

2.5.1 Epoch Review

Accelerometers measure physical activity in terms of counts. These counts provide a quantitative measure of activity and its intensity over time, with higher intensity activity producing higher counts. The frequencies at which the accelerometer can measure counts are determined by the epoch setting, which can vary between one to 240 seconds. However, the epoch setting selected can affect information captured by the accelerometers.

Children's physical activity behaviour is highly sporadic in nature, involving irregular short bouts of moderate to highly vigorous activity. Previous accelerometry studies (Trost et al., 1998; Riddoch et al., 2004, 2007) have used epoch settings of 60 seconds in the assessment of children's physical activity. However, recently concerns have developed surrounding the effectiveness of these long epoch lengths and their ability to accurately capture children's physical activity, in particular the shorter bouts of moderate to very vigorous physical activity that children are renowned for.

A study by Bailey et al. (1995) developed an observation system that quantifies the duration, intensity and frequency of children's physical activity to assess energy expenditure. Fifteen children, aged 6 to 10 years, carried out activities in free living conditions. Observations were noted every three seconds. Bailey et al found that the median duration of low and medium intensity activities was six seconds, whereas the median for high intensity bouts was only three seconds. It was also found that 95% of moderate to high intensity bouts lasted under 15 seconds. Furthermore, an accelerometry based study by Baquet et al. (2007) also assessed intensity and duration of children's physical activity, using a high frequency epoch setting of two seconds. Thirty-four children, aged eight to 10 years, wore an Actigraph accelerometer for seven days. Mean physical activity bout durations were calculated for each activity intensity level, results were as follows; light 71 seconds, moderate nine seconds, vigorous five seconds and very vigorous two seconds. This study further reported that 80% of moderate and 93% of vigorous physical activity also lasted for less than 10 seconds. Both findings reported by Baquet et al study and Bailey et al would suggest that using low frequency epoch settings are important in providing more accurate assessments of moderate to very vigorous physical activity. Furthermore, using a higher epoch setting may result in children being misclassified as doing less high intensity physical activity.

A number of studies have investigated this issue by examining the effects that different epoch settings may have on physical activity output. A study by Rowlands et al. (2006) used 60 second and one second epochs to assess total activity and time spent in differing levels of physical activity (light, moderate, vigorous, hard and very hard) in 7 to 11 year old children. This study found that relative to the one second epoch, using a 60 second epoch overestimated time spent in moderate and vigorous activity, but underestimated time spent in very vigorous activity. An earlier study by Nilsson et al. (2002) found large differences in high intensity physical activity by epoch setting, reporting that children accumulated one minute of vigorous physical activity when using a 60 second epoch, as opposed to 12 minutes when using a five second epoch. Reilly et al. (2008) suggests that one way around this issue is to classify moderate to very vigorous activity together. Many current studies already tend to do so, as the amount of time individuals spend in moderate to vigorous activity is one of the main measures for health.

Furthermore, Reilly et al. (2008) using a range of different epoch settings of 15, 30, 45 and 60 seconds on data collected from five to six year old children examined time spent in moderate to vigorous physical activity and sedentary time. The frequency of epoch setting was non-significant for sedentary behaviour, however small but significant differences were found according to epoch setting for moderate to vigorous physical activity. These findings therefore suggesting that the epoch setting is relevant to the accumulation of moderate to vigorous physical activity. Nonetheless, Reilly et al argues that despite the notion that shorter epochs are essential to measure physical activity in children, the empirical evidence is limited and does not support shorter epochs as being necessary. However, the shortest epoch setting used by Reilly et al was 15 seconds. Therefore, taking into account the results of Baquet et al. (2007), it may be that much of the moderate to very vigorous activity bouts may still have been missed in their analysis.

Further research remains necessary to determine the influence of the epoch setting on moderate to very vigorous activity output. However, since a focus of this research is in assessing children’s moderate to vigorous physical activity, an epoch setting of five seconds will be used.

2.5.2 Defining the Duration of Measurement

It is necessary to determine the number of days of monitoring required to provide valid and reliable assessments of children's usual habitual physical activity. Trost et al. (2000) examined this issue in children of different age groups using accelerometry. Reliability coefficients for moderate to vigorous physical activity were examined for one, four and seven days of monitoring. In younger children reliability was found to increase with the number of days monitored; one day (R) 0.49; two to three days (R) 0.70; four to five days (R) 0.80 and between 9 to 11 days (R) 0.90. Trost et al found that there was less day to day variability in moderate to vigorous physical activity of younger children, compared with adolescent children. These findings suggest that physical activity levels vary greatly in adolescent children on a daily basis, compared with younger children.

Variability in children's physical activity levels between weekend and weekday (Trost et al., 2000; Riddoch et al., 2006; Kristensen et al., 2006; Rowlands et al., 2008; Nilsson and Anderssen et al., 2009), as well as within different times of the day (Gidlow et al., 2008; Steele et al., 2010; Nettlefold et al., 2011) has been well documented. Trost et al. (2000) also examined between and within day variability in physical activity. They found that moderate to vigorous physical activity varied significantly for boys, but not girls between weekend and weekdays. Furthermore, physical activity levels were found to vary significantly dependent on the time of day.

Based on the literature, between three and nine days of monitoring provide a reliable estimate of habitual physical activity in young children. In addition, this should include weekend and weekdays, as well as morning, afternoon and early evening time periods. A four day period of wear was chosen for this study, consisting of two weekend days and two weekdays.

2.5.3 Defining the Minimum Wear Criteria

Defining minimum wear per day is an important decision rule, since only data collected within the specified time frame (i.e. the waking day or 24 hours) or which meets the minimum wear criterion (i.e. 500 minutes or 10 hours) are used within analysis. This affects the amount of data that can be used and therefore may influence study findings. For instance days with only a short amount of wearing time, i.e. four hours compared with eight hours, includes a limited amount of data and therefore may under or overestimate physical activity (Ward et al., 2005).

Study perceptions of what constitutes a day are variable, for instance younger populations, such as pre-school and primary school children are likely to have fewer wakeful hours compared to adolescent and adult populations. Many studies however, use the same minimum wear criteria for assessing children's physical activity that is used for adults, of 600 minutes per day (Anderson et al., 2005; Mattocks et al., 2008; Owen et al., 2009). Since there is likely to be a reduction in the number of waking hours, particularly in younger children, this may lead to high proportion of children displaying insufficient data per day for analysis. Therefore setting a minimum wear criterion that takes into account reduced wakeful hours may be more appropriate for physical activity assessment of young children. Lower minimum wear criterion has therefore been adopted by other studies of eight hours per day (480 minutes) (Eiberg et al., 2005; Dencker et al., 2006). For this study a minimum wear time of 500 minutes will be used.

3.5.4 Omitting Spurious Data

Participants are asked to remove activity monitors for water based activities, as well as bathing and showering. These periods of non-wear, if unaccounted for within analysis, can influence the outputted data. The Actigraph monitors have been designed to record the slightest of movements. Therefore long periods of zero counts within the data may indicate that the monitor had been removed and should be excluded from analysis. It is common for studies with children to omit periods of 20 minutes or more of consecutive zero counts (Catellier et al., 2005; Owen et al., 2009). However, as young children often struggle to stay still for sustained periods of time, shorter time periods of 10 minutes have also been used Eilberg et al. (2005).

It is also common practice to omit the first and last days of accelerometer data from analysis, since these are often incomplete days, which are unlikely to meet the minimum wear period. This also allows time for participants to familiarise themselves with the accelerometer, whilst controlling for reactivity from the introduction of the monitoring equipment (Eiberg et al 2005). For this study, periods of 20 minutes or more of consecutive zero counts, and the first and last day of accelerometer wear will be excluded from analysis.

2.5.5 Threshold Review

Accelerometers measure physical activity in terms of accelerations of body movement, which produces data in terms of counts. Cut-point thresholds can then be used to convert accelerometer counts into different physical activity intensities, allowing us to determine the amount of time participants spent in each. There are however, numerous different published cut-point thresholds available for the analysis of Actigraph data and great variation between them. The cut-points chosen to represent physical activity intensity can significantly influence study findings. For instance a study by Mota et al. (2007) examined the effects two different cut-points had on the length of time children assessed as spending in moderate to vigorous physical activity. Data were analysed using published cut-points by Freedson et al. (1998) and Puyau et al. (2002). Results suggested that when using the lower cut-point of >1952 CPM by Freedson et al, participants engaged in significantly more moderate to vigorous physical activity ($p = 0.01$), compared with the higher cut-point of >3200 CPM by Puyau et al. Mota et al also found that the percentage of children reaching the physical activity criteria for health (60 min of moderate to vigorous physical activity per day) were significantly higher when using the Freedson et al cut-point, compared to that of Puyau et al. These findings highlight the significance of selecting appropriate cut-points for the study population.

Cut-points are often derived and validated by studies carried out in lab based settings, which require participants to wear accelerometers whilst performing different physical activities. It is important however, that a wide range of activities are used that incorporate treadmill, structured and free living exercises to produce cut-points suitable for assessing regular daily activity. Freedson et al. (2005) suggest that accelerometer calibration studies with children should be performed in a setting where a variety of activities can be included that best reflect the wide range of activities that children usually carry out. For instance, activities such as, colouring and watching TV should be included, in addition to walking and running, playground games such as skipping, hopscotch and tig, as well as more structured activities such as football and netball.

2.5.5.1 Cut-points for Physical Activity

Puyau et al. (2002); Treuth et al. (2004) and Mattocks et al. (2007) have derived Actigraph cut-points for children, using a wide range of structured and free-living activities (table 2.5.5.1).

Table 2.5.5.1 Threshold Values of Counts Per Minute (CPM) for Each Activity Intensity Level by Author

	Cut-point thresholds in CPM		
Activity Level	Puyau et al. 2002	Treuth et al. 2004	Mattocks et al. 2007
Light	800 -3199	50 - 1499	n/a
Moderate	3200 -8199	1500 - 2600	3581 – 6121
Vigorous	≥8200	≥2600	≥6121

Puyau et al. (2002) established cut-point thresholds for light, moderate and vigorous activity from a range of free living exercises. Twenty-six children, aged 6 to 16 years, each wore an Actigraph accelerometer for six hours. Energy expenditure was measured against room respiration calorimetry and heart rate by telemetry. First resting metabolic rate was measured by asking the children to remain still for 20 minutes. Children were then asked to perform a number of structured indoor activities, which were divided into four categories. These included, light activities included aerobic warm-up, by video, for 10 minutes and walk one, where children walked on a treadmill at 2.5mph, for 10 minutes. Moderate activities included Tae Bo martial arts exercises for 10 minutes, play time two involved children playing a variety of games such as basketball, hula hoop, bouncing and throwing of a ball for 20 minutes and walk two which involved the children walking on a treadmill for 10 minutes at 3.5 mph and 4 mph for 6 to 7 and 8 to 16 year old children respectively. Finally, vigorous activities involved children jogging on a treadmill for 10 minutes at speeds of 4.5 mph, 5mph and 6mph for children aged 6 to 7, 8 to 10 and 11 to 16 respectively. Afterwards children also carried out a number of outdoor field activities for three minutes each, these included football, skipping, jogging around the track and then walking around the track at their own speed for five minutes. A linear regression equation of activity energy expenditure (AEE) on activity counts was used in analysis to define thresholds for light, moderate and vigorous levels of physical activity (table 2.5.5.1). The regression equation showed a strong positive relationship between AEE (kcal/kg/min) and Counts (p=0.66). Each level of activity was determined by kcal/kg/minute, which corresponded with a mean heart rate of 90, 130 and 160 beats per minute for light, moderate and vigorous activity intensity categories respectively. The high correlations between activity counts and AEE and heart rate strongly reflect energy expended through activity, suggesting that these cut-points are reliable for predicting time spent in light to vigorous activity.

Earlier studies by Freedson et al. (1998) and Hendleman et al. (2000) have used METs (metabolic equivalents) to define activity thresholds in adults. METs are defined as a multiple of resting VO_2 (Mattocks et al., 2007). The amount of METs used during an activity determines its intensity. For instance, <3 METs = light; 3 to 6 METs = moderate; >6 METs = vigorous activity. However, Puyau et al argues that energy costs of resting metabolism in adults are not applicable to children as they have a higher resting metabolic rate than adults. According to Puyau et al children's resting energy expenditure ranges from 6 to 3.5 mL O_2/kg/min therefore using the lower adult rate of 3.5mL would produce age dependent bias when trying to predict energy expenditure and activity intensity in child populations.

A study by Treuth et al. (2004) used age appropriate MET values, determined from the group mean for resting VO_2 levels, in order to establish accelerometer threshold cut-points in girls aged 13 to 14 years. Seventy-four participants carried out a range of physical activities of different intensities, including walking, running, sweeping the floor, step aerobics and basketball, which Treuth et al propose reflect activities typical of girls their age. $VO_{2,}$ heart rate and accelerometry counts were collected for each activity, then using the individual MET levels, a random-coefficients model was used to test the relationship of accelerometer counts and VO_2 levels against the different activities. Based on the correct identification of the target or higher intensity activities and the correct exclusion of the lower intensity activities, Treuth et al determined a range of counts for defining activity intensity. This involved using a system of false positives and negatives to determine each threshold. The optimal threshold was the cut-point that both balanced and minimised the number of false positives and false negatives. The approach that had the least amount of false positives and false negatives was the one used to identify differences between a slow and brisk walking. This was then used to determine the moderate intensity threshold. It can be argued that the activities used to determine cut-points should not depend solely on different walking speeds, as this does not accurately reflect children's activity behaviours. However, Treuth at al argue that their decision was based upon brisk walking being categorised as a moderate activity by government health authorities. In addition, Treuth et al also admit that walking speeds alone can be a limiting factor when determining threshold cut-points and difficulties were experienced in defining thresholds for light and vigorous activity. This may have been due to a number of the activities that the participants carried out were not ones that could be accurately captured by the type of accelerometer used. For instance, basketball uses a lot of upper body movement that waist worn accelerometers find it difficult to detect accurately.

Mattocks et al. (2007) also used METs to derive cut-points, this time for moderate to vigorous intensity activity only. Again this study used the more viable method of using the group mean of resting VO_2 levels as the baseline. Two-hundred and forty-six participants, aged 12 years, performed a range of five minute activities, which included lying, sitting, slow and fast walking, hopscotch and jogging, whilst wearing an Actigraph accelerometer and a portable metabolic unit (K4). Epochs were set to record every 10 seconds. Children were divided into a developmental group (n=163) and a validation group (n=63). Analysis used only counts taken during minute 3.5 to 4.5 which were then paired with the corresponding K4 data. Two different METs levels were used to determine the lower threshold of moderate intensity activity. The reasoning being 3 METs was comparable to previous studies, but the authors argued that 4 METs was more appropriate for use with children. Six METs was used to define the threshold between moderate and vigorous activity. A prediction equation was formulated to determine what constituted 1 MET for the average child using the mean baseline = (VO_2 = 5.7mL·kg^{-1}·min$^{-1)}$ =1 MET. Cut-points were determined for the development group. The validation group were then used to test the sensitivities and specificities of the lower threshold 95.5% and 60.7% respectively and higher moderate intensity thresholds 74.1% and 94.7% respectively. Table 2.5.5.1 shows the cut-points determined by Mattocks et al for the lower and higher thresholds of moderate intensity activity.

It is evident from the literature that Puyau et al, Treuth et al and Mattocks et al each propose considerably different cut-points for each intensity threshold. There are a number of factors that may account for the differences in the threshold outcomes. For instance, Mattocks et al used only a small number of activities to determine cut-points for moderate to vigorous physical activity, whereas Treuth et al and Puyau et al used a wider range of activities to produce differing intensities to determine their cut-points for all levels of physical activity. However, Mattocks et al had a substantially larger sample size than both Treuth et al and Puyau et al, which is more likely to produce a reliable representation of a population than a relatively small sample size.

Age, weight and height may influence physical activity levels. A study by Reilly et al. (2008) examined the effect of age on accelerometry measured physical activity. One-hundred and eight participants, from three different age groups, 3 to 4 years (n=35, mean height 1.08, mean weight 18.8kg) 5 to 8 years (n=42, mean height 1.20m, weight 34.1kg) 9 to 10 years (n=31, mean height 1.40m, weight 37.1kg), took part in 45 to 55 minutes of physical activity. Analysis showed that there were no significant difference in accelerometry measured sedentary time (666 CPM, 716 CPM, 607 CPM respectively) and moderate to vigorous physical activity (2650 CPM, 2524 CPM and 2688 CPM respectively), between the age groups. Suggesting that age, weight and height have little effect on accelerometry measured physical activity. Puyau et al (2002) also examined the effect of age on accelerometry measured physical activity in their sample of 6 to 16 year old children. In contrast to Reilly et al, Puyau found that energy expenditure and physical activity counts were associated with age. The age range used by Puyau, however, was much broader and also included adolescents. Such findings may indicate that different cut-points may be required that can account for differences between the activity behaviour of children and adolescents.

A recent study by Owen et al. (2009) explored ethnic differences in physical activity levels among 9 to 10 year old White European and South Asian children. They used a cut-point of 2000 CPM for moderate to vigorous physical activity. They suggest that the threshold of 2000 CPM is equivalent to walking at a moderate speed of 4km/h. These cut-points have also been used in other free living studies with children of a similar age (van Sluijs et al., 2008; Steele et al., 2009, 2010).

2.5.5.2 Cut-points for Sedentary Behaviour

Trost et al. (2011) compared two accelerometer cut-points for predicting activity intensity in youth. Two-hundred and six children, aged 5 to 15 years, wore the Actigraph GT1M whilst carrying out different types of activities. The sedentary activities carried out included lying down, writing, and playing on a computer game. $V0_2$ was measured throughout the activities using a portable metabolic system. Cut-points for sedentary behaviour, by Puyau (2002) of <800 counts per minute and the more commonly used ≤100 counts per minute (Treuth et al., 2004; Freedson et al., 2005; Mattocks et al., 2007; Evenson et al., 2008), were evaluated for accuracy. Trost et al found that the latter of these cut-points displayed excellent accuracy against all of the sedentary activities carried out, suggesting that this lower threshold would be the most appropriate for assessing the sedentary behaviour of children in free living studies.

2.5.5.3 Conclusion

After reviewing the current literature, it is evident that more research is required regarding the development of standardised cut-points for all intensity levels. It is also difficult to determine which cut-points are the most suitable for measuring children's physical activity levels, since there was no clear choice due an array of methodological issues associated with each of the validation studies. However, using cut-points that allow a comparison of findings between similar studies is of great interest to this study. Since the aim of this study is to make ethnic group comparisons of the time spent in different levels of physical activity and sedentary behaviour, adopting the cut-points used by Owen et al. (2009) would be more appropriate to the study outcomes than selecting those that perhaps provide the most reliable measures of physical activity levels.

2.6 Dietary Intake Assessment

There are a wide range of methods available for assessing dietary intake. The choice of method will largely depend on the main research interests. However, dietary assessment generally involves collecting information on the frequency and quantity of food and beverage items consumed, and with the additional use of nutritional software, energy and nutritional composition can also be calculated.

This chapter will review potential dietary assessment methods including food records, diet recall, multiple-pass diet recall (MPDR) and food frequency questionnaires (FFQs). It will evaluate their advantages and disadvantages and report reliability and validity for assessing ethnic group differences in energy and macronutrient intake of children aged 9 to 11 years.

2.6.1 Food Records

This prospective method of dietary assessment involves a detailed reporting of food and beverage intake at time of consumption. The complexity of this method can vary from a simple list through to weighing every item consumed. Weights, using electronic scales or household measures, such as cups and tablespoons, along with detailed descriptions of these food items and/or ingredients, including brand names, preparation and cooking method and recipes for composite dishes may be required with this method. Leftover food may also be weighed and recorded. Participants are provided with food record sheets, detailed instructions and weighing scales. Both food diaries and weighed records have been used with adult populations (Gregory et al., 1990; Henderson et al., 2002; Anderson et al., 2005) but are impractical for use with 9 to 11 year old children.

2.6.2 Diet Recall

The diet recall is a retrospective, interviewer administered, method, which assesses dietary intake during a defined period, usually during the previous day or the past 24 hours. This method can be administered either in person, over the phone or on a computer. However, Biro et al. (2002) suggests that the personal contact between the interviewer and interviewee adds to the reliability of data. Diet recalls are usually carried out in the form of a structured interview, in which the trained researcher asks individual participants to report, in chronological order, everything they have consumed in the assessed period. Recalled data may be recorded in paper format or directly into computer analysis software. Full and detailed descriptions of all food and beverage items consumed are required, which include gaining as much information as possible on meal components, recipes, composite dishes, preparation and cooking methods and brand names. Prompts for missing items should also be carried out. Estimates of quantities consumed can be gained using an additional food photographic atlas, food models or typical household measures. The interviewer should be trained to fully develop skills in conducting recalls and be knowledgeable about common foods, nutritional habits, and preparation techniques, as well as ethnic, regional and seasonal variations of the populations under investigation to increase data quality (Biro et al., 2002). A minimum of three days, including at least one weekend day should be used to gain a more reliable assessment of habitual intake (Acheson et al., 1980).

Twenty-four hour recalls are cost effective, relatively straight forward and quick to administer, they have a low participant burden and are not thought to alter food intake patterns (Biro et al., 2002). They are also appropriate for use in large studies within varied populations that may differ in age and ethnicity. However, this method is heavily dependent on the respondent's memory and their ability to accurately recall dietary intake and is also subject to respondent bias

2.6.3 Multiple Pass Recall

The multiple pass method is a more structured and in depth adaptation of the 24 hour recall, developed by the US Department of Agriculture (Lee and Nieman, 2003), to provide a more accurate assessment of dietary intake. Multiple pass refers to the numerous steps involved during the interview that allows the revisiting and checking of dietary information. The first pass usually involves recording a quick list of foods consumed. The second pass prompts for forgotten items, including snacks and drinks. Third pass requires information regarding time and named eating occasion. The fourth pass collects information regarding portion sizes and where the eating occasion took place and whether anything was consumed between eating occasions. The fifth pass involves a final review and additional probing for forgotten items.

As with standard diet recalls the multiple pass diet recall method has a relatively low participant burden and is not thought to alter food intake pattern. It is appropriate for use in large studies with varied populations that may differ in age and ethnicity. Interviews are relatively quick 20 to 30 minutes and literacy is not essential.

2.6.4 Food Frequency Questionnaire

This method is commonly used to examine dietary intake in relation to disease risk. It is a retrospective method that gains information regarding the frequency with which specific dietary items are consumed over a specified period. FFQ can be interviewer or self-administered either in paper format or computer based. Some FFQ may ask for estimates of portion sizes and information regarding cooking methods and reduced fat products. FFQ can be adapted to examine dietary intake specific to different populations or different food and nutrient groups. For example, Kassam-Khamis et al. (2001) designed a FFQ that includes food and dishes commonly consumed by British South Asian populations to assess micro and macro nutrients intake within these populations. However, FFQs are more frequently used to assess intake in adult populations (Brunner et al., 2001; Pollard et al., 2001; Riboli et al., 2002; Mosdol et al., 2007; Barclay et al., 2008; Linos et al., 2008), rather than child populations (Stein et al., 1992; Lamb et al., 2007), because they demand the ability to estimate frequency of food consumption.

The advantages of the FFQs are that they are relatively inexpensive, easy to administer and adaptable to research interest and different study populations. Furthermore they can assess habitual diet over a long period of time; they have low respondent burden; can be administered by post or internet and are able to collect information on a few or a wide range of dietary items. The disadvantages of the FFQs are that they rely on respondent's memory, literacy and numeracy skills. Furthermore, the respondent may be more inclined to report consumption of 'good' over 'bad' foods.

2.6.5 Validity of Self-report Dietary Assessment Methods for use with Children

An article by McPherson et al. (2000) conducted a review of six studies to assess the validity of the food record to estimate dietary intake in school aged children. They found that the food record method both under and overestimate energy intake, with differences in mean energy intake ranging between 28% below to 31% above the validation standard. These findings suggest great variability in its accuracy for assessing energy intake in child populations. However, the validity of this method in the assessment of nutrient intake was found to be reasonable with variability between studies much more reduced. McPherson et al suggest that adult assistance would be required if using this method with children under nine years old.

Some food or beverage consumption may be missed from food records. A study by Matthys et al. (2007) used food records to assess dietary intake over seven days in adolescent children. Incomplete food records were found to be a major problem, with a large proportion of children failing to complete the full record, therefore eliminating 70 of the 411 participants from their final analyses. Using the food record as the main method of dietary assessment may therefore prove problematic in gaining accurate estimates of dietary intake and collecting the necessary dietary data from children.

McPherson et al. (2000) reviews a further 11 studies to examine the validity of the food recall method for use with children and adolescents. Of the studies that reported on energy intake, again both under and over estimation was common with this method. The overall difference in mean energy intake ranged between 34% below and 18% above intake gained from the validation standard. Furthermore, validity of the assessment of nutrient intake was also highly variable. These findings therefore suggest that whilst the dietary recall is a popular method for assessing dietary intake in child populations (Nicklas et al., 1993; Lytle et al., 1998; Parsons and Godson et al., 1999; Reynolds et al., 1999; Edwards et al., 2006) the accuracy of this method may be poor.

However, using a food record as a memory prompt for children during recall may improve the validity of data. Lytle et al. (1998) examined the accuracy of using a combined approach using both the food record and diet recall to assess dietary intake in 9 to 10 year old children. It was found that this combination provided more accurate assessments of food and nutrients than using 24 hour recall alone. Furthermore, this study discovered that whilst an overestimation in vegetable intake occurred from using the 24 hour recalls alone, when the combined method was used serving estimations of fruit and vegetable intake were improved.

Johnson et al. (1996) conducted a comparison study of energy intake assessed using the multiple pass diet recall method, against total energy expenditure determined by doubly labelled water, with children aged between four to seven years. Three non-consecutive multiple pass diet recalls were collected to estimate mean energy intake. Johnson et al. found no significant difference between three day mean energy intake and total energy expenditure as a group measure, suggesting that this method made valid group estimates of energy intake. However, this method was found to be inaccurate when measuring energy intake on an individual basis. A review article by Burrows et al. (2011) examined energy intake assessed by multiple pass diet recall in four studies with children aged 3 to 12 years. They conclude that whilst children still tended to over report by around 9% using this method, the multiple pass diet recall methods produced more modest over-reports of diet intake, compared with other methods of self-report.

Individual studies examining the validity of FFQ with children have varied findings (Kaskoun et al., 1994; Arnold et al., 1995; Bellu et al., 1995; Perks et al., 2000), with under and overestimations of energy intake common. However, in their review McPherson et al. (2000) conclude that the FFQ method was found to overestimate both children's energy expenditure and intake of specific macronutrients. In conclusion, no one method has been found to accurately assess energy intake in young children. However, whilst the multiple pass diet recall may prove ineffective at assessing intake on an individual basis, it seems to be the most reliable of self-report methods for providing group means, when used over a minimum of three days with children aged 4 to 12 years. Furthermore, whilst the food record is not recommended for assessing children's dietary intake as a method alone, using it as an additional method to aid dietary recall may improve the reliability and validity of data.

2.6.6 Examining Dietary Intake of Different Ethnic Populations

Assessing dietary intake in ethnic populations whose cuisine or cooking practices differ to that of the host society requires additional considerations. For example, the FFQ will need to be adapted to ensure items common to the ethnic group under examination are included. However, it is important to note that individuals may consume items that come from both their own culture and that of their host society; therefore items from both should be included. If FFQs or diet recalls are interviewer administered, the interviewer ideally should be from the same ethnic or cultural background as the study population. However, if this is not possible then ensuring they are fully knowledgeable regarding commonly consumed foods, nutritional habits and food preparation methods of the ethnic population understudy is essential. Furthermore, the choice of dietary assessment method may also be dependent on literacy and language abilities of children from different ethnic groups, where they are likely to differ from that of general population. For example, children may find recalling diet an easier option to reading items on a FFQ or reporting them in a food record.

McPherson et al. (2000) examined validation studies reporting on ethnic differences in children's ability to use dietary assessment tools. McPherson et al found that of the two studies reporting on ethnic differences in the validity of the food record in assessing energy intake, one study reported no significant differences between ethnic groups in the reporting of energy intake (Bandini et al., 1997), whereas Champagne et al. (1998) found that in comparison with White children, Black children over reported energy intake when using this method. McPherson further report, that of the two studies investigating ethnic differences in the accuracy of dietary recall, evidence was mixed, with Baxter et al. (1997) reporting no significant ethnic differences in the accuracy of meal recall, whereas Todd et al. (1986) found significant differences between accuracy of meal recall between young Chinese and Hispanic children, in the US. Finally, only one study by Byers et al. (1993) was found to report on accuracy of dietary assessment measured by the FFQ by ethnic group, where no significant differences were identified. In conclusion, evidence supporting the ability of these different methods to assess dietary intake of different ethnic populations are mixed, therefore no conclusion can be made as to which method may be the most reliable when assessing dietary intake across different ethnic populations. Most significantly, there are no studies considering the validity and reliability of dietary assessment in British children of South Asian origin.

2.6.7 Reliability and Validity of Methods of Self-Report for Dietary Assessment

The reliability and validity of children's dietary data can heavily depend on the method chosen to collect the data, more specifically whether it appropriate for the age of the study population. For instance, the food record requires that the child has the literacy skills and cognitive ability to record dietary items accurately. Livingstone and Robson (2000) suggest that around the age of seven to eight years a child's ability to self-report dietary intake over the last 24 hours increases. In addition, studies have proven that by the age of 8 to 10 years children are able to accurately report their diet intake (Van Horn et al., 1990; Lytle et al., 1993). However, it is likely that a child's ability to recall will vary significantly by individual at this age. Biro et al. (2002) suggest that children over 10 years of age are able to carry out dietary recalls with acceptable reliability and validity. However they suggest that the FFQ is more appropriate for children aged 12 years and over. Furthermore, Livingstone and Robson assert that due to a child's inability to conceptualise frequency, FFQs would not be suitable for use with children less than 10 years of age.

2.6.8 Portion Size Estimates

Studies have used household measures and food models to assist respondents with the estimation of portion sizes consumed (Jenner et al., 1989; Lytle et al., 1993; Van horn et al., 1990). Validation of these tools for improving children's estimation of portion size is relatively unknown. However, it is likely that children may struggle to quantify the amount of food they consume even by using such tools. Livingstone and Robinson (2000) suggest that until a child has an accurate concept of time, they are unable to provide frequencies and estimates of food intake. Furthermore, they suggest that since it is unlikely for many children to pay attention to frequencies and portion sizes when eating, the task of food quantification is likely to prove difficult.

Food photographs are a more recent tool in dietary assessment studies, which are used to gain valid estimates of portion sizes. Nelson et al., (1997) compiled a photographic food atlas consisting of a series of eight photographs of different food items and meals of varying portion sizes. A study by Frobisher and Maxwell (2003) assessed adults and child (mean age 12 years) estimates of food portion sizes using the food photographic atlas. This was done at two different time points, immediately after serving themselves with the food and again three to four days later. Large differences in the accuracy of portion size estimates were observed for most foods regardless of age or time point, although greater error was found in child estimates. These findings suggest that modifications of food portion sizes or age appropriate portion size photographs would be better suited to assist in children's dietary assessment studies. A study by Foster et al. (2006) examined the importance of using age appropriate food photographs for estimation of portion size in children aged 4 to 11 years. This study found that providing children with age appropriate photographs significantly reduced estimation error, when compared with estimates from adult food photographs. At commencement of data collection there were no published age appropriate photographic food atlases for use with children.

2.6.9 Misreporting

Self-report dietary assessment methods are subject to misreporting due to exclusions of dietary items, which may occur either consciously or unconscious. Conscious inclusions and exclusions may occur due to consumption of what are perceived to be 'good' and 'bad' food. For instance individuals who are overweight or obese may be more likely to underreport dietary intake on a whole, as well as what may be perceived to be bad foods. Unconscious exclusions may also occur. This is due to methods of self-report being heavily dependent on respondent's memory and their ability to recall. In addition, snacks and beverages are particularly subject to under-reporting due to them being consumed infrequently and out of the regular meal time routine. However, probing for forgotten and missing food, snack and beverage items during dietary assessment may help counteract misreporting.

2.6.10 Conclusion

After reviewing current methods available for assessing dietary intake in children, the multiple pass diet recall will be used to assess dietary intake over three days, including one weekend day, as this method is found to provide the most reliable and valid assessments of children's dietary intake. Furthermore, the previous day multiple pass diet recall is also an appropriate tool to examine ethnic differences in children's intake, which is essential to this study. A food record will also be used to act as a memory prompt during diet recall, as a means to improve the reliability and validity of recalled data. Interviewers will be trained in multiple pass diet recall methodology and be familiar with South Asian food ways, in particular Pakistani cuisine. In addition, estimates of portion sizes and measures will be collected using the adult's photographic food atlas. Finally, constant probing for forgotten and missing dietary items will be carried out to reduce error from underreporting.

Chapter Three: Methods, Data Processing and Analysis

This chapter provides information on the study methodology. More specifically it will outline the study design; describe the study setting and its participants; and discuss the study protocol, data processing techniques and data analysis.

3.1 Study Design

This thesis is a cross-sectional observational study that gathers data from children and their parents. It is conducted from a multidisciplinary perspective, spanning across the fields of medical anthropology, behavioural epidemiology, nutrition and public health. Furthermore, it uses a mixed multi-method approach, which includes accelerometry, recall, questionnaire and interviews, to collect a range of quantitative and qualitative data, investigating physical activity and dietary intake of girls aged 9 to 11 years of White British and British Pakistani ethnicity. Hypotheses are formulated based on the literature reviewed in Chapter one.

3.2 Study Setting and Participants

This section will describe the study location, data collection time scale, ethical approval and funding sources. It will also describe the study sample and recruitment procedures.

3.2.1 Background of Study Population

This study was conducted in Teesside, located in the North East England. According to data provided by Race for Opportunity (2010), five per cent of the North East population belong to ethnic minorities. Of these, 57,100 (49%) are of Asian or British Asian origin. Teesside is composed of the following districts: Middlesbrough, Stockton-on-Tees, Redcar and Hartlepool. Middlesbrough and Stockton-on-Tees have some of the highest proportions of ethnic minorities in the North East of England. According to Race for Opportunity (2010), 14% of the population in Middlesbrough and eight per cent in Stockton-on-Tees are of ethnic minority, with British Pakistanis being the largest minority ethnic group in both areas (Office for National Statistics, 2004).

Data from the North East Public Health Observatory (2012), suggest that deprivation in these regions is higher than average for England, with around 9,800 children in

Middlesbrough and 8,400 children in Stockton-on-Tees living in poverty. The average life expectancy for men and women is lower than the English average (North East Public Health Observatory, 2012). Premature death from heart disease and stroke are falling, but are generally worse than the national average for England. Furthermore, around 21% of children in these regions are classified as obese, which again is higher than average for England (North East Public Health Observatory, 2012).

3.2.2 Sample Size

Original power calculations were carried out using G-power 3.0.3 and were based on physical activity as the primary outcome, as evidence suggests this may be the most important factor in causing health inequalities between the two groups. The results of the *Health Survey for England* 2004 (Sproston and Mindell, 2006) provided the best basis on which to base power calculations. It was found that 36% of Pakistani-origin girls and 61% of general population girls aged 2 to 15 years achieved the recommended level of physical activity (i.e. 60 minutes of moderate to vigorous activity per day). To discriminate a difference in physical activity levels of this order, at a significance level of 0.05 and power of 0.8, a sample size of 62 girls in each ethnic group was needed.

3.2.3 Ethical Approval

Durham University ethics committee approved ethical clearance for this study. Each of the researchers were required to undertake an enhanced Criminal Records Bureau check (CRB) before being allowed to work in schools with children.

Participation in the study was on a voluntary basis and participants were free to withdraw at any time without negative consequences. Head/deputy head teachers were fully informed of all procedures before consenting to participate in the study. Participants' parents were each required to read, sign and return a study consent form before their child was allowed to participate in the study.

3.2.4 Data Protection

Confidentiality was maintained at all times. All participants were given a unique reference number and once data collection was complete, they were identified by number only. Registers relating to study participants, including their year group and class, were kept. They were not removed from the school and were destroyed immediately after data collection had ceased within the school. Participant information was not discussed outside of the research team. However, if any issues relating to child protection were to arise, the designated member of staff within the school was to be notified. None were identified.

3.2.5 Feedback to Schools

Once data had been collected from each school, the results were compiled into a detailed summary report regarding physical activity and dietary intake. The report focused on the school sample as a whole and did not differentiate between ethnicity. Each child participant received a certificate and a graph print out of their objectively measured physical activity for their time spent in the study. Schools and children were offered incentives to encourage recruitment; however these varied by school depending on the funding available. All participants and their family in schools with I.D. one and two received a complimentary weekend family pass to a health club. All child participants in schools (see table 3.3.1.1 page 76) with I.D. two, three and four were provided with the opportunity to participate in a complimentary after-school sports activity programme for a minimum period of six weeks. If study participants did not fill the activity programme, places were offered to all girls in school year groups five and six. School number five was offered the after-school sports activity programme but was unable to utilise it at the time. Participants in schools with I.D. six and seven were each provided with a complimentary pedometer.

3.2.6 Funding Sources

I am in receipt of an interdisciplinary 1+3 Economic and Social Research Council and Medical Research Council studentship. This funded me for my one year Master's degree in Research Methods in Anthropology and my three year PhD in Medical Anthropology, both completed at Durham University, UK.

Total Fitness Leisure, Stockton-on-Tees, provided the fully funded weekend family passes to their health club.

The after-school sport activity programmes were funded by 'Sports Unlimited', 'Active Lifestyles' and 'Healthy Towns' (all Middlesbrough).

3.3 Data Collection and Recruitment

Data collection was dependent on school term time and took place from January to July and November to December (2010). Physical activity and dietary data were collected from seven primary schools and the interview data were collected from the parents from six of these primary schools.

3.3.1 Recruitment of Schools

Girls selected for this study were in school years five and six, which includes ages nine to 11 years. This age range was selected as the data collection methods not suitable for children below this age. In addition, children of this age are relatively compliant with physical activity and dietary protocols, as evident from the large number of studies focusing on this age group (van Sluijs et al., 2008; Owen et al., 2009; Steele et al., 2010; Duncan et al., 2012).

The schools that were selected from Middlesbrough and Stockton-on-Tees, to take part in this study, were determined by the percentage of pupils with a first language other than English, as this can be a marker of the presence of minority ethnic groups. This information was gained from the Department for Education (http://www.education.gov.uk/inyourarea/gors/gor_A.shtml). Table 3.3.1.1 displays statistical information for the year 2010 for the schools recruited in the study. The main ethnic minority group on Teesside is British Pakistani; therefore, they were expected to be the largest minority group within these schools. I contacted twelve schools by letter (appendix A) inviting them to participate in the study; ten schools were followed up by a phone call; eight introductory meetings were then made with either the head teacher or deputy head teacher; finally, seven of these schools agreed to participate.

The introductory meeting with head teachers and deputy head teachers involved explaining the aims of the study, recruitment procedures, data collection methods and study rewards. Head teachers were provided with duplicate blank copies of all paper documents involved in the study, including parent/guardian study information letter (appendix B), staff study information letter (appendix C), study consent form (child) (appendix D), study booklet (appendix E) parent/guardian cover/interview recruitment letter (appendix F), parent/guardian questionnaire (appendix G), monitor wear reminder poster and data collection sheets used for PD-MPDR (appendix I) and PD-PAR (appendix J). Criminal Records

Bureau (CRB) certificates for each researcher were presented to the head teacher within this initial meeting. In addition, any specific requirements that individual schools may have, and the methods of recruitment and data collection were also discussed. In four of the seven schools the head teacher or year six teachers were unwilling to allow either all or a proportion of the year six girls from lessons to participate in the study; this was due to the end of year SATS tests.

3.3.2 Recruitment of Girls

In schools with I.D. one, five and seven, all girls in school year groups five and six were invited to participate, in schools with I.D. two and six all girls in school year group five and half of girls in school year group six were invited to participate, and in schools with I.D. three and four only girls in school year group five were invited to participate. Girls' recruitment to the study was irrespective of ethnicity; however only girls of White British and British Pakistani origin were included in the final data analysis.

Recruitment talks for girls averaged 20 minutes and were planned to take place within the final hour of school each Wednesday afternoon or at a time more convenient to the class teacher, if the proposed time was unsuitable. Girls were released from class for the duration of the recruitment talk. Depending on the number of girls within each class, the recruitment talk was given to either one or two classes at any one time, with one recruitment talk given per week. Recruitment talks involved providing the girls with a brief summary of the study aims and of the different procedures that they would be expected to comply with should they wish to participate in the study. Girls were shown the study booklet, which included the food diary, and the activity monitor. They were also shown a sample graph taken from the downloaded Actigraph data, and a certificate, both of which they would receive upon their completion of the study. Talks were designed to be fully informative, whilst making the study sound fun and interesting. Opportunity was provided for the girls to ask questions and raise any concerns they might have. They were also assured that participation in the study was by no means obligatory.

Following the recruitment talk, girls wishing to participate in the study were each provided with a parent/guardian study information letter and study consent form (child). Participants were asked to return their consent form completed and signed by their parent or guardian by Friday morning, to commence the study at Friday lunchtime. Girls who had not returned the consent form completed and signed by their parent/guardian were unable to participate in the study.

Table 3.3.1.1 School Information and Recruitment Statistics

School ID	School location	% 1st Language other than English	% claiming free school meals	Total no. of girls in year 5 & 6	Total no. of girls in year 5 & 6 accessible for recruitment	Total no. of girls in year 5 & 6 recruited	% of girls in year 5 & 6 recruited	Total no recruited of WB or BP ethnicity+	% recruited of WB or BP ethnicity +
School 1*	Stockton-On-Tees	56	40	28	28	23	82	19	83
School 2#	Middlesbrough	83	36	54	44	36	82	31	86
School 3#	Middlesbrough	33	16	81	42	33	79	32	97
School 4#	Middlesbrough	35	9	31	26	18	69	16	89
School 5	Middlesbrough	66	37	56	56	46	82	38	83
School 6	Stockton-On-Tees	14	57	26	26	16	62	15	94
School 7#	Middlesbrough	9	61	46	31	17	55	15	88
Total for all school recruited				322	253	189	75	166	88
Average for all school recruited		42	37						

*Repeat access was gained to year five during two separate academic years

#Access was gain to year five only or year five plus only part of year 6

+WB = White British; BP = British Pakistani

3.4 Study Protocol

3.4.1 Parent Meetings

Within the parent/guardian information letter were details of a meeting place and time, within the school, for any parents wishing to gain additional information about the study. This meeting provided the parent/guardian with a summary of the study aims, what would be required from their child as a participant in the study, a demonstration of the Actigraph activity monitor, and the opportunity to ask any questions and raise concerns regarding the research study. This meeting was also used as an opportunity to recruit parent/guardians for interviews.

3.4.2 Study Induction

Each Friday afternoon a group of 8 to 14 participants were given a study induction. This involved receiving a study pack including: i) a study booklet, ii) an activity monitor, iii) a parent/guardian cover/interview recruitment letter, iv) a monitor wear reminder poster. Participants were also provided with full verbal instructions regarding the activity monitor and completing their food records and were given the opportunity to ask questions and raise any concerns they may have. Participants were also provided with a full demonstration of wearing, attaching and removing their activity monitor. Participants were signposted, within the study booklet, to the study timetable (3.4.2.1) (should they be unsure on what tasks they were to do on which days), the child friendly instructions (to refer to if they were unsure about anything) and my contact details (should any problems arise preventing them from carrying out the set tasks).

3.4.3 The Study Booklet

Each participant received a study booklet (appendix E), which included a brief study introduction, a contents page for participants to navigate to pages of interest more efficiently, a study timetable (table 3.4.2.1) to enable participants to identify the tasks for each day they were involved in the study, child friendly instructions regarding wearing the activity monitor and how to complete the three day food record, including visual examples, and the three day food record sheets, with days clearly defined to reduce participant confusion. The study booklet also included some fun activities for participants to complete at their wish, an activity monitor log (with a visual example for participants to record periods of non-wear) and contact details (of myself, as the lead researcher, and my departmental supervisor Dr Pollard). Contact details were provided should participants or their parents have any questions or concerns regarding the study that remain unanswered after reading the study booklet.

3.4.4 Parent/Guardian Questionnaire

Questionnaires (appendix G) were sent home with each participant on a Friday and were to be returned, completed by a parent/guardian, on the Monday. Receiving the completed questionnaire on the Monday allowed interviewers to review background information on the child and their family before recall interviews began. This also allowed additional days to chase up the questionnaire had it been forgotten initially.

The questionnaire covered demographic information, such as parental marital status, ethnic background, language, household composition, education and employment. Additional information was requested regarding migration history, health and lifestyle. Questionnaires were in English following advice from a colleague familiar with the study population, suggesting that most British Pakistani households would include at least one parent fully literate in English and that levels of literacy in Punjabi or Urdu are generally low.

3.4.5 Parent/Guardian Cover/Interview Recruitment Letter

During the study induction participants were provided with a cover letter for their parent/guardians, which thanked them for allowing their child to participate in the study. Within this letter the parent/guardians were signposted to the study booklet for information and instructions regarding their child's involvement in the study and were requested to complete the parent/guardian questionnaire. An invitation for parents to be a part of the study by participating in an interview was also included within the letter, with an additional section for contact information to complete and return should the parent/guardian be willing to participate.

3.4.6 Poster

Each participant was also provided with a poster. They were instructed to display the poster somewhere very visible to remind them to put their activity monitor on when they awoke in the morning.

3.4.7 Actigraph Activity Monitoring

Physical activity was assessed with the Actigraph GTX3 accelerometer (Actigraph, LLC, Fort Walton Beach, FL). Participants were asked to wear the activity monitors from Friday lunchtime through to the following Wednesday lunchtime. This was to provide four complete days of physical activity data, including two weekend and two week days (school days only), a time period considered to provide reliable estimates of children’s habitual physical activity, whilst also accounting for weekend and week day variability (Trost et al., 2000). Activity monitors were initialised with a start time, but not end time, as participants reporting large amounts of non-wear time were requested to wear the activity monitor until the minimum wear criteria were thought to have been met. Monitors were set to record at five second epochs, as this is understood to gain a more accurate representation of physical activity in children, something which is recommended from the literature reviewed in chapter two, section 2.5.1. Participants were asked to wear the monitor on the left hip, using the elasticised belt provided, during all waking hours, removing it only for bathing, showering or water based activities. Participants were to record periods of activity monitor removal on the log sheet provided within their study booklet.

Table 3.4.2.1 The Eight Day Time Table for Participant Involvement in the Study

Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday
Receive introductory talk	Return consent form	Return consent form			Return parent questionnaire		
		Study induction					
		Receive and wear activity monitor	Wear activity monitor	Wear activity monitor	Wear activity monitor	Wear activity monitor	Wear and return activity monitor
				Complete food record	Complete food record	Complete food record	
					PD-PAR & PD-MPDR	PD-PAR & PD-MPDR	PD-PAR & PD-MPDR
							Complete PAQ-C

PD-PAR = Previous Day Physical Activity Recall

PD-MPDR = Previous Day Multiple Pass Diet Recall

PAQ-C = Physical Activity Questionnaire for Children

3.4.8 Food Record

Each participant was provided with a three day food record. Participants received full verbal and written instructions with regards to completing their food records, which were to be completed over three days, Sunday to Tuesday inclusive. Food records required participants to:

- Record the time of all eating/drinking/snacking occasions
- Provide a detailed description of food/beverage/snack item, including all main ingredients of composite dishes and/or components of meal
- Brand names of food/beverage/snack items
- Any cooking methods of the food/beverage/snack item

Participants were encouraged to observe the main food preparer during meal preparation, make enquiries about the names and ingredients of composite dishes, and any preparation and cooking methods; making particular enquiries into whether items had been fried either during preparation or as the main cooking method. It was requested that participants completed food records at the time of consumption, bringing their completed dietary record to school each day to assist with diet recalls. Food records were completed to varying standards. Memory, time and not having food records in their possession, at the time of food/beverage/snacking occasion, were common causes of missing and incomplete data reported by the girls.

3.4.9 Previous Day Multiple Pass Diet Recall (PD-MPDR)

Training was received for conducting PD-MPDR from the Obesity Research Group, within the School of Medicine and Health at Durham University. Frances Naylor, a Masters student in Anthropology, also received training on PD-MPDR and contributed to the data collection in schools with I.D. two, three, four and five. Interviewers familiarised themselves with South Asian food ways, in particular Pakistani cuisine, by reviewing current literature.

PD-MPDR were conducted over three days, a time frame understood to provide valid and reliable group estimates of dietary intake in child populations (Johnson et al., 1996) and included data from one weekend day. This gained dietary data for Sunday to Tuesday inclusive. PD-MPDRs were conducted in English on a one-to-one basis (interviewer/respondent) on school grounds, during normal school hours. Food records were used as a memory prompt during recall interviews.

The PD-MPDR protocol (appendix H) and data collection sheets (appendix J) were adapted from Nelson et al (accessed from http://toolkit.s24.net/dietary-assessment/methods/recalls/examples-and-links.html). A brief outline of the protocol involved firstly gaining a quick list of food and beverages consumed, in chronological order, within the day prior to recall. This included all meals, hot and cold beverages, water, snacks and sweets. Memory prompts were performed throughout, which may include asking what the respondent was doing within a specific time frame and whether they consumed anything before, during or after the activity (i.e. shopping in town). Once the quick list was complete, prompts were made for any forgotten food or drink items, which involved listing commonly forgotten items, such as drinks of squash or water, biscuits, crisps, fruit, sweets and puddings. The next procedure involved gaining details, in chronological order, of all quick list items including the time, place and a description of the eating occasion (i.e. breakfast, lunch, dinner, supper), ingredients of the composite dishes and/or meal components, cooking methods (particularly whether an item was fried, either during preparation or as the main cooking method), brand names or homemade, and second helpings and leftovers. Prompts for common accompaniments to recalled items were made throughout e.g. tomato ketchup, bread and butter. Participants were then asked to make estimations of portion sizes consumed and any leftovers, which were conducted using Nelson et al. (1997), food photographic atlas of adult portion sizes. Photographs to scale of crockery, cutlery, glasses, cups and mugs were provided, as a supplement to the food photographic atlas, for participants to provide more reliable estimations of portion size. After gaining details of portion sizes, for all items consumed, these were reviewed once more to check everything had been completed to the best of interviewer/respondent knowledge. Final prompts were also made for missing or forgotten food, beverage and snack items.

During recalls any unfamiliar food items or dishes that had been consumed were investigated further. This involved gaining as much information as possible regarding the name (including spelling) and main ingredients and/or components of the dish. Judd et al. (2000) (*The composition and nutrient content of foods commonly consumed by South Asians* *in the UK*), and Tan et al. (1985) McCance and Widdowson's second supplement ('*The composition of foods: Immigrant foods*') were used during recalls to identify unfamiliar Pakistani food items and dishes. Potential items and dishes were identified within these resources using main ingredients and components and checked with participant to ensure they corresponded.

PD-MPDR took approximately 20 minutes to complete, dependent on how well food records were completed and the individual's ability to recall. Eight to fourteen PD-MPDR interviews were conducted per day, depending on the number of interviewers present. Respondents who were absent for one or more recalls were asked to complete a recall for the same day the following week.

3.4.10 Previous Day Physical Activity Recall (PD-PAR)

I provided Frances Naylor, a Masters student in Anthropology, training on conducting PD-PAR. Both Frances Naylor and I familiarised ourselves with the literature associated with children's physical activity behaviour and South Asian physical activity habits.

PD-PAR were conducted consecutively over three days, a time frame understood to provide reliable and valid group estimates of habitual physical activity behaviour in child populations (Trost et al., 2000), and included data from one weekend day. This gained physical activity behaviour data for Sunday to Tuesday inclusive. PD-PARs were conducted following on from PD-MPDR.

The PD-PAR was based on a simple previous day recall structure. Activities were recorded onto data collection sheets (appendix J) Participants were asked to report in chronological order physical activities and sedentary activities they participated in from when they woke to when they went to bed, the day previous. The particular focus of this study was to identify participation in sport and exercise, outdoor play and screen time, whilst also collecting data on mode of school transport and participation in after-school based sport and exercise activities. However, some data regarding other types of activities, i.e. visiting relatives and evening attendance at mosque school, were also collected. Participants were asked to provide an approximate start time and estimate the duration of each activity they participated in and information regarding where the activity took place (i.e. at home, at school, outdoors) and who they were with (i.e. friends, family).

Physical activity recall interviews took approximately 10 to 15 minutes to complete, depending on the individual's ability to recall. Eight to fourteen PD-PAR interviews were conducted per day (Monday to Wednesday inclusive), dependent on the numbers of interviewers present. Respondents who were absent for one or more recalls were asked to complete the recall for the same day the following week.

3.4.11 Physical Activity Questionnaire

The self-report questionnaire chosen to assess typical physical activity in this sample of girls was the Physical Activity Questionnaire for Children (PAQ-C) (Kowalski et al., 2004). As this tool was developed in the US, modifications were made to the list of physical activities, replacing those that were more specific to the US with activities that were more specific to the UK. For example baseball was replaced with 'rounders'. Furthermore, language terminology was also adapted i.e. replacing recess with school break-time. The self-report PAQ-C has been designed and validated for assessing physical activity patterns, levels and behaviours in children aged eight to 14 years, over seven days (Crocker et al., 1997; Kowalski et al., 1997, 2004). Amongst other variables the PAQ-C requires participants to self-report after-school, evening and weekend sport and exercise activities, such as participation in sports, dance or active games, and school break-time activity. A copy of the PAQ-C can be found in appendix K. Each participant was requested to complete the PAQ-C on the Wednesday, as the final task in the research study. Interviewers were on hand to help the girls if required.

The PAQ-C data in this sample of girls may be subject to a degree of over-estimation error, as some participants reported participating in large and perhaps unrealistic amounts of physical activities. In these cases participants were asked to verbally recall all occasions they participated in these activities, as a method to reduce over reporting error.

The PAQ-C took approximately five to 10 minutes to complete, depending on individual ability to recall activities. A number of children provided incomplete questionnaires, which were not included within final analysis. The final PAQ-C sample is displayed in figure 3.6.2.1.

3.4.12 Parent Interviews

Interviews were conducted with White British and British Pakistani parents to investigate familial influences on girls' physical activity and dietary behaviour. These interviews were semi-structured with a brief list of topics to cover (table 3.4.12.1). Semi-structured interviews were more appropriate than unstructured or structured, since this allowed me to cover the necessary topics, but also gave the participant the opportunity to portray their own personal opinions, experiences and thoughts, whilst bringing in any additional themes or subject topics. Parents were recruited for interview either directly during the parent information meetings or indirectly by letter (parent/guardian cover/interview recruitment letter appendix F), which was sent home with their child following their induction into the study.

The semi-structured interviews took place within a community setting, such as the school or local Sure Start centre or within the participant's home. It was necessary for interview participants to read, complete and sign a consent form before commencement of the interview (appendix L). I conducted all interviews in English. An Urdu speaking assistant accompanied me on a small number of interviews with Pakistani parents. However, English was always spoken and understood by at least one Pakistani parent present during the interview. Interviews lasted approximately 45 minutes, although the range varied from 35 minutes through to one hour 15 minutes. Interviews were entirely voluntary and no rewards were given for participating.

All parental interviews were recorded using a digital voice recorder and later transferred onto a hard drive. Recording interviews means that data can be referred back to, thus counteracting the limitations of memory and to ensure the context of data is properly understood. Written notes were made immediately following the interviews, which can provide important extras to recorded data (Bernard, 2002). It is important to recognise that participant responses may be influenced by the interviewer, in terms of their age, gender and ethnicity (Shuman and Presser, 1981). Furthermore, interviews are also subjective to social desirability responding, with participants reporting desirable responses rather than actual occurrences.

Interviews were conducted in a non-judgemental manner (Bryman, 2004). During interviews I revealed information relating to my own personal life, as a mother to a child of a similar age to those recruited for this study, and related my personal experiences to interview discussions. This served to make the parents more at ease and willing to share their experiences, whilst aiming to reduce social desirability responding.

3.4.12.1 Parent Interview Topics

Physical activity behaviour	**Dietary behaviour**
Parental perceptions of their daughter's physical activity levels	Parental perceptions of their daughter's dietary behaviour
Parental activity behaviour	Common family consumption habits
Family interaction in physical activities	Child snacking behaviour
Child participation in community & school based sport and exercise	Common cooking practices
Child participation in outdoor play	Fast-food habits
Barriers to participation in physical activity	
Attitudes towards physical activity	Parental perceptions of healthy eating

3.5 Data Processing

All data from all participants (n=189) were entered into SPSS (statistical package for social sciences) V17.0 for processing and analysis. Each participant was assigned an identification number, a date of commencement into the study, a school and a year group.

3.5.1 Parent Questionnaire

Data on the study population collected from the parental questionnaire was entered manually to the assigned variables within SPSS. Each participant was assigned to an ethnic group: White British or British Pakistani, which were self-reported by the parent. Children of 'other' ethnicities were included within the data set; however they were excluded from the main data analysis. Other variables, such as parental country of birth and first language were used to confirm ethnicity. Educational data were coded based on the English education system. Parents' age upon leaving full time education was used to confirm education status. Parent occupation was coded using Office for National Statistics Socio-economic Classification (NS-SEC) system (2005). When appropriate, missing or confusing data were confirmed by participants. The parent questionnaires were regularly returned incomplete, usually with data regarding the father and occupation status absent. Because of this, the father sample regarding demographic data is small and the number of participants for each response is variable. Furthermore, occupational status was very poorly completed and therefore was not used within any further analysis. Some of the questionnaire data were recoded strategically to reduce testing categories using SPSS (table 3.5.1.1).

Table 3.5.1.1 Parent Questionnaire Category Recodes

Original variables	**Recoded variables**
Parental marital status	
1. Married or Co-habiting	1. Married/Co-habiting
2. Single 3. Separated or Divorced 4. Widowed	2. Single/separated
Education (data not shown)	
1. GCSEs/ O Levels or equivalent	1. Secondary
2. A Levels/ B.Tec/NVQ or equivalent 3. Access/Foundation certificate	2. Tertiary
4. Degree/ postgraduate degree or equivalent	3. University
Socio-economic status (data not shown)	
1 Higher managerial and professional Occupations 2 Lower managerial and professional occupations 3 Intermediate occupations 4 Small employers and own account workers	1. Salaried with benefits
5 Lower supervisory and technical occupations 6 Semi-routine occupations 7 Routine occupations	2. Contract wage earners
8 unemployed	3. Long-term unemployed/sick/homemakers
Employment status	
1. Work Full time 2. Work Part time 3. Full time education	1. Employed/FT Education
4. Look after home	2. Look after home
5. Unemployed 6. Unable to work due to long term sickness or disability	3. Unemployed/long term sick

3.5.2 Weight and Height

Weight and height were not collected from this sample of girls due to concerns regarding the effect this may have on recruitment numbers. I was involved in a previous study of children from primary schools in the same geographical area, which experienced some difficulties with recruitment as a consequence of collecting weight and height data. It was clear that heavier children were often unwilling to participate (Henderson et al., 2011). I therefore, decided to avoid limiting my potential sample size and introducing sample bias, by omitting anthropometry from this study. In line with other studies, Henderson et al. (2011) found no difference in height and body mass index (BMI) between White British and British Pakistani children. Therefore, it is hopeful that the ethnic group comparison of physical activity levels and diet would be influenced by ethnic differences in BMI in this sample of girls.

3.5.3 Accelerometry

Actigraph data files were downloaded and batch analysed using the specifically designed software programme MAHUFFE (http://www.mrc-epid.cam.ac.uk). Data were processed in five second epochs to capture brief periods of activity at higher intensities typical of children (Nilsson et al., 2002; Rowlands et al., 2006). To allow comparison of results to similar studies (Owen et al 2009; Steele et al 2010) activity thresholds were defined as: sedentary <100 CPM; light >100 to <2000 CPM; moderate 2000 to <4000 CPM; vigorous >4000. Moderate to vigorous physical activity (MVPA) was defined by combining moderate and vigorous physical activity. Runs of 20 minutes or more of zero counts were deemed as non-wear periods and were excluded, as, with children, motionless periods of more than this time have been deemed biologically implausible (Esliger et al., 2005). Incomplete first and last recorded days were omitted. As discussed in chapter two, minimum registered time for inclusion was defined as ≥500 minutes of data for any day.

Data were firstly reviewed to determine whether the 500 minimum of registered time was achieved for a minimum of three days, including at least one weekend day. Data collected outside the hours of 7 am to 11 pm were excluded from analysis. This method has been used elsewhere with children of this age (Steele et al., 2010).

Minute by minute data were screened for the Actigraph monitor malfunction code 32,767 CPM and for CPM values that ≥15’000. Esliger et al. (2005) states persistent CPM of ≥15, 000 is biologically implausible and therefore should be removed. However, Alhassen et al. (2008) included CPM ≥15, 000 in analysis if high intensity activity could be confirmed around this time by parents, otherwise they were omitted from the data. In this present study, CPM ≥15, 000 were included in analysis if they were deemed rational (i.e. at a time of day when high intensity activity would usually be accumulated and when surrounding CPM were also high), or omitted from the data. Error codes and one minute data either side of those values were changed to zero (Alhassen et al., 2008). Hour by hour data were screened for mean CPM calculated from <10 minutes of registered time, as this produced spuriously high CPM for the hour. In such cases, the data were omitted from analysis.

3.5.3.1 Accelerometry Outcome Measures

Hourly Actigraph data were imported into SPSS from excel files produced by MAHUFFE. Sedentary time was calculated by taking the total minutes active away from the total registered time. Percentage of registered time spent in sedentary time was calculated by dividing total sedentary time by total registered time multiplied by 100. Registered sedentary time (minutes) can be affected by registered wear time, with an increase in registered time generally resulting in an increase in sedentary time (minutes). Therefore, sedentary time will also be presented as a percentage of the registered day (%RTSed), which provides a more reliable representation of sedentary behaviour.

Mean CPM were calculated by dividing total counts by total registered time. Moderate to vigorous physical activity was calculated by adding moderate and vigorous activity. Daily totals and overall mean totals were calculated for outcome variables registered time, counts, minutes spent in light, moderate to vigorous and sedentary physical activity, the percentage of registered time spent in sedentary behaviour and steps. Daily means and total means were calculated for CPM. Means were then calculated for weekend days, school days, during-school (9am to 3pm) and out-of-school (7am to 9 am and 3pm to 11 pm) for each outcome variable. Mean CPM and %RTSed were calculated on an hourly basis for weekend days and school days.

All daily outcome variables were screened using histograms to identify skewed data. All data seemed normally distributed apart from vigorous physical activity, a similar pattern as that seen by Owen et al. (2009). For the purpose of results, skewed data were not an issue, as moderate to vigorous physical activity is the desired outcome variable and not vigorous physical activity alone.

3.5.4 Multiple Pass Diet Recall

3.5.4.1 Data Entry

All dietary data collected from the PD-MPDR was entered into WISP V3.0 (Tinuviel software, Anglesey, UK) intake, recipe and menu analysis system, for examining energy and macro/micro nutrients on an individual or group level. An intake file was compiled for each participant, which involved a separate day for each day of dietary data. Dietary data for each participant was entered in chronological order day by day. Daily dietary data could be entered either for the day as a whole or for separate eating occasions (i.e. breakfast, lunch, dinner). Data were initially entered using the prior method to gain group means for daily, weekend and school day intakes and later re-categorised into eating occasions 'out-of-school' and 'during-school' for school day data only. I personally coded and entered all PD-MPDR data into WISP.

To determine the energy and nutrient composition of food and beverages, each item was individually entered into the name match search within WISP and a list of corresponding items were displayed. An item was selected if it was identical or very similar (e.g. Kellogg's coco pops breakfast cereal/coco snaps supermarket own brand) to the item description listed on the PD-MPDR sheet. WISP allows the entry of single items (e.g. potatoes) or composite dishes (e.g. chicken and potato curry). When selecting items, particularly composite dishes from within WISP, it was essential to use the item properties facility, which allowed the checking of ingredients prior to item selection to ensure an appropriate item match.

3.5.4.2 Portion Sizes

Pre-recorded item weights and measures were calculated using Nelson et al. (1997) *food portion sizes* (supplement book accompanying the food photographic atlas) and were entered along with the consumed item. However, for spreads, conserves, milk (added to cereal or hot beverages), bottled sauces and such like, a standard portion size was consistently used throughout, unless other measures were specified.

3.5.4.3 Cooking Method and Brand Names

Dietary items and composite dishes were selected from WISP by their cooking method i.e. grilled, fried, baked. If a cooking method was reported as unknown, the predetermined average within the WISP database was used.

Where a brand name was stated this was used to identify consumed items. Occasionally item brand names were reported as unknown. In these cases, either the predetermined average within the WISP database was used or an average was calculated from up to three items matching the description listed on the PD-MPDR (e.g. Birds Eye fish-fingers, economy fish-fingers and supermarket own brand fish-fingers) were entered manually, as a new item, into the WISP database.

3.5.4.4 Novel Items and Recipes

WISP also had the facility to enter new items and recipes of dishes that were not already included within the WISP database. This was particularly useful for items and dishes commonly consumed by children and those specific to Pakistani cuisine, which lacked from the original WISP package database. Nutritional composition of individual items was gained from various sources including the product packaging, an online product search or mysupermarket.com (a supermarket product and price comparison site). Recipes of Pakistani composite dishes were acquired from Judd et al. (2000) and entered, by ingredients, into the package database. Where information was vague regarding an item or composite dish description, the nearest matching item or recipe was used.

3.5.4.5 Data Screening

Once three days of dietary data had been entered into WISP for each participant, nutritional data in relation to energy and macro-nutrient intake were analysed and exported into SPSS. All exported data were screened using histograms to identify skewed data and outliers. All data were normally distributed and no extreme outliers were identified. All data were therefore included in analysis.

3.5.4.6 Selection of Nutrients for Consideration

WISP is able to produce output analysis of energy and 55+ nutrients. The interests of this study, however, aim to examine, by ethnic group, energy intake (EI), macro-nutrients and absolute intake (g). Namely:

- Energy (kJ/Kcal)
- Fat
- Saturated fat (SFA)
- Carbohydrate (CHO)
- Sugar
- Fibre

Protein and percentages of energy obtained from macro-nutrients (fat, SFA, CHO and sugar) will also be analysed by ethnic group, to allow comparison of the relative nutrient composition of diet

3.5.4.7 Methods for Calculating Energy Intake from Macro-Nutrients

Exported data consisted of energy measured in Kcal and macro-nutrients measured in absolute weight (grams). The energy contributed by each macro-nutrient was calculated by multiplying each macro-nutrient by its Kcal contribution per gram, which provides total energy (Kcal) intake from each macro-nutrient (i.e. total fat x 9 (Kcal) = Kcal intake from total fat). Energy contributions (Department of Health, 1991) were as follows:

- Fat 1 g = 9 Kcal
- SFA 1 g = 9 Kcal
- CHO 1 g = 3.75 Kcal
- Sugar 1 g = 3.75 Kcal
- Fibre 1 g = 2 Kcal
- Protein 1 g = 4 Kcal

The percentage of daily energy provided by each macro-nutrient (total fat, saturated fat, total carbohydrates and sugar), will be calculated by dividing the energy intake from each macro-nutrient by total energy intake and then multiplying this amount by 100 (i.e. Kcal from total fat divided by total energy intake (Kcal) multiplied by 100 equals the percentage of daily energy from total fat).

3.5.4.8 Daily and Patterns of Dietary Intake

The primary aim of this study is to investigate ethnic group differences in average daily energy and macro-nutrient intake. However, examining patterns of intake can highlight key areas for dietary intervention. Therefore results will be presented by ethnic group for average mean daily intake, in addition to patterns of mean intake for Sunday (representing weekend days), school days (average from two week days), during-school (9 am to 3 pm on school days) and out-of-school (everything consumed outside the hours of 9 am to 3 pm on school days).

3.5.4.9 Dietary Behaviour

PD-MPDR data is also used to investigate the dietary habits of White British and British Pakistani girls. The selection of variables is centred around investigating differences in consumption habits and dietary practices:

- Meal time dietary behaviour by food group (breakfast time only) and meal type investigating whether meals were home prepared, quick and easy or fast-food (lunch and evening meals only)
- Traditional Pakistani cooking
- High fat cooking practices
- Food and beverages associated with high energy intake and excess weight gain

3.5.4.10 Meal Time Dietary Behaviour

Named eating occasions (breakfast, lunch, dinner and supper) were self-defined during PD-MPDR. Dietary items were classified as a meal if it was consumed within a named eating occasion, which was self-defined by the respondent, as either breakfast, lunch, dinner or supper. Subjects that consumed no food items or a beverage only within an eating occasion were classified as skipping that meal. Evening meals, which included dinner and supper were grouped together and analysed as one evening meal. Meal time dietary behaviour excludes snacks and beverages since the consumption of typical snacks and sugar-sweetened beverages, which are associated with excess weight gain and cardiometabolic risk, are analysed separately (table 3.5.4.13.1) by WISP, which is able to provide reliable and valid estimates of absolute intake.

3.5.4.10.1 Classification of Meal Type

Meals were classified into types using a method adapted by Cho et al. (2003), according to the following criteria:

- All foods consumed were from that meal type category
- Food from that meal type category contributed more calories to the meal than those of any other meal type category

For example, an individual consuming ready to eat cereal (250 Kcal) and an apple (100 Kcal) would be assigned to the cereal category or an individual consuming freshly cooked spaghetti bolognaise (550 Kcal) and oven chips (200 Kcal) for lunch would be assigned to the home cooked category.

PD-MPDR data were collected from each participant for three consecutive days. Participants' data could therefore be classified in up to three separate meal type categories for each of the three named eating occasions (breakfast, lunch and evening meal). For example, participant one, for her evening meal on Sunday, consumed a 'Home Cooked' Sunday style roast; on Monday she consumed a 'Quick' meal of fish fingers and chips and on Tuesday she had 'Fast-Food' from McDonald's. Therefore, participant one was classified once in to each of the following evening meal type categories: home cooked, quick and fast-food/snack food. Participant two, for her evening meal on Sunday, consumed a home cooked Sunday roast; on Monday she consumed a quick meal of jacket potato and beans; and on Tuesday she consumed a quick meal of beans on toast. Therefore, participant two was classified into the following categories: once into Home Cooked and twice into Quick. Data were analysed to determine the proportion of girls that had consumed each meal type category over the three days of recall. Participants are only counted once within each meal type category; however, they could be included in up to three meal type categories for any one named eating occasion.

3.5.4.10.2 Breakfast

PD-MPDR data for all food and beverage items consumed at breakfast time was entered manually into SPSS within predefined food categories (table 3.5.4.10.2.1) adapted from Cho et al. (2003). An additional snack category was included.

Table 3.5.4.10.2.1 Description Breakfast Food Categories

Description of Food Items Included within Food Categories	Food categories
Did not consume food items Milk based drink/fruit juice	**Skipped**
Ready-to-eat cereals Cooked cereals/porridge/ready-brek	**Cereal**
Meat/poultry/fish/eggs/beans	**Meat & eggs**
Bread/toast/rolls Croissants/sweet pastries/ biscuits Cake/doughnuts/muffins/pancakes	**Bread & baked produce**
Chocolate/crisps Fresh/dried/tinned/vegetables/salad Yogurt/Cheese	**Snack**

3.5.4.10.3 Lunch (Sunday) and Evening Meals (Dinner and Supper)

PD-MPDR data for food consumed for lunch on Sundays and all evening meals were entered into SPSS within predefined meal type categories (table 3.5.4.10.3.1).

3.5.4.10.4 Lunch (School days)

PD-MPDR data for food consumed at lunch, on school days (table 3.5.4.10.4.1), was entered into SPSS under slightly different categories to those for lunch on Sundays. This was due to the inclusion of school prepared and packed lunch meals on school days. The school/home prepared meal type category definitions remained the same as lunch and evening mealtime categories; however, they differentiated in terms of where the meal was consumed. Packed lunches, however, commonly include a different set of food items to those that may be consumed within home cooked category and those consumed from the school canteen. Therefore, it was decided that lunch box items would be examined separately, on an individual basis. Commonly consumed lunch box items defined by Evans et al. (2009) were used as the variables for data entry (3.5.4.10.4.1). Drinks of pure or freshly squeezed fruit juice of 125 ml or more were classified as a portion of fruit (Schneider et al., 2008). In all of the schools involved in the study, carbonated soft drinks were not allowed in packed lunch boxes.

Table 3.5.4.10.3.1 Description of Lunch (Sunday Only) and Evening Meal Type Categories

Description of food items included within meal type categories	Meal type categories
Did not consume food items/beverage only classed as skipped	**Skipped**
Meat, fresh vegetable, potato, pasta, rice based dishes	**Home cooked**
Sandwiches, cold pastries, salad Jacket potatoes, eggs, beans Packaged, tinned, jarred items; such as fish-fingers/processed meat	**Quick**
Items purchased from a food outlet that had its own takeout food business, limited or no waiting staff and payment was made prior to receiving food items (Block et al., 2004) OR Crisps, chocolate, fruit and raw vegetables, yogurt, biscuits	**Fast-food/snack food**

Table 3.5.4.10.4.1 Description of Food Items Included Within Lunch (School Days Only) and the Meal Type Categories Included within Analysis

Place of meal	Description of food items included within meal type categories	Meal type category
School canteen	Did not consume food items/beverage only classed as skipped	**Skipped**
	Meat, fresh vegetable, potato, pasta, rice based dishes	**Home cooked**
	Sandwiches, cold pastries, salad Jacket potatoes, eggs, Packaged, tinned, jarred, fish-fingers/processed meats/	**Quick**
Home lunch	Meat, fresh vegetable, potato, pasta, rice based dishes	**Home cooked**
	Sandwiches, cold pastries, salad Jacket potatoes, eggs, Packaged, tinned, jarred, fish-fingers/processed meats/	**Quick**
	Purchased from a food outlet that had its own takeout food business, limited or no waiting staff and payment was made prior to receiving food items Fruit, yogurt, crisps, chocolate	**Fast-food/snack food**
Packed lunch	Sandwiches/chapatti / tortilla wraps	**Sandwich**
	Potato crisps, corn snacks, savoury biscuits	**Savoury packaged snack**
	Fresh, tinned, dried, fruit juice	**Fruit**
	Biscuits plain/chocolate coated/cake/doughnut/sweet pastries Chocolate bar/chocolate desert	**Baked produce/chocolate**
	Yogurt/packaged cheese (not included in sandwich)	**Dairy**

3.5.4.11 Traditional South Asian

Data were also coded as to whether meal types consumed could be classified as traditional South Asian/Pakistani. The definition of 'traditional' is based on pre-existing literature (Kassam-Khamis et al., 1995; Parsons and Godson et al., 1999; Anderson and Lean, 2000; Judd et al., 2000). Thus the classification of a meal as traditional South Asian/Pakistani was made if the whole meal or components of that meal consisted of the following dishes/items: chapatti, curry (meat and/or vegetables, potatoes), dahl, mixed rice (meat and/or vegetable), minced lamb keema or kofta, kebab and snack items such as pakora and samosas. All meals consumed by all participants within the named eating occasions were classified as either traditional South Asian or non-traditional. This identifies to what extent 'traditional' cooking is still practised by parents of this sample of British Pakistani girls and to what extent White British children have adopted South Asian food into their diet.

3.5.4.12 Cooking Practices – Frying Food

Meals were also coded according to preparation/cooking practices, in particular whether the whole meal or components of that meal had been either fried during preparation or as the main cooking method. These categories included 'shallow fried', in which components of the meal were fried, but not submerged in fat/oil, and 'deep fried', in which components of the meal were completely submerged in fat/oil, either during preparation or as the main cooking method.

3.5.4.13 Food and Beverage Intake

WISP is able to produce output analysis of up to 17 user defined food groups. The interests of this study aim to examine, by ethnic group consumption of food groups associated with being protective or adversely associated with excess weight gain and cardiometabolic risk, namely:

- Fruit and vegetable
- Baked produce
- Chocolate and confectionary
- Packaged snacks
- Sugar-sweetened beverages (SSB)

Food groups (table 3.5.4.13.1) were adapted from Bennett et al. (2009). Intake of food groups are presented as mean daily intake as both an absolute measure (g) and the number of portions. Absolute intake of food groups was used to calculate means for daily number of portions consumed. Child portion sizes were determined using Bennett et al. (2009) defined in table 3.5.4.13.1. The number of portions was calculated in SPSS by dividing the absolute weight by the portion size weight for that food group (table 3.5.4.13.1).

Table 3.5.4.13.1 Food Groups for Analysis, Description of Food and Beverage Items Included within Each Food Group and Weight (g) of Child Portion Size for Each Food Group

Food groups	Food group inclusion description	Portion size Weight in grams
Vegetable	Vegetables, beans & lentils weighed as served	75 g
Fruit	Weighed with peel	150 g
Fruit juice	100 % fruit juice	125 ml
Baked produce	Cake, biscuits, sweet pastry, bread, rolls	40 g
Chocolate/confectionary	Chocolate, chocolate biscuits, sweets	25 g
Savoury packaged snacks	Crisps, corn snacks, biscuits	25 g
Sugar-sweetened beverages	Carbonated soft drinks, high sugar soft drinks	125 ml

3.5.5 Previous Day - Physical Activity Recall (PD-PAR)

PD-PAR collected data regarding all activities participants participated in within the day prior to recall. This resulted in an extensive range of physical and sedentary activities. All were entered into SPSS under individual activities or broader groups for uncommon activities. For example, individual activities included gymnastics or cycling, or broader groups included outdoor games, which included less extensively played street based games, such as 'hide and seek' and 'curby'. Participants reported estimates regarding duration and intensity of each activity they participated in, which were totalled and entered for each activity for each recalled day. This original data set was extensive involving many activities, which also included shopping, household chores, walking activities and indoor play activities.

3.5.5.1 Selection of Physical Activities and Sedentary Activities for Consideration

Children's participation in sport and exercise, outdoor play and active modes of travel are positively associated with physical activity in children and these were the main focus of physical activity behaviour in this sample of girls. Self-reported screen time was used as a measure of sedentary time.

PD-PAR frequency and activity duration data were entered into SPSS under individual activities (table 3.5.5.1.1 column B). Data were then grouped according to activity type (table 3.5.5.1.1 column A) before being categorised under three broad activity groups; 'sport and exercise'; 'outdoor play' and 'screen-time' (table 3.5.5.1.1), the criteria for inclusion of activities within these categories were adapted from Page et al. (2010).

Data regarding active modes of school transport, break-time activity, P.E. and after-school based sports were also key areas of interest and entered into SPSS, in addition to other activities that did not fit within the predefined categories. For example shopping and visiting relatives.

3.5.5.2 Active Mode of School Transport

Children were classified as participating in active modes of school transport if they had travelled to or from school by walking, cycling or scooter. Data were entered separately for each type and occasion of travel, per day of PAR.

3.5.5.3 School Break-time

School break-time data were entered separately for each individual activity, within each break-time and for each day, and grouped into activity group (3.5.5.1.2). In addition to sport and exercise and outdoor play, break-time activities included two further categories for walking and chatting and sitting and chatting, which were common activities reported by this study sample. Other break-time activities included indoor activities, such as practising an instrument or doing jobs for teachers. These were categorised into to an 'other' category, but excluded from the main analysis since my interests were in sport and exercise, outdoor play and walking activities within the playground.

3.5.5.4 School-Based Sport and Exercise and Secondary Variables

Frequency and duration of P.E., after-school based sport and exercise activity and evening attendance at mosque school on week days were also extracted from PAR data due to potential influences these activities may have on children's overall physical activity and sedentary time. The final selection of physical activities and sedentary activities for analysis are displayed in table 3.5.5.1.2.

3.5.6 Physical Activity Questionnaire

Participant data from each of the 10 questions were entered separately for each question into SPSS. However, only data from questions three, four and seven were presented within this thesis. Of these question responses were recoded for further analysis (table 3.5.6.1). One indicated low activity and five indicates high activity.

Table 3.5.5.1.1 Physical Activity Categories and Content

Sport and exercise		Out-door play		Screen time	
A	**B**	**A**	**B**	**A**	**B**
Structured activity classes	Gymnastics Dance Martial arts	**Non-team sports**	Cycling Scooter Skipping Trampolining	**Screen based activities**	TV Games console PC Lap top
Sports	Football Netball/basket ball Cricket Tennis Rounders Swimming	**Play activities**	Chasing games Non-team ball games Other outdoor games Park equipment		

Table 3.5.5.1.2 Key Physical Activity and Sedentary time Categories Derived from PAR.

Main variables	Sport and exercise Outdoor play Screen time
Secondary variables	Mode of school transport Break-time activities sport and exercise outdoor play walking/chatting sitting chatting After-school based sport/exercise Scheduled P.E Attendance at evening mosque school Visiting relatives

Table 3.5.6.1 PAQ-C Questions used for Analysis, their Multiple Choice Answers and Recoded Categories for Analysis

Question number/topic	Original classification	Recoded classification
3 and 4. Break/lunch time activity	1. Sat down talking/reading 2. Stood around/walked around	**Inactive**
	3. Ran/Played a little bit 4. Ran/Played quite a bit 5. Ran/Played most of time	**Active**
7. Weekend activity	1. None	**None**
	2. 1 time 3. 2 – 3 times 4. 4 – 5 times 5. 6 or more times	**Some**

3.5.7 Parent Interview

Interviews were transcribed directly into a Microsoft Word document. A brief overview of interviewees, time, location, ethnic background and family composition were used as an introduction to each transcription. I conducted and transcribed all interviews, which allowed for a better understanding of the data and its context.

Interview data relating to all physical activity outlined in table 3.5.5.1.2 and diet behaviour outlined in table 3.5.3.9.1 and section 3.5.4 were identified and coded. The coding system meant that all statements relating to each topic could be extracted and categorised. Data could be included in more than one category depending on the issues discussed during the statement. The primary use of the interview data is to contextualise the quantitative findings and provide some understanding of familial influences on children's physical activity and dietary habits.

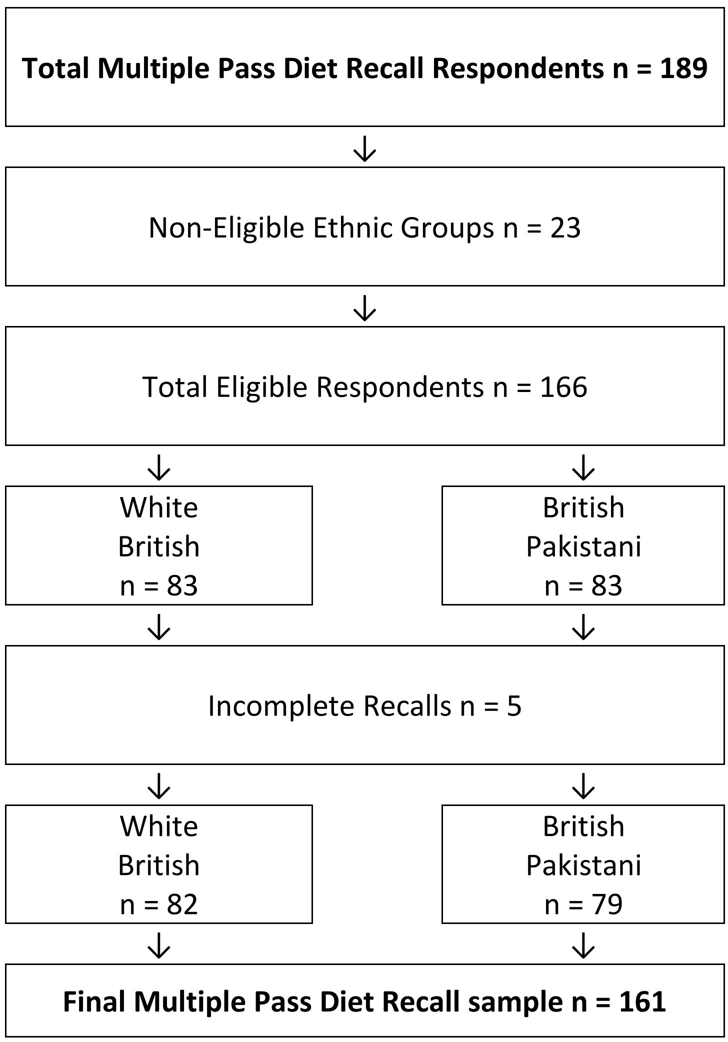
3.6 Sample Statistics

The breakdown of the study inclusion/exclusion for participants included in the dietary and physical activity sub-samples are displayed in figure 3.6.1.1 and 3.6.2.1, respectively. One hundred and eighty-nine participants were recruited for this study. Of these, 23 were classified as non-White British or non-British Pakistani and were excluded from analysis. This left a total of 166 eligible participants.

3.6.1 PD-MPDR Sub-Sample for Analysis

An additional five of the 166 eligible participants provided incomplete PD-MPDR due to being absent from school during the final week of data collection within that particular setting, resulting in a total of 161 participants being included within the final dietary analysis.

Figure 3.6.1.1 Dietary Sub-Sample

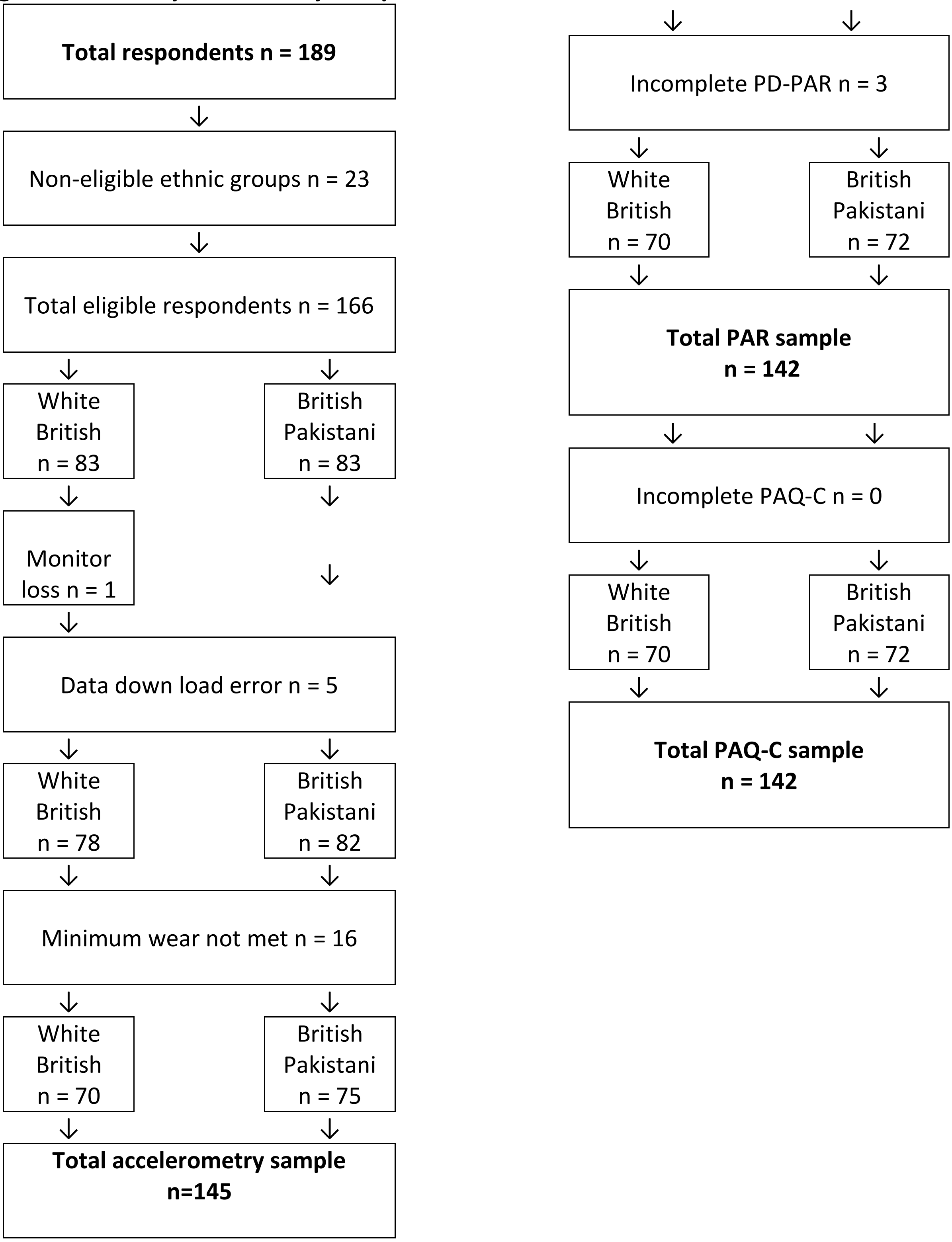


3.6.2 Physical Activity Sub-Sample for Analysis

Of the total eligible 166, one participant lost her monitor, which meant no data could be retrieved from this individual. The data from five monitors became corrupt during data download and was irretrievable. An additional 16 participants failed to meet the minimum wear criterion of three days of ≥500 minutes, including at least one weekend and one school day. This resulted in a total accelerometry sub-sample of 145 (figure 3.6.2.1).

Only participants included in the accelerometry sample were eligible for PAR analysis. Of the 145 participants that provided accelerometry data for analysis, three participants failed to complete PAR, due to being absent from school during the final week of data collection within that particular setting, resulting in a final PAR sample of 142 (figure 3.6.2.1). Each participant from the final PAR sample provided PAQ-C data.

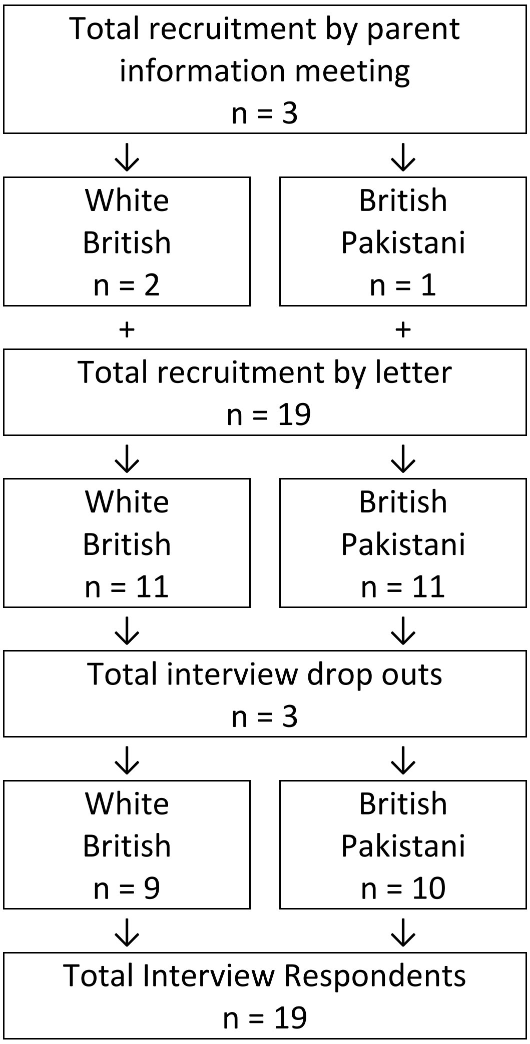
Figure 3.6.2.1 Physical Activity Sample



3.6.3 Parent Interview Sample for Analysis

In total, 22 participants were recruited for parental interviews. One White British mother and one British Pakistani father phoned to cancel the arranged interview and showed no interest in arranging a further interview. One British Pakistani father was not home when I called to conduct the interview. The remaining interview sample was 19. Of the White British sample, six mothers, one father and two mother and father couples were interviewed; of the British Pakistani sample, eight mothers, zero fathers and two mother and father couples were interviewed. However, of the British Pakistani couples that were interviewed, the fathers (who both were born in the UK) spoke most, as the mothers were both migrants to the UK, with English as their second language.

Figure 3.6.3.1 Parent Interview Sample



3.7 Statistical Analysis

3.7.1 Sample Statistics

Chi-square tests were used to test for significant ethnic group differences in recruitment numbers by season, school and year group.

3.7.2 Background Information

Chi-square tests were used in the child and parent samples to test for significant associations between ethnic group and areas including, parental marital status, language and household composition.

3.7.3 Weekend and School Day; Out-of-School and During-School Variation

Patterns (weekend, school day, during-school and out-of-school) of objectively measured physical activity and energy and macro-nutrient intake were examined using the paired sample t-tests to determine between and within day variability.

3.7.4 Controlling for Environmental and Socio-Demographic Determinants of Objectively Measured Physical Activity and Energy and Macro-Nutrient Intake

The main statistical analyses were conducted using analysis of variance (ANOVA), controlling where possible, for key factors thought to influence physical activity and diet. These were season, school and year group.

Season was defined by British day light saving; late March to late October was classified as summer, late October to late March was classified as winter. This seasonal definition has been used previously (Cooper et al., 2010) when assessing physical activity levels in British children. School may act as a determinant due to differences in policies influential on physical activity and dietary behaviour (Ferreira et al., 2006; Griew et al., 2010). Socio-economic status was measured using the participants' mother's age when she left full time education. This is a variable previously found to influence children's physical activity (Ferreria et al., 2006). In addition, mothers' education was the best available measure of socioeconomic status due to incomplete questionnaire data. Analysis of variance are to be conducted initially to determine the influence each of these factors (season, school; year group and mothers education) have on physical activity in this sample of girls and as a means to determining variables to control for within the final ANOVA model when testing for ethnic group differences in the girls diet and physical activity.

3.7.5 Multilevel Modelling

Multi-level modelling is increasingly being used in the analysis of data collected from children from a number of different schools (e.g. Griew et al., 2010, Ridgers et al., 2011) as it allows for a more correct modelling of data with a two-level hierarchical structure, in this case of girls nested within schools. However, if the number of second-level groups (schools) is small, group effects can be captured using fixed effects modelling, as in classic Analysis of Variance (mlwin manual). Multilevel modelling also allows the addition of further school-level variables to models to explain differences between schools. However, in this case my interest was not in explaining differences between schools, but rather in controlling for differences between schools. For these reasons I chose to conduct my analyses using standard Analysis of Variance, including school as a control variable where necessary.

3.7.6 Ethnic Group Comparisons of Objectively Measured Physical Activity and MPDR Energy and Macro-Nutrient Intake

The data were examined using analysis of variance (ANOVA), controlling for other variables as necessary. Adjusted group means, standard deviations and 95% confidence intervals were produced by ANOVA.

It is important to note that power calculations for data collection were based upon physical activity as the primary outcome since this was the primary interest of the study. Therefore, the power of analyses with respect to diet may be limited. The ability to be able to reject the null hypothesis may be lost as a consequence of the small sample size. It is worth noting that for energy intake, post hoc calculations using G Power show that my study was powered at 0.19 to identify a difference of the scale reported by Donin et al. (2010) between British Pakistani and White children (i.e. a difference of 559KJ). For percentage fat intake, for which a difference between the two groups was hypothesised, calculations show that my study was powered at 0.33 to identify a difference of the scale reported by Donin et al. (2010) between British Pakistani and White children (i.e. a difference of 1.0). It is clear that larger studies are needed to investigate differences in total energy intake and dietary composition between these groups of children because effect sizes may be small.

3.7.7 Ethnic Group Comparison of Objectively Measured Physical Activity during School Break-time

Ethnic group differences in school break-time activities will be tested for using ANOVA. However, school staff keeping children inside during rain can influence break-time physical activity. Therefore, for days that girls wore the accelerometers, weather information regarding rainfall and maximum daily temperature, which can also affect children's physical activity during school break-time (Ridgers et al., 2010), will be obtained from a weather station that is situated between two and five miles from each school. These variables will be controlled for in all analyses.

3.7.8 Ethnic Group Comparisons of Meal Time Dietary Behaviour

Food consumption by ethnic group will be examined using logistic regression, controlling for season, school and year group. Chi-square test will be conducted to test for significant associations in the proportion of White British and British Pakistani girls consuming school, packed or home lunch.

Chi-square tests will be used to test for significant associations between the proportion of White British and British Pakistani girls consuming traditional South Asian meals/food items and in the proportion of girls consuming dishes/food items that had been either fried during preparation or as the main cooking method.

3.7.9 Ethnic Group Comparison of the Consumption of Food and Beverages Related to Excess Weight Gain

Data will be examined using ANOVA to test for significant differences between white British and British Pakistani girls' absolute mean intake (g) of each of these food groups. The mean intake is determined from three days of PD-MPDR data.

3.7.10 Previous Day Physical Activity Recall (PD-PAR) and Physical Activity Questionnaire (PAQ-C)

Logistic regression, controlling for season, school and year group, will be used to test for associations in the proportion of White British and British Pakistani girls participating in sport/exercise, outdoor play, screen time, active modes of school transport and after-school based sport and exercise activities. Analysis of variance will be used to test for ethnic group differences in the mean duration White British and British Pakistani girls spent participating in sport/exercise, outdoor play, screen time and active modes of school transport and break-time activities.

3.7.11 Qualitative Data Analysis – Interviews

Qualitative interview data relating to physical activity, sedentary time (table 3.5.5.1.2), food groups (table 3.5.3.9.1), and dietary habits (section 3.5.4) will be used as a narrative to the associated quantitative data. Only data relating to the associated quantitative data will be extracted and used in this way.

Chapter Four: Characterising Physical Activity of White British and British Pakistani Girls

4.1 Background

British South Asian girls in general display lower levels of objectively measured physical activity and spend more time sedentary compared with their White European counterparts (Owen et al., 2009). There is also evidence to suggest that self-reported physical activity is lower in British Pakistani girls compared to British Indian and to some extent British Bangladeshi girls (Sproston and Mindell, 2006). There is, however, no data comparing levels of objectively measured physical activity and sedentary time in White British and British Pakistani girls, and there is no information comparing activity levels at different times of the week.

4.2 Aims

This chapter reports on the results and discusses the findings in relation to objectively measured physical activity and sedentary time, using the Actigraph GTX3, in a school-based study of White British and British Pakistani girls, aged 9 to 11 years, living on Teesside, North-East England. Overall mean levels of activity are compared, and patterning of activity over weekends and the school day is also compared.

4.3 Hypotheses

This chapter sets out to test the first three hypotheses outlined in section 1.14. These are:

- British Pakistani girls will have significantly lower measures of objectively measured total physical activity, compared with White British girls
- British Pakistani girls will spend significantly less time in objectively measured moderate to vigorous physical activity, compared with White British girls
- British Pakistani girls will spend significantly more time in objectively measured sedentary time, compared with White British girls

4.4 Results

4.4.1 Description of the Study Sample

A total of 164 girls, n=82 White British; n=82 British Pakistani, aged 9 to 11 years, participated in wearing the Actigraph GTX3 activity monitor. Twelve per cent of the total study sample failed to meet the minimum wear criteria and were excluded from analysis. One hundred and forty-five girls (n=70 White British, n=75 British Pakistani) of the total study sample met the required minimum wear criteria (500 min/three days/including one weekend day). Ninety-one per cent of the study sample had data for both Saturday and Sunday. The mean age of the total study sample was 10.0 years ± 0.7 years (White British = 9.9 years ± 0.7 years; British Pakistani = 10.0 years ± 0.7 years). Descriptive statistics for the study sample are summarised in tables 4.4.1.1 and 4.4.1.2. The school break-time sample differed slightly to the main study sample, due to a difference in inclusion criteria. Girls who recorded two days of break-time data were included in analysis, n= 153 (74 White British and 79 British Pakistani).

Recruitment numbers by ethnicity varied significantly between school (chi-square p=<.001), but not by year group (p=0.5) (table 4.4.1.1) or season (p=0.06) (table 4.4.1.2). Associations between season, school and year group and activity outcomes are examined in Section 4.4.3.

Background information taken from the parental questionnaire are summarised in tables 4.4.1.3, 4.4.1.4 and 4.4.1.5. Almost three quarters of British Pakistani girls had English reported as their first language. More White British parents reported being single or separated from the child's biological father compared to British Pakistani parents. Also, more White British households supported a single child, compared to a greater number of British Pakistani households supporting four children or more.

More than half of British Pakistani respondent mothers reported that they were first generation migrants to the UK, although the majority (96%) of the migrant sample reported having lived in Britain for 10 years or more, suggesting that the vast majority of girls in the study were born in the UK. Almost two-thirds of Pakistani mothers reported Punjabi/Urdu as their first language.

In terms of working status, over half of White British respondent mothers reported being in paid employment or a full time student, as opposed to 70% of British Pakistani respondent mothers who reported looking after the home as their main occupation.

Many mothers failed to state information regarding the child's father. This may have been due to a number of factors, including mother and father being separated, the mother not knowing certain information about their partner (child's father) or unwillingness to share the requested information. This resulted in data for the father being considerably reduced in comparison to that reported for the child and mother.

Of the information received, over half of British Pakistani fathers were reported as born in Britain. The majority of first generation migrant fathers were reported to have lived in the UK for 10 years or more. Over 50% of Pakistani fathers had Punjabi/Urdu reported as their first language. Finally a higher percentage of Pakistani compared to White British fathers reported having some form of further education.

Table 4.4.1.1 Description of the Study Sample Composition Comparing White British and British Pakistani Girls by School and Year Group

		White British n=70 n (%)	British Pakistani n=75 n (%)	All Girls n=145 n (%)
School 1	**Year 5**	6 (9)	8 (11)	14 (10)
	Year 6	0	5 (7)	5 (3)
	School total	6 (9)	13 (18)	19 (13)
School 2	**Year 5**	3 (4)	16 (21)	19 (13)
	Year 6	0	6 (8)	6 (4)
	School total	3 (4)	22 (29)	25 (17)
School 3	**Year 5**	16 (23)	13 (17)	26 (18)
	Year 6	0	0	0
	School total	16 (23)	13 (17)	26 (18)
School 4	**Year 5**	6 (9)	4 (5)	10 (7)
	Year 6	0	0	0
	School total	6 (9)	4 (5)	10 (7)
School 5	**Year 5**	7 (10)	12 (16)	19 (13)
	Year 6	7 (10)	10 (13)	17 (12)
	School total	14 (20)	22 (29)	36 (25)
School 6	**Year 5**	7 (10)	0	7 (5)
	Year 6	4 (6)	1 (1)	5 (3)
	School total	11 (16)	1 (1)	12 (8)
School 7	**Year 5**	6 (9)	0	6 (4)
	Year 6	8 (11)	0	8 (6)
	School total	14 (20)	0	14 (10)
Total	**Year 5**	51 (73)	53 (71)	104 (72)
	Year 6	19 (27)	22 (29)	41 (28)

Table 4.4.1.2 Description of the Study Sample Composition Comparing White British and British Pakistani Girls by Season

	White British n=70 n (%)	British Pakistani n=75 n (%)	All Girls n=145 n (%)
Summer	32 (46)	46 (61)	78 (54)
Winter	38 (54)	29 (39)	67 (46)

Table 4.4.1.3 Summary of Background Information Comparing White British and British Pakistani Children

		White British	British Pakistani
		n (%)	**n (%)**
*****First language n=144**	**English**	70 (100)	54 (73)
	Punjabi/Urdu	n/a	20 (27)
***Parental marital status n=145**	**Married/cohabiting**	37 (53)	53 (71)
	Single/separated	33 (47)	22 (29)
*****Children (U18) in household n=141**	**1**	16 (23)	3 (4)
	2 or 3	45 (64)	38 (51)
	≥4	9 (13)	34 (45)

***Significant at ≤0.001 by Chi-Square test
*Significant at ≤0.05 by Chi-Square test

Table 4.4.1.4 Summary of Background Information Comparing White British and British Pakistani Mothers

		White British	British Pakistani
		n (%)	**n (%)**
*****Country of birth n=139**	**UK**	70 (100)	32 (46)
	Pakistan	n/a	37 (54)
*****Years UK resident n=133**	**From birth**	70 (100)	33 (53)
	≥16 Years	n/a	17 (27)
	11-15 Years	n/a	9 (14)
	6-10 Years	n/a	2 (3)
	≤5 Years	n/a	2 (3)
*****First language n=141**	**English**	70 (100)	27 (38)
	Urdu/Punjabi	n/a	44 (62)
***Age left FT education n=124**	**≤16**	49 (75)	33 (56)
	≥17	16 (25)	26 (44)
*****Employment status n=139**	**Full/part time employed/student**	37 (54)	11 (16)
	Unemployed/sick	15 (22)	10 (14)
	Housewife/look after home	16 (24)	50 (70)

***Significant at ≤0.001 by Chi-Square test
*Significant at ≤0.05 by Chi-Square test

Table 4.4.1.5 Summary of Background Information Comparing White British and British Pakistani Fathers

		White British	British Pakistani
		n (%)	**n (%)**
*****Country of birth n=132**	**UK**	69 (100)	27 (43)
	Pakistan	n/a	36 (57)
*****Years UK resident n=119**	**From birth**	66 (100)	26 (49)
	≥16 Years	n/a	17 (32)
	11-15 Years	n/a	5 (9)
	6-10 Years	n/a	5 (9)
	≤5 Years	n/a	n/a
*****First language n=134**	**English**	70 (100)	25 (39)
	Urdu/Punjabi	0	39 (61)
*****Age left full time education n=90**	**≤16**	37 (86)	18 (38)
	≥17	6 (14)	29 (62)
Employment status n=103	**Full/part time Employed/student**	37 (84)	47 (80)
	Unemployed/sick	7 (16)	10 (17)
	Housewife/look after home	0	2 (3)

***Significant at ≤0.001 by Chi-Square test
*Significant at ≤0.05 by Chi-Square test

4.4.2 Physical Activity Level of All Girls

Results reporting on overall mean daily physical activity for the total study sample n=145 are summarised in table 4.4.2.1. Results reporting on weekend (table 4.4.2.2) and school day (table 4.4.2.3), during-school (table 4.4.2.4) and out-of-school (table 4.4.2.5) patterns of physical activity are also summarised.

Table 4.4.2.1 Overall Mean, Median, Standard Deviation Daily Physical Activity for the Total Study Sample

	All girls n=145		
Outcome	**Mean**	**Median**	**SD**
Registered time (min. day)	778	778	70
Counts (day)	363038	345623	123261
CPM (day)	468	446	152
Sedentary (min. day)	533	527	67
Sedentary (%.day)	69	69	6
Light (min. day)	186	181	45
MVPA	59	56	21
***Steps (day)**	8911	8665	2672

*for steps, *n* reduces to 131

Table 4.4.2.2 Mean, Median, Standard Deviation Weekend Physical Activity for the Total Study Sample

	All girls n=145		
Outcome	**Mean**	**Median**	**SD**
Registered time (min. day)	746	743	89
Counts (day)	369311	350441	177977
CPM (day)	495	459	224
Sedentary (min. day)	503	496	88
Sedentary (%.day)	68	67	8
Light (min. day)	184	184	52
MVPA (min. day)	58	54	28
***Steps (day)**	8433	7873	3721

*for steps, *n* reduces to 131

Table 4.4.2.3 Mean, Median, Standard Deviation School Day Physical Activity for the Total Study Sample

	All girls n=145		
Outcome	**Mean**	**Median**	**SD**
Registered time (min. day)	807	809	77
Counts (day)	357178	349943	105268
CPM (day)	444	431	127
Sedentary (min. day)	559	565	70
Sedentary (%.day)	69	70	6
Light (min. day)	188	177	47
MVPA	59	58	19
***Steps (day)**	9363	9091	2413

*for steps, *n* reduces to 131

Table 4.4.2.4 Mean, Median, Standard Deviation During-School (09:00 – 15:00) Physical Activity for the Total Study Sample

	All girls n=145		
Outcome	**Mean**	**Median**	**SD**
Registered time (min. day)	353	360	20
Counts (day)	133159	125238	46965
CPM (day)	377	356	131
Sedentary (min. day)	257	262	30
Sedentary (%.day)	73	73	8
Light (min. day)	74	72	21
MVPA (min. Day)	22	20	9
***Steps (day)**	3752	3672	1129

*for steps, *n* reduces to 131

Table 4.4.2.5 Mean, Median, Standard Deviation Out-Of-School (07:00 – 09:00 & 15:00 – 23:00) Physical Activity for the Total Study Sample

	All girls n=145		
Outcome	**Mean**	**Median**	**SD**
Registered time (min. day)	451	457	77
Counts (day)	221976	209453	83735
CPM (day)	493	464	176
Sedentary (min. day)	300	303	62
Sedentary (%.day)	66	67	7
Light (min. day)	113	108	35
MVPA	37	35	15
***Steps (day)**	5550	5209	1998

*for steps, *n* reduces to 131

Weekend and school day differences in physical activity outcome measures were examined using paired sample t-tests. Girls recorded significantly more registered time (p=<0.001); spent a greater number of minutes of registered time in sedentary behaviour (MRTSed) (p=<0.001); spent a greater percentage of registered time in sedentary behaviour (%RTSed) (p=0.001); and accumulated significantly more steps (p=0.001) on school days. CPM was significantly greater (p=0.002) on weekend days. Total activity counts and time spent in light and moderate to vigorous physical activity did not differ significantly by weekend and school day.

During-school registered wear time falls slightly short of the maximum (360 minutes), this could be due to children temporarily removing monitors whilst at school (e.g. for swimming lessons) or sitting still for long periods of time, which resulted in data being counted as non-wear time. Comparisons of during-school and out-of-school physical activity identified significant differences in all outcome measures. Girls accumulated significantly more registered time (p=<0.001), counts (p=<0.001), CPM (p=<0.001), light (p=<0.001), moderate to vigorous physical activity (p=<0.001), steps (p=<0.001) and MRTSed (p=0.001) out-of-school. Only %RTSed was significantly higher during-school (p=<0.001).

In conclusion, whilst this study has identified daily levels of physical activity in this sample of girls, it has also identified significant differences between weekend and school day and during-school and out-of-school measures of physical activity, contributing to our current understanding of patterns of physical activity in young girls.

4.4.3 Environmental and Socio-Demographic Factors Association with Physical Activity

ANOVA models were run with season, school and year group as independent variables, to examine whether any of these variables were associated with physical activity in this sample of girls.

4.4.3.1 Season

Table 4.4.3.1.1 Significance Values for Season as a Predictor of Physical Activity Determined by ANOVA Controlling for School and Year Group

	Overall Mean	Weekend	School day	During-school	Out-of-School
Registered time (min. day)	**0.039**	0.088	**0.041**	0.877	**0.038**
Counts (day)	0.354	0.346	0.631	0.068	0.143
CPM (day)	0.776	0.688	0.749	0.068	0.591
Sedentary (min. day)	0.653	0.871	0.309	0.404	0.477
Sedentary (%.day)	0.197	0.178	0.562	0.317	0.135
Light (min. day)	**0.002**	**0.004**	**0.017**	0.473	**<0.001**
MVPA (min. day)	0.983	0.883	0.784	0.165	0.768
Steps (day)	0.988	0.398	0.218	**<0.001**	0.277

Seasonal differences were more prominent in registered time and light activity, both of which were higher in summer and lower in winter (data not shown). A significant seasonal difference was identified for steps during-school, which became significantly higher in winter months (data not shown).

Overall seasonal effects on the girl's physical activity outcomes were minimal, suggesting that season was not a strong influence on counts, CPM, moderate to vigorous physical activity or sedentary time. However, as season was, on occasion, significantly associated with registered time, light activity and steps it was included in models making ethnic group comparisons of physical activity in this sample of girls.

4.4.3.2 School

School can act as a determinant of physical activity dependent on policies regarding duration and frequency of school break-times, whether sports/play equipment is provided during this time, the frequency and type of PE sessions, as well as the available sports facilities (Ridgers et al., 2010). It is also possible for school to act as a determinant of physical activity out-of-school', due to the proportion of children within each school using active modes of school transport and opportunities for before or after-school sports activities (King et al., 2011). School may also have a more indirect effect on physical activity in terms of acting as a proxy for socioeconomic status, depending on school location and catchment area.

Table 4.4.3.2.1 Significance Values for School as a Predictor of Physical Activity Determined by ANOVA Controlling for Season and Year Group

	Overall Mean	Weekend	School day	During-school	Out-of-school
Registered time (min. day)	0.102	0.74	0.007	**0.002**	**0.002**
Counts (day)	0.299	**0.06**	0.265	**<0.001**	0.957
CPM (day)	0.096	**0.035**	0.088	**<0.001**	0.128
Sedentary (min. day)	0.076	0.747	**0.001**	**<0.001**	**0.031**
Sedentary (%.day)	**0.001**	0.173	**<0.001**	**<0.001**	**0.002**
Light (min. day)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
MVPA (min. day)	0.077	**0.028**	**0.059**	**<0.001**	0.65
Steps (day)	0.391	0.134	0.065	**<0.001**	0.848

School was strongly associated with registered time, total physical activity (counts, CPM and steps), MVPA, light and sedentary time during-school. School was also associated with physical activity within other measured time frames, particularly influencing MVPA, light and sedentary time. Evidence suggests that objective measurements of physical activity varied significantly by school, both during-school hours and within other measured time frames. This suggests that physical activity in this sample of girls was not only influenced by the school they attended, but also suggests that school may be acting as proxy for a presently unmeasured variable, such as socioeconomic status. Thus school was included in models when making ethnic group comparisons of physical activity.

4.4.3.3 Year Group

Literature indicating age as a determinant of physical activity in children is indeterminate (Sallis and Prochaska et al., 2000); therefore assessing the association between age and physical activity in this sample of girls is important.

Table 4.4.3.3.1 Significance Values for Year Group as a Predictor of Physical Activity as Determined by ANOVA Controlling for Season and School

	Overall Mean	Weekend	School day	During-school	Out-of-school
Registered time (min. day)	0.754	0.474	0.614	0.252	0.6
Counts (day)	0.529	0.984	0.149	**<0.001**	0.795
CPM (day)	0.489	0.843	0.212	**<0.001**	0.408
Sedentary (min. day)	0.179	0.216	0.406	**<0.001**	0.558
Sedentary (%.day)	0.11	0.322	**0.059**	**<0.001**	0.492
Light (min. day)	0.18	0.46	0.095	**0.003**	0.973
MVPA (min. day)	0.295	0.628	0.106	**<0.001**	0.977
Steps (day)	0.511	0.922	0.165	**<0.001**	0.365

Year group was not associated with overall mean daily, weekend, school day or out-of-school physical activity, yet was strongly associated with total physical activity (counts, CPM and steps), MVPA, light and sedentary time during-school. This suggests that physical activity accumulated during-school differed greatly between year groups. Differences between physical activity and year group were marked, with year six girls accumulating less total activity, less time in physical activity levels and spent more time in sedentary time in comparison to year five girls (data not shown). These findings suggest that year group is a determinant of physical activity in this sample of girls, which will need to be controlled for when making ethnic group comparisons of physical activity.

4.4.3.4 Socioeconomic Status

Socio-economic status, determined by the child's mother's age when she left full time education (see table 4.1.3b), which apart from school was the best available measure for socioeconomic status), was added to a final model with a reduced sample size (n=124) because this variable was not available for all girls. This variable proved non-significant and was not used in further models.

4.4.3.5 Conclusion

Season, school and year group were associated with some measures of physical activity in this sample of girls. Each of these variables was therefore controlled for within ANOVA models examining ethnic group differences in girls' physical activity levels.

4.4.4 Ethnic Group Comparison of Overall Mean Objectively Measured Physical Activity

Ethnic group comparisons of objectively measured physical activity found significant differences in total physical activity, levels of physical activity and sedentary time between White British and British Pakistani girls (table 4.4.4.1). No significant ethnic group difference was found in registered time, however, on average White British girls recorded significantly more counts, CPM and steps, spent significantly more time in light and moderate to vigorous physical activity and spent significantly less MRTSed and %RTSed compared to British Pakistani girls.

4.4.5 Ethnic Group Comparison of Weekend and School Day Patterns of Objectively Measured Physical Activity

Ethnic group comparisons of objectively measured physical activity on weekend days also found significant differences in total physical activity, levels of physical activity and sedentary time between White British and British Pakistani girls (table 4.4.5.1). Again no significant ethnic group differences were identified in registered time, however, on average White British girls recorded significantly more total counts, CPM and steps, spent significantly more time in light and moderate to vigorous physical activity and spent significantly less MRTSed and %RTSed compared to British Pakistani girls.

Ethnic group comparisons of objectively measured physical activity on school days again found significant ethnic group differences in total physical activity, levels of physical activity and sedentary time between White British and British Pakistani girls (table 4.4.5.2). An ethnic group difference was identified in registered time, with White British girls accumulating significantly less registered time on school days, compared to British Pakistani girls. However, White British girls recorded significantly more total counts, CPM and steps, spent significantly more time in moderate to vigorous physical activity and spent significantly less MRTSed and %RTSed compared with British Pakistani girls. Levels of light activity were, on average, similar by ethnic group on school days, thus no significant difference was found.

Comparisons of weekend and school day total physical activity identified that White British girls accumulated significantly less registered time ($p=<0.001$), fewer total counts ($p=0.028$), CPM (p=0.001), %RTSed (p=<0.001) and MRTSed (p=<0.001) on weekend days compared to school days. Similar amounts of steps (p=0.376), light (p=0.134) and moderate to vigorous physical activity (p=0.112) were accumulated on weekend and school days by White British girls.

Pakistani girls accumulated similar amounts of total counts (p=0.167), CPM (p=0.466) and %RTSed (p=0.483) on weekend and school days. However, British Pakistani girls accumulated significantly fewer steps (p=0.001), spent less time in light (p=0.011), moderate to vigorous physical activity (p=0.002) and MRTSed (p=<0.001) on weekend days compared to school days.

4.4.6 Ethnic Group Comparison of Hourly Patterns of Total Physical Activity and Sedentary time for Weekend and School Days

Hourly patterns of total physical activity (CPM) and sedentary time are displayed by ethnic group for weekend (figures 4.4.6.1a and 4.4.6.1b) and school days (4.4.6.2a and 4.4.6.2b). Ethnic group differences in hourly patterns of total physical activity and sedentary time patterns are clearly marked on weekend days. On school days, hourly patterns of total physical activity and sedentary time for White British and British Pakistani girls display similar peaks and troughs throughout the school day, representing periods of low physical activity during lessons and high physical activity during school break-time. On school day evenings, ethnic group differences in total physical activity become more apparent after 16:00 hours, where the gaps in CPM become distinctly wider. A sharp peak in total physical activity is evident in White British girls between 18:00 to 19:00 hours and although there is a slight increase in total physical activity in British Pakistani girls it is not as marked as that of White British girls.

Table 4.4.5.1 Ethnic Group Comparisons, Mean, 95 % Confidence Intervals and Median, of Objectively Measured Overall Mean Physical Activity in 9 to 11 Year Old Girls Living on Teesside[1]

	White British n=70				British Pakistani n=75				
Outcome	Mean	Lower 95% CI	Upper 95% CI	Median	Mean	Lower 95% CI	Upper 95% CI	Median	Sig. Val
Registered time (min. day)	770	752	788	773	780	760	799	785	0.459
Counts (day)	406977	376506	437448	384024	299803	267414	332192	304957	<0.001
CPM (day)	532	495	569	515	384	345	423	400	<0.001
Sedentary (min. day)	512	495	529	515	558	539	576	539	<0.001
Sedentary (%.day)	67	65	68	68	72	70	73	70	<0.001
Light (min. day)	191	182	200	182	174	164	184	179	0.012
MVPA (min. day)	67	61	72	64	48	42	53	49	<0.001
***Steps (day)**	9939	9181	10696	9421	7150	6366	7933	7745	<0.001

*for steps, *n* reduces to 66 in White British and 65 in British Pakistani and 131 overall

[1] Adjusted means and significance values determined by analysis of variance, controlling for season, school and year group

Table 4.4.5.2 Ethnic Group Comparisons, Mean, 95 % Confidence Intervals and Median, of Objectively Measured Weekend Physical Activity In 9 to 11 Year Old Girls Living on Teesside[2]

	White British n=70				British Pakistani n=75				
Outcome	Mean	Lower 95% CI	Upper 95% CI	Median	Mean	Lower 95% CI	Upper 95% CI	Median	Sig. Val
Registered time (min. day)	749	725	774	742	743	717	769	745	0.716
Counts (day)	427580	383656	471503	404052	279737	233048	326425	291700	<0.001
CPM (day)	576	521	631	528	377	318	435	404	<0.001
Sedentary (min. day)	485	462	509	484	535	510	561	519	0.004
Sedentary (%.day)	65	63	67	66	72	70	74	69	<0.001
Light (min. day)	195	184	207	182	164	152	177	186	<0.001
MVPA (min. day)	68	61	75	65	43	36	50	43	<0.001
***Steps (day)**	9802	8724	10879	8639	7487	5069	7186	6857	<0.001

*for steps, *n* reduces to 66 in White British and 65 in British Pakistani and 131 overall

[2] Adjusted means and significance values determined by analysis of variance, controlling for season, school and year group

Table 4.4.5.3 Ethnic Group Comparisons, Mean, 95 % Confidence Intervals and Median, of Objectively Measured School Day Physical Activity in 9 to 11 Year Old Girls Living on Teesside[3]

	White British n=70				**British Pakistani n=75**				
Outcome	Mean	Lower 95% CI	Upper 95% CI	Median	Mean	Lower 95% CI	Upper 95% CI	Median	Sig. Val
Registered time (min. day)	785	766	805	793	814	793	835	833	0.042
Counts (day)	386231	359303	413160	380674	320402	291779	349026	309388	0.001
CPM (day)	493	461	525	469	393	359	427	390	<0.001
Sedentary (min. day)	533	516	551	541	577	559	595	586	0.001
Sedentary (%.day)	68	67	69	68	71	70	72	71	0.002
Light (min. day)	187	177	197	174	184	173	194	180	0.642
MVPA(min. day)	65	60	70	64	53	48	59	52	0.002
***Steps (day)**	10004	9315	10692	9792	7940	7228	8651	8397	<0.001

*for steps, *n* reduces to 66 in White British and 65 in British Pakistani and 131 overall

[3] Adjusted means and significance values determined by analysis of variance, controlling for season, school and year group

Figure 4.4.6.1a Mean Hourly CPM for Weekend Days by Ethnic Group

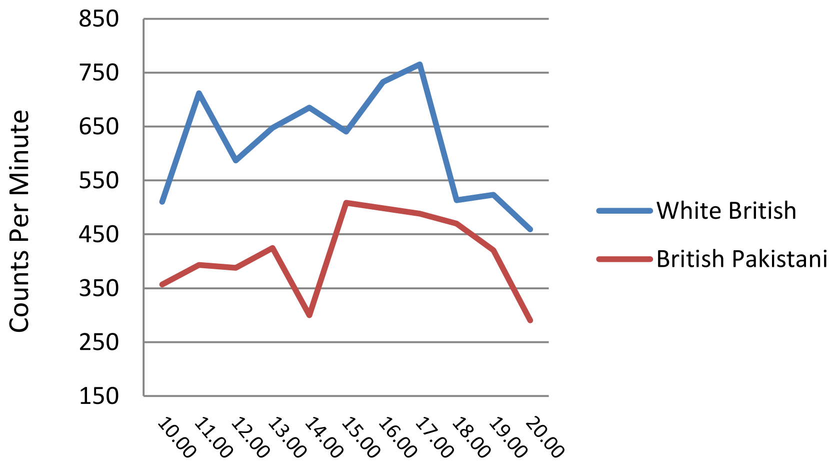


Figure 4.4.6.2a Mean Percentage of Hourly Time Spent in Sedentary time on Weekend Days by Ethnic Group

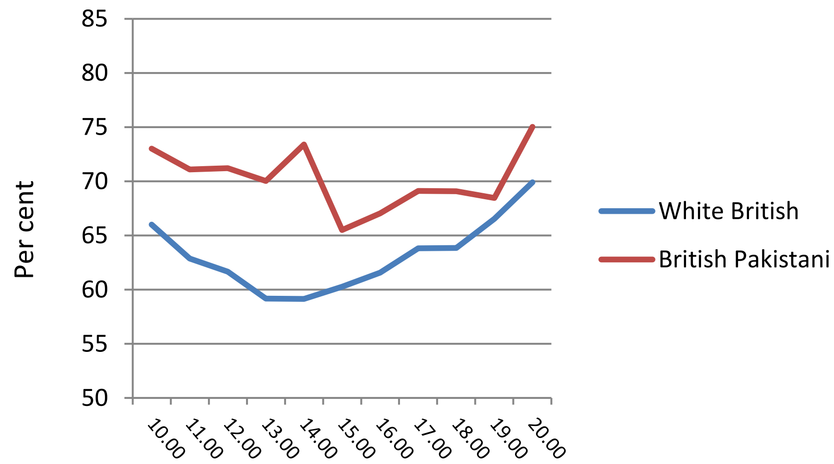


Figure 4.4.6.1b Mean Hourly CPM for School Days by Ethnic Group

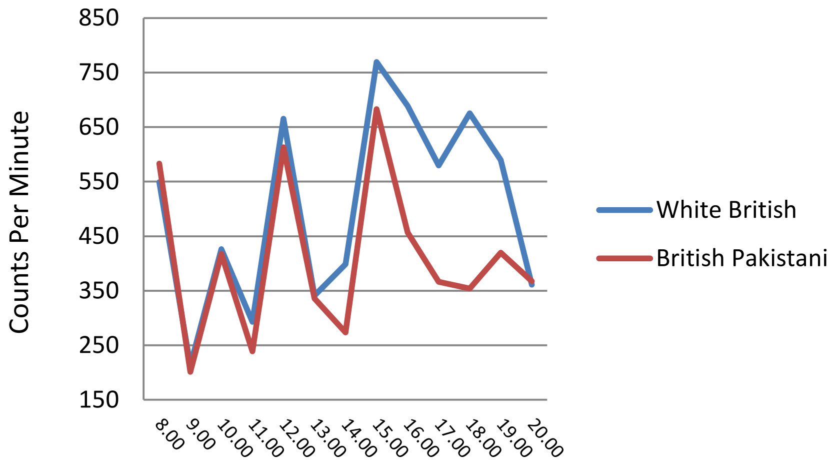
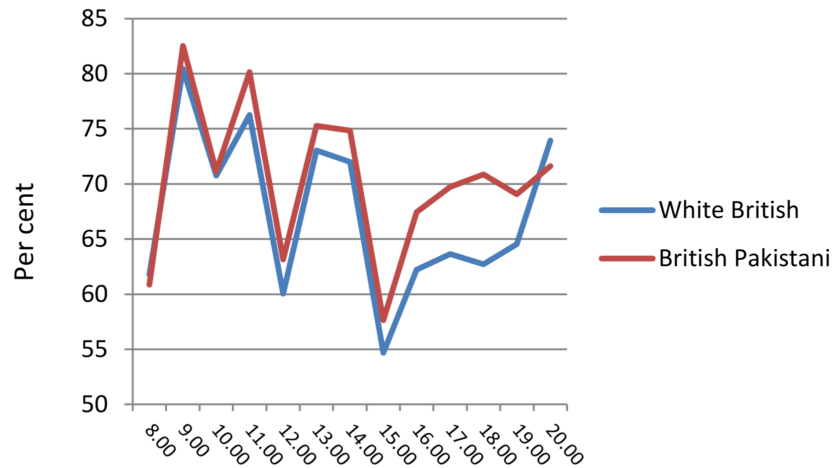


Figure 4.4.6.2b Mean Percentage of Hourly Time Spent in Sedentary time on School Days by Ethnic Group



4.4.7 Ethnic Group Comparison of Out-of-School and During-School Objectively Measured Physical Activity

Ethnic group comparisons of objectively measured physical activity out-of-school (07:00 to 09:00 and 15:00 to 23:00) on school days identified significant ethnic group differences in total physical activity, levels of physical activity and sedentary between White British and British Pakistani girls (table 4.4.7.1). No significant ethnic group difference was identified in registered time. However, White British girls recorded, on average, significantly more total counts, CPM and steps, spent significantly more time in moderate to vigorous physical activity and spent significantly less MRTSed and %RTSed compared to British Pakistani girls. Levels of light physical activity were, on average, similar by ethnic group out-of-school on school days, thus no significant difference was identified.

Ethnic group comparisons of objectively measured physical activity during-school (09:00 to 15:00) on school days (table 4.4.7.2) did not show significant ethnic group differences in total physical activity, by measures of total counts and CPM. There was however, a significant ethnic group difference in steps. White British girls accumulated significantly more steps, during-school, compared to British Pakistani girls. There were no significant ethnic group differences in moderate to vigorous and light physical activity or in sedentary time, by measures of MRTSed or %RTSed.

Comparisons of out-of-school and during-school objectively measured physical activity and sedentary time identified that White British girls accumulated significantly more registered time ($p=<0.001$), fewer total counts ($p=<0.001$), CPM ($p=<0.001$), steps ($p=<0.001$), light ($p=<0.001$) and moderate to vigorous physical activity ($p=0.001$) and MRTSed ($p=<0.001$), but spent less %RTSed out-of-school compared with during-school.

Comparisons of out-of-school and during-school objectively measured physical activity and sedentary time identified that British Pakistani girls accumulated significantly more registered time ($p=<0.001$), fewer total counts ($p=<0.001$), CPM ($p=<0.001$), steps ($p=<0.001$), light ($p=<0.001$), moderate to vigorous physical activity ($p=<0.001$) and MRTSed ($p=<0.001$), but spent less %RTSed ($p=<0.001$) out-of-school compared with during-school.

Table 4.4.7.1 Ethnic Group Comparisons, Mean, 95 % Confidence Intervals and Median, of Objectively Measured Out-Of-School (07:00 to 09:00 and 15:00 to 23:00) Physical Activity in 9 to 11 Year Old Girls Living on Teesside[4]

	White British n=70				British Pakistani n=75				
Outcome	Mean	Lower 95% CI	Upper 95% CI	Median	Mean	Lower 95% CI	Upper 95% CI	Median	Sig. Val
Registered time (day)	429	410	449	439	454	433	474	473	0.1
Counts (day)	253884	232932	274836	227060	188110	165944	210277	191132	<0.001
CPM (day)	567	523	610	525	420	374	467	411	<0.001
Sedentary (min. day)	293	285	302	285	309	300	317	319	0.01
Sedentary (%.day)	65	63	67	67	68	66	70	67	0.01
Light (min. day)	114	107	120	101	111	104	117	115	0.5
MVPA	43	39	47	39	32	28	36	32	<0.001
***Steps**	6344	5788	6900	5686	4646	4041	5250	4724	<0.001

*for steps, *n* reduces to 66 in White British and 65 in British Pakistani and 131 overall

[4]Adjusted means and significance values determined by analysis of variance, controlling for season, school and year group

Table 4.4.7.2 Ethnic Group Comparisons, Mean, 95 % Confidence Intervals and Median, of Objectively Measured During-School (09:00 to 15:00) Physical Activity in 9 to 11 Year Old Girls Living on Teesside[5]

	White British n=70				**British Pakistani n=75**				
Outcome	Mean	Lower 95% CI	Upper 95% CI	Median	Mean	Lower 95% CI	Upper 95% CI	Median	Sig. Val
Registered time (day)	353	348	358	360	352	347	358	360	0.9
Counts (day)	138208	127707	148708	140955	124992	113684	136300	116186	0.8
CPM (day)	390	360	419	397	353	322	385	325	0.9
Sedentary (min. day)	254	249	260	252	261	255	266	268	0.1
Sedentary (%. day)	72	71	74	71	74	72	76	75	0.1
Light (min. day)	76	72	80	77	72	67	77	71	0.2
MVPA	22	20	24	22	20	18	23	19	0.2
***Steps**	3857	3618	4095	3888	3240	2975	3505	3534	<0.001

*for steps, *n* reduces to 66 in White British and 65 in British Pakistani and 131 overall

[5] Adjusted means and significance values determined by analysis of variance, controlling for season, school and year group

4.4.7.1 Comparisons of Objectively Measured Physical Activity and Sedentary time in Non-Attendees and Attendees at Evening Mosque School in British Pakistani Girls

Table 4.4.7.1 Comparisons, Mean and 95 % Confidence Intervals of Objectively Measured Out-of-School (07:00 to 09:00 and 15:00 to 23:00) Physical Activity, in Non-Attendees and Attendees at Mosque School, on School Day Evenings, of 9 to 11 Year Old British Pakistani Girls, Living on Teesside[6]

	Non-attendees at Mosque n=26			Attendees at Mosque n=48			Sig Val
	Mean	Lower 95 % CI	Upper 95 % CI	Mean	Lower 95 % CI	Upper 95 % CI	
Counts	198516	163486	233545	203718	173442	233994	0.755
CPM	428	363	493	422	365	478	0.841
***Steps**	5166	1496	6137	5139	4307	5971	0.952
%Sedentary	70	66	73	70	67	73	0.959

*for steps, *n* reduces to 21 non-mosque attendees, 43 mosque attendees and 65 British Pakistani overall

Many British Pakistani girls attended mosque school during weekday evenings. This is a potential source of sedentary time and levels of activity in girls who did and did not attend mosque school were therefore compared (table 4.4.7.1). There were no significant differences in total counts, CPM, steps or %RTSed between British Pakistani girls who attended mosque, on at least one occasion over the two measured school day evenings, and those who did not attend mosque.

[6] Determined by ANOVA controlling for season, school and year group

4.4.8 Ethnic Group Comparison of Objectively Measured School Break-time Physical Activity

School break-time offers children equal opportunity to be physically active, physical activity accumulated during this period are an important contribution to children's overall daily physical activity levels (Ridgers et al., 2006).

Table 4.4.8.1 Ethnic Group Comparisons, Mean and 95% Confidence Intervals, of Objectively Measured School Break-Time Physical Activity in 9 to 11 Year Old Girls Living on Teesside[7]

	White British n=74			British Pakistani n=79			
Outcome	Mean	Lower 95% CI	Upper 95% CI	Mean	Lower 95% CI	Upper 95% CI	Sig. Val
Registered time	66	65	66	66	65	66	0.654
% Sedentary	57	53	60	61	57	65	0.018
% Light	29	26	32	27	24	30	0.144
% MVPA	15	12	18	12	9	15	0.042

Ethnic group comparisons of objectively measured physical activity during school break-time (table 4.4.8.1) found no significant ethnic group differences in registered time or in the proportion of school break-time spent in light physical activity. There were however, significant ethnic group differences found in the proportion of school break-time spent in moderate to vigorous physical activity and sedentary time. Thus suggesting that despite school break-time offering similar opportunity to be physically active, White British girls spent significantly more time in moderate to vigorous physical activity and less time sedentary, compared with British Pakistani girls.

[7] Determined by analyses of variance controlling for season, school, year group, temperature and rainfall (see section 3.7.7). The break-time sub-sample increases from 145 (70 White British: 75 British Pakistani) to 153 (74 White British: 79 British Pakistani) resulting from a greater number of girls wearing the monitors on school days.

4.5 Discussion

To my knowledge, this is the first study, to date, to provide objective evidence that British Pakistani girls have, on average, lower total physical activity, as measured by total counts, CPM and steps, lower levels of physical activity, as measured by light and moderate to vigorous physical activity and higher levels of sedentary time, as measured by MRTSed and %RTSed, compared with White British girls. Furthermore, to my knowledge this is the first study to provide objective evidence of ethnic group differences in weekend and school day, during-school and out-of-school patterns of total physical activity, levels of physical activity and sedentary time in White British and British Pakistani girls.

4.5.1 Ethnic Group Comparisons of Overall Objectively Measured Physical Activity

Daily registered time was similar in this sample of White British and British Pakistani girls, suggesting that ethnic group differences found in total physical activity, as measured by counts and steps, levels of physical activity as measured by moderate to vigorous physical activity and light activity and MRTSed are not significantly influenced by registered time.

Study by Owen et al. (2009) investigated ethnic and gender differences in objectively measured physical activity for 9 to 10 year old White European and South Asian children in the UK. They report that South Asian girls accumulated significantly more registered time, compared with White European girls. These findings contrast to those reported currently for White British and British Pakistani girls. In this present study only accelerometry data collected between the hours of 07:00 to 23:00 hours were analysed. Owen et al do not state such action. This may provide some indication to why registered time is greater in their sample of girls.

4.5.1.1 Total Physical Activity

This study found marked ethnic group differences in overall average daily measures of total physical activity, with British Pakistani girls accumulating significantly fewer total counts, CPM and steps, in comparison to White British girls. In keeping with this current study Owen et al. (2009) also report significant ethnic group differences in all measures of total physical activity, with South Asian girls accumulating, on average, 24’481 fewer total counts, 49 fewer CPM and 1089 fewer steps, compared to White European girls. In this current study

British Pakistani girls accumulated, on average, 107’174 fewer total counts, 148 fewer CPM and 2789 fewer steps, per day, compared to White British girls. It is possible that geographical location of these two studies may account, in part, for this variation between studies. However, previous studies (Sproston and Mindell, 2006) have found significant differences in self-reported physical activity levels of children from South Asian minority groups, with findings indicating that Pakistani and Bangladeshi girls, aged 2 to 15 years, were less active than Indian girls. Owen et al do not display measures of total physical activity for girls of different South Asian minority groups. However the difference between studies may support lower total physical activity in British Pakistani girls compared with other South Asian minority girls, in particular Indian girls. Furthermore, a study reported by Duncan et al. (2012) examined weekend and week day variability in physical activity, by pedometer measured steps, in White and South Asian primary school children, from central England. Ethnic group comparisons of average daily steps suggest that White European children accumulated significantly more steps than South Asian children. These findings are in keeping with objectively measured physical activity reported both in this present study and by Owen et al. (2009). Objectively measures of total physical activity reported in this present study also support self-report findings by Woodfield et al. (2002) who examined physical activity, by questionnaire, in adolescent children from central England. They identified that children of South Asian ethnicity had lower average daily energy expenditure, compared to White European children.

Findings from this present study suggest that White British girls are far more physically active, in terms of objective measures of total activity, than British Pakistani girls. These findings are supportive of previous literature suggesting that White children are more physically active than British South Asian children.

4.5.1.2 Moderate to Vigorous and Light Levels of Physical Activity

Results of this study also identified marked ethnic group differences in levels of physical activity, with British Pakistani girls accumulating significantly less time in moderate to vigorous physical activity and light activity, compared to White British girls. In line with this present study, Owen et al also report significant ethnic group differences in moderate to vigorous physical activity, between South Asian and White European girls, which were 57 and 62 minutes per day, respectively. In this present study, British Pakistani girls accumulated 48 minutes of moderate to vigorous physical activity, compared to 67 minutes accumulated by White British girls. Whilst moderate to vigorous physical activity for White British girls were comparable to that of White European girls, between studies comparison of moderate to vigorous physical activity of British Pakistani and South Asian girls were not. Again this discrepancy may support the notion that British Pakistani girls are less active than other South Asian minorities.

Results from this present study support self-report findings from the *Health Survey for England* 2004 which identified that a large proportion of British Pakistani girls were failing to meet the current physical activity guidelines for health (60 minutes or more of moderate to vigorous physical activity per day (Department of Health, 2011). In line with these findings this study identified that on average British Pakistani girls fell considerably short of 60 minute of moderate to vigorous physical activity per day, indicating that a large proportion of these girls are also failing to meet the current recommendations for health. Evidence from this study also support previous findings reported by Duncan et al. (2008) for self-reported physical activity in adolescent White and South Asian children from central England. In this study Duncan et al identified that South Asian children were less likely to participate in high intensity physical activity than White European adolescent children, with an average ethnic group difference of 20 minutes of moderate to vigorous physical activity per day. These figures are similar to the 19 minutes difference reported between white British and British Pakistani girls in this present study.

4.5.1.3 Sedentary Time

Results comparing sedentary time also identified significant ethnic group differences in both average MRTSed and %RTSed, with British Pakistani girls spending an additional 46 minute per day in sedentary time and spending five per cent more registered time sedentary, compared to White British girls. These findings are in line with those reported by Owen et al, with White European girls spending significantly less MRTSed, compared to South Asian girls, with an average difference of 49 minutes per day. A slightly greater MRTSed is reported in their sample of White European and South Asian girls, however this may be explained by the higher registered time reported by Owen et al.

Ethnic group comparisons of objectively measured sedentary time contrast with previous self-report findings by Khunti et al. (2007) who estimated sedentary time of adolescent children by measuring self-reported screen time (TV viewing, computer and games console usage). Unlike the objective findings of sedentary time reported in this present study, self-reported sedentary time was similar in both White and South Asian children. However, sedentary behavior, measured by self-reported screen time, does not take into account other forms of sedentary behaviour that may lead to ethnic group differences in physical activity behaviour. A longitudinal study reported by Brodersen et al. (2007) also assessed ethnic group differences in sedentary behaviour of adolescent children by self-reported screen time. They found that sedentary time of South Asians girls was found to increase at a much greater rate than white girls. Based on the evidence these findings may suggest that the already elevated levels of objectively measured sedentary time found in this sample of British Pakistani girls, may potentially increase even more with age, with the ethnic difference in girl's sedentary time potentially becoming wider still.

4.5.2 Ethnic Group Comparisons of Weekend and School Day Patterns of Objectively Measured Physical Activity

Registered time was similar for the two ethnic groups on weekend days, suggesting that this is unlikely to account for any significant ethnic group differences in measures of total physical activity, levels of physical activity and sedentary time during this time. However, significant ethnic group differences were found in registered time on school days; with British Pakistani girls accumulating more registered time on school days, compared with White British girls. Such a difference in registered time may particularly influence MRTSed; therefore findings are also reported as %RTSed, which reduces bias caused by a difference in registered time.

4.5.2.1 Total Physical Activity

This study found marked ethnic group differences in average weekend measures of total physical activity, with British Pakistani girls accumulating significantly fewer total counts, CPM and steps, in comparison White British girls. These findings are in line with Duncan et al. (2012), who identified that White Children accumulated more steps on weekend days, compared to South Asian children, which were 11'135 and 10'383 respectively; however this difference did not reach significance. A comparison of step counts between studies identified that average weekend steps reported by Duncan et al were slightly higher than those reported in this present study, which averaged 9’802 in White British and 7’487 in British Pakistani girls. These findings imply that both White British and British Pakistani girls in this present study were less physically active than those reported by Duncan et al. However, they do not report on ethnic differences by gender group, but do report a significant difference between boys and girls, with boys accumulating more steps than girls. Therefore this large difference in steps between studies is potentially attributable to gender variations in total physical activity.

There is a distinct lack of additional literature comparing ethnic differences in patterns of weekend physical activity in British children. However, a number of studies have reported results for average weekend physical activity in similar samples of primarily White girls. In these studies total physical activity, as measured by average CPM, range between 424 to 690 CPM (Trayers et al., 2006; Mattocks et al., 2007; Riddoch et al., 2007; van Sluijs et al., 2008; Page et al., 2009; Steele et al., 2010). The average weekend CPM for White British girls in this present study fit comfortably within this range. However, average weekend CPM for British Pakistani girls were well below this range, suggesting that Pakistani girls in this present study were far less physically active on weekend days compared to other British populations of White girls.

Ethnic group comparisons of total physical activity on school days also identified significant differences, with results indicating that average school day total counts, CPM and steps were all significantly lower in Pakistani girls, compared to White British girls. School day ethnic group differences were not as marked as those exhibited on weekend days, however they remained substantial. These findings are in line with Duncan et al. (2012) reporting that White children accumulated significantly more steps on week days, compared to South Asian children, reported as 14’734 and 13’023 respectively. However between studies comparison found that Duncan et al report a higher accumulation of steps, compared to the 10’004 for White British and 7’940 for British Pakistani girls reported in this present study. Again gender differences in total physical activity may account for some of this variation. However this difference may also indicate British Pakistani girls are less active, on school days, than other South Asian minority girls.

Published studies reporting on similar samples of White girls in the UK, found average measures of total physical activity, on school days, to range between 515 to 592 CPM (Trayers et al., 2006; Mattocks et al., 2007; Riddoch et al., 2007; van Sluijs et al., 2008; Page et al., 2009). Average school day CPM reported for White British girls in this current study are slightly lower than reported previously. King et al. (2011) examined correlates of objectively measured physical activity in seven year old children from North-east England. Season was identified as a significant determinant of total physical activity, with average CPM significantly lower in winter and spring/fall, compared to summer. In this present study primary data collection took place from mid-January to early July 2010 and early November to early December 2010, thus data collection excluded a large part of summer, when activity levels would expectedly be higher. This may account for the lower measures of total activity identified in this present study.

Results of this study indicate that White British girls were significantly more active, as measured by total counts and CPM on school days compared to weekend days. Furthermore, British Pakistani girls were significantly more active in terms of steps on school days compared to weekend days. Previous studies have identified a significant increase in measures of total physical activity in children on week days, compared to weekend days (Riddoch et al., 2007; Owen et al., 2009; Duncan et al., 2012). A study by Gidlow et al. (2008) investigating children's physical activity in-school and out-of- school suggests that despite a lack of opportunity for children to be physically active within the school day itself, a large proportion of children may compensate for this out-of-school. Evidence also suggests that active modes of school transport (Cooper et al., 2005; Saksvig et al., 2007; Owen et al., 2012; Slingerland et al., 2012), and participation in school-based sports and active play at school break-times (Gidlow et al., 2008; Ridgers et al., 2006; Nettlefold et al., 2011) provide important contributions to physical activity on school days.

4.5.2.2 Moderate to Vigorous and Light Physical Activity

Ethnic group differences in average weekend moderate to vigorous physical activity have been identified, with Pakistani girls accumulating, on average, 25 fewer minutes per day, compared to White British girls. A study by Cleland et al. (2010), investigating the effects of outdoor time on children's physical activity levels, reported that the amount of time spent outdoors was a significant predictor of moderate to vigorous physical activity in girls. British Pakistani girls may be spending less time outdoors on weekend days, which might help account for their significantly low levels of moderate to vigorous physical activity. This issue is investigated in Chapter five.

This study also identified marked ethnic group differences in levels of physical activity on school days, with White British girls accumulating, on average, 12 minutes more moderate to vigorous physical activity, compared to British Pakistani girls. In line with previous studies (van Sluijs et al., 2008; Steele et al., 2010), White British girls accumulated a similar amount of time in moderate to vigorous physical activity on weekend days, compared to school days. However, the increased time spent in moderate to vigorous physical activity on school days, compared to weekend days, by British Pakistani girls suggests that physical activity associated with school days provide an important contribution to moderate to vigorous physical activity in these girls.

5.4.2.3 Sedentary time

Ethnic group comparisons of sedentary time identified that British Pakistani girls accumulated more MRTSed and spent a greater %RTSed on weekend days, compared to White British girls, with a significant difference of 50 minutes and seven per cent, respectively. These findings suggest that Pakistani girls are spending a much greater proportion of their weekend days in sedentary activities. To my knowledge there is currently no published literature providing ethnic group comparisons of patterns of sedentary time in British children on weekend days, thus making comparisons with other study findings difficult.

Steele et al. (2010) report objective measurements of sedentary time for weekend days, in their sample of primarily White girls of the same age. They report the average time spent in sedentary time on weekend days was 424 minutes, which is lower than the weekend average of 485 minutes reported for White British girls and the 535 reported for British Pakistani girls in this current study. The greater amount of registered time reported in this present study for both White British and British Pakistani girls, is likely to contribute to the between studies difference in MRTSed.

Comparisons of sedentary time on school days also identified significant ethnic group differences, with British Pakistani girls accumulating significantly more MRTSed and %RTSed compared to White British girls. However the differences in sedentary time between ethnic groups were not as marked as those reported for weekend days. Differences in patterns of children's sedentary time can be expected for weekend and school days, particularly as weekend days offer a greater amount of free time to be physically active. Increases in sedentary time on week days have been reported elsewhere (Mitchell et al., 2009; Nilsson and Anderssen et al., 2009; Steele et al., 2010) and are likely associated with high amounts of scheduled lesson time within school. In keeping with these findings, this study identified that White British girls spent a greater %RTSed on school days compared to weekend days. However, this pattern was not the same for British Pakistani girls who were found to accumulate similar proportions on both weekend and school days, despite the greater opportunity to participate in physical activity on weekend days. Finally, a slightly greater amount of MRTSed was observed in both ethnic groups on school days; however this is likely to be associated with the increased registered time also accumulated by these girls on school days.

4.5.3 Ethnic Group Comparisons of Out-of-School and During-School Patterns of Objectively Measured Physical Activity

4.5.3.1 Total Physical Activity

Ethnic group comparisons of total physical activity out-of-school identified that White British girls accumulated significantly more total counts, CPM and steps, compared to British Pakistani girls. To my knowledge no literature has been published examining ethnic group differences in objectively measured patterns of out-of-school physical activity in British school children. However, a study by Khunti et al. (2007) has assessed ethnic group differences in self-reported participation rates in evening activity of adolescent children. White and South Asian children were asked to report whether they had participated in activities, such as walking, cycling, sports, dancing during the evening. In contrast to out-of-school findings of objectively measured physical activity, Khunti et al identified no significant ethnic group differences in participation in evening activity. The sample reported by Khunti et al is older, involving children of adolescent age and the authors do not differentiate between genders, both factors which may contribute towards this difference in findings between studies. However, Khunti et al also only assessed participation in specific activities and did not take into account time spent outdoors or other forms of less structured active play that have been previously found to differ between ethnic groups (Sproston and Mindell, 2006).

A small number of studies have examined total physical activity in predominantly White samples of British children during this time frame. Steele et al. (2010) report a mean of 641 CPM for girls out-of-school, which is higher than the 567 and 420 CPM reported for this present sample of White British and British Pakistani girls respectively. Again seasonal variations are likely to play a role in these differences, particularly as an increase in daylight hours during the summer months, provides children with more opportunity to be active outdoors out-of-school hours. Previous studies have found that participation in outdoor physical activity can be affected by seasonal change in day light hours (Cooper et al., 2010) and the amount of time spent outdoors is positively associated with physical activity in children (Sallis and Prochaska et al., 2000; Ferreira et al., 2006; Hinkley et al., 2008; Cleland et al., 2010; Cooper et al., 2010). A study by Cooper et al. (2010) examined patterns of time spent outdoors after school in English children. This study identified that on average children spent a little over 40 minutes outside after school each day. A peak in outdoor time was observed within the hour immediately following school.

Active modes of school transport and participation in after-school clubs are also positively associated with total physical activity in primary school children (Faulkner et al., 2008; King et al., 2011) and can provide important contributions to total physical activity out-of-school. Hourly patterns of CPM (figure 4.4.6.1a/b) confirm peaks of high activity within the hour immediately before and after school, which suggest a large proportion of these children, were using active modes of school transport and perhaps participating in after-school based sports activities. Thus further investigation into ethnic differences in outdoor play, active modes of school transport and participation in both school-based and community-based sport/exercise activities is warranted. In doing so may explain ethnic group differences in total physical activity out-of-school between white British and British Pakistani girls.

Ethnic group comparisons of total physical activity during-school suggest that total counts and CPM were similar in both White British and British Pakistani girls and no significant differences were identified. To my knowledge no literature has been published on ethnic group difference in objectively measured physical activity of British school children within the school day itself (09:00 to 15:00). A number of studies however, have examined patterns of total physical activity accumulated during-school and out-of-school in samples of predominantly White British children. Steele et al. (2010) report a mean of 496 CPM for girls within school hours, which is considerably higher than the 390 and 353 CPM reported for White British and British Pakistani girls respectively, in this present study. As previously indicated, Steele et al data collection took place during summer term. As schools generally offer more time to be active outdoors during the warmer months of the year, it is likely that seasonal variation partly plays a role in these between study differences in CPM. A further study by Gidlow et al. (2008) also examined total physical activity during-school, with data collection covering both summer and winter months. Total measures of physical activity were 382 CPM for girls, which were more in line with those reported in this present study.

Results from this study, however, suggest that White British girls accumulated significantly more steps during-school, compared to British Pakistani girls. Examining ethnic group differences in girls' physical activity behaviours at school may help provide understanding to why White British girls had a greater accumulation of steps during-school compared to British Pakistani girls.

4.5.3.2 Moderate to Vigorous Physical Activity

Ethnic group comparisons out-of-school activity levels identified that White British girls accumulated, on average, 11 minutes more in moderate to vigorous physical activity compared to British Pakistani girls. Steele et al also investigated activity levels out-of-school, reporting that girls accumulated an average of 13 minutes in vigorous activity during this time. They do not report on moderate intensity physical activity, however these findings for vigorous activity would suggest that out-of-school moderate to vigorous physical activity would have been much greater in their sample of girls. Again seasonality is likely to play a role, however variations in participation of after-school and evening sport/exercise, time spent outdoors and the use of more active modes of school transport are also common explanations into differences in children's activity levels, not only between study findings, but are also likely sources to the ethnic group differences identified in out-of-school moderate to vigorous physical activity. Gidlow et al. (2008) found that moderate to vigorous physical activity accumulated out-of-school makes up around 32 to 34 per cent towards the weekly total in children of a similar age to this present sample of girls, indicating this as an important time frame for contributions to children's total moderate to vigorous physical activity.

Ethnic group comparisons of activity levels accumulated during-school, identified that White British and British Pakistani girls were accumulating similar amounts of moderate to vigorous physical activity during this time and any observable differences were small and non-significant. In-school moderate to vigorous physical activity made up around a third towards the minimum physical activity recommendation in both ethnic groups. Steele et al. (2010) found girls' vigorous physical activity during-school contributed, on average, eight minutes to their daily total. A study by Gidlow et al. (2008) found that morning and lunch time break contributed around 50% towards girls moderate to vigorous physical activity accumulated during-school, whereas P.E contributed 13%. These findings indicate that the school day, but more specifically break-time periods, are critical for the accumulation of high intensity physical activity during-school hours.

4.5.3.3 Sedentary time

This study has identified that British Pakistani girls were more sedentary out-of-school, accumulating significantly more %RTSed and MRTSed, compared with white British girls. Mosque school generally lasts for around 1.5 to 2.5 hours every week day evening and, similar to lesson time in school, it is generally a sedentary activity. Findings from this study suggest that attendance at mosque school on a school day evening was not associated with increased %RTSed out-of-school in British Pakistani girls. Thus, indicating that the British Pakistani girls who did not attend mosque school on week day evenings were equally as sedentary as those who did. Such findings warrant investigation into sedentary time behaviour of those girls who did not attend mosque on school day evenings, where we might expect to find an increase in screen time or other forms of sedentary time within these girls.

Ethnic group comparisons of sedentary time during-school identified that both White British and British Pakistani girls spent a similar proportion of their during-school hours in sedentary time. To my knowledge this is the first study to provide ethnic group comparisons in patterns sedentary time on school days, which make comparisons with other studies difficult. However, a small number of studies have examined sedentary time in-school in samples of white girls. In built lesson time results in children spending large proportions of the school day in sedentary time. Nettlefold et al. (2011) report that girls in year five and six spent around 71% of in-school hours sedentary, which are comparable to White British and British Pakistani girls in this present study, who spent 72% and 74% respectively, of their school day sedentary.

Steele et al report an average MRTSed of 242 for their sample of girls, which were 12 and 14 minutes fewer than this sample of White British and British Pakistani girls respectively. Again seasonal variation is likely to play a role in this slight difference in findings. A European study, of 9 to 15 year olds, by Nilsson and Anderssen (2009), however, report far lower levels of sedentary time for girls, with a range of 128 to 153 minutes for in-school hours. These findings indicate that European girls are spending less than half of their school day in sedentary time, which is far less than reported for these samples of young British school girls

4.5.4 Ethnic Group Comparison of School Break-time Physical Activity

School break-time offers children equal opportunity to be physically active, with activity accumulated during this time found to provide important contributions to children's daily physical activity (Ridgers et al., 2006; Nettlefold et al., 2011). The mean break-time duration identified in the results support the notion that White British and British Pakistani girls had equal amounts of school break-time to be physically active. Evidence from this study however, suggests that White British girls spent a significantly greater proportion of their school break-time periods in moderate to vigorous physical activity and a significantly smaller proportion in sedentary time, compared to British Pakistani girls.

Findings reported by Khunti et al. (2007), which to my knowledge is the only UK based study to report on ethnic group differences in self-reported activity of children break-time, contrast with those reported in this present study. They found that similar proportions of White European and South Asian girls reported active behaviour at school during morning and lunch time break. Their sample however, was adolescent children and the proportions

White European and South Asian girls reporting active behaviour was very low at eight per cent and seven per cent respectively. Therefore, the difference between study findings may be associated with the age difference between the two samples, as further evidence reported by Khunti et al suggest that active behaviour at school break-time was more evident in the younger adolescent children.

4.6 Conclusion

Based on these study findings it can be concluded that British Pakistani girls were, on average, less physically active, in measures of total physical activity, spent less time in moderate to vigorous physical activity and spend a greater proportion of their time in sedentary time, compared to White British girls. This study provides additional evidence to support previous objective and self-report studies which have identified South Asian children, but more specifically British Pakistani girls, are less physically active than their White counterparts. Furthermore this study has also identified that despite given equal opportunity to be physically active, which became evident in school break-time activity, ethnic variations still occurred and therefore warrant further investigation.

Discussing findings of objectively measured physical activity and sedentary time in relation to additional literature, indicates that variations in the participation of activities, such as outdoor play, sport and exercise, the use of active modes of school transport and in relation to more sedentary type of activities may provide important understanding into how these ethnic variations occurred.

Furthermore, this study also identified significant ethnic group differences in patterns of weekend and school day, out-of-school and during-school physical activity and sedentary time, in doing so has allowed the identification of where the biggest variations occur. This information is essential to health intervention.

Chapter Five: Ethnic Group Comparison of Physical Activity and Sedentary Behaviour of White British and British Pakistani Girls

5.1 Background

White British girls, on average, have significantly higher objectively measured physical activity and significantly lower measures of sedentary time, compared to British Pakistani girls. Chapter four identified where the greatest ethnic variations in activity occurred through investigating between and within day patterns in objectively measured physical activity and sedentary behaviour. Identifying differences in physical activity related behaviours and the amount of time spent in them will provide understanding into how ethnic group differences in physical activity and sedentary time occur.

5.2 Aims

Chapter five aims to investigate ethnic group differences in physical activities and sedentary behaviour in this sample of White British and British Pakistani girls, by examining data collected by previous day physical activity recall (PD-PAR) and the physical activity questionnaire for children (PAQ-C) (Kowalshi et al., 2004). This chapter will also investigate ethnic group differences in patterns of self-reported physical activities and sedentary types of behaviour to provide additional evidence into why such differences occurred.

The main focus of this chapter is on analysing ethnic differences in the following activity categories; 'sport and exercise' including football, netball, cricket, tennis, rounders', swimming, gymnastics, dance and martial arts; 'outdoor play' including riding a bike or a scooter, roller-skating, skipping, playing on a trampoline, chasing games, non-competitive ball games, playing on park equipment and other unstructured games and 'screen-time' including watching television, playing on games consoles, computer and laptop activities. In addition, ethnic group differences in 'active modes of school transport' including walking, and riding a bike or scooter, and participation in after-school based sports/exercise activities will also be examined.

Data collected from White British and British Pakistani interviewees exploring physical activity behaviour within these families, will be used to provide further detailed information on practices in relation to physical activity and sedentary behaviour throughout this chapter.

5.3 Results

5.3.1 Description of Study Sample

The physical activity sample and child/parent demographics have been presented previously in chapter four. However, this recall sample incurred further exclusion due to incomplete recall data n=3, resulting in a final sample of n=142, consisting of White British n=70 and British Pakistani n=72.

The proportions of White British and British Pakistani girls (graph 5.3.2.1) self-reporting participation in each activity category was largely similar between groups. No significant ethnic group differences were identified.

On average, White British girls reported an additional 14 minutes in sport/exercise and 24 minutes in outdoor play activities per day, compared to British Pakistani girls (table 5.3.2.2). The difference in time spent in sport/exercise activities approached but did not reach statistical significance, while the difference in time spent in outdoor play activities was highly significant. On average, White British girls reported spending an additional 38 minutes in sport/exercise and outdoor play activities combined per day, compared to British Pakistani girls ($p=<0.001$). There was however, no significant ethnic group difference found in the average reported screen time, which were similar in both White British and British Pakistani girls.

These findings suggest that whilst the proportion of White British and British Pakistani girls self-reporting participation in activity categories were similar, there is some indication of ethnic group differences in the average length of time spent in sport/exercise activities and further stronger evidence to suggest that White British girls spend more time, on average, in outdoor play, compared to British Pakistani girls.

5.3.2 Ethnic Group Comparison of Overall Self-Reported Activities

Graph 5.3.2.1 Ethnic Group Comparisons of the Percentage of White British and British Pakistani Girls Participating Overall in Self-Reported Activities[8 9]

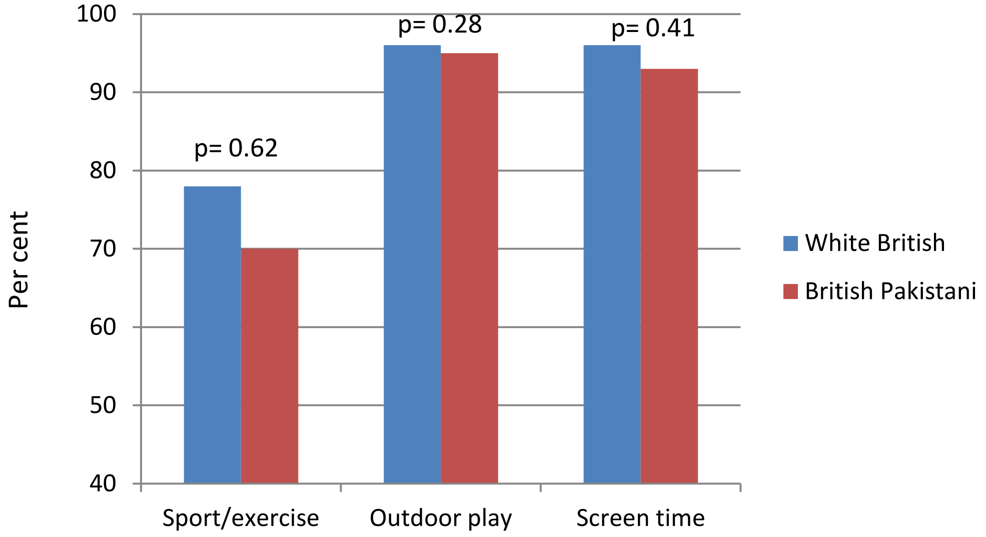


Table 5.3.2.2 Ethnic Group Comparisons of Mean and 95% Confidence Intervals for Overall Mean Daily Duration Spent in Self-Reported Activity, for White British and British Pakistani Girls[10 4]

	White British n=70		British Pakistani n=72		
	Mean Duration (Minutes)	Lower-Upper 95 % CI	Mean Duration (Minutes)	Lower-Upper 95 % CI	Sig. Val
Sport/exercise	33	23 – 42	19	9 – 29	0.06
Outdoor play	50	42 – 59	26	17 – 34	<0.001
Screen time	119	100 – 138	118	98 – 139	0.92

4 Ethnic group comparison of the mean daily duration spent in self-reported activities determined by three days (Sunday plus two school days) of previous day physical activity recall

8 Ethnic group comparison of the percentage of White British and British Pakistani girls participating in self-reported activities, on at least one occasion, over the three days (Sunday and two school days) determined by previous day physical activity recall

9 P values are derived from logistic regression controlling for season, school and year group

10 Adjusted means and significance values are derived from ANOVA controlling for season, school and year group

Interviews explored parents' perceptions of their children's physical activity levels. It was common for White British parents to indicate that their daughters were physically active, as highlighted by the following statement *'I have no worries about my daughter's activity levels, she's a very active kid…she doesn't stop, I don't know where she gets the energy from, she's definitely not a couch potato'* White British mother. British Pakistani parents seemed to make less reference to their daughters overall activity levels, with the exception of one British Pakistani mother who described her daughters' activity as follows *'they never sit down, either if they have the music on they will dance and exercise or they have on the Wii fit* [Nintendo games console] *with the controls where they move all about'.*

Sport/exercise activities such as community based (as opposed to school based activities) dancing and gymnastic classes were reported by more than half of White British interviewees as activities their daughters participated in regularly. Furthermore, it was reported that attendance at these classes could be anything from three to six times per week, as highlighted by this White British father *'the only day they don't do dance is on a Monday'*. Only one British Pakistani parent reported that her daughter regularly took part in a community based gymnastics class. Structured activity classes in White British and British Pakistani girls are discussed further in relation to weekend and school day activities in the proceeding sections of this chapter.

Although British Pakistani parents less frequently reported participation in sport/exercise activities such as dancing and gymnastics, reference was made to participation in other types of sport activities, as highlighted by this British Pakistani father *'We play cricket, I take the girls to the field, 'Z' is good at football and 'A' is good at cricket …I try to spend as much time with them as I can to encourage these sorts of things'*.

Whilst sport/exercise activities were not reported by all White British parents, participation in outdoor activities was. This was something that came across as common practice for many White British girls as the following statements suggest *'I'd say if they're bad, that's the only time they want to stay in'* White British father, *'they just play out, they go over the park and play round about…nine times out of ten they want to play out'* White British mother, '*she's always out…playing football…out on her scooter or her bike'* White British mother. British Pakistani parents also indicated participation in outdoor play activities *'they play out* *quite a bit'* British Pakistani father *'she plays in the back on her bike or roller-skates'* British Pakistani mother.

A few parents made reference to their daughters' lack of interest in participating in physical activity as suggested by this British Pakistani father '*activity wise, I'm pretty sure that she much prefers plonking herself on the sofa in front of the TV or up on the computer*'. Although, as one mother suggests, getting children to play outdoors may just take a little persuasion *'once you get them out they will be running around or playing with a football, skips, or their scooter, you know they are quite happy when they're out; it's just sometimes they're like 'oh do we have to'* White British mother. Parents also stressed apprehension in allowing their daughters to play outdoors, with safety concerns identified as an underlying cause. This was reported by both White British and British Pakistani parents, as the following statements suggest, *'I much prefer them to play out the back in the alley or back yard…the cars sometimes go flying down that side road'* British Pakistani father; *'I don't like her playing in the streets, I don't think it's safe, you don't know who they might come across round here and all the busy roads too'* White British mother. However, this one Pakistani mother stressed very different reasons for not wanting her daughters to play outdoors '*here they have school and nothing to do on an evening… I don't like them playing out…here they might say they are doing things like going to school or going to town and they could not be… I want them to be in an environment where there's no temptation from boys or anything*'. In this statement this British Pakistani mother was also stressing her desire to move to Pakistan with her husband and five children.

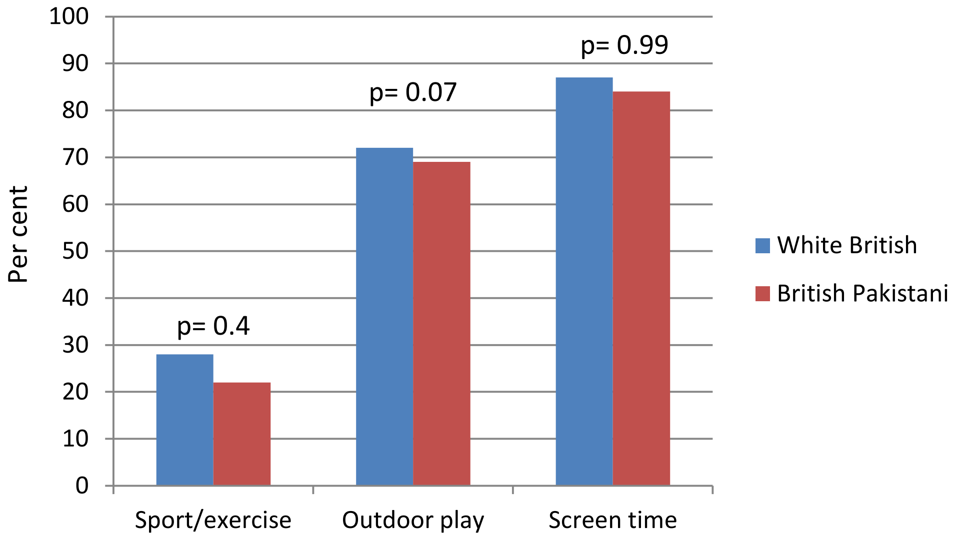
Most White British and British Pakistani parents mentioned their children playing on computers or game consoles and/or regularly watching television. A number of White British parents indicated that the use of these more sedentary style activities was limited '*we don't watch a great deal of TV, Sundays are no TV days...she spends less than half an hour a week on the computer and I can't remember the last time I saw her on the Wii or her DS'* '*she doesn't sit and watch TV a lot, it's rare that she will sit for more than half an hour…she can watch TV or play on her DS for half an hour at bed time'*. A number of British Pakistani parents identified a need to limit screen time. However parental control was something that did not come across very strongly within the following households; *'they sit* *in front of the TV, I know it's a bit difficult for them at school, but even on a weekend they would sit there all day'* British Pakistani mother, *'they do spend a lot of time on the computer, they have no sense of time, they would sit up there all day, they have the attitude that they only need to come off when someone tells them to come off. I tried to control it loads of times, where you cut it off at a certain time, but they end up nagging you and that and you forget'* British Pakistani father. It was common for White British parents to report an increase in their daughter's screen time when the weather was poor '*if the weather's bad she will probably sit in and play on her play-station'* White British mother*, 'When the snow has been down they stayed in watching telly or play in their bedroom*' White British mother.

Spending time with relatives was also a commonly reported activity in many British Pakistani households, as described by this Pakistani father '*well if I'm at work they will probably go round to her parent's house, spend some time there…the women just tend to sit about doing their thing* [talking] *and the kids, they have the games consoles to occupy them'* Pakistani father. White British parents also reported seeing relatives, however it came across more as a means to help out with childcare or fitting in with other routine rather than an activity in itself, as implied by these two parents *'well she goes to my mum and dad's after-school, until I get in from work'* White British mother, *'Saturday morning the girls were at dance… I went to see my mam for a bit before picking them up'*. Additional data collected by physical activity recall, further support the notion that visiting relatives was much more common practice in British Pakistani families, with 34% of White British compared to 64% of British Pakistani girls self-reporting spending time either visiting or being visited by relatives, on at least one occasion, over the three days of physical activity recall, this difference proved statistically significant (p= 0.001) by logistic regression, controlling for season, school and year group.

Girl's participation in sport/exercise and outdoor play activities was more frequently reported by White British parents than British Pakistani parents. Furthermore White British parents more frequently implied that their daughter's screen-time was limited. It is possible that interview recruitment may have experienced bias, perhaps towards parents who are more knowledgeable about physical activity and/or whose daughters were very physically active in comparison to other girls. Furthermore, it is important to note that parents may also be unknowingly or knowingly portraying an idealised picture of their daughter's activity behaviour.

5.3.3 Ethnic Group Comparison of Self-Reported Activities on Weekend Days

Graph 5.3.3.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Participating in Self-Reported Activities on Sundays [11] [5]

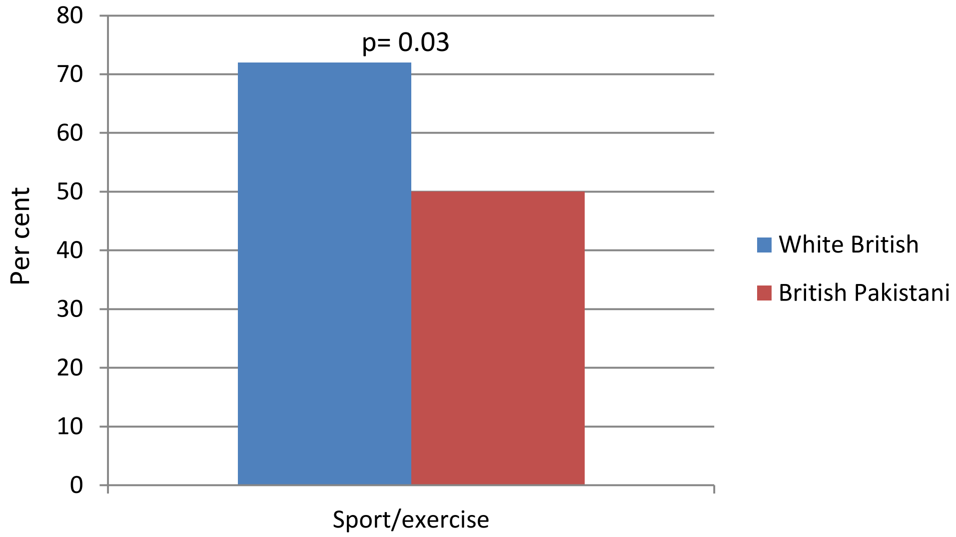


No significant associations were found in the proportion of White British and British Pakistani girls (graph 5.3.3.1) reporting participation in each activity category, on Sundays, which were largely similar between ethnic groups.

[4] Ethnic group comparison of the percentage of White British and British Pakistani girls participating in self-reported activities on Sundays determined by one day (Sunday) of previous day physical activity recall

[5] P values are derived from logistic regression controlling for season, school and year group

Graph 5.3.3.2 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Participating in Self-Reported Sport or Exercise Activity, for 30 Minutes or More on Weekend Days Determined by PAQ-C [12] [13]



A significant association was observed in the proportion of girls reporting in the PAQ-C that they participated in sport/exercise activities on weekend days (graph 5.3.3.2), with more White British girls reporting sports/exercise than British Pakistani girls. Although these findings may seem to contrast slightly with those presented for PD-PAR, it is important to note that the PAQ-C data were collected for both weekend days, as opposed to Sunday only for the PD-PAR.

[12] Ethnic group comparison of the percentage of White British and British Pakistani girls participating in self-reported sport or exercise activity, for 30 minutes or more, on at least one occasion, over two weekend days, determined by the physical activity questionnaire for children (PAQ-C)

[13] P values are derived from logistic regression controlling for season, school and year group

Table 5.3.3.3 Ethnic Group Comparison of Mean and 95 % Confidence Intervals for Mean Duration on Sundays Spent in Self-Reported Activities for White British and British Pakistani Girls[14 15]

	White British n=70		British Pakistani n=72		
	Mean Duration (Minutes)	Lower-Upper 95 % CI	Mean Duration (Minutes)	Lower-Upper 95 % CI	Sig. Val
Sport/exercise	42	22 - 62	13	-8 – 35	0.06
Outdoor play	62	47 - 77	23	6 – 39	0.001
Screen time	162	130 - 194	175	141 – 209	0.58

On average, White British girls reported an additional 29 minutes in sport/exercise activities and an additional 39 minutes in outdoor play activities, on Sunday, compared to British Pakistani girls (table 5.3.3.3). The difference in time spent in sport/exercise activities approached but did not reach statistical significance, while the difference in time spent in outdoor play activities was highly significant. On average, White British girls reported spending an additional 68 minutes in sport/exercise and outdoor play activities combined, compared to British Pakistani girls (p=<0.001). The average amount of weekend screen time reported by each ethnic group was similar in White British and British Pakistani girls.

These findings provide some indication to suggest that the proportion of girls participating in sport/exercise activities on a weekend differs significantly by ethnic group. Furthermore, whilst there is some evidence to suggest that White British girls spend more time in sport/exercise activities on Sundays. There was however, much stronger evidence to suggest a significant difference in the amount of time spent in outdoor play activities, with White British girls spending significantly more time in activities from this category, on Sundays, compared to British Pakistani girls.

[14] Adjusted means and significance values are derived from ANOVA controlling for season, school and year group

[15] Ethnic group comparison of the mean duration spent in self-reported activities on Sundays, determined by one Sunday of previous day physical activity recall

As previously highlighted, the parents of White British girls frequently reported their daughter's participation in sport/exercise (community-based) dance and gymnastics activities. It was also reported that attendance at such activities may take place multiple days per week, which could incorporate Friday evenings, as well as both weekend days, as the following statement implies '*Friday is ballet five till six, Saturday ballet twelve till two-thirty, then on Sunday she goes to gym ten till twelve'* White British mother. Other forms of sport/exercise activities, such as these highlighted in the following statement, may also be integrated into a weekend routine *'Friday she has two hours of dance…Saturday is swimming and dance, Sunday horse riding and dance'* White British mother. In the British Pakistani sample only one mother reported that her daughter regularly attended a community-based gymnastics class on a Saturday morning, perhaps suggesting that girls' participation in such activities were not as common place in this British Pakistani interview sample.

Swimming was reported as a fairly regular weekend structured activity by both White British and British Pakistani parents, as highlighted in the following statements *'She goes swimming a lot with her dad on a Sunday, I don't like swimming, so he takes her'* White British mother, *'once a week they go swimming on Sundays, their dad takes them, I don't go swimming, before I used to….I'd take them to the ladies only swimming at the sports centre…now they prefer to go with their dad to splash* [large leisure centre pool with slides and inflatables]*'* (British Pakistani mother). It was more common in both White British and British Pakistani households for the fathers to take the children swimming. In Pakistani households this practice is possibly associated with the women's adherence to *purdah*, which traditionally involves ensuring certain areas of the body are not on display to the opposite sex. As one British Pakistani mother discusses; *'the Qur'an does not say we cannot exercise, we just need to be modest when we do…I used to take my children swimming when they were younger, as I didn't want them to miss out, but it meant going early on a morning and leaving if any men came into the pool…I really like swimming but it's difficult for me to get to the sessions for women only'*.

On weekend days unstructured activities, such as taking their children to the park was reported by a small number of parents *'if we have any time on Sunday afternoon I'll take her* *and her friend to Albert park'* White British mother, '*on a weekend I like to take them to the park and while they're playing I can get on with a bit of my reading or writing'* British Pakistani father. As indicated by some White British parents, the girls may also be allowed to go to the local park either with friends or on their own *'Sunday she went to the park for a few hours with her friend on their bikes'* White British mother, *'she goes to play football in there* [the park] *she'll play with anyone she knows in there'* White British mother. Allowing their girls to go places on their own was not a practice discussed by British Pakistani parents.

Girls playing on their bikes or family bike rides were reported by a number of White British parents as weekend activities, as highlighted by this White British mother '*last Sunday we rode the bikes over the barrage...we had lunch there too'.* The Barrage offers a good cycle path; its use was reported by other White British interviewees. Cycling activities and the ownership of bikes, was not something generally reported by British Pakistani parents. Only one British Pakistani mother mentioned that her daughter had a bike, which she would regularly ride around their large garden. Another British Pakistani mother stated *'we've not got bikes, I think I'll get them for Christmas, but they always want other stuff'* this British Pakistani mother further suggested that riding a bike would be difficult for her '*I wear the scarf and Jilbab* [full length long sleeved dress] *so it would be hard for me to get on the bikes now, as I've decided to get into my faith more*'.

Walking was also reported as a weekend activity by a number of White British and British Pakistani families, as highlighted through the following statements *'in the decent months we go for walks and that with them, generally up the hills…we like to try keep them active'* White British mother, *'We do family activities like Roseberry topping* [part of the Cleveland hills], *a group of us might go, as the kids enjoy going with each other'* British Pakistani mother. For the small number of White British parents who had a pet dog, taking them for walks was also reported as a regular activity that their children would often participate in *'we use the cemetery a lot for walking the dog, L will happily come walk with you, although if I'm on my own with them and the dog needs walking they have no choice'.* Dog walking was not an activity reported by Pakistani parents, since relatively few British Pakistani households are dog owners.

Shopping was more frequently reported as a regular weekend activity in this sample of British Pakistani parents, as indicated in this statement made by a British Pakistani father *'it would be town with their mum on Sunday*. Although shopping was not reported by White British parents as a weekend activity, one mother describes it as forming part of an activity *'were always out and about on a Saturday…I love walking…even if it's only town, we'll walk round there, then have a meal out'*. As well as shopping, going to the cinema, eating out and taking the children to play centres were also occasional weekend activities reported by some of the British Pakistani parents *'we might go to town, the cinemas or Fun City* [indoor play centre]*…we go to Nando's and Pizza Hut'* British Pakistani mother.

A number of Pakistani parents reported less 'physical' activities forming part of their families' regular weekend routine, as indicated in the following households; *'weekends we just tend to stay in...Saturday is clean-up day… do the washing, hoover, you know clean the house and Sundays we just doss upstairs all day in our pyjamas…we might stroll round my sister's house* [round the corner] *for tea'* British Pakistani mother. *'We don't really make plans to go out, we have the family round and just tend to stay in and watch stuff on the telly'* British Pakistani father. In interviews visiting family and grandparents was frequently reported as an activity by British Pakistanis, and was reported less frequently by White British parents.

5.3.4 Ethnic Group Comparison of Self-Reported Activities on School Days

Firstly section 5.3.4 examines ethnic group differences in activity categories for the whole recalled day, for the two school (week) days. The school day will then be further examined for ethnic group differences in school break-time activities, after-school sport/exercise activities, active modes of school transport and out-of-school activities. Furthermore, as many British Pakistani children are required to attend mosque school on week day evenings, the effect this may have on the girl's physical activity behaviour is also explored.

The proportions of White British and British Pakistani girls (graph 5.3.4.1.1) self-reporting participation in each activity category on school days were largely similar between ethnic groups, with no significant differences identified between them.

5.3.4.1 Ethnic Group Comparison of Self-Reported Activities on School Days

Graph 5.3.4.1.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Self-Reporting Participation in Activities on School Days[16] [17]

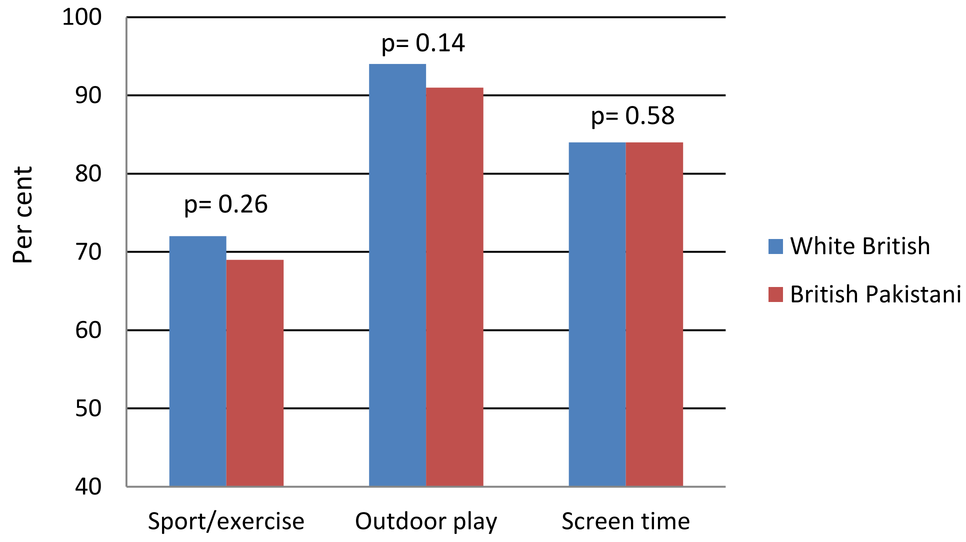


Table 5.3.4.1.2 Ethnic Group Comparison of the Mean and 95 % Confidence Intervals for the Mean Duration Spent in Self-Reported Activities on School Days by White British and British Pakistani Girls[18] [19]

	White British n=70		British Pakistani n=72		
	Mean Duration (Minutes)	Lower-Upper 95 % CI	Mean Duration (Minutes)	Lower-Upper 95 % CI	Sig. Val
Sport/exercise	34	25 – 43	28	18 – 37	0.34
Outdoor play	64	54 – 73	27	17 – 38	<0.001
Screen time	98	79 - 117	89	69 - 109	0.53

[16] Comparison of the percentage of White British and British Pakistani girls participating in self-reported activities, on at least one occasion over the two school (week) days, determined by two school days of previous day physical activity recall

[17] P. Values are derived from logistic regression controlling for season, school and year group

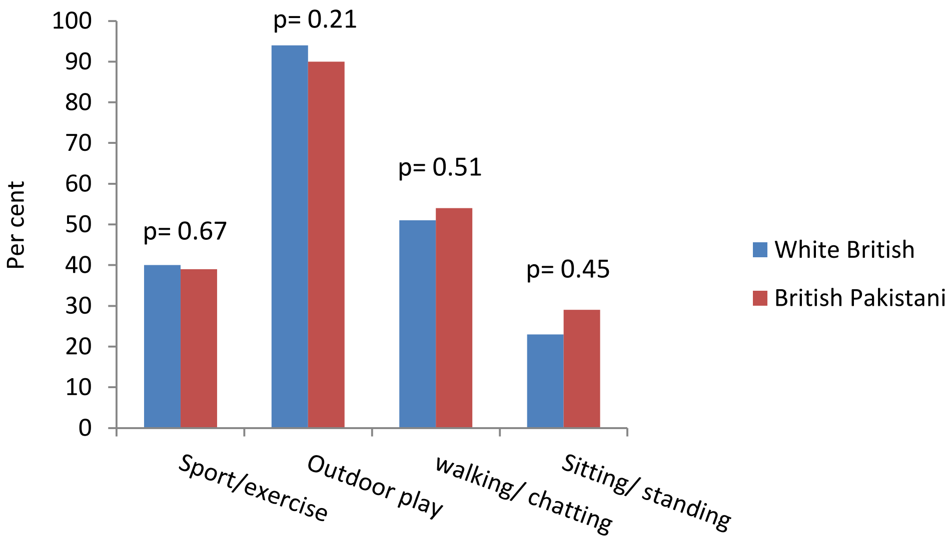
[18] Adjusted means and significance values are derived from ANOVA controlling for season, school and year group

[19] Comparison of the mean duration spent in self-reported activities on school days, determined by two school days of previous day physical activity recall

On average, White British girls reported spending an additional six minutes in sport/exercise and 37 minutes in outdoor play activities on school days, compared with British Pakistani girls (table 5.3.4.1.2). This greater difference in outdoor play activity proved statistically significant. On average, White British girls reported spending an additional 43 minutes in sport/exercise and outdoor play activities combined, compared with British Pakistani girls (p=<0.001). The average amount of screen time accumulated on school days was similar for White British and British Pakistani girls.

5.3.4.2 Ethnic Group Comparison of Self-Reported Activities during School Break-time

Graph 5.3.4.2.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Participating in Self-Reported Activities during School Break-time[20, 21]



The proportion of White British and British Pakistani girls (graph 5.3.4.2.1) self-reporting participation in each activity categories during morning break was similar, with no significant associations were observed.

[20] Ethnic group comparison of the percentage of White British and British Pakistani girls participating in self-reported activities during school break-time determine by two school days of previous day physical activity recall.

[21] P. Values are derived from logistic regression controlling for season, school and year group

Table 5.3.4.2.2 Ethnic Group Comparison of the Mean and 95 % Confidence Intervals for the Mean Duration Spent in Self-Reported Activities at School Break-time, by White British and British Pakistani Girls [22] [23] [24]

	White British n=70		British Pakistani n=72		
	Mean Duration (Minutes)	Lower-Upper 95 % CI	Mean Duration (Minutes)	Lower-Upper 95 % CI	Sig. Val
Sport/exercise	10	7 - 13	6	3 - 10	0.17
Outdoor play	24	20 - 29	19	15 - 24	0.09
Walking/chatting	8	6 - 11	5	2 - 7	0.06
Sitting/standing	2	0.5 - 4	4	1 - 6	0.13

On average, White British and British Pakistani girls (table 5.3.4.2.2) reported spending similar amounts of time in sport/exercise and sitting/standing activities during school break-time, no significant differences were identified between them. There may be some indication to suggest that White British girls spent more time in outdoor play and walking/chatting during school break-time, compared to British Pakistani girls with p values approaching significance levels for these activities. Upon combining sport/exercise, outdoor play and walking/chatting activities (table 5.3.4.2.2), White British girls reported spending, on average, an additional 12 minutes in these activities during school break-time, compared with British Pakistani girls (p=0.002).

Twelve British Pakistani girls also went home for lunch, however this was found not to affect time spent in school break-time sport/exercise (p=0.35), outdoor play (p=0.21), walking/talking (p=0.58) or sitting/standing (p=0.86) activities.

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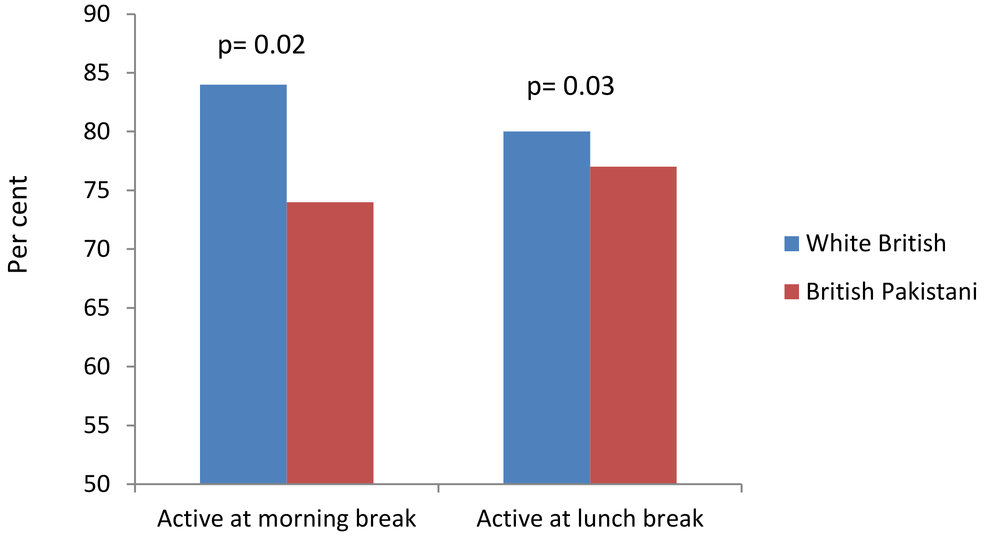
[22] Ethnic group comparison of the mean duration, in minutes, spent in self-reported activities during school break-time, determine by two school (week) days of previous day physical activity recall. there are also a number of activities that are not included within this analysis, for instance the time spent consuming the lunch time meal, jobs for teachers, practicing for performances, all of which are not included within this analysis

[23] Adjusted means and significance values are derived from ANOVA controlling for season, school, year group, temperature and rain

[24] Schools often prevent children from participating in outdoor break-times in the event of rain or when very cold; therefore rain and temperature were included, as a control variable, within the break-time physical activity ANOVA model

Graph 5.3.4.2.3 Ethnic Group Comparison of the Proportion of White British and British Pakistani Girls Classified as Active at School Break-time, as Reported in the PAQ-C [25] [26]



A significantly greater proportion of White British girls (graph 5.3.4.2.3) self-reported activity that classified them being active at morning and lunch break-times, compared with British Pakistani girls.

Despite similar proportions of White British and British Pakistani girls self-reporting participation in each activity category, findings suggest that the average duration spent in sport/exercise and outdoor play activities was slightly greater in White British girls. These differences alone only approached statistical significance. However, upon combining the average duration spent in sport/exercise and outdoor play activities a significant ethnic group difference was found, with White British girls spending more time in these activities combined, compared to British Pakistani girls. Furthermore, a greater proportion of White British girls were classified as active, during school break-times.

[25] Ethnic group comparison of the proportion of White British and British Pakistani girls classified as active at school break-times, over five school days, determined by the self-report physical activity questionnaire for children

[26] P. Values are derived from logistic regression controlling for season, school and year group, temperature and rain

5.3.4.3 Ethnic Group Comparison in the Use of Active Modes of School Transport

Graph 5.3.4.3.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Using Active Modes of School Transport [27] [28]

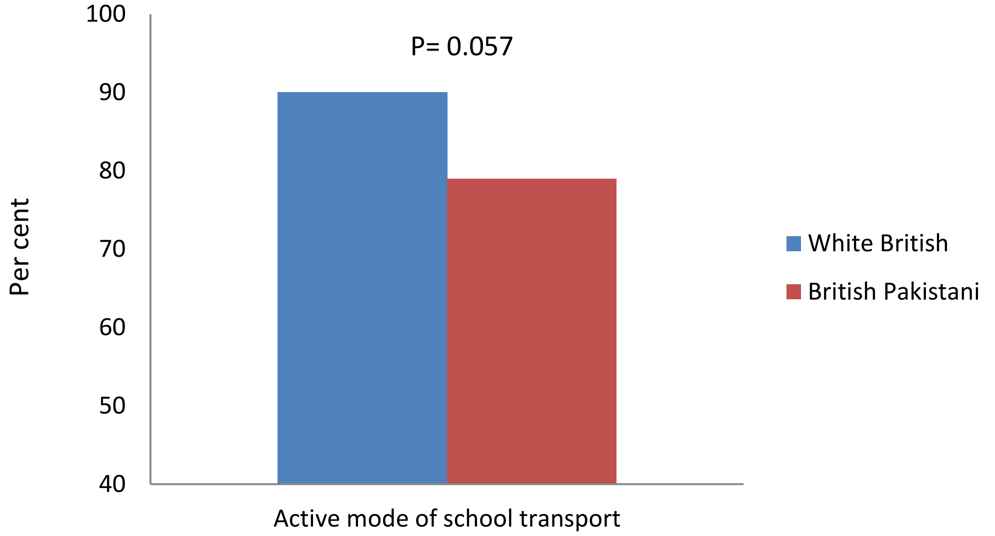


Table 5.3.4.3.2 Ethnic Group Comparison of the Mean and 95 % Confidence Intervals for the Mean Duration Spent in Active Modes of School Transport for White British and British Pakistani Girls [29] [30]

	White British n=70		British Pakistani n=72		
	Mean Duration (Minutes)	Lower-Upper 95 % CI	Mean Duration (Minutes)	Lower-Upper 95 % CI	Sig. Val
Active mode of school transport	13	11 - 16	9	6 - 12	0.04

A slightly greater proportion of White British (graph 5.3.4.3.1), compared with British Pakistani girls used active modes of school transport, however this difference only approached statistical significance.

[27] Ethnic group comparison of the percentage of White British and British Pakistani girls self-reporting using active modes of school transport, on at least one occasion over the two recalled school days, determined by previous day physical activity recall

[28] P. Values are derived from logistic regression controlling for season, school and year group

[29] Ethnic group comparison of the mean duration spent using active modes of school transport, including walking, cycling or a scooter, by White British and British Pakistani girls, determined by two school days of self-reported previous day physical activity recall.

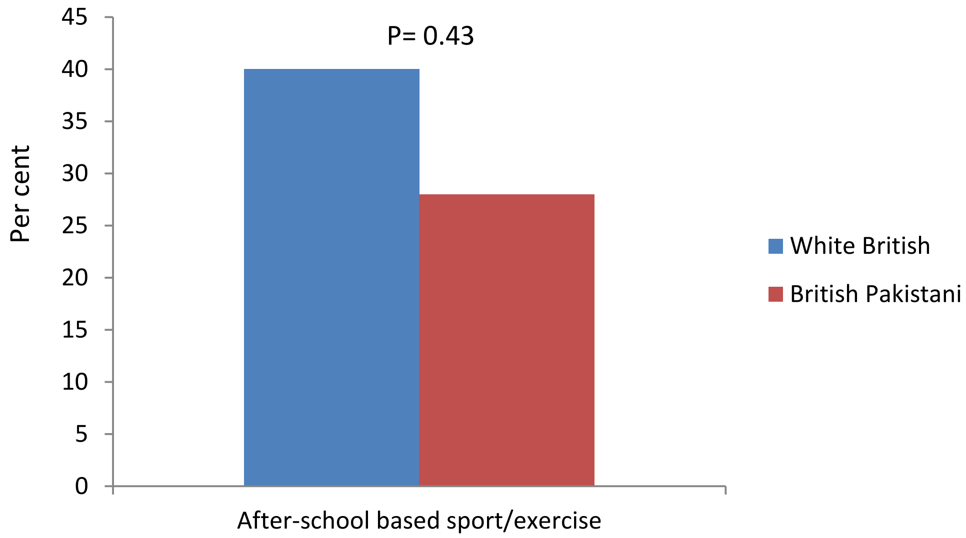
[30] Adjusted means and significance values are derived from ANOVA, after controlling for season, school and year group

On average, White British girls spent significantly more time in active modes of school transport (table 5.3.4.3.2), accumulating an additional four minutes more, per day, compared to British Pakistani girls. These findings suggest that whilst similar proportions of White British and British Pakistani girls used active modes of school transport, White British girls spent significantly more time, on average, in active school transport per day.

Modes of school transport were discussed during interviews. Walking was the most common form of active school transport, as indicated by these two White British mothers '*she's quite happy to walk to school… I walk with her …it's about ten to fifteen minutes, it's a bit quicker now she's older*', *'she's just started walking on her own, well with her friend that lives round the corner…she walks to school and back every day come rain, snow, whatever'*. Whilst active modes of school transport were a popular choice in both White British and British Pakistani households, a number of interviewees describe why they use the car to run their children to and from school '*if I'm at work I'll run her to breakfast club in the car' White British mother, 'I was doing it before* [walking the children to and from school], *but it's too much, the little one gets tired and wants carrying, it's easier to take them in the car'* British Pakistani mother.

5.3.4.4 Ethnic Group Comparison of Self-Reported Participation in After-School Based Sport and Exercise Activities

Graph 5.3.4.4.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Self-Reporting Participating in After-School Based Sport and Exercise Activities[31] [32]



Participation in after-school-based sport/exercise activities (graph 5.3.4.4.1) was slightly greater in White British, compared with British Pakistani girls, however this difference proved non-significant.

Girls' participation in after-school-based sport/exercise activities was reported by a high proportion of parents during interviews. The following statements highlight the range of different activities that have been provided by the school for the girls to participate in; *'every term the school runs a club, like dance, drama, gymnastics, usually I let them do one as they need to do something…but this term she's doing two, she's starting kickboxing on Monday'* British Pakistani mother. '*If there's activities after-school she'll be there…she does hoola-hoop on a Wednesday, she was doing gymnastics, but it kept getting cancelled…it depends what's on, what appeals to her and what her friends are doing'* White British mother. A number of parents however, reported that their daughters did not participate in

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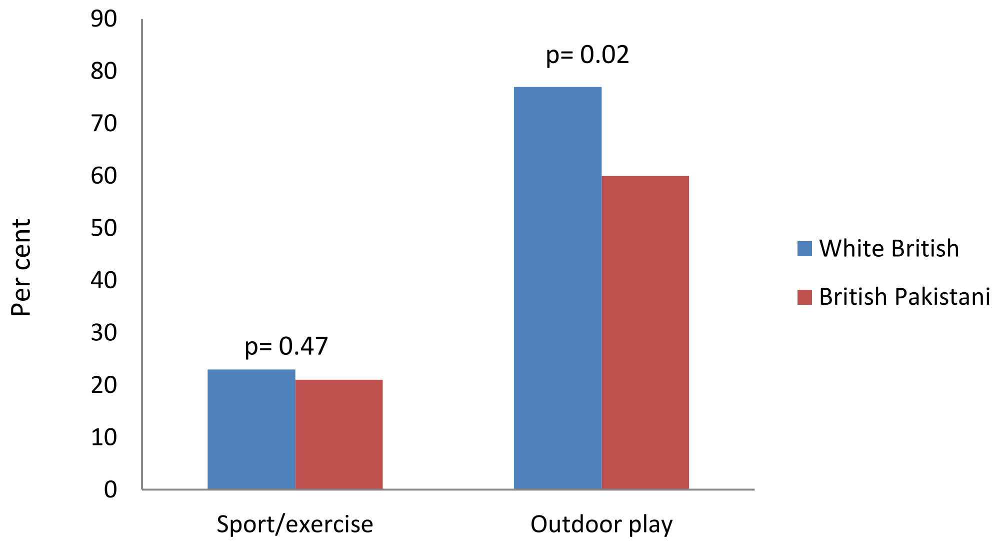
[31] Ethnic group comparison of the percentage of White British and British Pakistani girls self-reporting participation in after-school based sport and exercise activities, on at least one occasion, over the two school days, determined by previous day physical activity recall

[32] P values are derived from logistic regression controlling for season, school and year group

after-school sport/exercise activities. The following statements highlight a number of different reasons for them not doing so; '*she was getting a bit of a handful at home so I thought I would get rid of her for an hour…she enjoyed it, but she saw she was getting rewarded for being naughty so I took her out*' British Pakistani mother, '*she doesn't take part in after-school clubs, but they do stuff at the school like steel band or gymnastics… she's mentioned karate and dancing but it's always too hectic when they come back from school, they only have an hour or so before they have to go to Mosque…you could probably make time for them, but it's not something we've paid much attention to really*' British Pakistani father. One British Pakistani girl who was present during the interview stated '*I don't do after-school stuff, I like cricket, but they don't do that'.*

5.3.4.5 Ethnic Group Comparison of Participation in Self-Reported Out-of-School Activities

Graph 5.3.4.5.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Participating in Self-Reported Activities Out-of-School [33] [34]



The proportion of girls self-reporting participating in sport/exercise activities out-of-school (graph 5.3.4.5.1) was similar by ethnic group. However, a significant difference was identified between ethnic groups in participation in outdoor play activities, suggesting that a

[33] Ethnic group comparison of the percentage of White British and British Pakistani girls participating in self-reported activities out-of-school, determine by two school (week) days of previous day physical activity recall

[34] P. Values are derived from logistic regression controlling for season, school and year group

greater proportion of White British girls self-reported participation in outdoor play activity out-of-school, during the two recalled school days, compared with British Pakistani girls.

Table 5.3.4.5.2 Ethnic Group Comparison of the Mean and 95 % Confidence Intervals for the Mean Duration Spent In Self-Reported Activities Out-Of-School for White British and British Pakistani Girls [35] [36]

	White British n=70		British Pakistani n=72		
	Mean Duration (Minutes)	Lower-Upper 95 % CI	Mean Duration (Minutes)	Lower-Upper 95 % CI	Sig. Val
Sport/exercise	10	4 - 17	8	1 - 16	0.71
Outdoor play	41	32 - 50	10	-0.1 - 20	<0.001

The amount of sport/exercise activity accumulated out-of-school (table 5.3.4.5.2) was similar in both ethnic groups. However, White British girls accumulated significantly more outdoor play activity out-of-school compared to British Pakistani girls, with an average of 31 minutes difference per day, between ethnic groups. On average, White British girls accumulated an additional 33 minutes in sport/exercise and outdoor play activities combined out-of-school, compared to British Pakistani girls (p=<0.001).

Participation in sport/exercise activities out-of-school was reportedly low in both ethnic groups, with no significant differences identified between them. There were however, significant ethnic group differences identified in outdoor play activities, suggesting that White British girls were more likely to report participation in this activity category and spend significantly more time in outdoor play activities out-of-school, compared to British Pakistani girls.

On school day evenings a number of White British parents reported that their daughters regularly participated in community based sport/exercise activities. However, in a small number of cases a variety of other activities were also incorporated into their school day evenings, as this one White British mother describes *'she's at Brownies Monday, Tuesday*

[35] Ethnic group comparison of the mean duration, in minutes, spent in self-reported activities out-of-school for White British and British Pakistani girls, determined by two school (week) days of previous day physical activity recall.

[36] Adjusted Means and significance values are derived from ANOVA, after controlling for season, school and year group

she's dancing, Wednesday she does singing and piano, we're never in'. Apart from after-school-based activities, British Pakistani parents who were interviewed did not report their daughters participating in any regular structured activities on school day evenings.

A small number of parents reported participation in sport/exercise activities, such as football on an evening after-school *'every night she'll come home and go out to play, playing football...she's always out and she's always coming home all sweaty and red'* White British mother. However, sport/exercise activities such as football and cricket were generally reported as activities that were played with friends in the street or nearby field or park, as identified by previous statements.

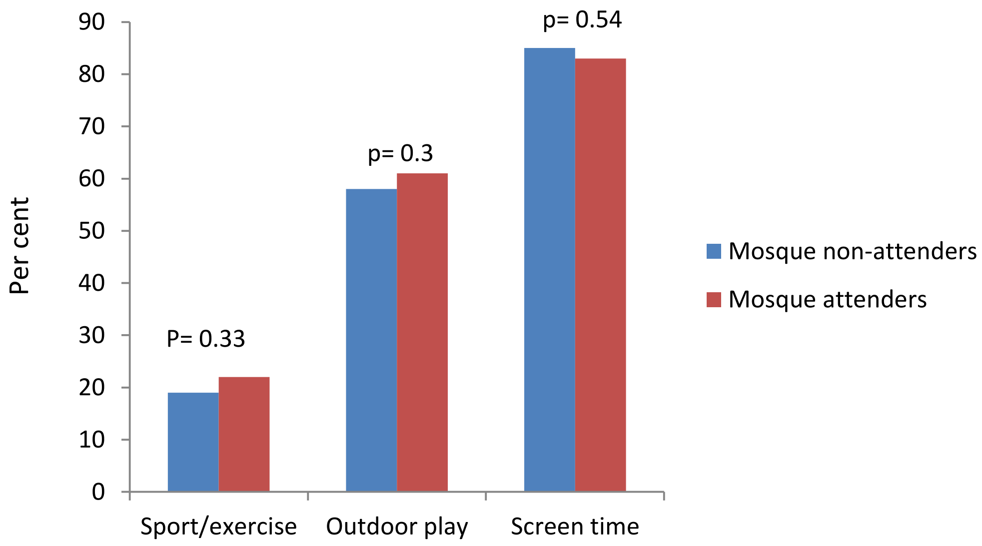
It was common for White British parents to report that their daughters would play outdoors on an evening after-school. The following statements highlight some of the different after-school outdoor play activities they regularly participate in: '*she plays out on her scooter or she might go out on her bike*' White British mother *'She has a trampoline out the back, she's always on that or we might go for a walk…she's at her dad's two nights through the week, she plays out more there, she has lots of friends round there'* White British mother. Although these activities were less frequently reported by British Pakistani parents, one mother suggested her daughter regularly participated in outdoor play activities on an evening, '*when she comes in from Mosque at six-thirty she has her dinner then plays in the garden…she has her skates and her bike, her cousins play out too, for one hour, then she comes back in'* British Pakistani mother.

Screen time was not generally discussed as an evening activity by parents. However, one White British mother talked about how the TV formed part of a regular activity pattern on school days *'the TV gets turned on for about half an hour before they go to school, they put the telly on when they come in and it gets switched off when we have our meal, then they will play out, then when they come in the telly goes back on'*. Whereas another mother suggests her children watch TV on an evening as there's nothing else for them to do '*there's not much to do round here after mosque, it's just TV*' British Pakistani mother.

5.3.4.5 Attendance at Evening Mosque School and Participation in Self-Reported Activities

Mosque school generally takes place on week day evenings, for approximately one and a half to two hours, between the hours of four and seven pm. Sixty-five per cent (n=48) of British Pakistani girls attended mosque school, on at least one occasion, over the two recalled school days.

Graph 5.3.4.5.1 The Proportion of Non-Mosque Attendees and Mosque Attendees (Pakistani Girls Only) Participating in Self-Reported Activities Out-Of-School [37] [38]



The proportion of Pakistani girls (graph 5.3.4.5.1) self-reporting participation in sport/exercise, outdoor play and screen time activities out-of-school were similar for non-mosque and mosque attendees, thus no significant differences were found.

[37] The percentage of non-mosque attendees and mosque attendees (Pakistani girls only) participating in self-reported activities out-of-school determined by two school (week) days of previous day physical activity recall.

[38] P. Values are derived from logistic regression controlling for season, school and year group

Table 5.3.4.5.2 Mean Duration Spent in Self-Reported Activities Out-Of-School for Pakistani Girls, who were Non-Attendees and Attendees at Evening Mosque School, on School (Week) Day Evenings[39] [40]

	Non-attendees at Mosque n=26		**Attendees at Mosque n=48**		
	Mean Duration (Minutes)	Lower-Upper 95 % CI	Mean Duration (Minutes)	Lower-Upper 95 % CI	**Sig Val**
Sport/exercise	6	-9 - 20	7	-8 - 19	0.91
Outdoor play	17	8 - 26	9	1 - 17	0.07
Screen time	74	43 - 104	55	29 - 82	0.22

Mean time spent in sport/exercise out-of-school (graph 5.3.4.5.2) was similar in Pakistani girls, who were non-attendees and attendees at mosque school on school day evenings, thus no significant differences were identified. However, these results provide some indication to suggest that attendance at mosque school may affect time available for outdoor play. Non-mosque attendees, on average, reported spending slightly more time in outdoor play, this difference approached statistical significance. However, non-attendees at mosque school also reported slightly higher screen-time, although this difference proved small and non-significant. These findings indicate that despite mosque school taking place on week day evenings, this was not a strong influence on the girl's activity behaviour.

To support these findings a small number of Pakistani parents implied that activities can be made to fit around mosque school and that mosque school, to a certain extent, can fit around after-school sport/exercise activities, as indicated in the following statements *'She does after-school sports once a week, so that day she's off from Mosque, as she has to do a two hour reading session four till six pm, they are alright with her missing that day, they have their own kids so they understand, they don't mind'* British Pakistani mother, *'My girls don't start till four thirty* [Mosque school] *so they go to after school clubs for half an hour then they come home, quickly eat something and get dressed and go, it's like rush, rush, rush'* British Pakistani mother. Also along these lines, one Pakistani mother indicates that

[39] Comparison of the mean duration, in minutes, spent in self-reported activities out-of-school for Pakistani girls only, who were non-attendees and attendees at evening mosque school, on school (week) day evenings.

[40] Adjusted means and significance values are derived from ANOVA controlling for season, school and year group

although mosque school does take up a good part of her children's week day evenings, there is still time to take part in physical activities *'mosque does take up take up a lot of my kids spare time, but they do after-school activities and they can play out after mosque…during the school holidays mosque school is moved to during the day'.* However, girls' attendance at Mosque school and after-school structured activities is likely to vary depending on individual parental attitudes towards mosque education and physical activity.

5.4 Discussion

This study found ethnic group differences in self-reported physical activity behaviour, which suggest that White British girls spent, on average, significantly more time in 'out-door play' and were more likely to travel on foot or by bicycle to school compared with British Pakistani girls. These differences in activity behaviour are likely associated with the greater accumulation of objectively measured physical activity also observed in White British girls, compared with British Pakistani girls in chapter four.

Values associated with the Islamic religion, which are commonly practiced by British Pakistanis, can significantly influence how they behave and live their daily lives (chapter one section 1.5). Adhering to these values can have an effect on their overall physical activity levels and can influence their participation in sport and exercise. Whilst it is important to consider practices associated with these values when examining their physical activity, it is also important not to over generalise, as great variation in how these values are put into practice, particularly in the West, is to be expected.

5.4.1 Ethnic Group Comparison of Overall Physical Activity and Sedentary Behaviour

Ethnic group comparisons of physical activity behaviour suggest that White British girls, on average, spent more time in sports/exercise activities compared with British Pakistani girls. There is much stronger evidence, however, to suggest a significant ethnic group difference in outdoor play activities, with White British girls self-reporting spending more time, on average, in these types of activities compared to British Pakistani girls. Previous studies have found time spent outdoors to be a significant predictor of physical activity (Cooper et al., 2010) and moderate to vigorous physical activity (Cleland et al., 2010) in children. Therefore, we can assume that this greater difference in out-door play activities, between ethnic groups, is likely to be a main source of the ethnic group differences observed in objectively measured physical activity previously in chapter four.

The *Health Survey for England* 2004 also reported on ethnic group differences in self-reported sports and exercise and active play in children. It identified that a greater proportion of the general population girls participated in sports/exercise and for a longer duration of time, compared to British Pakistani girls. Evidence from this current study indicate some small differences in sport/exercise participation and duration between ethnic groups, which may stem from a greater uptake of community-based sport/exercise activity classes, such as dance and gymnastics, by White British girls. Furthermore, the *Health Survey for England* 2004 also report that a slightly greater proportion of White British girls participated in active play, compared to British Pakistani girls, with the average duration spent in this activity 6.4 and 3.6 hours, per week, respectively, suggesting that White British girls spent almost twice as much time in active play compared to Pakistani girls. Evidence from this current study support these findings, with White British girls also reporting spending almost twice the amount of time in outdoor play, compared to British Pakistani girls, which averaged 50 and 26 minutes, per day, respectively, the equivalent to 5.8 and 3.0 hours per week respectively.

Studies reporting on ethnic group differences in activity behaviours of adults in the UK found that British Pakistani women were less likely than the general population of women to report participation in sports and exercise (Sproston and Mindell, 2006), including cycling and swimming (Hayes et al., 2002). Unlike the White British parents, none of the British Pakistani parents from the current interview sample made reference to cycling as an activity that they participate in. This may suggest that cycling was an uncommon activity for this sample of British Pakistani parents. In addition, just one British Pakistani parent made reference to her daughter riding a bike, which may indicate that the uptake of cycling activity is also low in British Pakistani girls, although further evidence would be warranted to confirm this notion.

A number of review articles (Sallis and Prochaska et al., 2000, Van Der Horst et al., 2007; Hinkley et al., 2008) have found evidence to suggest that parental physical activity is a predictor for children’s levels of physical activity, indicating that children with inactive parents are more likely to be inactive themselves. If this evidence is correct, the low levels of physical activity observed in British Pakistani adults may predict low levels of physical activity in British Pakistani children. Furthermore, this evidence may suggest that the poor uptake of specific physical activities, such as participation in sports and exercise activities, including swimming and cycling, found in British Pakistani parents, may predict a low uptake of these activities in their children.

Low levels of physical activity, however, are not a feature specific to Pakistanis living in the UK; Jafar et al. (2008) examined data from a large scale survey carried out in urban Pakistan and found that, on average, children spent a little over half an hour in physical activity per day. They also found that almost one third of children did no exercise at all out-of-school and girls were less physically active than boys. Although, girls are, in general, less physically active than boys (Sallis and Prochaska et al. 2000; Van der Horst et al. 2007), the gender differences reported by Jafar et al may be more exacerbated since, until recently, government rulings in Pakistan did not allow females to participate in sport, in public (Espncricinfo, 2005). It is likely that negative attitudes towards female participation in sport are still present in Pakistan, as well as here in the UK, which would undoubtedly influence the overall physical activity levels of Pakistani girls today.

Physical barriers to participation in physical activity by British Pakistani women and girls were highlighted within the findings of this study. It was suggested by one British Pakistani mother that her Islamic dress was unsuitable for participating in exercise, particularly cycling. Muslim women may choose to wear Islamic dress such as the *jilbab* (long sleeved full-length dress) or *shalwar-qamis* (loose trousers and long sleeved blouse) and *hijab* (head-scarf). Wearing this type of dress, which meets the expectations of *purdah* in keeping the body, arms and legs covered, can prove problematic when it comes to participating in physical activity. In further support of this notion, similar issues were highlighted in a study by Carroll and Hollinshead (1993), which investigated ethnic conflict surrounding participation in secondary school physical education, and found that it was not the activity itself that was seen as the problem, rather the way Muslim girls were required to dress for physical activity. However, since this type of dress is generally worn by females after reaching puberty, this was not yet something experienced by many of the young girls involved within this current study.

White British and British Pakistani girls, however, reported accumulating similar amounts of screen-time, suggesting that both ethnic groups spent, on average, equal amounts of time in activities such as watching TV, playing on game-consoles and/or the computer. Similarities in screen-time activities do not help to explain the significant ethnic group difference in objectively measured sedentary time presented in chapter four. Khunti et al. (2007) investigated sedentary behaviours of White European and South Asian secondary school children, in relation to TV, computer and video viewing. In line with findings from this current study, Khunti et al identified no significant differences between ethnic groups. Thus evidence from both studies implies that differences in objectively measured sedentary time are likely to stem from elsewhere.

This study identified that spending time with relatives was more frequently reported as an activity by British Pakistani girls, in comparison to White British girls. During interviews, British Pakistani parents made reference to sedentary types of activities taking place during visits, including watching television, playing on games consoles and sitting chatting. A further study by Hayes et al. (2002) examining ethnic differences in adults in North-East England, identified that compared to White Europeans, a significantly greater proportion of South Asian women reported that their day time activity consisted of mainly sitting with relatively little walking. It is possible that activities such as spending time with relatives and high periods of sitting are linked and, if confirmed, may be a predictor for the higher levels of sedentary time observed in British Pakistani girls. A study reported by Cleland et al. (2010), investigating environmental influences on children's time spent outdoors, found that playing outdoors provides children with greater social opportunities. However, if Pakistani girls are gaining socialisation though spending time interacting with relatives indoors, they may have less desire to venture outside to fulfil this need.

5.4.2 Ethnic Group Comparisons of Weekend Physical Activity and Sedentary Behaviour

This study further explored ethnic group differences in physical activity and sedentary behaviour on weekend days, to help determine why British Pakistani girls had significantly lower levels of objectively measured physical activity and higher levels of sedentary time, on these days, compared to White British girls. This chapter shows that the proportion of girls reporting participation in sport/exercise, outdoor play and screen time, measured by previous day physical activity recall, did not differ significantly by ethnic group. However, further examination of participation in sports/exercise activities, over both weekend days, using the PAQ-C, did find a significant ethnic group difference, suggesting that White British girls reported participating in more sports/exercise activities over the weekend, compared to British Pakistani girls. This discrepancy in findings between methods may indicate that White British girls were more likely to participate in sports/exercise on Saturdays compared to Sundays. Furthermore, this chapter found ethnic variations in self-reported time spent in sport/exercise and outdoor play on Sundays. However, despite White British girls reporting spending almost half an hour more in sports/exercise on these days, this difference did not prove statistically significant.

There was however, much stronger evidence to support a significant ethnic group difference in the amount of time spent in outdoor play, with White British girls reporting spending almost 40 minutes more in this activity category, on Sundays, compared with British Pakistani girls. Whilst the additional time spent in sport/exercise activities may play a role in understanding how White British girls accumulated significantly more objectively measured physical activity on weekend days. These findings suggest that outdoor play is likely to be the main contributor to the increased levels of physical activity found in white British girls on a weekend day.

Literature examining patterns of physical activity behaviours of South Asian populations in the UK is extremely limited, making comparison to additional studies difficult. However, one study reported by Hayes et al. (2002) measured ethnic group differences in weekend activity behaviour, in terms of average miles walked and cycled, per day, by adult Europeans and South Asians. Significant ethnic differences were identified, with a greater proportion of European adults reporting walking and cycling longer distances on weekend days, compared to adult South Asians. A small number of parents referred to family bike rides as a weekend activity in this sample of White British interviewees, however this was not an activity reported by British Pakistani interviewees.

Interview findings reported in this current study also provide some indication of ethnic group differences in sports/exercise activities on Sundays, with dance and gymnastics both seeming popular weekend activities for White British girls, but not for British Pakistani girls. A study by Carrington et al. (1987), investigating gender, leisure and sport in young South Asians in north-east England, found that regular participation in sport, such as football, cricket, gymnastics and dance was minimal in South Asian females. It is possible that the low uptake of community based sport, such as dancing and gymnastics, observed in this sample of British Pakistani girls, may be associated with the social and religious values and practices of British Pakistanis.

Swimming was reported as a popular weekend activity, for girls, by this sample of White British and British Pakistani interviewees. These findings are in line with those reported by Carrington et al. who found that whilst swimming was by no means a regular activity, it was one of the more popular activities reported by South Asian females. Swimming is viewed as particularly problematic in relation to *purdah*, because of its mixed sex environment and issues towards maintaining dress code. In this present study interview statements made by a small number of Pakistani mothers suggested reluctance in joining mixed-sex swimming sessions, which further support this notion. However, these mothers also indicated that they were willing to take their daughters to the female only sessions or that the fathers would take them, which meant these girls were able to participate in swimming activity. Furthermore, as it is likely that many of the girls involved in this study had not yet reached puberty, maintenance of *purdah* is likely to be less relevant, thus suggesting that the girl's participation in swimming activity is not so much of an issue at this young age.

The study reported by Carrington et al. was carried out in 1987 and may, in reality, provide a better reflection of childhood activity behaviour within this sample of Pakistani parents. Previous studies have recognised that parent's physical activity levels can influence those of their children (Sallis and Prochaska et al., 2000; van der Horst et al., 2007; Hinkley et al., 2008). It may also be expected that the types of activities parents participate in currently or as a child may have some influence on the types of activities their children participate in. Therefore if Pakistani mothers are unaccustomed or reluctant for reasons relating to *purdah* to participate in certain sport/exercise activities, such as swimming, cycling or dance, this may consequently influence uptake of these activities in their children.

A study reported by Lawton et al. (2006) investigating barriers towards physical activity in South Asian women, highlights that there is a lack of socialization into sport/exercise in South Asian females which results in the low uptake of these kinds of activities in this population. Furthermore, Sriskantharajah and Kai (2007) identified similar notions suggesting that South Asian women generally perceive sport and exercise as a western practice, which is not recognised as part of their culture. Therefore, based on this evidence, the lack of exercise culture within South Asian adult populations will have a negative influence on that of the child and without parental support of activities, uptake is likely to be low.

This study also identified that White British girls spent more time in outdoor play on a weekend compared to British Pakistani girls. It was reported by a number of White British parents that on weekend days their daughters were given the freedom to play at the park unsupervised, this however was not something reported by British Pakistani parents. A study reported by Carver et al. (2010), investigating parental restrictions on children's physical activity outdoors, identified a negative relationship between parents who placed restrictions and moderate to vigorous physical activity, particularly in girls. Such findings may indicate that girls with parents who are less restrictive of where they play are more likely to spend a greater amount of time outdoors being physically active.

Carroll and Hollinshead (1993) found that Pakistani (Muslim) parents who maintain a strong faith may place certain restrictions upon their children, particularly their daughters, preventing them from going out on their own. Parents were reluctant to allow their daughter to be out alone because of concern about them developing social relationships with boys, which would damage not only their reputation, but also their marriage prospects. Evidence of this concern was highlighted in a statement made by a British Pakistani mother in this present study, which implied that she did not allow her daughters to play outdoors due to worries about them mixing with boys. Although these practices may be more strongly applied to girls from puberty onwards, they may also play a role in restrictive behaviour towards younger girls. This is supported by the British Pakistani mother, whose concern did not distinguish between her daughters by their age, but seemed to apply to all. Further investigation, however, into parental attitudes surrounding unsupervised outdoor play is warranted before conclusions can be drawn.

5.4.3 Ethnic Group Comparison of School Day Physical Activity and Sedentary Behaviour

This chapter also investigated ethnic group differences in school day patterns of physical activity and sedentary behaviours in relation to sports/exercise, outdoor play and screen-time. Ethnic group comparisons suggest that similar proportions of White British and British Pakistani girls reported participation in sports/exercise, outdoor play and screen time activities. Furthermore, it was found that ethnic group differences in average duration spent in sports/exercise and screen time activities were small and non-significant. However, there was much stronger evidence to support a significant ethnic group difference in outdoor play, with White British girls averaging an additional 37 minutes more in this activity category on school days, compared to British Pakistani girls.

5.4.3.1 Ethnic Group Comparison of Break-time Activities

School break-time offers children equal opportunity to be physically active, with activity accumulated during this period having being found to providing important contribution to children's overall daily physical activity levels (Ridgers et al., 2006). Findings presented in chapter four confirm that the average break-time duration for both White British and British Pakistani girls was 66 minutes per day. White British girls spent significantly more time in objectively measured moderate to vigorous physical activity and less time in sedentary time during breaks, compared with British Pakistani girls. Findings from this study suggest that self-reported participation in sport/exercise, outdoor play and sitting/standing activities were similar, between ethnic groups, during school break-time. There was some slight indication towards ethnic group differences in the average length of time spent in outdoor play and walking/chatting activities during school break-time; however these differences only approached significance levels. Further investigation, combining sport/exercise, outdoor play and walking/chatting activities, did prove statistically significant, suggesting that White British spent significantly more time being physically active during school break-time, compared to British Pakistani girls. These findings are in line with the greater levels of objectively measured moderate to vigorous physical activity previously identified in chapter four. Furthermore, they also provide some explanation into the significantly greater accumulation of steps identified in White British girls during-school, compared with British Pakistani girls.

To further support findings of ethnic group differences in school break-time activity, PAQ-C data, assessing physical activity behaviour during morning and lunch time break, suggest that a significantly greater proportion of White British girls self-reported participation in activities that classified them as being active, during both of these periods. Sedentary time, sitting/standing shows no significant difference between ethnic groups and therefore indicates that assessment of this activity category alone does not account for British Pakistani girls spending a significantly greater percentage of their school break-time in objectively measured sedentary time, which was previously identified in chapter four.

Khunti et al. (2007) also investigated ethnic differences in adolescent girl’s participation in activity during school break-times, where it was identified that only a very small proportion eight and seven per cent respectively of White European and South Asian girls participated in any sport activity during these periods, with no significant differences identified between them, whereas chatting with friends was a more popular activity in both ethnic groups. Variation between studies in the proportion of White British and British Pakistani girls participating in sport/exercise activities and the proportion of White European and South Asian girls reporting participation in sport activity may come from the difference in measurement techniques. However, it is also possible that this difference may support a reduction in participation of sport activities during break-time with the transition from primary to secondary school. Findings reported by Khunti et al further identified that active behaviour, in terms of participation in sport activities, was more evident in younger pupils.

5.4.3.2 Ethnic Group Comparison of the Use of Active Modes of School Transport

Studies have consistently found that children using active modes of school transport, such as walking and cycling, have higher levels of physical activity compared to those who use inactive modes of school transport such as the car (Cooper et al., 2005; Saksvig et al., 2007; Owen et al., 2012; Slingerland et al., 2012). Therefore encouraging children to use active modes of school transport is an important opportunity to increase their daily physical activity. This study found that a slightly greater proportion of White British to British Pakistani girls reported using active modes of school transport, although this difference only approached statistical significance. Stronger evidence was identified supporting significant ethnic group differences in the time spent in active modes of school transport, with White British girls accumulating an additional four minutes per day in active modes of school transport, such as walking or cycling/scootering, compared to British Pakistani girls. These findings may indicate that White British girls were perhaps more inclined to use active modes of transport to travel longer distances to school than British Pakistani girls.

Studies have previously identified that an increased living distance from the school can lead to an increase in the use of motorized school transport in British school children (Page et al., 2010; Owen et al., 2012). This notion cannot be confirmed in this current sample of girls since travelling distance from home to school was not assessed. A small number of studies however, have investigated ethnic differences in modes of school transport. A study reported by Owen et al. (2012) examined ethnic differences in travel to school in 9 to 10 year old children, which identified that White European children were more likely to walk or cycle to school, whereas South Asian children were more likely to travel by car. Furthermore, in their sample of secondary school children Khunti et al. (2007) support these findings, showing that White European children were more likely to walk or cycle to school than South Asian children.

Currently there is no literature directly investigating why South Asian children are less likely to use active modes of school transport than White British children. There is however, a study by Khunti et al. (2008) that reports on staff perspectives of physical activity behaviour in South Asian secondary school children. They found that parents prefer to take their children to school in the car rather than allowing them to walk. As previously indicated by Carroll and Hollinshead (1993), some South Asian parents may be less willing to allow their daughters to travel anywhere by themselves, due to the implications it may have on a family's honour. Such a belief is likely to reduce participation in active modes of school transport by Pakistani girls. However, further investigation within this field is warranted to confirm this notion.

Evidence supports a greater use of active modes of school transport in White children. Given that active modes of school transport significantly increases children's daily physical activity levels, it is likely that the ethnic group differences identified surrounding active modes of school transport in this present study are associated with school day differences in objectively measured physical activity previously identified in chapter four.

5.4.3.3 Ethnic Group Comparison of Participation in After-School Sports and Exercise Activities

Children's participation in after-school clubs has been associated with significantly increased levels of physical activity (King et al., 2011). Therefore identifying potential ethnic group differences in participation in after-school sport/exercise activities may help to identify how White British girls had higher levels of objectively measured physical activity out-of-school compared to British Pakistani girls. This study found that although a slightly greater proportion of White British girls participated in after-school sport/exercise activities this difference did not reach statistical significance. This suggests that participation in after-school sport/exercise activities was not a main source of the ethnic group differences in objectively measured physical activity previously identified in chapter four. These findings perhaps indicate a strong influential role of the school in relation to the girls' participation in sport/exercise activities. Participation in sport/exercise activities on weekend days is likely to involve parental influence and organisation, unlike after-school based activities in which the school is responsible for organisation.

The similar participation rates in after-school based sport/exercise activities also indicate the possibility of attitudes towards exercise for girls in the British Pakistani population are undergoing social change, partly under the influence of British social institutions such as schools. Williams et al. (2011) reports on intergenerational differences in participation rates of physical activity, with British born South Asians accumulating higher measures of physical activity compared with migrant South Asians. Such findings imply the adoption of more westernised attitudes towards participation in physical activity by British born South Asians. Furthermore, this change in attitude is likely to persist in future British born South Asians, which in time may help bridge the gap in physical activity participation between South Asian and White British populations.

5.4.3.4 Ethnic Group Comparison of Out-of-School Activities

This chapter further explored ethnic group differences in sport/exercise and outdoor play activities out-of-school to help determine why White British girls had higher levels of objectively measured physical activity within this time frame, compared to British Pakistani girls. This study identified that both the proportion of girls reporting participation and the average duration spent in sport/exercise activities, out-of-school, was largely similar between ethnic groups. The proportion of girls self-reporting participation in sport/exercise activity out-of-school was low in both ethnic groups. A greater proportion of White British and British Pakistani girls reported participating in outdoor play out-of-school. There was also strong evidence of ethnic group differences in this activity category during this time frame, with significantly more White British girls reporting participation in outdoor play out-of-school, compared with British Pakistani girls. Furthermore, a significant ethnic group difference in the average duration spent in this activity category was also identified. From examining ethnic group differences in activity behaviour out-of-school, findings suggest that outdoor play is likely to play a significant role in the increased measures of objectively measured physical activity observed in White British girls previously in chapter four.

In contrast to findings presented in this current study, Khunti et al. (2007) in their sample of secondary school girls found no significant differences in the proportion of White European and South Asian girls self-reporting participation in any activity behaviour, which included brisk walking, jogging, cycling, sport, dancing, on a school day evening. However, Khunti et al did not distinguish between sport/exercise and outdoor play activities in this older sample of girls, which may be a contributing factor towards these discrepancies in study findings.

This study also investigated whether attending mosque school on week day evenings was a predictor for participation in sport/exercise, outdoor play and screen time, as well as the amount of time spent in each of these activities out-of-school. Attendance at mosque proved non-significant in predicting lower participation in sport/exercise, outdoor play and screen time activities out-of-school. Mosque attendance also proved non-significant in predicting lower mean duration spent in sport/exercise, and screen time between British Pakistani girls out-of-school. However, there was some indication to suggest that evening mosque attendance may affect outdoor play, with the small increased duration in this activity in non-mosque attendees approaching statistical significance. However, this sample size was small and therefore warrants further investigation. As attendance at mosque school on week day evenings did not significantly affect the physical activity behaviour of Pakistani girls, we would not expect it to account for the lower levels of objectively measured physical activity identified in Pakistani girls out-of-school, in chapter four. Qualitative findings reported by Khunti et al. (2008) indicated that mosque school attendance on a week day evening was suggested as a potential barrier towards participation in physical activity by South Asian pupils. However, in this present study British Pakistani interviewees suggest that children’s participation in school based sport/exercise activities seemed to be unaffected by attendance at Mosque, with parents suggesting these two activities could be made to fit in with each other, thus supporting the quantitative findings of this current study.

5.5 Conclusion

Ethnic group comparisons of physical activity and sedentary behaviour have provided some insight into why British Pakistani girls have lower objectively measured physical activity compared to White British girls. Outdoor play, weekend participation in sport/exercise and active modes of school transport were each identified as significant determinants of ethnic group differences in objectively measured physical activity in this sample of white British and British Pakistani girls. Screen time however, did not differ between the groups and does not explain the higher objectively measured sedentary time evident in British Pakistani girls. Therefore further investigation into other types of sedentary activities is warranted.

Discussing findings of physical activity behaviour of British Pakistani girls in relation to Islamic religious expectations provides important understanding into why these variations in physical activity and sedentary behaviour are occurring. Information regarding objectively measured physical activity and sedentary time, physical activity and sedentary behaviours of British Pakistani girls, in addition to cultural understanding of why these variations occur are essential in providing knowledge to health care providers in the planning of effective, culturally appropriate health interventions to increase physical activity and reduce sedentary time in these populations as a means to reduce disease risk later in life.

Chapter Six: Characterising Ethnic Differences in Dietary Intake of White British and British Pakistani Girls

6.1 Background

Examining ethnic group differences in dietary intake of White British and British Pakistani girls may provide important clues to the increased cardiometabolic risk found in the latter. However, literature examining dietary intake of British South Asian children is limited. Furthermore, since there is good reason to expect differences in dietary intake between South Asian groups, focusing on specific South Asian subgroups is important, and may also provide some explanation of the differences in cardiometabolic risk between them.

6.2 Aims

This chapter reports on the results and discusses the findings in relation to total daily energy and macronutrient intake.

6.3 Hypothesis

Based on evidence from the literature review (chapter one) I aim to test the hypothesis;

- British Pakistani girls will have a significantly greater daily mean intake of fat, when measured as a percentage of energy intake, compared to White British girls

6.4 Results

6.4.1 Description of the Study Sample

A total of 164 girls, n=82 White British; n=82 British Pakistani, aged 9 to 11 years, participated in the dietary assessment study. One hundred and sixty-one girls (n=82 White British, n=79 British Pakistani) of the total study sample met the three day criteria for dietary recalls (one weekend/two week day). The mean age of the total dietary sample was 9.9 (SD 0.7) years (White British = 9.9 (SD 0.7) years; British Pakistani= 10.0 (SD 0.7) years). The distribution of the study sample across schools, year group and season is summarised in tables 6.4.1.1 and 6.4.1.2.

Table 6.4.1.1 Description of the Study Sample Composition Comparing White British and British Pakistani Girls by School and Year Group

		White British	British Pakistani	All Girls
		n (%)	n (%)	n (%)
School 1	Year 5	6 (7)	8 (10)	14 (7)
	Year 6	0	5 (6)	5 (3)
	Total	6 (7)	13 (16)	19 (10)
School 2	Year 5	4 (5)	20 (25)	24 (15)
	Year 6	0	6 (8)	6 (4)
	Total	4 (5)	26 (33)	30 (19)
School 3	Year 5	18 (22)	11 (14)	29 (18)
	Year 6	0	0	0
	Total	18 (22)	11 (14)	29 (18)
School 4	Year 5	10 (12)	6 (8)	16 (10)
	Year 6	0	0	0
	Total	10 (12)	6 (8)	16 (10)
School 5	Year 5	8 (10)	12 (15)	20 (12)
	Year 6	7 (9)	10 (13)	17 (11)
	Total	15 (18.5)	22 (28)	37 (23)
School 6	Year 5	10 (12)	0	10 (6)
	Year 6	4 (5)	1 (1)	5 (3)
	Total	14 (17)	1 (1)	15 (9)
School 7	Year 5	7 (9)	0	7 (4)
	Year 6	8 (10)	0	8 (5)
	Total	15 (18.5)	0	15 (9)
Total	Year 5	63 (77)	57 (72)	120 (75)
	Year 6	19 (23)	22 (28)	41 (25)
		82 (100)	79 (100)	161 (100)

Table 6.4.1.2 Description of the Study Sample Composition Comparing White British and British Pakistani Girls by Season

	White British	British Pakistani	All Girls
	n (%)	n (%)	n (%)
Summer	39 (48)	48 (61)	87 (54)
Winter	43 (52)	31 (39)	74 (46)
	82 (100)	79 (100)	161 (100)

Recruitment numbers by ethnicity varied by school (chi-square p=<0.001), but not by year group (p=0.3) or season (p=0.06). Dietary intake of all girls (n=161) is examined by school, year group and season in section 6.4.3.

Background data were missing for some children due to questionnaires being returned incomplete. Background information taken from parental questionnaires are summarised in tables 6.4.1.3 to 6.4.1.6. Differences between the groups were as described in section 4.4.1 for the physical activity sample. Pakistani families were significantly more likely to have a greater number of adults living in the household than White British families (table 6.4.1.6). In Pakistani households, mothers were always the main food preparers, while in a few White British families, fathers or grandparents were the main food preparers.

Table 6.4.1.3 Summary of Background Information Comparing White British and British Pakistani Girls

		White British	British Pakistani
		n (%)	n (%)
***First Language n=160	English	82 (100)	59 (76)
	Punjabi/Urdu	0	19 (24)
*Parental Marital Status n=156	Married/Cohabiting	41 (50)	55 (70)
	Single/Separated	41 (50)	24 (30)
***Children (U18) in Household n=155	1	19 (23)	4 (5)
	2 or 3	51 (62)	40 (51)
	≥4	12 (15)	35 (44)

*** Significant by chi-square test ≤ 0.001
*Significant by chi-square test ≤ 0.05

Table 6.4.1.4 Summary of Background Information Comparing White British and British Pakistani Mothers

		White British	British Pakistani
		n (%)	n (%)
***Country of Birth n=155	UK	82 (100)	33 (45)
	Pakistan	0	40 (55)
***Years UK Resident n=148	From Birth	82 (100)	33 (50)
	≥ 16 Years	0	19 (28)
	11 - 16 Years	0	9 (14)
	≤ 10 Years	0	5 (8)
***First Language n=157	English	82 (100)	30 (40)
	Punjabi/Urdu	0	45 (60)
*Age Left Full Time Education n=136	≤16 Years	55 (73)	33 (54)
	≥17 Years	20 (27)	28 (46)
***Employment Status n=153	FT/PT Employed/Student	44 (56)	12 (16)
	Unemployed/Sick	18 (23)	10 (14)
	Housewife/Look After Home	17 (22)	52 (70)

*** Significant by chi-square test ≤ 0.001
*   Significant by chi-square test ≤ 0.05

Table 6.4.1.5 Summary of Background Information Comparing White British and British Pakistani Fathers

		White British n (%)	British Pakistani n (%)
***Country of Birth n= 146	UK	81 (100)	30 (46)
	Pakistan	0	35 (54)
***Years UK Resident n=133	From Birth	77(100)	29 (52)
	≥ 16 Years	0	17 (30)
	11 - 16 Years	0	5 (9)
	≤ 10 Years	0	5 (9)
***First Language n=147	English	82 (100)	27 (42)
	Punjabi/Urdu	0	38 (58)
***Age Left Full Time Education n=98	≤16 Years	40 (85)	20 (39)
	≥17 Years	7 (15)	31 (61)
Employment Status n=110	FT/PT employed/student	40 (83)	49 (79)
	Unemployed/Sick	7 (15)	11 (18)
	Housewife/Look After Home	1 (2)	2 (3)

*** Significant by chi-square test ≤ 0.001

Table 6.4.1.6 Summary of Background Information Regarding the Number of Adults, Aged 18 Years and Over, and the Main Food Preparer within each Household

		White British n (%)	British Pakistani n (%)
***Number of adults in house-hold n=141	1	23 (30)	12 (19)
	2	47 (61)	37 (58)
	≥3	7 (9)	15 (23)
*Main food preparer n=154	Mother	72 (90)	74 (100)
	Father	6 (8)	0
	Grandparent	2 (2)	0

*** Chi-square significant at ≤0.001
*Chi-square significant at ≤0.005

6.4.2 Overall Mean Daily Dietary Intake and Patterns of Mean Dietary Intake of all Girls in this Study

Determining mean daily dietary intakes is important in understanding the role of diet in relation to disease risk in different populations. Identifying patterns in dietary intake is important in the planning of effective health intervention.

Results reporting on mean daily dietary intake in relation to total energy and macro-nutrient intake, for all girls in this study (n=161) are summarised in table 6.4.2.1. Results reporting on mean daily dietary intake on weekend days (6.4.2.2); school days (6.4.2.3); during-school (6.4.2.4) and out-of-school (6.4.2.5) are also summarised.

Table 6.4.2.1 Overall Mean, Standard Deviation and Median, Daily Dietary Intake for the Total Study Sample

	All girls n= 161		
Outcome	**Mean**	**S.D**	**Median**
Energy (kJ)	8518.4	2481.3	8161.1
Energy (kcal)	2037.9	593.6	1952
Fat (g)	78.9	25.8	73.8
Fat (% energy)	*34.7*	*4.2*	*34.1*
Saturated fat (g)	27.6	9.8	25.7
Saturated fat (% energy)	*12.1*	*2.4*	*11.7*
Carbohydrate (g)	287.2	89.5	270.9
Carbohydrate (% energy)	*52.8*	*4.9*	*53.7*
Sugars (g)	135.5	55.8	121.8
Sugars (% energy)	*24.6*	*5.5*	*25.1*
Total Fibre (g)	18.2	5.9	17
Protein (g)	62.8	17.8	62.1
Protein (% energy)	*12.5*	*2.0*	*12.8*

The mean total daily energy intake of all girls in this study (table 6.4.2.1) exceeded the current UK recommendations of 1740 Kcal / 7218 KJ per day for girls aged 7 to 10 years (Department of Health, 1991).

Table 6.4.2.2 Mean, Standard Deviation and Median for Total Dietary Intake for Sunday for the Total Study Sample

	All girls n=161		
	Mean	**S.D**	**Median**
Energy (kJ)	8244.5	3153.2	7532.3
Energy (kcal)	1972.4	754.3	1802.0
Fat (g)	77.1	35.8	68.1
Fat (% energy)	*34.3*	*7.2*	*33.9*
Saturated fat (g)	26.2	14.0	23.1
Saturated fat (% energy)	*11.6*	*3.9*	*11.3*
Carbohydrate (g)	277.5	111.6	249.7
Carbohydrate (% energy)	*53.9*	*8.2*	*54.1*
Sugars (g)	130.5	69.8	114.2
Sugars (% energy)	*24.8*	*7.9*	*24.7*
Total Fibre (g)	17.9	7.7	17.3
Protein (g)	59.4	23.0	55.5
Protein (% energy)	*12.5*	*3.0*	*12.3*

Table 6.4.2.3 Mean, Standard Deviation and Median for Total Dietary Intake for School Days for the Total Study Sample

	All girls n=161		
	Mean	**SD**	**Median**
Energy (kJ)	8655.3	2587.2	8168.6
Energy (kcal)	2070.7	618.9	1954.2
Fat (g)	79.8	26.8	74.8
Fat (% energy)	*34.6*	*4.6*	*34.6*
Saturated fat (g)	28.2	10.4	26.7
Saturated fat (% energy)	*12.3*	*2.7*	*11.9*
Carbohydrate (g)	292.1	94.3	273.3
Carbohydrate (% energy)	*52.8*	*5.4*	*52.9*
Sugars (g)	138.1	58.9	127.2
Sugars (% energy)	*24.6*	*6.1*	*24.4*
Total Fibre (g)	18.3	6.6	17.1
Protein (g)	64.5	19.5	63.3
Protein (% energy)	*12.6*	*2.3*	*12.6*

Mean total dietary intake was examined separately for Sundays (table 6.4.2.2) and school days (6.4.2.3). Mean energy intake exceeded current recommendations on both weekend and school days. On average, the total study sample consumed 98 Kcal / 410 KJ more, per day, on school days, compared to weekend days. A paired sample t-test found this difference to border statistical significance (p=0.055). No significant differences were identified (by paired sample t-test) between mean intakes of macronutrients, fat, saturated fat, carbohydrates, sugar, fibre and protein, when measured as either absolute intake or as a proportion of total energy intake, on Sundays, compared to school days.

The standard deviation is greater on Sundays, compared to school days. This suggests a greater variability between subject in intakes of total energy and macronutrients, fat, saturated fat, carbohydrates, sugar, fibre and protein on Sundays, compared to school days. This reflects either, between subject variation in dietary intake or greater reporting error due to dietary intake data derived from a single day of data (Sunday), as opposed to two school days.

Table 6.4.2.4 Mean, Standard Deviation and Median for Total Dietary Intake During-School Hours (09:00-15:00) on School Days for the Total Study Sample

	All girls n=161		
	Mean	**SD**	**Median**
Energy (kJ)	2618.0	854.2	2542.1
Energy (kcal)	626.3	204.4	608.2
Fat (g)	25.4	10.6	24.7
Fat (% energy)	*36.0*	*7.6*	*36.4*
Saturated fat (g)	8.2	4.1	7.6
Saturated fat (% energy)	*11.9*	*4.7*	*11.5*
Carbohydrate (g)	83.7	30.7	80.6
Carbohydrate (% energy)	*50.1*	*8.7*	*50.9*
Sugars (g)	32.8	17.9	29.5
Sugars (% energy)	*19.3*	*8.2*	*17.9*
Total Fibre (g)	6.2	4.3	5.5
Protein (g)	21.0	7.4	20.6
Protein (% energy)	*13.9*	*4.4*	*13.2*

Table 6.4.2.5 Mean, Standard Deviation and Median for Total Dietary Intake Out-of-School Hours on School Days for the Total Study Sample

	All girls n=161		
	Mean	**SD**	**Median**
Energy (kJ)	6051.3	2254.3	5643.7
Energy (kcal)	1447.7	539.3	1350.2
Fat (g)	54.5	23.4	51.1
Fat (% energy)	*33.8*	*6.0*	*34.1*
Saturated fat (g)	20.1	9.2	18.4
Saturated fat (% energy)	*12.4*	*3.2*	*12.2*
Carbohydrate (g)	208.9	83.3	193.2
Carbohydrate (% energy)	*54.1*	*7.0*	*54.4*
Sugars (g)	105.7	55.2	96.2
Sugars (% energy)	*26.8*	*8.7*	*26.9*
Total Fibre (g)	12.4	5.3	11.4
Protein (g)	43.3	16.8	43.1
Protein (% energy)	*12.1*	*2.7*	*12.0*

Total mean energy intake and mean intakes of macronutrients, fat, saturated fat, carbohydrates, sugar, fibre and protein, measured as both absolute and a proportion of total energy intake were explored separately for during-school hours (table 6.4.2.4) and out-of-school hours (6.4.2.5). Mean energy intake during school hours contributed approximately 30% to the total mean energy intake on school days.

In conclusion, whilst this study has identified mean total daily dietary intake, it has also highlighted patterns of dietary intake, both of which contribute to our current understanding of energy and macronutrients in this sample of girls of mixed ethnicity.

6.4.3 Environmental and Socio-Demographic Factors Association with Dietary Intake

Identifying whether environmental and socio-demographic factors were associated with dietary intake in this sample of girls is necessary before examining data for ethnic group differences in dietary intake. This will allow us to control for any possible determinants of dietary intake, which will allow us to provide more accurate analysis of ethnic group differences in dietary intake.

Dietary intake will be examined using an ANOVA model including environmental and socio-economic variables, season, school and year group (section 6.4.3) to determine whether any of these variables were significantly associated with dietary intake within this sample of girls.

6.4.3.1 Season

Dietary intake may vary depending on the time of year/season. Comparisons were made between dietary intake data collected during summer and winter.

Table 6.4.3.1.1 Significance Values for Season as a Predictor of Dietary Intake Determined by ANOVA Controlling for School and Year Group

	Overall Mean	Sunday	School Day	During-school	Out-of-School
Energy (kJ)	0.58	0.09	0.8	0.83	0.8
Energy (kcal)	0.56	0.09	0.8	0.83	0.8
Fat (g)	0.95	0.29	0.52	0.48	0.77
Fat (% energy)	*0.2*	*0.57*	*0.18*	***0.02***	*0.78*
Saturated fat (g)	0.82	0.45	0.36	0.38	0.65
Saturated fat (% energy)	*0.12*	*0.42*	*0.12*	*0.08*	*0.62*
Carbohydrate (g)	0.39	0.09	0.91	0.2	0.84
Carbohydrate (% energy)	*0.23*	*0.94*	*0.15*	***0.004***	*0.84*
Sugars (g)	0.74	0.45	0.99	0.42	0.9
Sugars (% energy)	*0.73*	*0.4*	*0.76*	*0.22*	*0.97*
Total Fibre (g)	0.15	**0.02**	0.69	0.22	0.72
Protein (g)	0.57	**0.03**	0.56	0.18	0.85
Protein (% energy)	*0.84*	*0.21*	*0.41*	*0.07*	*0.96*

Seasonal variations in overall mean daily dietary intake and patterns of mean daily dietary intake on weekend, school days, during-school and out-of-school were limited (table 6.4.3.1.1). A small number of significant variations however, were found in absolute intake of fibre and protein on weekend days, and carbohydrate, measured as a percentage of energy intakes during-school hours, all of which were greater during summer months (data not shown). A significant difference was also found for fat, measured as a percentage of energy intakes, also during-school hours, which suggests a greater intake of fat was evident during-school hours during the winter (data not shown), compared to the summer.

Seasonal variations in nutrient intake during-school hours may reflect changes to the types of meals on offer or selected for school lunches during winter and summer months, as well as a possible change in the proportions of children consuming either school or packed lunches by season. Children may be more likely to consume hot cooked school lunches during the colder winter months and packed lunches during the warmer summer months.

Due to a small number of significant differences identified in dietary intake by season, and since it is common practice for dietary studies to control for season when data collection spans the different times of year (Donin et al., 2010), season was controlled for within analysis investigating ethnic group differences in dietary intake.

6.4.3.2 School

School may act as a determinant of dietary intake depending on school lunch policies and the provision of snacks and drinks during school break-time. It is also possible that differences in dietary intake between schools may also be a reflection of socio-economic or ethnic differences, since ethnicity was previously found to vary significantly by school in this study sample (section 6.4.1).

Table 6.4.3.2.1 Significance Values for School as a Predictor of Dietary Intake Determined by ANOVA Controlling for Season and Year Group

	Overall Mean	Sunday	School Day	During-School	Out-of-School
Energy (kJ)	**0.001**	**0.002**	**0.003**	**0.004**	**<0.001**
Energy (kcal)	**0.001**	**0.002**	**0.003**	**0.004**	**<0.001**
Fat (g)	**0.004**	**0.02**	**0.02**	**0.06**	**0.02**
Fat (% energy)	**0.05**	**0.04**	0.15	0.27	0.36
Saturated fat (g)	**0.001**	**0.009**	**0.003**	**0.01**	**0.007**
Saturated fat (% energy)	**0.01**	**0.05**	0.07	0.15	0.41
Carbohydrate (g)	**<0.001**	**0.001**	**0.001**	**0.001**	**<0.001**
Carbohydrate (% energy)	0.1	**0.04**	0.33	**0.02**	0.23
Sugars (g)	**<0.001**	**<0.001**	**<0.001**	**0.007**	**<0.001**
Sugars (% energy)	**0.007**	**0.03**	**0.03**	0.2	**0.04**
Total Fibre (g)	**0.04**	**0.003**	0.21	0.32	**0.06**
Protein (g)	**0.007**	**0.01**	**0.017**	**0.005**	**0.02**
Protein (% energy)	0.13	0.42	0.17	**<0.001**	0.31

School was a strongly associated with total mean daily dietary intake and intake on Sunday, school days, during-school and out-of-school. The fact that school was strongly associated with mean dietary intake on Sundays and during out-of-school hours in this sample of girls suggests that school was acting as a proxy for an unmeasured variable such as socio-economic status or ethnicity. To conclude, these findings suggest that school was strongly associated with dietary intake in this sample of girls and it was therefore included in models when investigating ethnic group differences in dietary intake.

6.4.3.3 Year Group

Children's dietary intake is expected to vary by age due to children's energy and nutrient requirements increasing with age (Department of Health, 1991). Therefore, investigating the effect of this factor is essential.

Table 6.4.3.3.1 Significance Values for Year Group as a Predictor of Dietary Intake Determined by ANOVA Controlling for Season and School

	Overall Mean	Sunday	School Day	During-school	Out-of-School
Energy (kJ)	0.08	0.4	**0.06**	0.99	**0.02**
Energy (kcal)	0.11	0.4	**0.06**	0.99	**0.02**
Fat (g)	0.11	0.6	**0.03**	0.8	**0.02**
Fat (% energy)	0.41	0.99	0.2	0.7	0.2
Saturated fat (g)	0.13	0.5	0.09	0.99	**0.05**
Saturated fat (% energy)	0.85	0.7	0.9	0.8	0.6
Carbohydrate (g)	0.22	0.3	0.2	0.9	0.1
Carbohydrate (% energy)	0.21	0.8	**0.05**	0.9	**0.04**
Sugars (g)	0.75	0.8	0.8	0.8	0.7
Sugars (% energy)	**0.04**	0.3	**0.01**	0.7	**0.01**
Total Fibre (g)	**0.03**	0.3	**0.02**	0.3	**0.01**
Protein (g)	**0.02**	0.6	**0.004**	0.8	**<0.001**
Protein (% energy)	0.13	0.4	**0.05**	0.8	**0.01**

Year group was significantly associated with overall mean daily intake of sugar, when measured as a proportion of energy intake, as well as absolute intakes of fibre and protein. Year group was not significantly associated with dietary intake on Sundays or during-school hours. There were however, significant differences found between the year groups for mean intakes of energy; carbohydrates and sugar, when measured as a percentage of energy intake; and absolute measures of fat, fibre and protein on school days. In addition, significant differences were also found between year groups for mean intakes of energy, carbohydrates and sugar, when measured as a percentage of energy intake, and absolute measures of fat, saturated fat, fibre and protein, on school days and during out-of-school hours. These findings therefore suggest that year group should be controlled for when investigating ethnic group differences in dietary intake**.**

6.4.3.4 Socioeconomic Status

Socio-economic status; determined by the age of the child's mother when she left full time education (table 6.4.1.4), the best available measure for socioeconomic status, was added to a final model with a reduced sample size (n=138) because this variable was not available for all girls. ANOVAs were conducted controlling for age mother left full time education; season; school and year. However, this variable proved non-significant within this sample of girls and was therefore excluded from further models.

6.4.3.5 Conclusion

Season, school and year group were each found to be significantly associated with dietary intake within this sample of girls. Therefore they were each included in the final ANOVA model that aims to investigate ethnic group differences in dietary intake in this sample of girls.

6.4.4 Ethnic Group Comparisons of Mean Dietary Intake

Section 6.4.4 examines ethnic group differences in overall mean daily dietary intake and patterns (Sunday; school (week) days; during-school and out-of-school) of dietary intake in relation to total energy intake and macronutrients; fat, saturated fat; carbohydrates; sugar and protein, measured as both absolute intake and as a percentage of total energy intake. Fibre is presented as absolute intake only. All analyses examining ethnic group differences in dietary intake were conducted using ANOVA, controlling for season, school and year group.

6.4.4.1 Ethnic Group Comparisons of Overall Mean Daily Dietary Intake

Total mean daily intake of energy was similar between White British and British Pakistani girls (table 6.4.4.1.1), as were absolute intakes of macronutrients; fat, saturated fat, carbohydrates; sugar; fibre and protein. There was however a significant ethnic group difference identified in fat, when measured as a percentage of total mean daily energy intakes. This suggests that British Pakistani girls gained a significantly greater percentage of daily energy from fat, compared to White British girls. Intake of all other macronutrients; saturated fat; carbohydrates; sugar and protein, when measured as a percentage of daily energy was similar between White British and British Pakistani girls.

6.4.4.2 Ethnic Group Comparisons of Mean Daily Dietary Intake on Sunday and School Days

Total dietary intake on Sunday (table 6.4.4.2.1) and mean intake on school days (x2) (table 6.4.4.2.2), including intake of energy and macronutrients; fat; saturated fat; carbohydrates; sugar and protein, measured as both absolute intake and as a percentage of total daily energy intake was similar, as was absolute intake of fibre, in both White British and British Pakistani girls, with no significant differences identified between them.

6.4.4.1.1 Ethnic Group Comparison of Mean and 95% Confidence Intervals for Overall Mean Daily Dietary Intake of White British and British Pakistani Girls, Aged 9 – 11 Years, Living on Teesside[41] [42]

	White British n = 82			**British Pakistani n = 79**			
	Mean	Lower 95% CI	Higher 95% CI	Mean	Lower 95% CI	Higher 95% CI	**Sig. Value**
Energy (kJ)	8171.6	7563.1	8780.1	8443.0	7773.9	9112.1	0.6
Energy (kcal)	1965.2	1821.2	2109.3	2016.2	1860.0	2172.4	0.7
Fat (g)	73.9	67.5	80.3	79.8	72.8	86.8	0.2
Fat (% energy)	*33.8*	*32.8*	*34.9*	*35.5*	*34.3*	*36.6*	***0.04***
Saturated fat (g)	26.8	24.4	29.2	27.3	24.7	30.0	0.8
Saturated fat (% energy)	*12.3*	*11.7*	*12.9*	*12.2*	*11.5*	*12.8*	*0.8*
Carbohydrate (g)	278.9	257.0	300.7	282.0	258.0	306.0	0.9
Carbohydrate (% energy)	*53.5*	*52.3*	*54.7*	*52.4*	*51.0*	*53.7*	*0.2*
Sugars (g)	132.3	119.0	145.6	134.1	119.5	148.7	0.9
Sugars (% energy)	*25.1*	*23.8*	*26.4*	*24.6*	*23.1*	*26.0*	*0.6*
Total Fibre (g)	17.1	15.6	18.6	17.8	16.1	19.4	0.5
Protein (g)	61.0	56.6	65.5	61.2	56.3	66.0	1.0
Protein (% energy)	*12.7*	*12.2*	*13.1*	*12.2*	*11.6*	*12.7*	*0.1*

[41] Adjusted means and significance values are determined by ANOVA controlling for season, school and year group

[42] Mean energy and macronutrient intake derived from three days (Sunday and two school days) of previous day multiple pass diet recall

6.4.4.2.1 Ethnic Group Comparison of Mean and 95% Confidence Intervals for Mean Dietary Intake on Sundays for White British and British Pakistani girls, Aged 9 – 11 Years, Living on Teesside[43] [44]

	White British n = 82			British Pakistani n = 79			
	Mean	Lower 95% CI	Higher 95% CI	Mean	Lower 95% CI	Higher 95% CI	**Sig. Value**
Energy (kJ)	7755.5	6976.0	8535.0	8285.4	7428.3	9142.5	0.4
Energy (kcal)	1855.4	1668.9	2041.9	1982.2	1777.1	2187.2	0.6
Fat (g)	71.2	62.2	80.2	81.0	71.1	90.9	0.1
Fat (% energy)	*33.5*	*31.7*	*35.3*	*35.7*	*33.7*	*37.7*	*0.1*
Saturated fat (g)	24.8	21.3	28.3	27.1	23.2	30.9	0.4
Saturated fat (% energy)	*11.5*	*10.6*	*12.5*	*12.1*	*11.0*	*13.2*	*0.4*
Carbohydrate (g)	261.8	234.3	289.2	271.0	240.8	301.2	0.7
Carbohydrate (% energy)	*54.2*	*52.1*	*56.3*	*52.5*	*50.2*	*54.8*	*0.3*
Sugars (g)	122.1	105.1	139.1	130.1	111.5	148.8	0.5
Sugars (% energy)	*24.6*	*22.6*	*26.5*	*25.0*	*22.8*	*27.1*	*0.8*
Total Fibre (g)	16.9	14.9	18.8	17.3	15.2	19.4	0.7
Protein (g)	58.1	52.3	63.9	59.3	52.9	65.6	0.8
Protein (% energy)	*13.0*	*12.3*	*13.8*	*12.4*	*11.6*	*13.3*	*0.3*

[43] Adjusted means and significance values are determined by ANOVA controlling for season, school and year group.

[44] Mean energy and macronutrient intake derived from one day (Sunday) of previous day multiple pass diet recall

6.4.4.2.2 Ethnic Group Comparison of Mean and 95% Confidence Intervals for Mean Dietary Intake on School Days of White British and British Pakistani girls, Aged 9 – 11 Years, Living on Teesside [45] [46]

		White British n = 82			**British Pakistani n = 79**		
	Mean	Lower 95% CI	Higher 95% CI	Mean	Lower 95% CI	Higher 95% CI	**Sig. Value**
Energy (kJ)	8379.6	7739.7	9019.5	8521.8	7818.2	9225.4	0.8
Energy (kcal)	2004.7	1851.6	2157.8	2038.7	1870.4	2207.0	0.8
Fat (g)	75.2	68.5	81.9	79.2	71.9	86.6	0.4
Fat (% energy)	*33.7*	*32.6*	*34.9*	*35.0*	*33.7*	*36.2*	*0.2*
Saturated fat (g)	27.8	25.2	30.4	27.5	24.6	30.3	0.9
Saturated fat (% energy)	*12.6*	*11.9*	*13.2*	*12.1*	*11.4*	*12.9*	*0.4*
Carbohydrate (g)	287.4	264.2	310.7	287.5	261.9	313.0	1.0
Carbohydrate (% energy)	*53.6*	*52.3*	*55.0*	*52.9*	*51.4*	*54.4*	*0.5*
Sugars (g)	137.4	123.2	151.5	136.0	120.5	151.6	0.9
Sugars (% energy)	*25.4*	*23.9*	*26.8*	*24.7*	*23.1*	*26.3*	*0.5*
Total Fibre (g)	17.2	15.5	18.9	18.0	16.2	19.9	0.5
Protein (g)	62.5	57.7	67.3	62.1	56.8	67.4	0.9
Protein (% energy)	*12.7*	*12.1*	*13.2*	*12.2*	*11.6*	*12.8*	*0.3*

[45] Adjusted means and significance values are determined by ANOVA controlling for season, school and year group

[46] Mean energy and macronutrient intake derived from two school (week) days of previous day multiple pass diet recall

6.4.4.3 Ethnic Group Comparisons of Mean Dietary Intake During-School and Out-of-School

Total mean energy intake during-school hours only was similar in both White British and British Pakistani girls (table 6.4.4.3.1), as were absolute intake of macronutrients; fat; saturated fat; carbohydrates; sugar and protein. There was however a significant ethnic group difference identified in absolute fibre intake, with British Pakistani girls consuming significantly more fibre during-school hours compared to White British girls. Macronutrient intake; fat; saturated fat and sugar, when measured as a percentage of total energy intake was similar by ethnic group. However, there were significant ethnic group differences found in carbohydrates and protein when measured as a percentage of energy intakes, which suggests that British Pakistani girls were gaining a significantly greater percentage of energy for carbohydrates, on school days, during-school hours, compared with White British girls. Whereas, White British girls gained a significantly greater percentage of energy from protein during-school hours compared with British Pakistani girls.

Total mean energy intake, on school days, during out-of-school hours was similar by ethnic group (table 6.4.4.3.2). Absolute intakes of macronutrients; fat; saturated fat; carbohydrates; sugar; fibre and protein were also similar by ethnic group, with no significant differences found between them. Fat intake, however, when measured as a percentage of total energy intakes, was slightly greater in British Pakistani girls; when compared to White British, British Pakistani girls gained, on average, an additional 2.2% more of their total energy intake from fat. This difference however, only approached statistical significance. Intakes of other macronutrients; saturated fat; carbohydrates; sugar and protein, measured as a percentage of total energy intakes were similar by ethnic group, with no significant differences identified between them.

6.4.4.3.1 Ethnic Group Comparisons of Mean and 95% Confidence Intervals for Dietary Intake During-School Hours (09:00-15:00) for White British and British Pakistani girls, Aged 9 – 11 Years, Living on Teesside[47] [48]

	White British n = 82			British Pakistani n = 79			
	Mean	Lower 95% CI	Higher 95% CI	Mean	Lower 95% CI	Higher 95% CI	**Sig. Value**
Energy (kJ)	2695.6	2487.2	2904.1	2749.2	2519.9	2978.4	0.7
Energy (kcal)	644.9	595.0	694.8	657.7	602.9	712.5	0.7
Fat (g)	26.5	23.9	29.1	25.9	23.0	28.8	0.8
Fat (% energy)	*36.7*	*34.8*	*38.6*	*34.8*	*32.7*	*36.9*	*0.2*
Saturated fat (g)	8.8	7.7	9.8	8.4	7.3	9.5	0.6
Saturated fat (% energy)	*12.2*	*11.0*	*13.4*	*11.4*	*10.1*	*12.8*	*0.4*
Carbohydrate (g)	84.2	76.7	91.7	91.0	82.8	99.2	0.2
Carbohydrate (% energy)	*48.7*	*46.6*	*50.9*	*52.2*	*49.9*	*54.6*	***0.03***
Sugars (g)	33.5	29.1	38.0	35.9	31.0	40.8	0.5
Sugars (% energy)	*19.3*	*17.1*	*21.4*	*20.3*	*18.0*	*22.6*	*0.5*
Total Fibre (g)	5.2	4.1	6.3	7.1	5.9	8.2	**0.02**
Protein (g)	22.7	20.9	24.5	20.7	18.7	22.7	0.2
Protein (% energy)	*14.5*	*13.5*	*15.6*	*12.9*	*11.7*	*14.0*	***0.04***

[47] Adjusted means and significance values are determined by ANOVA controlling for season, school and year group

[48] Mean energy and macronutrient intake during school are derived from two school (week) days of previous day multiple pass diet recall

6.4.4.3.2 Ethnic Group Comparison of Mean and 95% Confidence Intervals for Dietary Intake Out-of-School Hours for White British and British Pakistani girls, Aged 9 – 11 Years, Living on Teesside[49 50]

	White British n = 82			British Pakistani n = 79			
	Mean	Lower 95% CI	Higher 95% CI	Mean	Lower 95% CI	Higher 95% CI	**Sig. Value**
Energy (kJ)	5666.4	5117.9	6215.0	5784.9	5181.7	6388.1	0.8
Energy (kcal)	1355.6	1224.4	1486.8	1384.0	1239.6	1528.3	0.8
Fat (g)	48.7	42.8	54.6	53.5	47.1	60.0	0.3
Fat (% energy)	*32.4*	*30.9*	*33.9*	*34.6*	*32.9*	*36.2*	*0.06*
Saturated fat (g)	19.0	16.7	21.3	19.2	16.7	21.8	0.9
Saturated fat (% energy)	*12.8*	*12.0*	*13.6*	*12.5*	*11.6*	*13.4*	*0.6*
Carbohydrate (g)	201.9	181.9	221.9	197.3	175.3	219.3	0.8
Carbohydrate (% energy)	*55.6*	*53.8*	*57.4*	*53.7*	*51.8*	*55.7*	*0.2*
Sugars (g)	103.3	90.2	116.4	100.5	86.1	114.9	0.8
Sugars (% energy)	*28.0*	*25.9*	*30.1*	*27.0*	*24.7*	*29.3*	*0.5*
Total Fibre (g)	11.7	10.4	13.1	11.5	10.0	13.0	0.8
Protein (g)	40.0	35.8	44.1	40.7	36.1	45.3	0.8
Protein (% energy)	*12.0*	*11.4*	*12.7*	*11.8*	*11.1*	*12.5*	*0.6*

[49] Adjusted means and significance values are determined by ANOVA controlling for season, school and year group

[50] Mean energy and macronutrient intake out-of-school are derived from two school (week) days of previous day multiple pass diet recall

6.5 Discussion

To my knowledge, this study is the first to provide ethnic group comparisons of dietary intake with a specific focus on White British and British Pakistani girls. Whilst previous literature has investigated ethnic differences in dietary intake of White European and South Asian children of a similar age (Donin et al., 2010), and provided comparisons of dietary intake between the South Asian subgroups; Indian; Pakistani and Bangladeshi, these findings were not subject to statistical analysis against white Europeans. Nor did Donin et al. take into account gender differences in dietary intake within ethnic groups.

The main findings from this study suggest that compared to White British girls, British Pakistani girls have a greater total mean daily intake of fat, when measured as a percentage of total mean daily energy intake. Study findings will now be discussed in relation to current literature.

6.5.1 Ethnic Group Comparison of Overall Mean Daily Energy Intake

Findings from this study suggest that total mean daily energy intake did not differ between white British and Pakistani girls aged 9 to 11 years living on Teesside. Previous literature investigating ethnic differences in daily energy intake in adult populations are inconsistent in their findings with no reliable pattern of energy intake identifiable between them (Smith et al., 1993; Sevak et al., 1994; Vyas et al., 2003 and Anderson et al., 2005) .

A study by Donin et al. (2010) was the first to report on ethnic differences in the nutritional composition of the diet of 9 to 10 year old children in the UK. In contrast to current findings, Donin et al found that total mean daily energy intake was significantly greater in South Asian children, compared to White European children. Donin et al also found that Pakistani children had the highest total mean energy intake of the South Asian subgroups, however differences were small and non-significant.

Findings from Donin et al. (2010) suggest that compared to White British children, on average, South Asian children consumed an additional 408 kJ/97 Kcal, and Pakistani children an additional 559 kJ/133 Kcal per day. In this present study, ethnic group differences in total mean daily energy intake (41 Kcal) were much smaller and did not reach statistical significance.

In line with findings reported by Donin et al. (2010) total mean energy intake of White British and British Pakistani girls exceeded the current recommended UK dietary guidelines of 1740 Kcal, per day, for children of this age (Department of Health, 1991). However, when compared to Donin et al excess total mean energy intake was far higher in this sample of girls, with White British and British Pakistani girls exceeding recommended intake of energy by 225 and 276 Kcal, per day, respectively. Excess intake of energy is adversely associated with excess weight gain and this excessive amount of energy intake reported by this sample of girls, if real and persistent, is likely to lead to overweight and obesity in this population. Teesside has high rates of childhood obesity (North East Public Health Observatory, 2012), therefore findings from this sample of White British and British Pakistani girls provides supporting evidence linking this excessive energy intake to the high obesity rates also within the local area.

It is also possible, however that reported total mean energy intake is subject to a degree of over reporting error. Although the method used to collect dietary data from this sample of children was selected as the most reliable and valid for use with children of this age, the selected method of multiple pass diet recall is subject to a degree of over reporting error, in relation to energy intake (McPherson et al., 2000). Furthermore, the use of an adult photographic food atlas, which was used by the children to estimate portion sizes, is also known to provide a degree of error in energy intake when used with child populations (Frobisher and Maxwell, 2003; Foster et al., 2006). Therefore, it is possible that total mean daily energy intake reported by this sample of girls may be slightly higher than what was actually consumed.

6.5.2 Ethnic Group Comparison of Overall Mean Daily Intake of Macronutrients

Measuring macronutrient intake as a percentage of total energy intakes reduces bias caused by over-reporting error and is therefore a more reliable intake measure. Within this chapter I aimed to test the hypothesis that British Pakistani girls would gain a significantly greater percentage of total mean daily energy intakes from fat, compared with White British girls.

6.5.2.1 Ethnic Group Comparison of Overall Mean Daily Intakes of Fat and Saturated Fat

This study found that British Pakistani girls gained a significantly greater percentage of their total mean daily energy intake from fat compared to White British girls. Based on these finding we can accept the hypothesis that British Pakistani girls gain a greater percentage of total daily energy intakes from fat, compared with White British girls. Total mean daily intake of fat as an absolute measure was 5.9g higher per day in British Pakistani girls compared with White British girls but this difference did not reach statistical significance (p=0.2).

Findings from this study are in line with previous studies examining ethnic differences in fat intake of adult women in the UK (Vyas et al., 2003; Anderson et al., 2005) that also found fat intake was higher in Pakistani and South Asian Punjabi women compared with their white counterparts. Furthermore, findings for fat intake were also similar to those reported by Donin et al. (2010) who found that fat intake, measured as a percentage of total daily energy intakes was significantly greater in South Asian children, who gained an additional 1.1% of total daily energy intake from fat, compared with white European children. Furthermore, they also report that British Pakistani children gained an additional one per cent of total daily energy intake from fat, compared with their White European counterparts. Compared with Donin et al the difference in fat intake, measured as a percentage of total daily energy intake, was slightly greater in this present study, with British Pakistani girls gaining an additional 1.7% of total daily energy intake from fat compared with White British girls. Levels of fat intake were the same for both studies; 36% in British Pakistani and South Asian girls and 34% in White British and White European girls, therefore supporting the validity of findings for fat intake within both samples. Donin et al also report a significantly greater intake of absolute fat in South Asians compared to white Europeans, with an average difference of 6.1g per day. Furthermore, absolute intake was higher in Pakistani children with an average difference of 7.6g per day compared to the white Europeans. Absolute intake of fat in this present sample of girls follows a similar trend, however differences were non-significant.

This study found no significant differences in saturated fat intake, as either absolute intake or when measured as a percentage of total daily energy intake. Also in line with this present study Anderson et al. (2005) found that saturated fat intake, both as absolute intake and as a percentage of total daily energy intakes, was similar in adult women of the general population and those of South Asian Punjabi origin. These findings both contrast with those reported by Donin et al. (2010), who found that saturated fat intake, when measured as a percentage of total daily energy intake, was significantly greater in White European compared with South Asian children. However, similar to this current study Donin et al report no significant difference between ethnic groups in saturated fat measured as absolute intake.

Evidence to suggest that excess intake of fat in the diet lead to excess weight gain and increased cardiometabolic risk is surprisingly poor (Hu et al., 2001). However there is much stronger evidence to suggest that fried food and fast-food (Pereira et al., 2005; Esmaillzadeh et al., 2006; Duffey et al., 2007; Lutsey et al., 2008) are linked to cardiometabolic risk. Determining fried food and fast food consumption habits in this sample of girls may not only help identify the source of the increased intake of total mean daily fat intake in British Pakistani girls, but may also provide important links to the increased cardiometabolic risk evident in these populations and therefore warrants further investigation in Chapter seven.

6.5.2.2 Ethnic Group Comparison of Overall Mean Daily Intakes of Carbohydrates; Sugar and Fibre

This study found no significant ethnic group differences in total mean daily intake of carbohydrates, measured either as a percentage of total daily energy intake or as absolute intake. This suggests that total mean daily intake of carbohydrates was similar in this sample of White British and British Pakistani girls. These findings are in line with those reported for adult women by Anderson et al. (2005) who also found that carbohydrate intake, when measured as percentage of total daily energy intake was similar in the general population and their sample of primarily Punjabi women. Vyas et al. (2003) however, reported slightly different findings, suggesting that carbohydrate intake, measured as a percentage of total daily energy intakes were significantly higher in their sample of European women compared with their sample of Pakistani women. Donin et al. (2010) also report a higher intake of carbohydrates in White European children compared with South Asian children, when measured as both a percentage of total daily energy intake and absolute intake. Donin et al found that carbohydrates, measured as a percentage of total mean daily energy intakes, were 1.3% greater in White European children compared with British Pakistani children. Despite no significant ethnic group differences in carbohydrate intake being found in this current sample of girls, White British girls were found to gain an additional 1.1% more of their total daily energy intake from carbohydrates compared with British Pakistani girls, a percentage similar to that reported by Donin et al.

This study found no evidence to support a significant ethnic group difference in total mean daily intake of sugar, measured as either a percentage of total daily energy intake or as absolute intake. Additional evidence reporting on ethnic differences in adult women is limited. However, in contrast to the findings of this present study Donin et al. (2010) found evidence to suggest that sugar intake, measured as both a percentage of total daily energy intake and as absolute was significantly greater in White European children, compared to South Asian children. Furthermore, Donin et al also highlight that sugar intake, measured as a percentage of total daily energy intakes were 2.6% greater in White European children compared with Pakistani children. In this present study ethnic group differences in sugar intake were much lower than reported by Donin et al, with White British girls gaining only 0.5% more of their total daily energy intake from sugar, compared with British Pakistani girls. However, sugar intake was high, contributing around 25% to total mean daily energy intake in both White British and British Pakistani girls. These levels are higher than those reported by Donin et al, who found that British Pakistani children gained just 21% and white European children 24% of their total mean daily energy intake from sugar. Finding the source of these high intakes of sugar in this sample of girls is important for dietary intervention and therefore warrants further investigation.

This study found that on average White British and British Pakistani girls consumed similar amounts of fibre, with no significant differences found between them. Vyas et al. (2003), however, found that fibre intake was significantly lower in their sample of Pakistani women compared to white European women. Donin et al. (2010) report contrasting findings to both studies suggesting that South Asian children had a higher absolute intake of fibre, compared with white European children. Furthermore, it was further reported that Pakistani children had a higher absolute intake of fibre compared with white European children. Unlike Donin et al, who reported fibre intake in relation to non-starch polysaccharide, this present study reports on total fibre, so that a between study comparison is not possible in relation to figures regarding absolute intake of fibre.

6.5.2.3 Ethnic Group Comparisons of Patterns (Sunday; School Day; During-School and Out-of-School) of Mean Energy and Macronutrient Intake

Currently there is no published literature examining ethnic group differences in patterns (Sunday; school day; during-school and out-of-school) of energy and macronutrient intake, therefore comparing finding with other studies is not possible. This study found no significant ethnic group differences in patterns (Sunday; school day and out-of-school) of total mean energy intake or macronutrients measured as either a percentage of total daily energy intake or as an absolute intake. There were however a small number of significant ethnic group differences found in carbohydrate measured as a percentage of total energy intake during-school hours and absolute intake of fibre during-school hours, both of which were higher in British Pakistani girls compared to white British girls. Investigating lunch time dietary habits, on school days, in this sample of White British and British Pakistani girls may help determine the source of this difference. However this difference did not influence total mean carbohydrate intake for school days, which suggests White British girls may have compensated for this difference out-of-school hours.

6.6 Conclusion

I found, in line with expectations based on previous studies, the diets of British Pakistani girls were, on average, significantly higher in fat when measured as a percentage of total mean daily energy intake compared with White British girls. There were however, no significant ethnic group differences found in total mean daily energy intake or total mean daily intake of all other macronutrients. These findings therefore suggest that British Pakistani girls have a diet that is higher in fat, but similar in terms of total mean daily energy intake and intakes of other macro-nutrient compared with White British girls.

Whilst evidence supporting an adverse relationship between fat intake and cardiometabolic risk is weak, there is evidence to suggest that the sources of fat intake, including fried food and fast food consumption are perhaps better indicators of cardiometabolic risk. Therefore investigating these dietary behaviours in this sample of girls, may not only help to determine sources of the greater intake of fat found in British Pakistani girls compared with White British girls, but may also provide important links to their increased risk of developing cardio metabolic disease later in life.

Chapter Seven: Ethnic Group Comparison of Dietary Behaviour of White British and British Pakistani Girls

7.1 Background

On making ethnic group comparisons of overall mean daily dietary intake (chapter six), I found that the diets of British Pakistani girls were higher in fat, when measured as a percentage of total mean daily energy intake, compared with White British girls. However, intakes of overall mean daily energy and all other macronutrients were similar by ethnic group, with no significant differences identified between White British and British Pakistani girls.

Examining dietary behaviour within this sample of girls may help explain why British Pakistani girls have a diet that is higher in fat, but similar in terms of other macronutrient compared with White British girls. It will also essentially add to the currently limited body of literature investigating ethnic group differences in dietary behaviour of British school children.

7.2 Aims

Chapter seven examines dietary behaviour associated with meal time dietary practices and consumption habits, with the aim of identifying the source of the higher proportion of fat found in the diets of British Pakistani girls, compared with White British girls. This chapter also aims to examine consumption habits of food and beverages associated with excess weight gain and cardiometabolic risk.

7.3 Results

A description of the study sample is presented in chapter six (section 6.4.1).

7.3.1 Ethnic Group Comparison of Meal Time Dietary Practices and Consumption Habits

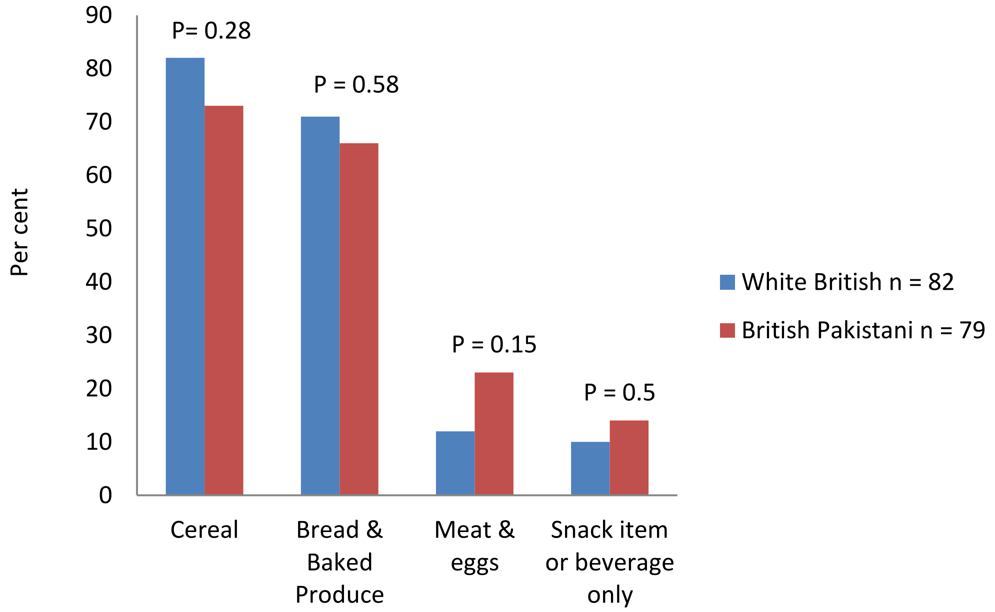
This section examines the proportion of girls participating in different meal time dietary practices and consumption habits by ethnic group. This section will also examine dietary behaviour that has been adversely associated with excess weight gain and cardio metabolic risk, including; breakfast skipping; fast-food and fried food consumption habits. Dietary behaviour in relation to snacking habits and beverage consumption are not examined along with meal time dietary practice and are instead examined by groups of food and beverages associated with excess weight gain and cardiometabolic risk (section 7.3.4).

The data presented in this section were collected by previous day multiple pass diet recall (PDMPDR), over three days, including one weekend (Sunday) and two school days. All analyses examining ethnic group differences in meal time dietary practices and consumption habits were conducted using binary logistic regression controlling for season, school and year group. The effect that each of these control variables has on dietary intake in this sample of girls has been examined previously in chapter six (section 6.4.3). Interview data are used to highlight meal time dietary practices and consumption habits in White British and British Pakistani households.

7.3.1.1 Ethnic Group Comparison of Breakfast Time Dietary Practices and Consumption Habits

Breakfast time data is for all three days (Sunday to Tuesday inclusive) combined. Seven per cent of white British and 17% of British Pakistani girls skipped breakfast, on at least one occasion, over the three days of recall (p=0.07). Breakfast habits were discussed during interviews; one British Pakistani girl (aged 11) present at parental interview expressed her reasons for skipping breakfast '*Mostly I eat breakfast, but sometimes I don't feel like it. Like before school I do, but on weekends I don't bother*'. Whereas, one white British mother stressed her concerns over her daughter skipping breakfast stating *'she will not eat breakfast, it's terrible; she just won't eat it'* '*I ask her why, she says it makes her feel sick*'. Both these statements imply that skipping breakfast is the choice of the child and is determined by whether they feel like having breakfast at the time.

Graph 7.3.1.1.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Consuming Each Meal Type at Breakfast Time[51 52]



The proportion of girls consuming each of the meal types (graph 7.3.1.1.1) were similar in white British and British Pakistani girls, with no significant differences identified between them. Breakfast cereal was the most commonly consumed meal type by both White British and British Pakistani girls, followed by bread and baked produce.

A small number of interviewees indicated that breakfast habits differed slightly on weekend days to school days in their households. Items from the meat and eggs group were more commonly consumed on weekend days, whereas consumption of cereal and bread and baked produce was more popular on school days as indicated in the following statements '*On weekends I give them a proper breakfast, like omelette, fried eggs, beans on toast, on school days they don't like anything too heavy so they have cereal*' Pakistani mother. '*Yesterday* (Sunday) *she had beans on toast for breakfast…this morning* (Monday) *she had toast',* White British mother. However, it was more common for parents to report that their

[51] p. values are derived from logistic regression analysis, controlling for season, school and year group.

[52] Ethnic group comparison of the percentage of White British and British Pakistani girls consuming each meal type at breakfast, derived from three previous day multiple pass diet recall per participant, including one Sunday and two school (week) days. Participants were classified into a meal type group if their breakfast consisted mainly of items from this meal type group (chapter 3 section 3.5.4) As data were collected from three days, participants could be included in up to three different meal type groups. Furthermore, the graph does not include girls who skipped the breakfast time meal. Therefore data within the graph will not add up to 100%.

children consumed cereal for breakfast most of the time as stated by this White British mother '*They usually have Weetabix for breakfast, with a glass of fruit juice*'. These findings support data presented in graph 7.3.1.1.1, suggesting that cereal and bread and baked produce were the more popular meal type at breakfast time in both ethnic groups.

Statistical analysis found 19% of White British and six per cent of British Pakistani girls attended the school breakfast club (chi-square p=0.01) on at least one of the recalled days. Thus White British girls were significantly more likely to attend school breakfast club compared with British Pakistani girls. School breakfast clubs generally offered items such as cereal and/or toast, with either a glass of fruit juice or milk, as described by this White British mother: *'When she goes she usually asks to have her breakfast here first, but we're not bothered because it's still worth it. It's only 30p and they get cereal, toast and either a glass of milk or fresh orange juice'.*

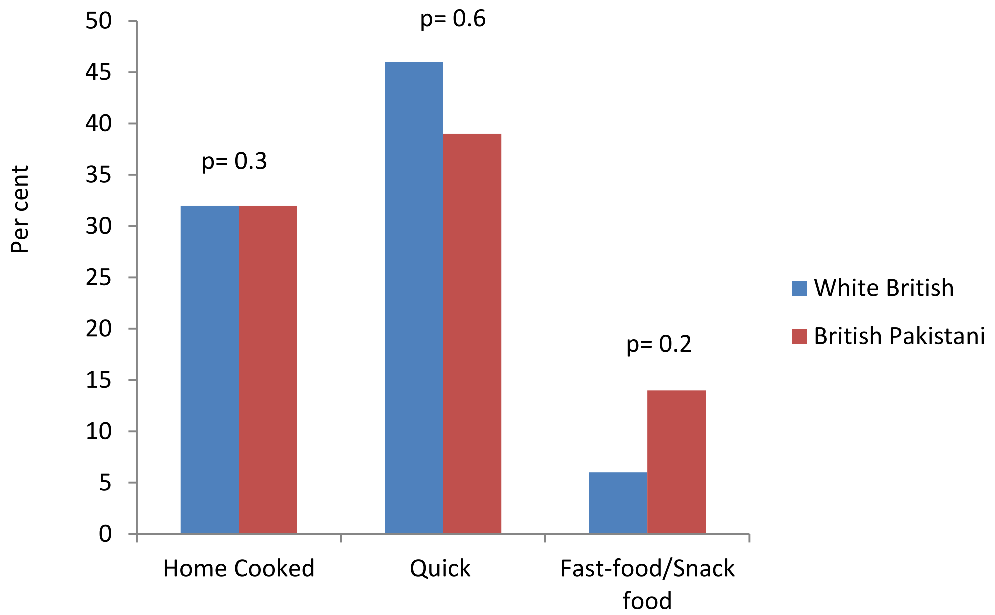
No significant differences were found in breakfast time meal types by ethnic group, suggesting that breakfast time consumption habits are similar in White British and British Pakistani girls. Interview statements support these similarities in consumption habits at this time. Furthermore, despite the slightly greater proportion of British Pakistani girls skipping breakfast compared with White British girls, this difference only approached statistical significance. There was however, stronger evidence to support a greater number of White British girls attending school breakfast club compared with British Pakistani girls. This is likely to reflect the significant difference found in mother's occupational status (chapter six, table 6.4.1.4) with a greater proportion of White British mothers in full or part time work, therefore increasing their need to send their daughters to school breakfast club. However interview findings suggest that breakfast meal types offered at school breakfast club are similar to those that would be consumed at home.

7.3.1.2 Ethnic Group Comparison of Lunch Time Dietary Practices and Consumption Habits

Sunday and school day lunch time dietary practices and consumption behaviour are examined separately.

Sixteen per cent of White British and 15 % of British Pakistani girls did not consume a lunch time meal on Sunday (chi-square p= 0.3).

Graph 7.3.1.2.1 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Consuming Each Meal Type at Lunch Time on Sundays [53] [54]



Lunch time meal types include; home cooked (main component of meal prepared and cooked at home from fresh ingredients), quick (main component prepared or cooked from packaged or tinned goods, but also includes jacket potatoes, sandwiches, pasties, eggs and salad) and fast-food/snack food (purchased from a fast-food outlet or items such as fruit, yogurt, crisps, chocolate).

Quick meals were the most commonly consumed meal type at lunch time on Sundays. This was followed by home cooked meals, which included Sunday roast, casserole or traditional

[53] P. values are derived from logistic regression analysis, controlling for season, school and year group.

[54] Ethnic group comparison of the percentage of White British and British Pakistani girls consuming each meal type at lunch are derived from one Sunday of previous day multiple pass diet recall. Participants were categorised into a meal type if their lunch consisted mainly of items from the meal type group (chapter 3, section 3.5.4). The graph does not include those children who skipped the lunch time meal; therefore the total of the graph does not add up to 100%.

South Asian dishes. Furthermore, a small proportion of White British and British Pakistani girls consumed fast-food or snack food for lunch on Sundays.

The full definition of what was classified as 'traditional' South Asian has been outlined previously (chapter three section 3.5.1.2), but may include chapatti, curried dishes (meat and/or vegetable), dhal, pilau or snack items such as pakora or samosas. Twenty-seven per cent of British Pakistani girls and one per cent of white British girls consumed a meal that was classified as traditional South Asian for lunch on Sundays. This difference proved significant (p=0.001)[55].

During interviews, a number of White British parents reported commonly consuming a traditional British style roast meal for lunch on Sundays. These lunches were described as follows: *'On a Sunday we like a roast dinner; I would usually do a chicken, potato, carrots, broccoli and cauliflower'* White British mother. *'We have roast chicken, potatoes and three or four different vegetables, it will be all fresh, we don't like frozen'* White British mother. However a traditional Sunday roast was not reported to be consumed by all White British interviewees at this time of day, with some reporting having a light lunch, with often a more 'traditional-style' dinner being consumed later in the day, as described by this White British mother *'Lunch on a weekend tends to be a sandwich and packet of crisps or a cheese toasty or something…. I was at work yesterday (Sunday) so my husband cooked Sunday lunch; we had it when I got in about six o clock'.*

A number of British Pakistani interviewees also reported adopting a British style Sunday roast into their meal time practices on a Sunday. Local variations of this meal had also been adopted, with some British Pakistani mothers reporting the accompaniment of Yorkshire puddings: *'Sundays we have a roast chicken with vegetables and Yorkshire pudding'* Pakistani mother. However, this meal type, as identified by one Pakistani father, may not be consumed every Sunday: *'On a weekend for lunch sometimes they would have special rice or a roast'* Pakistani father.

[55] p. values derived from logistic regression analysis, controlling for season, school and year group

Table 7.3.1.2.2 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Consuming Each Meal Type, as School, Home or Packed Lunch, at Lunch Time on School Days [56] [57]

	White British n=82 % (n)	British Pakistani n=79 % (n)	P. Value
School Lunch	**62 (51)**	**60 (47)**	
School cooked	78 (40)	79 (37)	0.97
Quick	65 (33)	66 (31)	0.43
Home Lunch	**0**	**17(13)**	
Home cooked		69 (9)	
Quick		69 (9)	
Fast food		0	
Packed Lunch	**49 (40)**	**34 (27)**	
Sandwich	85 (34)	85 (23)	0.36
Packaged savoury snack	55 (22)	85 (23)	0.22
Fruit	55 (22)	56 (15)	0.31
Baked produce/chocolate	68 (27)	70 (19)	0.16
Dairy	53 (21)	56 (15)	0.96

A significant difference was found in the proportions of white British and British Pakistani girls consuming school lunch, home lunch or packed lunch on school days (p=0.001)[6]. Findings suggest that whilst the proportion of girls consuming a school lunch were similar by ethnic group, only British Pakistani girls ate lunch at home and more White British girls consumed packed lunches.

Traditional South Asian food was also consumed at lunch time on school days. Eighteen per cent of White British and 23% of British Pakistani girls consumed a meal and/or food item

[56] p. values are derived from logistic regression analysis, controlling for season, school and year group
[57] Ethnic group comparison of the percentage of White British and British Pakistani girls consuming each meal type at lunch time on school days are derived from two school (week) days of previous day multiple pass diet recall data. Participants were classified into a meal type group if their lunch consisted mainly of items from this meal type group. As data were collected over two days, participants may be included in up to two different meal type groups (chapter 3, section 3.5.4). Therefore the percentages in each column for each meal type may not add up to 100%.

that was classified as traditional South Asian on at least one occasion of the two school day recalled lunch time meals (chi-square p=0.48).

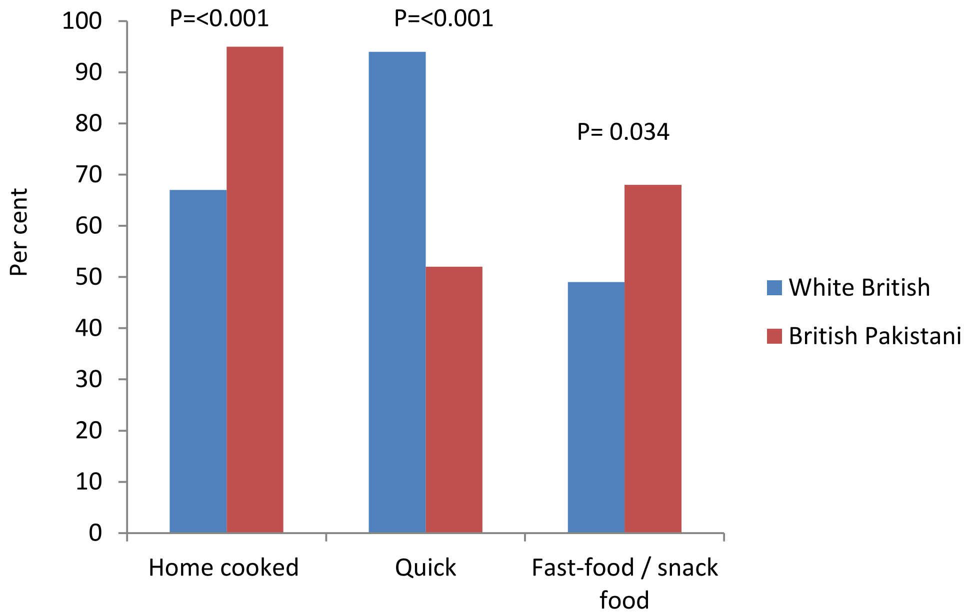
Of the girls consuming a school lunch, no significant differences were identified in the proportion of White British and British Pakistani girls consuming each meal type (table 7.3.1.2.2). Of the British Pakistani girls who went home for lunch similar proportions of home cooked and quick meal types were consumed over the two recalled school days. Sixty-nine per cent of British Pakistani girls who went home for lunch consumed meals that were classified as ‘traditional South Asian’, on at least one occasion, over the two recalled lunch time meals, on school days. One British Pakistani father describes food items consumed by his daughter who went home for lunch on school days: *‘for lunch she has things like fish fingers, vegetable fingers, chips, waffles that kind of thing’.* The consumption of these food items would be categorised into the quick meal type group. Of the girls consuming a packed lunch on school days, the food items consumed as part of the packed lunch did not differ significantly by ethnic group (table 7.3.1.2.2). Interview descriptions support these findings, with white British and British Pakistani mother describing providing similar items within their children’s packed lunch boxes. *‘She prefers a packed lunch, she has sandwich spread in her sandwich… she’ll have a couple of pieces of fruit, sometimes a yogurt’* white British mother. *‘She takes a packed lunch every day, she has a pot pineapple, sandwich, biscuit or chocolate or something and packet of crisps’* White British mother. *‘They have packed lunch with jam, chocolate or tuna sandwiches, a yogurt and a piece of fruit, usually an orange’* Pakistani mother. *‘She has a packed lunch, she eats the yogurt, chocolate and crisps, but she don’t eat the sandwich’* Pakistani mother.

In summary, meal types, on Sundays, were similar by ethnic group and whilst interview statements indicate that home cooked traditional Pakistani meals may be consumed at lunch time on Sundays, the adoption of British home cooked meals at this time was also apparent. On school days the only significant difference found by ethnic group was in the proportion of White British and British Pakistani girls going home for lunch and consuming a packed lunch. It was evident that school canteens offered ‘traditional’ South Asian style food at lunch time on school days.

7.3.1.2 Ethnic Group Comparison of Evening Meal Dietary Practices and Consumption Habits

Self-defined dinner and supper time meals were examined as one meal. Evening meal data is for three days (Sunday to Tuesday inclusive) combined.

Graph 7.3.1.2 Ethnic Group Comparison of the Percentage of White British and British Pakistani Girls Consuming Each Meal Type at Evening Meal Time [58] [59]



A significantly greater proportion of British Pakistani girls consumed home cooked meals from fresh ingredients, compared with White British girls (graph 7.3.2.1). The proportion consuming quick meals was significantly greater in White British girls, and although fast-food was a popular meal type in both ethnic groups, a significantly greater proportion of British Pakistani girls consumed fast-food as an evening meal type compared with White British girls. Furthermore, a small proportion of White British (12%) girls consumed meals that were classified as 'traditional South Asian' as their evening meal, however consumption was significantly greater in British Pakistani girls (89%) (p=0.001)[8].

[58] p. values are derived from logistic regression analysis, controlling for season, school and year group.

[59] Ethnic group comparison of the percentage of White British and British Pakistani girls consuming each meal type at lunch are derived from three days of previous day multiple pass diet recall data, including one Sunday and two school days. Participants were classified into each meal type based on whether their main meal consisted mainly of items from this meal type group (chapter 3 section 3.5.4). As data were collected over 3 days, participants could be included in up to three different meal type groups. Therefore data within the graph will not add up to 100%.

The types of evening meals consumed within the household were discussed with White British and Pakistani interviewees. Several White British parents describe the evening meals regularly consumed by their children. For example, this white British mother explained, '*I usually do dinners three times a week with meat and vegetables, I do vegetable pastas, we also have spaghetti bolognaise, fish and chips and maybe something with rice, like a chicken korma. On a Saturday though, the kids pick what they want to eat, they choose all sorts, like sausage, chips and beans or lasagne'.* However, several of the White British parents interviewed seemed more inclined to convey that most of the time they ate home-cooked meals, while quick meals or fast-food were portrayed as an easy option to be used occasionally. As highlighted by this White British father '*the majority of time we cook from fresh, but we always have something in the freezer for a quick tea such as frozen chips, waffles, fish-fingers… so they'll eat that occasionally, but it's not a regular thing*'.

The type of food consumed as evening meals were also discussed with Pakistani interviewees. This Pakistani father's description was fairly typical of those consumed by Pakistani families as evening meals '*We have the general types of Asian meals; you know home cooked curries with rice and chapattis. Some days we have grills, like chops and that you know, like today we're having kebabs, but weekends it will probably be something not too spicy with more veg and chicken…. generally we have home cooked Asian food'.* Meal items with a more westernised influence were also commonly reported, with roast dinners and pasta dishes also being popular meal options with Pakistani families, as illustrated by these Pakistani mothers: *'I like to do a Sunday roast with either chicken, chops, ribs or burgers and steamed vegetables; carrots, broccoli sweet corn; mash potato and Yorkshire puddings too'* Pakistani mother*; 'we usually have a pasta meal once a week, like spaghetti bolognaise, something like that'* Pakistani mother.

Similar to White British households, processed food items, including fish-fingers, chips, packet noodles, burgers and pizza were also described as evening meal items for children in Pakistani households. Again such items were reported to be consumed less frequently than home cooked meals from fresh ingredients. A number of Pakistani interviewees described the consumption of processed food items in relation to meal patterns within their household thus: '*well we had a curry last night so we'll probably have fish fingers, potatoes and salad tonight. We have potatoes more or less with every meal. Tomorrow we'll have* *boiled egg and chips'.* Pakistani mother; '*they usually have fish fingers, chips and pizza that kind of thing maybe three times a week'* Pakistani mother.

Both White British and Pakistani interviewees tend to suggest that their main evening meal generally consists of home cooked meals from fresh ingredients, with the consumption of packaged food items generally more restricted. Since these findings contrast with the quantitative data, it is possible that interviewees may be trying to convey a particular impression to the interviewer. Also there is the potential of bias in the interviewee sample, with those parents who generally consume what may be viewed as a more healthful diet, more willing to participate in interviews. Quick meals were also occasionally mentioned as evening meal options in both white British and Pakistani households. However, these types of meal, which also included the processed food items mentioned above, were often seen as a quick and easy option, and were described by Pakistani parents, as representing something more like a snack, which their children have before they go to mosque on weekday evenings: *'when they get back from school, they're very busy, they have to go to Mosque at four o clock, so I make them egg and toast, cheese and bread roll, micro-pizza, micro-chips…when she comes home at 6 o clock we have our dinner'* Pakistani mother.

In Pakistani households the main evening meal, which was generally the more 'traditional' home-cooked meal from fresh ingredients, seemed to be more commonly consumed later in the evening. This was in contrast to the White British households who were more likely to report having what represented their main evening meal earlier in the evening, and occasionally, what was described as supper later in the evening. Supper-time items described by White British parents generally consisted of items such as cereal and toast, sometimes with a hot or cold milk-based drink, as is suggested by this White British mother; *'she usually has cereal or toast for supper… before she goes to bed'.*

Fast-food consumption was also a popular evening meal choice in both ethnic groups, with almost half of White British girls (49%) consuming fast-food as an evening meal. However this figure was much greater in British Pakistani girls, with 73% reporting the consumption of fast-food as an evening meal. These findings however, were not reflected in most interviewees' accounts, where fast food consumption was generally described as a rare 'treat' as these fathers describe their fast-food habits and preferences; *'we rarely eat fast-*

food, it's a treat for us.…we had a MacDonald's bank holiday gone, which the kids looked forward to the whole week beforehand' White British father; *'no we don't get take-away, maybe once in a blue moon….if we were to get one it would be a meal deal thing, either pizza or chicken parmo something like that…I reckon once a month at most'* White British father; *'they only get once a week* [fast-food]*, but I get quite a few…. we might get pizza, parmo* [deep fried chicken in breadcrumbs, with béchamel sauce and cheese topping]*, kebabs and burgers and that….I would say I have at least three times a week'* Pakistani father. Such statements indicate parental concern about limiting fast-food consumption. Some White British interviewees suggested that buying fast-food was carried out as a matter of ease and convenience, which generally took place when time was more limited, as indicated by this White British mother: '*we might have one once a week, the kids will get MacDonald's and we might get a curry. Actually, we had two last week… we didn't have much time between finishing work and shopping, when that happens we just get a take-away on the way home'* White British mother.

It was evident, however, that some parents had a quite different perspective on fast-food consumption, as this White British interviewee explained that her daughter is given pocket money which she is free to spend; *'if she has money she'll go to pizza box and buy chips'.* Such a statement suggests a lack of control over her daughter's consumption habits outside of the home. However, it was also found that a number of Pakistani interviewees had family members who worked in fast-food outlets and described consuming food from those outlets: *'We get pizza from pizza supreme, my cousin's shop, we get like a family size pizza, chips and salad, which feeds all of us, for like less than a fiver instead of say eight or nine pounds….so really we can feed all the family for not a lot, which is good'* Pakistani father; *'Well my husband has a fish and chip shop…. I know fish is good, so we eat quite a lot of that'* Pakistani mum.

In summary, the greatest ethnic group differences in meal time dietary behaviour by meal type were evident within the evening meal. Findings from this study suggest that British Pakistani girls were more likely to consume a home cooked meal from fresh ingredients, compared with White British girls who were more likely to consume items from the quick meal type, as an evening meal. For British Pakistani girls, the evening meal was found to be the most 'traditional' consisting of more South Asian style food items compared with breakfast and lunch time meals. However, findings also suggest that a large proportion of British Pakistani girls have adopted more westernised consumption habits at evening meal time, including fast-food, which was consumed by a greater proportion of British Pakistani girls compared to White British girls. However, similarly it was also evident that White British girls have adopted traditional South Asian food into their diets. Interview findings provide an insight into differences and similarities in evening meal time dietary habits of White British and British Pakistani households.

7.3.2 Traditional South Asian Cooking Practices

Traditional South Asian, including Pakistani, cooking has a high fat content (chapter one). Therefore data were examined to determine the proportion of the sample, by ethnic group that reported consuming traditional South Asian food items/dishes. Ninety-five per cent (n=75) of British Pakistani girls reported consuming 'traditional' South Asian style food items/dishes, on at least one occasion over the three days of dietary recall. Whilst the proportion of British Pakistani girls consuming these food items/dishes were high, this data indicates that there was a small number of British Pakistani girls that did not consume any 'Traditional' South Asian food items/dishes during the recalled period, suggesting that their diets were composed completely of western meal types and consumption habits during this time. Furthermore, 29% (n=24) of White British girls reported consuming, what was classified as 'traditional' South Asian food items/ dishes, during the recalled period ($p=<0.001$)[60] indicating that the adoption of food practices was a two way process within this sample of girls.

Traditional South Asian cooking practices and consumption habits were explored during interviews. It was found that the frequency with which traditional evening meals were prepared and consumed varied considerably by household, as these statements by Pakistani mothers suggest '*I cook our own food* [traditional Pakistani] *as the main meal five to six times a week… usually curry, rice and chapatti*' Pakistani mum; '*I only make curry and chapatti maybe once a week now, I'm trying to watch my weight… but when my husband is home he's got to eat curry and chapatti every day… if he doesn't he says he's not full'*

[60] p. value derived from logistic regression analysis, controlling for season, school and year group

Pakistani mum. It was also evident that the child's preference played a role in the types of meals served and the frequency in which traditional meals were also consumed, as indicated by this Pakistani mother *'I cook traditional food maybe three times a week, but the kids complain, these days they just want all these pizza, burgers, chips and fries'*.

7.3.3 Ethnic Group Comparison of the Frying of Food during Cooking

This section examines diet recall data regarding cooking practices, in relation to whether components of a meal or dishes were either fried during preparation or as the main cooking method.

Table 7.3.3.1 Ethnic Group Comparison of the Frying of Food during Cooking [61] [62]

Preparation method	White British n = 82	British Pakistani n = 79	P. Value
	% (n)	% (n)	
Shallow fried	31 (25)	77 (61)	<0.001
Deep fried	55 (45)	71 (56)	0.04

Findings from this study suggest that a significantly greater proportion of British Pakistani girls consumed meals that had been either shallow fried during preparation or as the main cooking method, in comparison to White British girls (table 7.3.3.1). Similar patterns were also evident in the proportion of meals that had been deep fried as the main cooking method, again with British Pakistani girls consuming significantly more meals that had been cooked this way compared with White British girls.

'Traditional' South Asian cooking often involves adding a substantial amount of oil, ghee, butter or margarine to the dish during preparation, which is generally a key ingredient in this style of cooking. Oil and spices are often fried together in the pan before adding meat and/or additional ingredients, such as potatoes and vegetables. The following statements highlight the use of oil in traditional Pakistani cooking and whilst parents often knew about the relationship between using large quantities of oil for cooking and health, oil was still

[61] p. values are derived from logistic regression analysis, controlling for season, school and year group.

[62] Ethnic group comparisons of the frying of food during cooking are derived from three days of previous day multiple pass diet recall data, including one Sunday and two school days per participant and all breakfast; lunch and evening meals

used in this style of cooking, as indicated by the following statements: '*All the curries are oil based'* Pakistani father. *'If you don't put the oil in, it don't taste nice'* Pakistani mum. However, a number of Pakistani interviewees also suggested that cooking styles, in relation to the quantity and type of fats and oils used in traditional Pakistani cooking were adapted to promoting better health, as a number of Pakistani parents explain '*I try to make my food healthy, you know by not using ghee and using olive oil… a lot of Pakistanis are switching to healthier cooking by using oil and not ghee, but I think the older generations, they still do'* Pakistani mother; 'w*hen I make the curry you need the oil, not loads, but for the flavour… other people I know they put loads in, but I know how much I put in'* Pakistani mother '*we try to use olive oil* [when making curry] *don't know whether it's right or not* [better for health]*, but it's mainly olive oil'* Pakistani father.

Although it was found that adaptations to cooking styles are being made, the reporting of deep frying as a method of cooking was still frequent, with a number of Pakistani interviewees reporting the use of a wok to deep fry traditional food items, such as samosas and pakoras. However, some stressed the cooking of this type of traditional food took place irregularly, as suggested by these Pakistani interviewees: *'we have a wok for frying, you know for when we make pakoras, samosas or something, I use this a lot when we have friends round'* Pakistani mother; '*we have a wok, we use it to cook samosas, she makes it on at least one day of the week'* Pakistani father.

Finally, the use of a deep fat fryer was also reported by a small number of Pakistani interviewees for cooking meal items as indicated by this British Pakistani mother: *'I use the fryer when I cook the chips, but we don't eat them much, maybe every second week'* Pakistani mother. However another British Pakistani mothers reports more frequent usage of deep frying as a preparation method: '*I use the fryer cause it's easy, when you cook it in the oven it takes ages, or sometimes I put it* [food] *in the fryer for a little bit then I put it in the oven… plus it tastes better from the fryer'* Pakistani mother. Deep frying was not something regularly reported by White British parents who tended to express caution about the frying of food, with many stressing most meals were cooked by either grilling or baking in the oven as these White British mothers point out: '*I grill just about everything, I have a George Foreman* [grilling machine] *so everything goes on there, like beef burgers. If I do fish-fingers and chips, it's all oven based… I only use the fryer about once a week, maybe on a*

Sunday when I make the chips; I'll quickly pop them in the fryer for five minutes to brown them off' White British mum. *'We don't fry it* [food], *do we* [talking to husband], *we grill everything don't we'* White British mum.

The consumption of fried food, which was found to be more common in British Pakistani girls, is likely associated, in part, with traditional South Asian cooking practices in Pakistani households. Furthermore, the increased consumption of fast-food also found at evening meal times in British Pakistani girls is also likely to contribute to the increased consumption of fried food reported by these girls.

It is also evident that traditional Pakistani cooking still comprises a main part of children's dietary habits, particularly within the main evening meal itself, despite a strong influence from western style consumption habits. However, it is likely that traditional cooking practices, with their high fat content, coupled with a high intake of fast-food is a likely source of the higher intake of fat found in the diets of British Pakistani girls compared with white British girls (chapter six).

7.3.4 Ethnic Group Comparison of Food and Beverage Group Intake Associated with Excess Weight Gain and Cardiometabolic Risk

This section examines diet recall data relating to the absolute intake of food and beverages that are known to influence cardiometabolic risk.

Overall mean daily intake of all food and beverage groups (table 7.3.4.1) were similar in this sample of White British and British Pakistani girls, with no significant differences identified between them.

Table 7.3.4.1 Ethnic Group Comparison of Overall Mean Daily Intake (grams) and Mean Daily Portions of Food and Beverage Groups [63] [64]

Food and Beverage Groups	White British n=82		British Pakistani n=79		Sig. Value
	Grams (S.D) Mean	Portion Mean	Grams (S.D) Mean	Portion Mean	
Fruit	137.7 (105.2)	0.9	142.7 (110.1)	1.0	0.77
Fruit juice	119.9 (128.5)	1.0	125.7 (122.6)	1.0	0.77
Vegetables	110.5 (76.1)	1.5	123.5 (85.7)	1.7	0.31
Cakes and biscuits	50.1 (42.2)	1.3	51.9 (40.5)	1.3	0.79
Chocolate/confectionary	27.6 (22.2)	1.1	24.9 (25.4)	1.0	0.48
Packaged snacks	17.0 (13.6)	0.7	19.4 (17.5)	0.8	0.33
Sugar-sweetened beverages	240.9 (225.1)	1.9	254.2 (212.8)	2.0	0.70

Dietary habits in relation to fruit and vegetable, snacking and beverage consumption were investigated during interviews. Parents reporting consumption of fruit and vegetable at meal times or as snacks was common. In White British households vegetable consumption with main meals did not take place every day as highlighted by this White British mother *'we have veg about four times a week, like cabbage, carrots, peas and broccoli'*. Consumption habits in relation to vegetable intake were also discussed with Pakistani parents. Vegetables were often reported as being consumed as part of a composite dish, common to traditional South Asian cooking. Furthermore the types of vegetables reported to be commonly consumed in Pakistani households were found to differ to those consumed in White British households, as indicated by this Pakistani father *'it's vegetable curry tonight, with potatoes, cauliflower, spinach, lady fingers, peas and broccoli'.*

In both White British and Pakistani households parents often reported that it was more of a struggle to get their children to eat vegetables than fruit, as stated by a White British mother; *'she loves her fruit, she's not as keen on vegetables though, if I do a dinner she just tends to eat the mash, she's fussy with her greens'; 'they do eat vegetables, we have a bit of a battle with them over it… they both like different types, so me and the wife are alright we*

[63] Significance values are determined by ANOVA controlling for season, school and year group
[64] Ethnic group comparisons of food and beverage groups are derived from three days of previous day multiple pass diet recall, including one Sunday and two school days

get a pile of different veg. With their fruit they love bananas, grapes and maybe apples, but getting them to have anything other than that, it's a bit of a chore really' White British father; Pakistani mother *'we have a wide range of fruit and vegetables in the house, although I'm usually the one who ends up eating the fruit… she is very fussy now, she's not even eating her vegetables, it's like I literally have to force her'; 'when I cook vegetables with the meat they don't like to eat it, they just pick out the meat… when I make a roast and steam the vegetables they like it'* Pakistani mum. This last statement suggests more of a preference for westernised habits by the children of that household in relation to how vegetables are prepared and served. Parents often reported a greater frequency and variety regarding fruit intake, as suggested by these white British and Pakistani parents: *'they eat a lot of fruit, we buy about twenty-five pounds worth a week. They just help themselves to it, they always have some after tea… on a morning they have fruit juice'* White British father; *'they love their fruit, bananas, apples, clementines, strawberries, cherries; we have big bowls full in the fridge. I buy whatever's in season, the big packs what are on offer and the smart price stuff, you can get double with that… I probably top up two to three times a week… they have fruit juice, orange, apple, pineapple, they like the smoothies too'* Pakistani mother.

Most White British and Pakistani interviewees were aware of health messages in relation to fruit and vegetable consumption; however some stressed that they found them difficult to meet: *'I know how much fruit and vegetables they should be eating, but they don't eat that many, it's hard to get them to eat, we buy plenty of fruit. The thing is fruit and vegetables are really expensive aren't they, they say we should eat more of them yet they're so expensive'* Pakistani mother. '*I wouldn't say they get their five-a-day every day, I don't look at what they eat each day in that way, I think as long as they get some then that's OK… they have fruit as a snack if I suggest it… when they were younger they would eat what you put in front of them, but they're older now they have their own opinion, so now they won't eat it* [vegetables]*'* White British mum.

Snacking behaviour was discussed with interviewees. When asked to describe commonly consumed snacks within their household White British and Pakistani interviewees largely reported similar items, including fruit, crisps, biscuits and confectionary, as highlighted by the following statements: *'If they snack they'll have crisps and yogurt, plus their fruit'* White

British mother. *'We have the main type* [snacks], *you know the ones you're meant to avoid like chocolate bars, biscuits, crisps and stuff like that'* Pakistani father

White British and Pakistani parents often reported that they try to control the snacking behaviour of their children, which often involved limiting specific food items that may be viewed as 'bad', as indicated by this Pakistani father: *'we have a treats cupboard, they're allowed two to three things a day, you know like a ten pence mix-up, sugar free drink, chocolate bar, crisps. Once they've had their tea and after they help with a few jobs they can have their treats'.* Furthermore, placing a limit on individual items was also common, as this White British mother describes*: 'she might get a packet of crisps, but that would depend on what she's had in her lunch-box, so today she's had fruit and yogurt so if she'd had crisps she wouldn't be allowed anymore, same with chocolate, one bar a day, but she doesn't ask for chocolate a great deal'* White British mum.

However, practices regarding the limiting of snacks were not maintained by all parents, one Pakistani mother felt little need to regulate snack consumption in her children, as she was not concerned about her children's weight. *'I don't put a limit on snack food as my children are very skinny they don't need it. I just get heaps in and they just help themselves'.* A small number of parents also stressed a lack of control over their children's snacking behaviour, as highlighted by the following statements: *'she's always straight in at the crisps and biscuits when I've been shopping. They'd eaten eleven packets of crisps between four of them from when I'd got in from shopping on Monday to when I did the packed lunches last night (Tuesday)… as soon as your back is turned they're in there*' White British mother. *'When she's got money she spends it, she's got a sweet tooth, she eats a lot of sweets…she had two pounds the other day and went out and spent it all on sweets, I went mad with her'* White British mother. *'We'll mainly get things in bulk from Asda, Iceland places like that, it's meant to last the whole week, but sometimes they just go to the cupboard and it won't last a day'* Pakistani father

A number of white British and Pakistani interviewees reported regularly purchasing sugar-sweetened beverages. It was a common theme that this type of beverage was limited and may be purchased when conducting their regular supermarket shopping trip, but once it had been consumed no more would be purchased until the next planned shop. The following statements indicate these practices taking place in both White British and Pakistani households: *'We buy three bottles of pop, which last about two weeks, they'll probably have about one glass a day they don't get any more though if that goes'* White British mother. *'I buy fruit juice, they have Ribena for school, but mainly fruit juice or coke at home, we don't have much coke though, if that finish, they have the water or milk-shake what they make up or diluted juice, the old fashioned stuff'* Pakistani mother.

It was also evident that some parents were more opposed to their children consuming sugar-sweetened beverages on a regular basis, stating that consumption of this type of beverage was limited or only took place on special occasions, as indicated by the following statements: *'Fizzy drinks are rare, although myself, it tends to be one rule for me and another for them, but I try not to let them have fizzy drinks'* Pakistani father. *'We don't have fizzy drinks. I don't like to see her drinking that stuff even if her friends are. If we go to a restaurant she's allowed a glass of lemonade…She drinks a lot of water and diluted juice'* White British mother.

In summary, dietary habits in association with fruit and vegetable, snacking and sugar-sweetened beverage intakes were similar in White British and British Pakistani girls, with no significant differences identified. The similarities found in these dietary habits are unable to provide further evidence to support the greater total mean daily intake of fat found in British Pakistani girls, compared to White British girls. However, these findings may indicate why the diets of these two groups were similar in terms of total mean daily intake of energy and macronutrients: saturated fat, carbohydrates, sugar, fibre and protein, when measured as a percentage of total daily energy intakes. It is also evident that parental attitudes and practices relating to these dietary habits vary considerably by household, irrespective of ethnic group.

7.4 Discussion

7.4.1 Meal Time Dietary Practices

Evidence suggests that children who persistently skip breakfast are at increased risk of excess weight gain, in terms of a higher BMI and waist circumference in school children (Kovacs et al., 2010). This current study found that a small proportion of White British and British Pakistani girls skipped breakfast, on at least one occasion, over the three days of dietary recall. A previous study by Parsons and Godson et al. (1999) investigated inter-generational differences in the diets of migrant Pakistani pre-school children. They found that a small proportion (8%) of their sample skipped breakfast on the day of their diet recall. However, an additional UK based study by Harding et al. (2008) reported much higher rates of breakfast skipping in their large multi-ethnic sample of adolescent children. In which they found that 50% of Pakistani/Bangladeshi and 43% of White British girls were not consuming breakfast every day. These proportions are far greater than reported by both this present study and Parsons et al. However this discrepancy may be associated with a difference in age.

The meal types consumed at breakfast time were largely similar between White British and British Pakistani girls, with cereal, bread and baked produce being the most commonly consumed meal types in both ethnic groups. This study found that traditional South Asian food items were not consumed at breakfast in this sample of girls, which suggests that westernised consumption habits have been adopted within this meal time. It has been previously suggested that breakfast is likely to be the first meal that migrants adapt, since it is the least culturally significant meal of the day (Crane and Green, 1980), with evidence from this study supporting this statement. Furthermore, Parsons and Godson et al. (1999) also found that traditional South Asian foods were not consumed at breakfast time in their sample of Pakistani pre-schoolers.

Ethnic group differences in lunch time dietary practices were minimal, again with no significant differences identified between ethnic groups. This study, however, did find that that on school days British Pakistani girls had a greater tendency to go home for lunch compared with White British girls, whereas White British girls were more likely to have packed lunch compared with British Pakistani girls. In recent years statutory food-based guidelines (Department of Education and Employment, 2001) have been introduced to encourage nutritionally-balanced school meals to help reduce diet inequalities between children (Rogers et al., 2007). There is now evidence to suggest that school lunches are better nutritionally compared to home prepared packed lunches (Rogers et al., 2007; Evans et al., 2009). This evidence therefore suggests that girls from this study consuming a school prepared meal are more likely to have a meal that is balanced nutritionally compared with those who are consuming a packed lunch. Currently however, there is no literature investigating differences in the nutritional content of home lunches in comparison to school prepared and packed lunches, therefore further investigation within this area maybe warranted.

Traditional South Asian meals/food items were consumed by around a quarter of British Pakistani girls for lunch on school days. Most schools in this study served meals or food items that were classified as traditional South Asian and were also halal. These meal and food items mainly consisted of chicken curry, rice and naan and vegetable samosas. As a result this study found that a number of White British girls were also consuming this food, at lunch time, on school days. However, further evidence supports a greater consumption of westernised meals than of traditional South Asian by both ethnic groups, at lunch time, on weekend and school days. These findings support the statement made by Parsons and Godson et al. (1999), which suggests that following the breakfast meal, lunch is the next most likely meal to encounter dietary change in migrants. Parsons et al. further suggest that this is because the lunch time meal is usually when the most contact is made with the dietary habits and cultural norms of the host society. Furthermore, findings from this study support those reported by Anderson and Lean (2005), which investigated dietary change in a small sample of South Asian women and found that westernised food items had been adopted by five out of ten women at lunch time. Anderson and Lean further report that the types of meals and food items consumed at lunch time were similar items to those identified in this present study, with processed meat, egg dishes, fish fingers, veggie-burgers, pizza and super noodles being reported as popular lunch time meal options.

Interview data from this study found evidence to suggest an ethnic group difference in evening meal patterns between White British and British Pakistani girls. Simmons and Williams (1997), in their study investigating dietary practices among Europeans and South

Asians in Coventry, UK, found that the main evening meal in White British households generally takes place earlier than the main evening meal in South Asian households. Interview findings from this study also indicate a similar pattern, with Pakistani parents often reporting that evening meals, particularly on week days, were structured around evening attendance at mosque. Parents, in general, reported that a light meal or snack would be consumed by their children in between arriving home from school and going out to Mosque, which was followed by the main meal, later in the evening, once the children arrived home from Mosque. Pallan et al. (2012) report similar findings relating to the structuring of South Asian children's evening meal patterns around evening Mosque school. This meal pattern differs to that of White British children, who generally consume their main evening meal between arriving home from school and early evening time, in some cases with an additional meal, usually classified as supper, being consumed later in the evening. Previous studies have found that eating late at night led to an increase in overall daily energy intake (de Castro, 2007), and had a significant adverse effect on the blood lipid profile of adults (Lennernas et al. 1995). These findings, therefore, suggest that regular late night eating observed in this sample of British Pakistani and White British girls may not only lead to excess weight gain, but may also have a negative effect on their cardiometabolic risk profile.

The greatest ethnic variation in meal time dietary practices and consumption habits in this study took place within the evening meal. A significantly greater proportion of British Pakistani girls were found to consume a home-cooked meal from fresh ingredients as an evening meal, compared with White British girls. This difference is likely associated with the high proportion of British Pakistani girls consuming what was classified as a traditional South Asian meal also at this time. In contrast, a significantly greater proportion of White British girls were found to consume a quick meal as their evening meal, compared with British Pakistani girls. Wyke and Landman (1997) found that South Asians often viewed this type of food as snack food, unlike traditional South Asian food, which were described as a proper meal.

In addition, this study found that despite being strongly denied by interviewees, fast-food was a popular evening meal choice in both ethnic groups. A significant difference between ethnic groups was also evident, with a far greater proportion of Pakistani girls consuming fast-food as an evening meal compared with White British girls. A previous study by Edwards et al. (2006) also found that fast-food consumption was common in their Bradford sample of 9 to 10 year old South Asian children, reporting that 23% of their sample consumed fast-food within the 24 hours prior to recall. Although the proportion of children consuming fast-food are lower in the Edwards et al. sample, compared with this current sample of British Pakistani girls, this may be associated with the difference in the recall duration between studies, with fast-food intake in this current study based upon three days of recall, compared with just one 24 hour recall, by Edwards et al. Despite this discrepancy, findings from both studies suggest that fast-food is a popular meal choice for British Pakistani children. The consumption of fast-food, however, is not a dietary habit specific to Pakistani migrants here in the UK. Previous studies have found that fast-food is also a popular meal choice of children living in Pakistan (Hydrie et al., 2004; Jafar et al., 2008; Mushtaq et al., 2011).

The consumption of fast food has been associated with a greater intake of total fat (Bowman et al., 2004), as well as being adversely associated with cardiometabolic risk (Pereira et al., 2005; Duffey et al., 2007). Based on this evidence it is likely that the greater intake of fat, when measured as a percentage of total daily energy intake, found in British Pakistani girls, in this present study may, in part, be associated with the greater intake of fast-food at evening meal times. Furthermore, it is also possible that this significantly greater intake of fast-food, at evening meal times, is associated with the increased cardiometabolic risk found in British South Asians, compared with White British in childhood (Feltbower et al., 2002, 2003; Whincup et al., 2002, 2011).

This study also found that a high proportion of British Pakistani girls were consuming evening meals that were classified as traditional South Asian. These findings are in line with previous studies that have consistently found that the main evening meal is the most likely, of all daily meals, to remain ‘traditional’ (Kassam-Khamis et al., 1995; Bradby et al., 1997; Wyke and Landman, 1997; Lawson et al., 2008). Kocturk (1996) suggests that meals derived from the migrant country are maintained as the main evening meal as a means to reinforce the cultural identity of the migrant family.

7.4.2 Cooking Practices

This study found that 95% of British Pakistani girls consumed a home-prepared meal from fresh ingredients, on at least one occasion over the three recalled days, and of these meals 87% were classified as traditional South Asian in style. These findings indicate that within Pakistani households a small proportion of home prepared meals from fresh ingredients were made up of dishes entirely adopted from western society. Interview data suggest that adopted meals may include pasta and/or meat, potato and vegetable dishes. However, Bush et al. (1998) who investigated dietary practices of British South Asians highlight that whilst western dishes are being adopted by South Asians in the UK, it is possible that they are modified with spices to make it more acceptable to taste. Findings from this study also suggest that a proportion of British Pakistani girls (13%) consumed no traditional South Asian food over the three recalled days, implying that western style meals were perhaps the preferred diet of these British Pakistani girls. Furthermore, one third of White British girls were also found to consume traditional South Asian food, therefore suggesting that dietary change, in this sample of girls, is occurring in some instances both ways.

However, it is likely that the cooking practices of British Pakistanis, in particular those of traditional South Asian style, are contributing to the higher fat intake, measured as a percentage of total daily energy intake, found in this sample of British Pakistani girls, compared to white British girls. Investigations by Kassam-Khamis et al. (2000) into the nutritional composition of traditional dishes commonly consumed by South Asians in the UK report that this style of cooking generally involves adding large amounts of fats or oils to the dish during preparation. Furthermore, Kassam-Khamis et al found that participants would often pour the oil directly into the pan rather than measuring it first. This was also a practice I witnessed whilst observing traditional cooking during the interview process. This is not to say this practice is uncommon in White British households. However, findings from this study support the widespread use of fats or oils in traditional South Asian cooking, with many Pakistani parents reporting such practices particularly in the preparation of curry type dishes. This study also found that a significantly greater proportion of British Pakistani girls were consuming meals that were shallow fried during preparation. This greater intake witnessed in British Pakistani girls is therefore likely associated with traditional South Asian cooking practiced in these households. Although it is also important to note that great variation in the amount, as well as types of oils and fats used for traditional cooking are likely within this sample of British Pakistani families. Kassam-Khamis et al. (2000) found that large variations in fat content of traditional dishes were reported, which resulted from the adoption of lower fat versions by some of their sample. Interview data from Pakistani parents further supports the adoption of lower fat versions of traditional Pakistani cooking, with some Pakistani parents reporting reducing the amount of oil used during cooking.

This study also found evidence to suggest that consumption of meals and/or food items that had been deep fried as the main cooking method was significantly greater in British Pakistani girls compared with white British girls. Again the consumption of traditional South Asian food items, such as samosa and pakora, which are generally deep fried as the main cooking method, is likely to contribute to this ethnic group difference. Interview data also identified the use of deep frying during cooking of traditional South Asian food items. However, it was also reported that the consumption of deep fried traditional items was fairly infrequent, perhaps as little as once a week or kept to special occasions. Bush et al. (1998) report similar findings, suggesting that the consumption of deep fried traditional food items were a feature of special meals. Interview findings however, suggest that deep frying food as a main cooking method was practiced by a number of Pakistani parents when cooking more westernised meals/food items, such as fish-fingers and chips, whereas White British parents suggested that they limited deep frying as a cooking method. A study reported by Lip et al. (1995) investigating dietary fat purchasing habits of whites, blacks and Asians in England identified similar findings, suggesting that both frying during the preparation of traditional curried dishes and deep-frying were the most common cooking method reported by Asians, compared to grilling, boiling and poaching more commonly practiced by whites and blacks.

In addition, fast-food, which may include chips, chicken and fish, is generally deep fried as the main cooking method. Therefore the significantly greater intake of fast-food as an evening meal reported by British Pakistani girls is also likely to contribute to their significantly higher intake of deep fried food. Given the unfavourable links between fried food consumption and metabolic syndrome (Lutsey et al., 2008) it is possible that a greater intake of fried food by British Pakistanis contributes to the increased cardiometabolic risk of British South Asians.

In summary, evidence suggests that cooking practices, in relation to a greater intake of home cooked traditional South Asian meal/food items, fast-food, and of meal/food items, which have been either shallow or deep fried during preparation or as the main cooking method are contributing to the greater intake of fat, measured as a percentage of total daily energy intake, also found in this sample of British Pakistani girls compared with White British girls.

7.4.3 Ethnic Group Comparisons of Food and Beverage Group Intake Associated with Excess Weight Gain and Cardiometabolic Risk

Findings suggest that daily fruit, vegetable and fruit juice consumption were similar between ethnic group, with White British and British Pakistani girls averaging 3.4 and 3.7 portions of fruit, vegetables and fruit juice per day, respectively. The *Health Survey for England* 2004 (Sproston and Mindell, 2006) also investigated ethnic group differences in self-reported fruit and vegetable consumption of children aged 4 to 18 years. In line with findings from this present study, fruit and vegetable consumption were similar between White British and British Pakistani girls, which averaged 2.7 and 3.0 portions, per day, respectively. It is possible that this present sample of girls were consuming, on average, more fruit and vegetables, per day, compared with those reported by the *Health Survey for England*. However it is also possible that this small discrepancy in findings could be related to differences in measurement techniques. In addition, it is not clear whether the *Health Survey for England* counted fruit juice as portions of fruit, whereas both White British and British Pakistani girls within this present study averaged one portion of fruit juice per day, which counted towards their total daily fruit intake.

A diet rich in fruit and vegetables has been associated with a reduction in a range of cardiometabolic risk factors (Ness and Powles, 1997; Joshipura et al., 1999; Williams et al., 1999; He et al., 2006). Current health guidelines recommend a minimum intake of five portions of fruit and/or vegetables per day (National Health Service, 2012). Findings from this study suggest that both White British and British Pakistani girls were failing to meet these current health guidelines. However, since there was little difference found in fruit and vegetable consumption between ethnic groups, these findings were unable to explain ethnic group differences in cardiometabolic risk, between White British and South Asian populations, in the UK.

The consumption of sugar-sweetened beverages was similar between ethnic groups, with White British and British Pakistani girls averaging 1.9 and 2.0 portions, per day, respectively. These findings suggest that the consumption of sugar-sweetened beverages was common in both ethnic groups. In line with these findings, Edwards et al. (2006) found that fizzy drinks consumption was common in their UK sample of South Asian children, with 67% reporting the consumption of at least one fizzy drink, during the 24 hours, prior to recall. A review article by Hu and Malik (2010) found that adults consuming one or more portions of sugar-sweetened beverage per day significantly increased their risk of developing cardiometabolic disease. The high intake of sugar-sweetened beverages reported by this sample of girls may therefore suggest potential links to the poor cardiometabolic profile presently found in White and South Asian children in Britain (Feltbower et al., 2002, 2003; Whincup et al., 2002; 2011).

Lower than recommended intakes of fruit and vegetables and frequent consumption of sugar-sweetened beverages have also been observed in children living in Pakistan, as noted in Section 1.10.5. Jafar et al (2008) found that intake was low, with only 15% and 28% of children reporting consuming fruit and vegetables, respectively, on a daily basis. These findings may perhaps suggest that British Pakistani children, here in the UK, are consuming more portions of fruit and vegetables than children living in Pakistan, although further evidence would be required to support this notion. Furthermore, Hydrie et al. (2004) reported that around 40% of Pakistani children were consuming sugar-sweetened beverages on a daily basis. Such evidence would suggest that children's poor dietary habits may also be a cause for health concern in Pakistan.

In summary, the consumption of food and beverages associated with excess weight gain and cardiometabolic risk was found to be similar between White British and British Pakistani girls. This helps to explain the similarities found between ethnic group in the total mean daily intakes of macronutrients, saturated fat, carbohydrates, sugar and fibre, but not the ethnic group differences found in total mean daily intake of fat measured as a percentage of total mean daily energy intake found in chapter six.

7.5 Conclusion

Examining dietary behaviour associated with meal time dietary practices and consumption habits found that the consumption of fried food, which was likely related to traditional South Asian cooking practices, as well as fast-food, was more common at evening meal time in British Pakistani homes, compared with White British. These are likely sources of the greater intake of fat, measured as a percentage of total daily energy intakes for British Pakistani girls, compared with White British found previously in chapter six.

Furthermore the greater intake of fried food and fast-food found in this sample of British Pakistani girls provide clues to sources of health inequalities, in relation to cardiometabolic risk, also found between these populations in both childhood and later in life.

Finally, breakfast and lunch time dietary practices, and consumption habits in relation to food and beverage intake associated with excess weight gain and cardiometabolic risk, were similar in both groups. This suggests that westernised dietary habits have been adopted by a large proportion of the British Pakistani girls within this sample. Furthermore these similarities in breakfast and lunch time dietary practices and consumption habits provide some insight into how the diets of White British and British Pakistani girls were similar in relation to total mean daily intake of saturated fat, carbohydrates, sugar and fibre, measured as a percentage of total meal daily energy intake.

Chapter Eight: Conclusion

8.1 Summary of Study Aims

This interdisciplinary study spanned the areas of medical anthropology, nutrition and epidemiology and used quantitative and qualitative research methods to investigate physical activity and dietary behaviour of British Pakistani and White British girls, aged 9 to 11 years, living on Teesside, North-east England.

Ethnic group comparisons of objectively measured physical activity and sedentary time and recalled physical activity and sedentary behaviours have been made. In addition, energy and macronutrient intake, meal time dietary practices and consumption habits and dietary behaviour associated with cardiometabolic risk have also been compared by ethnic group.

Based on the evidence reviewed in chapter one I formulated and tested the following hypotheses:

- British Pakistani girls will have significantly lower measures of objectively measured total physical activity than White British girls
- British Pakistani girls will spend significantly less time in objectively measured moderate to vigorous physical activity than White British girls
- British Pakistani girls will spend significantly more time in objectively measured sedentary time than White British girls
- British Pakistani girls will have a significantly higher intake of fat, measured as a proportion of daily energy intake than White British girls.

Furthermore, semi-structured interviews were also conducted with parents to investigate familial influences on children’s physical activity and dietary intake.

This final chapter proceeds to highlight the strengths and limitations of the study, summarise the main findings and identify areas for future research and health intervention.

8.2 Study Strengths and Limitations

When interpreting the results from this study the following strengths and limitations should be considered.

8.2.1 Sample

The total sample size of this current study was 166, which is relatively small compared with previous studies that have investigated ethnic group differences in children's physical activity (Owen et al., 2009) and dietary intake (Donin et al., 2010). However using a small study sample meant multiple methods could be used to collect a wider range of data on both diet and physical activity. Power calculations were based on physical activity (using results from the Health Survey for England 2004 (Sproston and Mindell, (2006)) as the primary outcome, as evidence suggests this may be the most important factor in causing health inequalities between the two groups. This determined that a minimum sample of 124 (62 White British and 62 British Pakistani) girls was required to achieve a good degree of reliability in the study findings. This current sample (chapters four and five) exceed the minimum sample size determined by the power calculations therefore strengthening study findings regarding physical activity.

The dietary sample, however, was limited in its power to detect small effects. Given the potential differences in dietary intake between these two groups, further investigation is warranted with a larger sample size that meets power requirements.

8.2.2 Methods

The multiple mixed method approach to data collection is a particular strength of this study. The use of accelerometry, physical activity recall, questionnaires, multiple pass diet recall and semi-structured interviews enabled a holistic investigation of physical activity and dietary intake in this sample of girls. This approach has successfully provided: objective measurements of the intensity and duration of free living physical activity and sedentary time; self-reported estimates of physical activity and sedentary behaviour; self-reported daily intakes of energy, macronutrients, and dietary practices and eating habits for British Pakistani and White British girls. This not only allowed a thorough investigation into ethnic group differences in physical activity, sedentary time and dietary intake, but also helped to determine the source to some of these differences.

An additional strength of this study was the use of the Actigraph accelerometer, which provided valid and reliable real time estimate of the children's physical activity and sedentary time. In addition, objective measurements of physical activity were taken over four days, including two weekend and two weekdays. Ninety-one per cent of the sample provided four complete days of physical activity data. This exceeds the minimum recommendation of three days (Trost et al., 2000), therefore adding strength to the reliability and validity of these findings.

A limitation of the Actigraph is its inability to accurately capture all types of activities, which includes static work and movement against external forces, such as pushing and lifting heavy objects, stair climbing, cycling, rowing and resistance training. I therefore acknowledge that the results presented in this thesis, for objectively measured physical activity, may not be a true measurement of all physical activities. However, all of these activities, with the exception of cycling, are not activities commonly carried out by British school children. Therefore the extent of inaccurately captured data should be minimal. In addition, cycling was not an activity commonly reported by British Pakistani girls; therefore it is unlikely to account for any ethnic group difference observed in physical activity levels.

A further limitation of the Actigraph accelerometer used to collect the data for this study was that it was not waterproof, therefore the children were asked to remove the Actigraph accelerometer during water based activities. This means that activities, such as swimming which was reported by a small number of White British and British Pakistani girls, were not captured objectively. As a result, the measures of objective activity will suggest that they have carried out less activity than actually performed. Furthermore, removing the accelerometer for activities will also result in a reduced amount of wear time, which may, in turn, affect individual ability to meet the minimum wear criterion.

An additional limitation of this study is in the decision to use the Actigraph to collect data on sedentary time. The Actigraph, which measures sedentary time by a lack of movement, is unable to distinguish between different postures, such as sitting and standing. Since spending prolonged periods of time sitting is understood to be detrimental to health, having the ability to distinguish between the times spent sitting and standing, would be of public health importance.

Strength of this study was in the collection of dietary data, which used food records and the multiple pass diet recall. Not only has the latter method been found to provide the most reliable estimates of children's dietary intake on a group mean basis (McPherson et al., 2000), combining this method with the food record has proven to increase the accuracy of estimates of food and nutrient intake, and servings of fruit and vegetables (Lytle et al., 1998). Therefore, this multiple method approach to dietary data collection contributes to the reliability and validity of the study findings.

An additional strength of the dietary findings is the total number of days data were collected from each participant. A validation study by McPherson et al. (2000) found that three days of dietary data, collected by 24 hour recall, provide more valid and reliable group estimates of intake in comparison to a single day of dietary data (McPherson et al., 2000). Furthermore, including data collected from both weekend and week days help control for day-to-day variability in dietary intake. Previous studies examining ethnic group differences in dietary intake of children have collected data, by 24 hour recall, for one day only (Parsons and Godson et al., 1999; Edwards et al., 2006; Donin et al., 2010). This study however, collected data for three consecutive days (including one weekend day), which contributes to the reliability and validity of the dietary findings.

Weaknesses that may be associated with the results of this study are within the patterns of physical activity and dietary intake. These patterns were determined from one or two days of data, and so the reliability of these estimates is not as good as for the overall measures of physical activity and diet.

An additional weakness of the study lay within the self-report data collection methods. Previous day physical activity recall and multiple pass diet recall were used to collect dietary intake and physical activity and sedentary behaviour. These methods however, as with all methods of self-report, rely heavily on memory and ability to estimate. Studies examining measurement issues of the 24 hour recall, found that a child's ability to recall improved with age (McPherson et al., 2000), and by the age of 10, children were found to report reliable and valid estimates of dietary intake (Biro et al., 2002). Data were collected from girls aged 9 to 11 years, therefore it is possible that the younger children may not have been as capable as the older children within this sample, at recalling and estimating activity duration and the time they took place and recalling dietary intake and estimating portion sizes. Furthermore, it was evident, when conducting the previous day recalls, that the girls from year six were, in general, more able to recall and estimate physical activities and dietary intake. However, since there was not a significant difference in the proportion of British Pakistani and White British girls recruited from each year group. This weakness in the data collection methods is therefore unlikely to influence any significant differences found in physical activity and dietary intake between ethnic groups.

Data collection within this study used an adult photographic food atlas for the children to estimate portion sizes. Using adult portion sizes with children is not ideal and is likely to result in a degree of over estimation error. Frobisher and Maxwell (2003) investigated error in adult and child estimates of dietary intake using the photographic food atlas. They report that greater error was found in child estimates of portion sizes compared with adults, which is likely associated with the atlas being designed for use with adult populations and not children. Data collection for this current study, however, used the supplementary photographs provided with the food photographic atlas of crockery, cutlery, glasses, cups, mugs, which were to scale, for participants to aid more accurate estimates of portion sizes, with the aim of reducing overestimation error. Using these supplementary photographs is thought to aid estimations, since participants are able to see the actual size of the plate or bowl and therefore able to make a more accurate estimate. Ideally however, a food photographic atlas of child portions would have been more effective in reducing over reporting error. A study by Foster et al. (2006) found that providing children with age appropriate photographs significantly reduced estimation error, when compared with estimates from adult food photographs. At commencement of data collection there was no published age appropriate photographic food atlas for use with children. However, reporting energy intake from nutrients, as a percentage of total energy intakes, should eliminate bias caused by reporting error.

Analyses were also conducted to examine ethnic group differences in the consumption of the different types of food. To perform these analyses on the recalled dietary data I categorised meals into different ‘types’. While established procedures were followed as much as possible, this process is challenging and the meal types defined were necessarily broad. For example, the snack category included snacks of very different values with respect to health, and combining fast-foods with snack foods meant that this category was rather variable. However, the number of children consuming only snack food as a meal was minimal. This also seemed to be less practiced by British Pakistani children.

The measure of screen time was unable to explain the ethnic group difference found in the duration of sedentary time (chapter four). It is possible that any ethnic group difference in screen time was obscured by error in recall, but it is perhaps more likely that the source of the difference in sedentary time stems from other forms of behaviour. Gorley et al. (2007) found that watching television, doing homework, using motorised transport, sitting talking, listening to music, spending time chatting on the telephone, using a computer and reading were all popular sedentary activities in their sample of adolescent girls. Therefore, it may have been beneficial to the investigation on sedentary behaviour if more information on sedentary activities were captured from the physical activity recalls.

The physical activity questionnaire for children was used to collect data on habitual physical activity for the seven day period prior to completing the questionnaire. This questionnaire has previously been validated for use with children of this age (Crocker et al., 2000). However it was evident that the participants in this study required some help in understanding the questions when completing the questionnaire. Furthermore, the questionnaire requires participants to report activities that they had participated in during the previous seven days and their activity levels during specific active periods (i.e. school break-time during the last seven days). It was apparent that the participants had difficulty in remembering and accurately recalling activities and estimating their own activity levels over the specified time period, particularly as the time between the activity and completing the questionnaire became greater (i.e. questionnaires were completed on the Wednesday, but were asking about participation in activities from the previous Wednesday). Therefore it is likely that data collected using the physical activity questionnaire is subject to some reporting error although the extent to which this may have occurred is unknown.

Measuring socioeconomic status within this sample proved difficult due to incomplete questionnaire data. Mothers' education (age mother left full time education) was found to be the most complete measure of socioeconomic status, but there remained a small percentage of mothers who did not provide data for this question. It is possible that language, in the Pakistani sample only, may have acted as barrier which led to incomplete questionnaire data. It is also possible that a measure of socioeconomic status with no missing data would have revealed a relationship with physical activity or diet. However, as discussed previously, the school attended acted, to some extent, as a proxy variable for socioeconomic status in this study.

Weight and height were not collected from this sample of girls because of concerns about the effects on recruitment. Therefore the BMI for this sample of girls could not be calculated. In a previous study, Henderson et al. (2011) found no difference in height and BMI between White British and British Pakistani children in the same population on Teesside. Therefore, it is unlikely that the ethnic group comparison of physical activity levels and diet would be influenced, by ethnic group differences in height or weight, in this sample of girls.

8.3 Summary of the Main Study Findings

Ethnic group comparisons of objectively measured physical activity and sedentary time indicate that British Pakistani girls were less physically active, spent less time in moderate to vigorous physical activity and spent more time sedentary compared to White British girls. These low levels of physical activity, moderate to vigorous physical activity and high amounts of sedentary time in British Pakistani girls may be associated with the greater incidence of type 2 diabetes found in British South Asian children, compared to White European children (Feltbower et al., 2002) and towards ethnic group differences in type 2 diabetes precursors found in British children within children of primary school age (Whincup et al., 2002, 2011).

Ethnic group comparisons of physical activity-related behaviours suggest that British Pakistani girls were less likely to report participating in sport and exercise activities and, most particularly, spent less time in outdoor play and active modes of school transport compared to White British girls. Since sport and exercise, outdoor play and active modes of school transport are each determinants of physical activity and moderate to vigorous physical activity in children we can assume that the reduced participation in these activities observed in British Pakistani girls contribute to the lower objective measures of physical activity and moderate to vigorous physical activity also observed in this sample when compared to White British girls.

Deeply situated religious and social values and practices of Muslim societies strongly influence the day-to-day lives and behaviour of their women. This has not only had an impact on female involvement in sport, but is also likely to have had a negative impact on their overall physical activity levels. Despite the recent evidence to suggest that the attitudes of Muslim societies are now undergoing change, to allow female engagement in sporting activities, a complete shift in these attitudes will no doubt take time. Therefore it is probable that these social and religious values and practices will continue to influence the physical activity behaviour of Muslim women, including that of British Pakistani girls, until a complete shift in attitudes has taken place. It is also likely that the previous negative attitudes towards female participation in sport activities have influenced the physical activity behaviour of the British Pakistani girls involved in this study, although the extent to which this has occurred is not known and is likely to vary considerably depending on how closely the individuals and their families adhere to social and religious values and practices.

This study also found some evidence which may suggest that some British Pakistani parents are less willing to allow their daughters to play outdoors unsupervised. There was also evidence to suggest that Pakistani parents were willing to allow their daughters to play, perhaps unsupervised, within the immediate environment. However, when venturing further afield, such as to the local park, it was reported that adults accompanied them. White British parents also made reference to accompanying their daughters to the park, yet it was also indicated by some that their daughters were allowed to play away from the immediate environment, in the park, unsupervised. These findings perhaps indicate that British Pakistani parents are less willing to allow their daughters to venture away from the immediate environment unsupervised, where White British parents may be slightly more relaxed about this issue. However, variation in parental attitudes and values are likely to influence the extent to which unsupervised play is practiced by children, irrespective of ethnic group.

These same attitudes of British Pakistani parents may also be influencing the use of active modes of school transport by British Pakistani girls. Parents who are less willing to allow their daughters out alone, may be more likely to use motorized school transport, thus reducing the average amount of time spent in active modes of school transport in this sample of British Pakistani girls.

Sedentary behaviour, in terms of recreational screen time, was also compared by Ethnic group. The findings from this study suggest that the proportion of girls reporting participation in recreational screen time and the average amount of time spent in this activity did not differ significantly by ethnic group. Therefore, comparisons of self-reported recreational screen time were unable to explain the ethnic group difference in objectively measured sedentary time. This study, however, found that British Pakistani girls are more likely to visit relatives as a leisure activity, which seemed to be a common feature of British Pakistani family life, particularly on weekend days. Such visits appear to be sedentary in style for both adults and children and it is possible that they contribute to higher levels of sedentary time in British Pakistani girls.

A high proportion of the British Pakistani girls sample reported attendance at evening Mosque school on week days. As this activity is sedentary in nature, an inverse relationship between attendance at evening Mosque school and out-of-school objectively measured sedentary time was expected. Findings from this study however, suggest that British Pakistani girls are equally sedentary regardless of Mosque attendance, thus suggesting that non-Mosque attendees are spending their out-of-school time in other forms of sedentary behaviour. Further analysis of recreational screen-time found that although British Pakistani non-Mosque attendees reported spending a slightly greater duration in sedentary time, this difference was not significant. Furthermore, total measures of objectively measured physical activity, sport and exercise and outdoor play activities out-of-school are also unaffected by Mosque attendance in this sample of British Pakistani girls.

This study also found that participation in after-school sport and exercise activities are largely similar by ethnic group. School plays an important role in influencing children's behaviour and can play a positive role in influencing girls to participate in after-school physical activities. Participation by British Pakistani girls, in after-school sports activities, appeared to be unaffected by evening Mosque attendance. Interview data supports this finding, with British Pakistani parents indicating, to a certain extent, evening attendance at Mosque school is reasonably adaptable and can be made to fit in with participation in after-school sport and exercise activities. This suggests that parents and Mosque school leaders are prepared to facilitate their children's interests in participating in after-school based activities.

School break-time offers an important opportunity for children to be physically active. Ethnic group comparisons of school break-time activity were made to determine whether, given the same opportunity, girls of White British and British Pakistani origin were equally as active. Objectively measured physical activity found that British Pakistani girls spent less time in moderate to vigorous physical activity and more time sedentary when measured as a percentage of school break-time. Findings from break-time physical activity perhaps indicate attitudes and values associated with religion, regarding modesty and mixed gendered environment display themselves, at this age, within the school playground.

Ethnic group comparisons of dietary intake found average energy and macronutrient consumption were largely similar between this sample of White British and British Pakistani girls. However, British Pakistani girls were found to gain a greater proportion of daily energy from total fat, compared to White British girls. Despite the fact that fat is the nutrient with the highest energy density, current evidence supporting links between total fat intake (as opposed to saturated fat intake) and cardiometabolic risk is weak. Therefore no conclusive indications can be made between the higher intakes of total fat observed in this sample of British Pakistani girls and cardiometabolic risk evident in these populations.

This study has also found evidence to suggest that British Pakistani girls are not compensating their low levels of physical activity and high periods of sedentary behaviour with lower energy intake, since total mean daily energy intake is higher in this sample of British Pakistani girls than is recommended for children of this age. Previous literature however, indicates that overweight and obesity is currently not a problem amongst the Teesside population of British Pakistani girls at this age (Henderson et al., 2011). However, if British Pakistani girls persistently exceed recommended energy intake and regularly fail to meet current physical activity guidelines, overweight and obesity is likely to become a problem over time. The high intake of energy in both White British and British Pakistani girls found in this sample of girls are however, in line with the high rates of overweight and obesity also found in this region (North East Public Health Observatory, 2012).

This study also found that the types of breakfast and lunch time meals consumed were similar by ethnic group, suggesting that British Pakistani families had adopted many westernised eating habits during these meal times. However, ethnic group differences in the types of meals consumed in the evening are evident, with a large proportion of British Pakistani girls consuming 'traditional' South Asian food as their evening meal. This supports the notion, reported elsewhere (Anderson and Lean, 2005; Kassam-Khamis et al., 1995; Bradby et al., 1997; Lawson et al., 2008), that the evening meal is the most likely to retain South Asian cultural identity. There was also evidence to suggest that evening meals are usually taken at times to fit in around children's attendance at evening Mosque school in British Pakistani families, which often meant that British Pakistani girls were consuming their main meal much later in the evening compared to White British girls. Eating late at night has previously proven to have a negative effect on cardiometabolic profile (Lennernas et al., 1995). Therefore consuming the main evening meal at this time may have important health implications within this Pakistani sample.

The consumption of South Asian cuisine, which is known for its high fat cooking methods, was high in this sample of British Pakistani girls, and is likely associated with the high frequency of consumption of light and deep fried food also found within these girls. Fast-food is also associated with a greater intake of total fat, and is likely to contribute to the greater intake of total fat also found in this sample of British Pakistani girls. Furthermore, given the links between fast-food and increased cardiometabolic risk (Pereira et al., 2005, Esmaillzadeh et al., 2006) findings from this study may also indicate a role of fast-food in cardiometabolic risk in British South Asians.

Ethnic group comparisons of obesity related dietary behaviour suggest that consumption habits were largely similar in White British and British Pakistani girls. Furthermore, findings suggest that girls, on average, irrespective of ethnic group consumed around two portions of sugar-sweetened beverages per day. Given the links between sugar-sweetened beverage consumption and cardio metabolic risk (Hu and Malik, 2010) it is possible that this increased intake in both White British and British Pakistani girls may be contributing to the poor cardiometabolic profile that is evident in young British children (Feltbower et al., 2002, 2003).

In conclusion, the findings of this study suggest that there may be marked differences in the physical activity and sedentary time of British Pakistani and White British girls, which are likely associated with the poorer cardiometabolic health in the former. Dietary differences between the groups may also contribute to poorer health in British Pakistani girls and women, although these were less reliable and of a smaller scale.

8.4 Areas for Future Research

This study found a significant ethnic group difference in objectively measured sedentary time. However, the source of this difference was not found through investigating self-reported screen time alone. Therefore there is great need for additional research to fully investigate a wider range of sedentary activities that White British and British Pakistani girls of this age may participate in on a regular basis. Such research has the potential to identify important areas for intervention.

A key area for future research will be to investigate the attitudes and values of Pakistani parents towards their daughter's participation in physical activity and sports and exercise, as well as outdoor play. In addition girls' beliefs and attitudes regarding their engagement in these types of activities should also be investigated. Furthermore, based upon the evidence suggesting that the attitudes and values of Muslim societies are undergoing social change to accommodate female participation in physical activity and sport, an investigation into intergenerational differences in attitudes, values and engagement in physical activity and sport would also be of importance to health intervention work.

Previous studies have found that children who use active modes of school transport recorded significantly more total daily physical activity compared with children who used sedentary forms of school transport (Owen et al., 2012). Findings from this study report on ethnic group differences in the proportion of girls using active modes of school transport and the mean duration of self-reported journey time. However, to date they have not yet reported on any determinants that have been associated with the use of active modes of school transport other than distance between home and school. Therefore, additional research to investigate the reasons for ethnic group differences in active/inactive modes of school transport, which should also take into consideration beliefs and attitudes specific to British Pakistanis, would be of value to public health knowledge.

In this study I found significant ethnic group differences in objectively measured break-time moderate to vigorous physical activity and sedentary time. This suggests that despite given equal opportunity to be physically active, British Pakistani girls spent significantly less time in moderate to vigorous physical activity and more time sedentary during this time. Data were not examined in as much detail for P.E. lessons or after-school sports activities. Therefore it may be of interest to determine whether ethnic group differences in girls' activity levels also occur during structured sports and exercise during P.E. lessons and after-school sports activities.

Evidence suggests that British South Asians, in particular British Pakistani women, are displaying low levels of physical activity. There is also evidence to support a positive relationship between the physical activity levels of the parent and that of their children, which suggests that children with active parents are more likely to be active themselves. Given this evidence, future health interventions which aim to increase the physical activity levels of children, may also benefit from addressing the physical activity levels of their parents. Furthermore, an area of future research may be in determining the full effect that a physical activity intervention with parents has on the physical activity levels of their children. In light of this evidence, health interventions targeting British Pakistanis should aim to engage parents in physical activities and increase their overall physical activity levels, as this could also have a positive impact on the physical activity levels of their children.

Accelerometry can provide accurate assessments of physical activity and sedentary time. However assessing activity behaviour using self-report can be difficult. Current methods available are both poorly validated and limited in their ability to provide assessments of both physical activity and sedentary behaviours. Therefore there is a great need to develop methods that are able to provide valid assessments of physical activity and sedentary behaviours in children.

Finally there is evidence to suggest that participation in physical activity deteriorates in girls and boys with age, and that this may be more marked in girls of South Asian ethnicity. Therefore research investigating physical activity and activity behaviour in adolescent Pakistani girls is warranted and will help track physical activity within these populations from childhood through to adulthood.

Bibliography

Acheson, K., I. Campbell, O. Edholm, D. Miller and M. Stock (1980). "The measurement of food and energy intake in man-an evaluation of some techniques." American Journal of Clinical Nutrition **33**(5): 1147.

Ainsworth, B. E., M. L. Irwin, C. L. Addy, M. C. Whitt and L. M. Stolarczyk (1999). "Moderate physical activity patterns of minority women: the cross-cultural activity participation study." Journal of Women's Health and Gender-Based Medicine **8**(6): 805.

Alhassan, S., J. Sirard, T. Spencer, A. Varady and T. Robinson (2008). "Estimating physical activity from incomplete accelerometer data in field studies." Journal of Physical Activity and Health **5**: S112.

Anderson, A. S., H. Bush, M. Lean, H. Bradby, R. Williams and E. Lea (2005). "Evolution of atherogenic diets in South Asian and Italian women after migration to a higher risk region." Journal of Human Nutrition and Dietetics **18**(1): 33.

Anderson, C. B., M. Hagströmer and A. Yngve (2005). "Validation of the PDPAR as an adolescent diary: effect of accelerometer cut-points." Medicine and Science in Sports and Exercise **37**(7): 1224.

Anderson, J. W., K. M. Randles, C. W. C. Kendall and D. J. A. Jenkins (2004). "Carbohydrate and fiber recommendations for individuals with diabetes: a quantitative assessment and meta-analysis of the evidence." Journal of the American College of Nutrition **23**(1): 5.

Appleby, P., M. Thorogood, J. Mann and T. Key (1998). "Low body mass index in non-meat eaters: the possible roles of animal fat, dietary fibre and alcohol." International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity **22**(5): 454.

Armstrong, N. (1998). "Young people's physical activity patterns as assessed by heart rate monitoring." Journal of Sports Sciences **16**(S1): 9.

Arnold, J. E., T. Rohan, G. Howe and M. Leblanc (1995). "Reproducibility and validity of a food-frequency questionnaire designed for use in girls age 7 to 12 years." Annals of Epidemiology **5**(5): 369.

Bailey, R. C., J. Olson, S. L. Pepper, J. Porszasz, T. J. Barstow and D. Cooper (1995). "The level and tempo of children's physical activities: an observational study." Medicine and Science in Sports and Exercise **27**(7): 1033.

Bandini, L. G., H. Cyr, A. Must and W. H. Dietz (1997). "Validity of reported energy intake in preadolescent girls." American Journal of Clinical Nutrition **65**(4): S1138.

Baquet, G., G. Stratton, E. Van Praagh and S. Berthoin (2007). "Improving physical activity assessment in prepubertal children with high-frequency accelerometry monitoring: a methodological issue." Preventive Medicine **44**(2): 143.

Barclay, A. W., V. M. Flood, J. C. Brand-Miller and P. Mitchell (2008). "Validity of carbohydrate, glycaemic index and glycaemic load data obtained using a semi-quantitative food-frequency questionnaire." Public Health Nutrition **11**(6): 573.

Bassett, D. and S. J. Strath (2002). "Use of pedometers to assess physical activity." Welk, G. (Ed). Physical activity assessments for health-related research, Champaign, IL: Human Kinetics Publishers.

Bauman, W. and A. Spungen (2008). "Coronary heart disease in individuals with spinal cord injury: assessment of risk factors." Spinal Cord **46**(7): 466.

Baxter, S. D., W. O. Thompson, H. C. Davis and M. H. Johnson (1997). "Impact of gender, ethnicity, meal component, and time interval between eating and reporting on accuracy of fourth-graders' self-reports of school lunch." Journal of American Dietetics Association **97**(11): 1293.

Beets, M. W., M. M. Patton and S. Edwards (2005). "The accuracy of pedometer steps and time during walking in children." Medicine and Science in Sports and Exercise **37**(3): 513.

Bellu, R., M. Ortisi, E. Riva, G. Banderali, I. Cucco and M. Giovannini (1995). "Validity assessment of a food frequency questionnaire for school-age children in Northern Italy." Nutrition Research **15**(8): 1121.

Bennett, C. A., A. M. de Silva-Sanigorski, M. Nichols, A. C. Bell and B. A. Swinburn (2009). "Assessing the intake of obesity-related foods and beverages in young children: comparison of a simple population survey with 24 hr-recall." International Journal of Behavioural Nutrition and Physical Activity **6**(1): 71.

Bhopal, R., N. Unwin, M. White, J. Yallop, L. Walker, K. G. M. M. Alberti, J. Harland, S. Patel, N. Ahmad, C. Turner, B. Watson, D. Kaur, A. Kulkarni, M. Laker and A. Tavridou (1999). "Heterogeneity of coronary heart disease risk factors in Indian, Pakistani, Bangladeshi, and European origin populations: cross sectional study." British Medical Journal **319**(7204): 215.

Biro, G., K. Hulshof, L. Ovesen and C. J. A. Amorim (2002). "Selection of methodology to assess food intake." European Journal of Clinical Nutrition **56**: S25.

Block, J. P., R. A. Scribner and K. B. DeSalvo (2004). "Fast food, race/ethnicity, and income." American Journal of Preventive Medicine **27**(3): 211.

Bouchard, C., A. Tremblay, C. Leblanc, G. Lortie, R. Savard and G. Theriault (1983). "A method to assess energy expenditure in children and adults." American Journal of Clinical Nutrition **37**(3): 461.

Bowman, S. A., S. L. Gortmaker, C. B. Ebbeling, M. A. Pereira and D. S. Ludwig (2004). "Effects of fast-food consumption on energy intake and diet quality among children in a national household survey." Pediatrics **113**(1): 112.

Bowman, S. A. and B. T. Vinyard (2004). "Fast food consumption of US adults: impact on energy and nutrient intakes and overweight status." Journal of the American College of Nutrition **23**(2): 163.

Bradby, H. (1997). Health, eating and heart attacks: Glaswegian Punjabi women's thinking about everyday food (in Caplan, P. (ed.) Food, Health and Identity). London, Routledge.

Brage, S., N. Wedderkopp, L. B. Andersen and K. Froberg (2003). "Influence of step frequency on movement intensity predictions with the CSA accelerometer: A field validation study in children." Pediatric Exercise Science **15**(3): 277.

Brage, S., N. Wedderkopp, U. Ekelund, P. W. Franks, N. J. Wareham, L. B. Andersen and K. Froberg (2004). "Features of the metabolic syndrome are associated with objectively measured physical activity and fitness in Danish children - the European Youth Heart Study (EYHS)." Diabetes Care **27**(9): 2141.

Bratterby, L. E., Sandhagen, B., Fan, H. and Samuelson, G., (1997). "A 7-day activitiy diary for the assessment of daily energy expenditure validated by doubly labelled water methods in adolescents." European Journal of Clinical Nutrition **51**: 585 .

Bray, G. A. and B. M. Popkin (1998). "Dietary fat intake does affect obesity!" American Journal of Clinical Nutrition **68**(6): 1157.

Brodersen, N. H., A. Steptoe, D. R. Boniface and J. Wardle (2007). "Trends in physical activity and sedentary behaviour in adolescence: ethnic and socioeconomic differences." British Journal of Sports Medicine **41**(3): 140.

Brunner, E., M. Juneja and M. Marmot (2001). "Dietary assessment in Whitehall II: comparison of 7 d diet diary and food-frequency questionnaire and validity against biomarkers." British Journal of Nutrition **86**(03): 405-414.

Bryant, M., J. Lucove, K. Evenson and S. Marshall (2007). "Measurement of television viewing in children and adolescents: a systematic review." Obesity Reviews **8**(3): 197.

Bryman, A. (2004). Social Research. Oxford: Oxford University Press.

Burdette, H. L., R. C. Whitaker and S. R. Daniels (2004). "Parental report of outdoor playtime as a measure of physical activity in preschool-aged children." Archives of Pediatrics and Adolescent Medicine **158**(4): 353.

Burrows, M., A. Baxter-Jones, R. Mirwald, H. Macdonald and H. McKay (2009). "Bone mineral accrual across growth in a mixed-ethnic group of children: are Asian children disadvantaged from an early age?" Calcified Tissue International **84**(5): 366.

Burrows, T., W. M. Janet and C. E. Collins (2011). "Long-term Changes in Food Consumption Trends in Overweight Children in the HIKCUPS Intervention." Journal of Pediatric Gastroenterology and Nutrition **53**(5): 543.

Bush, H., R. Williams, H. Bradby, A. Anderson and M. Lean (1998). "Family hospitality and ethnic tradition among South Asian, Italian and general population women in the West of Scotland." Sociology of Health and Illness **20**(3): 351.

Byers, T., F. Treiber, E. Gunter, R. Coates, A. Sowell, S. Leonard, A. Mokdad, S. Jewell, D. Miller and M. Serdula (1993). "The accuracy of parental reports of their children's intake of fruits and vegetables: validation of a food frequency questionnaire with serum levels of carotenoids and vitamins C, A, and E." Epidemiology: 350.

Caplan, P. (1997). Food, Health and Identity, London: Routledge.

Carrington, B., T. Chivers and T. Williams (1987). "Gender, leisure and sport: a case-study of young people of South Asian descent." Leisure Studies **6**(3): 265.

Carroll, B. and G. Hollinshead (1993). "Ethnicity and conflict in physical education." British Educational Research Journal **19**(1): 59.

Carter, P., L. J. Gray, J. Troughton, K. Khunti and M. J. Davies (2010). "Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis." British Medical Journal **341**(7).

Carver, A., A. Timperio, K. Hesketh and D. Crawford (2010). "Are safety-related features of the road environment associated with smaller declines in physical activity among youth?" Journal of Urban Health **87**(1): 29.

Catellier, D. J., P. J. Hannan, D. M. Murray, C. L. Addy, T. L. Conway, S. Yang and J. C. Rice (2005). "Imputation of missing data when measuring physical activity by accelerometry." Medicine and Science in Sports and Exercise **37**(11): S555.

Champagne, C. M., N. B. Baker, J. P. DeLANY, D. W. Harsha and G. A. Bray (1998). "Assessment of energy intake underreporting by doubly labeled water and observations on reported nutrient intakes in children." Journal of American Dietetics Association **98**(4): 426.

Cho, S., M. Dietrich, C. J. P. Brown, C. A. Clark and G. Block (2003). "The effect of breakfast type on total daily energy intake and body mass index: Results from the Third National Health and Nutrition Examination Survey (NHANES III)." Journal of the American College of Nutrition **22**(4): 296.

Cleland, V., K. Ball, C. Hume, A. Timperio, A. C. King and D. Crawford (2010). "Individual, social and environmental correlates of physical activity among women living in socioeconomically disadvantaged neighbourhoods." Social Science and Medicine **70**(12): 2011.

Clemes, S. A. and N. K. Deans (2012). "Presence and Duration of Reactivity to Pedometers in Adults." Medicine and Science in Sports and Exercise **44**(6): 1097.

Cooper, A. R., L. B. Andersen, N. Wedderkopp, A. S. Page and K. Froberg (2005). "Physical activity levels of children who walk, cycle, or are driven to school." American Journal of Preventive Medicine **29**(3): 179.

Cooper, A. R., A. S. Page, B. W. Wheeler, M. Hillsdon, P. Griew and R. Jago (2010). "Research Patterns of GPS measured time outdoors after school and objective physical activity in English children: the PEACH project." International Journal of Behavioural Nutrition and Physical Activity **7**(31)

Corder, K., U. Ekelund, R. M. Steele, N. J. Wareham and S. Brage (2008). "Assessment of physical activity in youth." Journal of Applied Physiology **105**(3): 977.

Craig, R. and J. Mindell (2008). "Health Survey for England 2006. Volume 1: Cardiovascular disease and risk factors in adults." London: HM Stationary Office.

Crane, N. T. and N. R. Green (1980). "Food habits and food preferences of Vietnamese refugees living in northern Florida." Journal of American Dietetics Association **76**(6): 591.

Crocker, P. R. E., R. C. Eklund and K. C. Kowalski (2000). "Children's physical activity and physical self-perceptions." Journal of Sports Sciences **18**(6): 383.

Crouter, S. E., P. L. Schneider, M. Karabulut and D. R. Bassett (2003). "Validity of 10 electronic pedometers for measuring steps, distance, and energy cost." Medicine and Science in Sports and Exercise **35**(8): 1455.

Daly, M. E., C. Vale, M. Walker, K. Alberti and J. C. Mathers (1997). "Dietary carbohydrates and insulin sensitivity: a review of the evidence and clinical implications." American Journal of Clinical Nutrition **66**(5): 1072.

Dauchet, L., P. Amouyel, S. Hercberg and J. Dallongeville (2006). "Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies." Journal of Nutrutrition **136**(10): 2588.

Dencker, M., O. Thorsson, M. Karlsson, C. Linden, S. Eiberg, P. Wollmer and L. Andersen (2006). "Daily physical activity related to body fat in children aged 8-11 years." The Journal of Pediatrics **149**(1): 38.

Department of Health (1991). Dietary reference values for food energy & nutrients for the United Kingdom: Report of the panel on dietary reference values of the committee on medical aspects of food policy. Norwich, HM Stationary Office.

Department of Health (2011) "Physical activity guidelines for adults (19-64 years)."Accessed from<http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_127931 [Date accessed 09/09/2012]

Department of Health (2011) "Physical activity guidelines for children and young people (5 - 18 years)."Accessed from <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_127931[Date accessed 09/09/2012]

Després, J. P. (2006). "Abdominal obesity: the most prevalent cause of the metabolic syndrome and related cardiometabolic risk." European Heart Journal Supplements **8**(SB4).

Després, J. P. and I. Lemieux (2006). "Abdominal obesity and metabolic syndrome." Nature **444**(7121): 881.

Després, J. P., I. Lemieux, J. Bergeron, P. Pibarot, P. Mathieu, E. Larose, J. Rodés-Cabau, O. F. Bertrand and P. Poirier (2008). "Abdominal obesity and the metabolic syndrome: contribution to global cardiometabolic risk." Arteriosclerosis, Thrombosis, and Vascular Biology **28**(6): 1039.

Donin, A. S., C. M. Nightingale, C. G. Owen, A. R. Rudnicka, M. C. McNamara, C. J. Prynne, A. M. Stephen, D. G. Cook and P. H. Whincup (2010). "Nutritional composition of the diets of South Asian, black African-Caribbean and white European children in the United Kingdom: The Child Heart and Health Study in England (CHASE)." British Journal of Nutrition **104**(2): 276.

Duffey, K. J., P. Gordon-Larsen, D. R. Jacobs, O. D. Williams and B. M. Popkin (2007). "Differential associations of fast food and restaurant food consumption with 3-y change in body mass index: the Coronary Artery Risk Development in Young Adults Study." American Journal of Clinical Nutrition **85**(1): 201.

Duncan, M. J., S. Birch, Y. Al-Nakeeb and A. M. Nevill (2012). "Ambulatory physical activity levels of white and South Asian children in Central England." Acta Paediatrica **101**(4): E156.

Duncan, M. J., L. Woodfield, Y. Al-Nakeeb and A. M. Nevill (2008). "Differences in physical activity levels between white and South Asian children in the United Kingdom." Pediatric Exercise Science **20**(3): 285.

Ebbeling, C. B., D. B. Pawlak and D. S. Ludwig (2002). "Childhood obesity: public-health crisis, common sense cure." The Lancet **360**(9331): 473.

Edwards, S., C. Murphy, R. G. Feltbower, C. R. Stephenson, J. E. Cade, P. A. McKinney and H. J. Bodansky (2006). "Changes in the diet of a South Asian transmigratory population may be associated with an increase in incidence of childhood diabetes." Nutrition Research **26**(6): 249.

Eiberg, S., H. Hasselstrom, V. Grønfeldt, K. Froberg, J. Svensson and L. B. Andersen (2005). "Maximum oxygen uptake and objectively measured physical activity in Danish children 6–7 years of age: the Copenhagen school child intervention study." British Journal of Sports Medicine **39**(10): 725.

Ekelund, U., S. Brage, K. Froberg, M. Harro, S. A. Anderssen, L. B. Sardinha, C. Riddoch and L. B. Andersen (2006). "TV viewing and physical activity are independently associated with metabolic risk in children: The European Youth Heart Study." Plos Medicine **3**: 2449.

Ekelund, U., A. Yngve and M. Sjöström (1999). "Total daily energy expenditure and patterns of physical activity in adolescents assessed by two different methods." Scandinavian Journal of Medicine and Science in Sports **9**(5): 257.

Elliott, S. S., N. L. Keim, J. S. Stern, K. Teff and P. J. Havel (2002). "Fructose, weight gain, and the insulin resistance syndrome." American Journal of Clinical Nutrition **76**(5): 911.

Department of Education and Employment (2001). The Education Nutritional Standards for School Lunches (England) Regulations 2000. London.

Epstein, L. H., C. C. Gordy, H. A. Raynor, M. Beddome, C. K. Kilanowski and R. Paluch (2012). "Increasing fruit and vegetable intake and decreasing fat and sugar intake in families at risk for childhood obesity." Obesity Research **9**(3): 171.

Erens, B., P. Primatesta and G. Prior (2001). "Health survey for England 1999: the health of minority ethnic groups." London: HM Stationery Office.

Esliger, D., J. Copeland, J. Barnes and M. Tremblay (2005). "Standardizing and optimizing the use of accelerometer data for free-living physical activity monitoring." Journal of Physical Activity and Health **3**: 366.

Esmaillzadeh, A., M. Kimiagar, Y. Mehrabi, L. Azadbakht, F. B. Hu and W. C. Willett (2006). "Fruit and vegetable intakes, C-reactive protein, and the metabolic syndrome." American Journal of Clinical Nutrition **84**(6): 1489.

Espncricinfo (2005). Bowlers in baggy pants will bat for women's rights. Available from>http://www.espncricinfo.com/ci/content/story/219995.html [accessed 7 July 2013]

Estruch, R., M. A. Martinez-Gonzalez, D. Corella, J. Basora-Gallisá, V. Ruiz-Gutierrez, M. I. Covas, M. Fiol, E. Gómez-Gracia, M. C. Lopez-Sabater and R. Escoda (2009). "Effects of dietary fibre intake on risk factors for cardiovascular disease in subjects at high risk." Journal of Epidemiology and Community Health **63**(7): 582.

Evans, C. and C. Harper (2009). "A history and review of school meal standards in the UK." Journal of Human Nutrition and Dietetics **22**(2): 89.

Evenson, K. R., D. J. Catellier, K. Gill, K. S. Ondrak and R. G. McMurray (2006). "Calibration of two objective measures of physical activity for children." Journal of Sports Sciences **24**(14): 1557.

Farooq, S. G., Grigg (2008). "Girls from ethnic minorities: sports participation." PE and Sport Today.

Farooqi, A., D. Nagra, T. Edgar and K. Khunti (2000). "Attitudes to lifestyle risk factors for coronary heart disease amongst South Asians in Leicester: a focus group study." Family Practice **17**(4): 293.

Farshchi, H. R., M. A. Taylor and I. A. Macdonald (2005). "Deleterious effects of omitting breakfast on insulin sensitivity and fasting lipid profiles in healthy lean women." American Journal of Clinical Nutrition **81**(2): 388.

Faul, F., E. Erdfelder, A. G. Lang and A. Buchner (2007). "G* Power 3: A flexible statistical power analysis program for the social, behavioural, and biomedical sciences." Behaviour Research Methods **39**(2): 175.

Faulkner, G. E. J., R. N. Buliung, P. K. Flora and C. Fusco (2009). "Active school transport, physical activity levels and body weight of children and youth: a systematic review." Preventive Medicine **48**(1): 3.

Feltbower, R., P. McKinney, F. Campbell, C. Stephenson and H. Bodansky (2003). "Type 2 and other forms of diabetes in 0–30 year olds: a hospital based study in Leeds, UK." Archives of Disease in Childhood **88**(8): 676.

Feltbower, R. G., H. J. Bodansky, P. A. McKinney, J. Houghton, C. R. Stephenson and D. Haigh (2002). "Trends in the incidence of childhood diabetes in south Asians and other children in Bradford, UK." Diabetic Medicine **19**(2): 162.

Ferrannini, E., A. M. Sironi, P. Iozzo and A. Gastaldelli (2008). "Intra-abdominal adiposity, abdominal obesity, and cardiometabolic risk." European Heart Journal Supplements **10**(B4).

Ferreira, I., K. Van Der Horst, W. Wendel ‐ Vos, S. Kremers, F. Van Lenthe and J. Brug (2006). "Environmental correlates of physical activity in youth – a review and update." Obesity Reviews **8**(2): 129.

Fischbacher, C. M., S. Hunt and L. M. Alexander (2004). "Levels of physical activity among South Asians: a literature review." Ethnicity and Health **9**: S114.

Foster, E., J. N. S. Matthews, M. Nelson, J. M. Harris, J. C. Mathers and A. J. Adamson (2006). "Accuracy of estimates of food portion size using food photographs–the importance of using age-appropriate tools." Public Health Nutrition **9**(04): 509.

Fox, K. R. and C. Riddoch (2000). "Charting the physical activity patterns of contemporary children and adolescents." Proceedings of the Nutrition Society **59**(04): 497.

Freedson, P., D. Pober and K. F. Janz (2005). "Calibration of accelerometer output for children." Medicine and Science in Sports and Exercise **37**(11): S523.

Freedson, P. S., E. Melanson and J. Sirard (1998). "Calibration of the Computer Science and Applications, Inc. accelerometer." Medicine and Science in Sports and Exercise **30**(5): 777.

French, S. A., L. Harnack and R. W. Jeffery (2000). "Fast food restaurant use among women in the Pound of Prevention study: dietary, behavioural and demographic correlates." International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity **24**(10): 1353.

Frobisher, C. and S. Maxwell (2003). "The estimation of food portion sizes: a comparison between using descriptions of portion sizes and a photographic food atlas by children and adults." Journal of Human Nutrition and Dietetics **16**(3): 181.

Gidding, S. S., B. A. Barton, J. A. Dorgan, S. Y. S. Kimm, P. O. Kwiterovich, N. L. Lasser, A. M. Robson, V. J. Stevens, L. Van Horn and D. G. Simons-Morton (2006). "Higher self-reported physical activity is associated with lower systolic blood pressure: The Dietary Intervention Study in Childhood (DISC)." Pediatrics **118**(6): 2388.

Gidlow, C., T. Cochrane, R. Davey and H. Smith (2008). "In-school and out-of-school physical activity in primary and secondary school children." Journal of Sports Sciences **26**(13): 1411.

Gorely, T., S. J. Marshall, S. J. H. Biddle and N. Cameron (2007). "The prevalence of leisure time sedentary behaviour and physical activity in adolescent girls: An ecological momentary assessment approach." International Journal of Pediatric Obesity **2**(4): 227.

Gregory, J., K. Foster, H. Tyler and M. Wiseman (1990). The dietary and nutritional survey of British adults, London: HM Stationary Office..

Gregory, J., S. Lowe, C. J. Bates and G. Britain (2000). National Diet and Nutrition Survey: young people aged 4 to 18 years; volume 1: report of the diet and nutrition survey, London: HM Stationary Office.

Griew, P., A. Page, S. Thomas, M. Hillsdon and A. R. Cooper (2010). "The school effect on children's school time physical activity: The PEACH Project." Preventive Medicine **51**(3-4): 282.

Gross, L. S., L. Li, E. S. Ford and S. Liu (2004). "Increased consumption of refined carbohydrates and the epidemic of type 2 diabetes in the United States: an ecologic assessment." American Journal of Clinical Nutrition **79**(5): 774.

Hakeem, R., J. Thomas and S. Badruddin (2002). "Urbanization and activity pattern of south Asian children." Journal of Pakistan Medical Association **52**(9): 402.

Hamburg, N. M., C. J. McMackin, A. L. Huang, S. M. Shenouda, M. E. Widlansky, E. Schulz, N. Gokce, N. B. Ruderman, J. F. Keaney and J. A. Vita (2007). "Physical inactivity rapidly induces insulin resistance & microvascular dysfunction in healthy volunteers." Arteriosclerosis Thrombosis and Vascular Biology **27**(12): 2650.

Hamer, M. and Y. Chida (2007). "Intake of fruit, vegetables, and antioxidants and risk of type 2 diabetes: systematic review and meta-analysis." Journal of Hypertension **25**(12): 2361.

Hamilton, M. T., D. G. Hamilton and T. W. Zderic (2007). "Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease." Diabetes **56**(11): 2655.

Hamilton, M. T., G. N. Healy, D. W. Dunstan, T. W. Zderic and N. Owen (2008). "Too little exercise and too much sitting: inactivity physiology and the need for new recommendations on sedentary behaviour." Current Cardiovascular Risk Reports **2**(4): 292.

Hamilton, M. T., T. Zderic, L. Bey and N. Akunuri (2004). "Defining the physical inactivity genome." Medicine and Science in Sports and Exercise **36**(5): S270.

Harding, S., A. Teyhan, M. J. Maynard and J. K. Cruickshank (2008). "Ethnic differences in overweight and obesity in early adolescence in the MRC DASH study: the role of adolescent and parental lifestyle." International Journal of Epidemiology **37**(1): 162.

Harrington, D. M., G. J. Welk and A. E. Donnelly (2011). "Validation of MET estimates and step measurement using the ActivPAL physical activity logger." Journal of Sports Sciences **29**(6): 627.

Hart, T. L., J. J. McClain and C. Tudor-Locke (2011). "Controlled and free-living evaluation of objective measures of sedentary and active behaviors." Journal of Physical Activity and Health **8**(6): 848.

Hayes, L., M. White, N. Unwin, R. Bhopal, C. Fischbacher, J. Harland and K. Alberti (2002). "Patterns of physical activity and relationship with risk markers for cardiovascular disease and diabetes in Indian, Pakistani, Bangladeshi and European adults in a UK population." Journal of Public Health **24**(3): 170.

He, F. J., C. A. Nowson and G. A. MacGregor (2006). "Fruit and vegetable consumption and stroke: meta-analysis of cohort studies." The Lancet **367**(9507): 320.

Healy, G. N., D. W. Dunstan, J. Salmon, E. Cerin, J. E. Shaw, P. Z. Zimmet and N. Owen (2007). "Objectively measured light-intensity physical activity is independently associated with 2-h plasma glucose." Diabetes Care **30**(6): 1384.

Healy, G. N., K. Wijndaele, D. W. Dunstan, J. E. Shaw, J. Salmon, P. Z. Zimmet and N. Owen (2008). "Objectively Measured Sedentary Time, Physical Activity, and Metabolic Risk The Australian Diabetes, Obesity and Lifestyle Study (AusDiab)." Diabetes Care **31**(2): 369.

Helmrich, S. P., D. R. Ragland, R. W. Leung and R. S. Paffenbarger, Jr. (1991). "Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus." New England Journal of Medicine **325**(3): 147.

Hendelman, D., K. Miller, C. Baggett, E. Debold and P. Freedson (2000). "Validity of accelerometry for the assessment of moderate intensity physical activity in the field." Medicine and Science in Sports and Exercise **32**(9): S442.

Henderson, L., J. Gregory, G. Swan and G. Britain (2002). The national diet and nutrition survey: adults aged 19 to 64 years, London: HM Stationery Office.

Henderson, E.J., C.H.D. Jones, Y.C. Hornby-Turner and T.M. Pollard (2011). "Adiposity and blood pressure in 7- to 11-year-old children: Comparison of British Pakistani and white British children, and of British Pakistani children of migrant and British-born mothers." American Journal of Human Biology **23**(5): 710.

Hill, J. O. and J. C. Peters (1998). "Environmental contributions to the obesity epidemic." Science **280**(5368): 1371.

Hinkley, T., D. Crawford, J. Salmon, A. D. Okely and K. Hesketh (2008). "Preschool children and physical activity - A review of correlates." American Journal of Preventive Medicine **34**(5): 435.

Hu, F. (2008). Obesity Epidemiology, Oxford University Press, USA.

Hu, F. B. (2003). "Sedentary lifestyle and risk of obesity and type 2 diabetes." Lipids **38**(2): 103.

Hu, F. B. and V. S. Malik (2010). "Sugar-sweetened beverages and risk of obesity and type 2 diabetes: epidemiologic evidence." Physiology and Behaviour **100**(1): 47.

Hu, F. B., J. A. E. Manson and W. C. Willett (2001). "Types of dietary fat and risk of coronary heart disease: a critical review." Journal of the American College of Nutrition **20**(1): 5-19.

Hu, F. B., R. J. Sigal, J. W. Rich-Edwards, G. A. Colditz, C. G. Solomon, W. C. Willett, F. E. Speizer and J. E. Manson (1999). "Walking compared with vigorous physical activity and risk of type 2 diabetes in women: a prospective study." The Journal of the American Medical Association **282**(15): 1433.

Hydrie, M. Z. I., A. Basit, N. Badruddin and M. Y. Ahmedani (2004). "Diabetes risk factors in middle income Pakistani school children." Pakistan Journal of Nutrition **3**(1): 43.

Hu, F. B., R. Van Dam and S. Liu (2001). "Diet and risk of type II diabetes: the role of types of fat and carbohydrate." Diabetologia **44**(7): 805.

Jafar, T., Z. Qadri, M. Islam, J. Hatcher, Z. Bhutta and N. Chaturvedi (2008). "Rise in childhood obesity with persistently high rates of undernutrition among urban school-aged Indo-Asian children." Archives of Disease in Childhood **93**(5): 373.

Jamal, A. (1998). "Food consumption among ethnic minorities: the case of British-Pakistanis in Bradford, UK." British Food Journal **100**(5): 221.

Janz, K. F. (2002). "Use of heart rate monitors to assess physical activity." In Welk, G. (2002). Physical activity assessments for health-related research, Champaign, IL: Human Kinetics Publishers.

Jenkins, D., T. Wolever, R. H. Taylor, H. Barker, H. Fielden, J. M. Baldwin, A. C. Bowling, H. C. Newman, A. L. Jenkins and D. V. Goff (1981). "Glycemic index of foods: a physiological basis for carbohydrate exchange." American Journal of Clinical Nutrition **34**(3): 362.

Jenkins, D. J. A., M. Axelsen, C. W. C. Kendall, L. S. A. Augustin, V. Vuksan and U. Smith (2000). "Dietary fibre, lente carbohydrates and the insulin-resistant diseases." British Journal of Nutrition **83**(S1): S157.

Jenner, D., K. Neylon, S. Croft, L. Beilin and R. Vandongen (1989). "A comparison of methods of dietary assessment in Australian children aged 11-12 years." European Journal of Clinical Nutrition **43**(10): 663.

Jeon, C. Y., R. P. Lokken, F. B. Hu and R. M. van Dam (2007). "Physical activity of moderate intensity and risk of type 2 diabetes: a systematic review." Diabetes Care **30**(3): 744.

Johnson, M., E. Everson-Hock, R. Jones, H. B. Woods, N. Payne and E. Goyder (2011). "What are the barriers to primary prevention of type 2 diabetes in black and minority ethnic groups in the UK? A qualitative evidence synthesis." Diabetes Research and Clinical Practice **93**(2): 150.

Johnson, M. R. D. (2000). "Perceptions of barriers to healthy physical activity among Asian communities." Sport, Education and Society **5**(1): 51.

Johnson, R. J., M. S. Segal, Y. Sautin, T. Nakagawa, D. I. Feig, D. H. Kang, M. S. Gersch, S. Benner and L. G. Sánchez-Lozada (2007). "Potential role of sugar (fructose) in the epidemic of hypertension, obesity and the metabolic syndrome, diabetes, kidney disease, and cardiovascular disease." American Journal of Clinical Nutrition **86**(4): 899.

Johnson, R. K., P. Driscoll and M. I. Goran (1996). "Comparison of multiple-pass 24-hour recall estimates of energy intake with total energy expenditure determined by the doubly labeled water method in young children." Journal of the American Dietetic Association **96**(11): 1140.

Joshipura, K. J., A. Ascherio, J. A. E. Manson, M. J. Stampfer, E. B. Rimm, F. E. Speizer, C. H. Hennekens, D. Spiegelman and W. C. Willett (1999). "Fruit and vegetable intake in relation to risk of ischemic stroke." The journal of the American Medical Association **282**(13): 1233.

Judd, P. A., T. K. Khamis and J. Thomas (2000). The composition and nutrient content of foods commonly consumed by South Asians in the UK, Aga Khan Health Board for the United Kingdom.

Kaskoun, M. C., R. K. Johnson and M. I. Goran (1994). "Comparison of energy intake by semiquantitative food-frequency questionnaire with total energy expenditure by the doubly labeled water method in young children." American Journal of Clinical Nutrition **60**(1): 43.

Kassam-Khamis, T., P. A. Judd, J. E. Thomas, L. Sevak, S. Reddy and S. Ganatra (2008). "Frequency of consumption and nutrient composition of composite dishes commonly consumed by South Asians originating from Gujerat and the Punjab." Journal of Human Nutrition and Dietetics **8**(4): 265.

Kassam-Khamis, T., K. Nanchahal, P. Mangtani, I. Santos Silva, A. McMichael and A. Anderson (2001). "Development of an interview-administered food-frequency questionnaire for use amongst women of South Asian ethnic origin in Britain." Journal of Human Nutrition and Dietetics **12**(1): 7.

Kassam-Khamis, T., J. E. Thomas and P. A. Judd (1995). "Diversity of diets amongst South Asian Muslims in Britain." Proceedings of the Nutrition Society **54**(3): 133.

Khunti, K., M. Stone, J. Bankart, P. Sinfield, A. Pancholi, S. Walker, D. Talbot, A. Farooqi and M. Davies (2008). "Primary prevention of type-2 diabetes and heart disease: action research in secondary schools serving an ethnically diverse UK population." Journal of Public Health **30**(1): 30.

Khunti, K., M. A. Stone, J. Bankart, P. K. Sinfield, D. Talbot, A. Farooqi and M. J. Davies (2007). "Physical activity and sedentary behaviours of South Asian and white European children in inner city secondary schools in the UK." Family Practice **24**(3): 237.

Khuwaja, A., Z. Fatmi, W. Soomro and N. Khuwaja (2003). "Risk factors for cardiovascular disease in school children-a pilot study." Journal of Pakistan Medical Association **53**(9).

Kimm, S., N. W. Glynn, A. M. Kriska, S. L. Fitzgerald, D. J. Aaron, S. L. Similo, R. P. McMAHON and B. A. Barton (2000). "Longitudinal changes in physical activity in a biracial cohort during adolescence." Medicine and Science in Sports and Exercise **32**(8): 1445.

King, A. C., K. N. Parkinson, A. J. Adamson, L. Murray, H. Besson, J. J. Reilly, L. Basterfield and G. M. S. C. Te (2011). "Correlates of objectively measured physical activity and sedentary behaviour in English children." European Journal of Public Health **21**(4): 424.

Kirk, D (2012). Empowering Girls and Women through Physical Education and Sport - Advocacy Brief. Bangkok: United Nations Educational, Scientific and Cultural Organisation Bangkok.

Klein, S., D. B. Allison, S. B. Heymsfield, D. E. Kelley, R. L. Leibel, C. Nonas and R. Kahn (2012). "Waist circumference and cardiometabolic risk: a consensus statement from shaping America's health: Association for Weight Management and Obesity Prevention; NAASO, the Obesity Society; the American Society for Nutrition; and the American Diabetes Association." Obesity **15**(5): 1061.

Koctürk, T. and A. Bruce (1996). "Human migration and nutrition. An overview." Scandinavian Journal of Nutrition **40**(2): 81.

Kohl III, H. W., J. E. Fulton and C. J. Caspersen (2000). "Assessment of physical activity among children and adolescents: a review and synthesis." Preventive Medicine **31**(2): S54.

Kovács, V., Z. Fajcsák, A. Gábor and É. Martos (2010). "Breakfast skiping is related to higher body mass index and higher waist circumference in primary school children." Acta Alimentaria **39**(3): 308.

Kowalski, K. C., P. R. E. Crocker and R. M. Donen (2004). "The physical activity questionnaire for older children (PAQ-C) and adolescents (PAQ-A) manual." Saskatoon: College of Kinesiology, University of Saskatchewan.

Kozey-Keadle, S., A. Libertine, K. Lyden, J. Staudenmayer and P. S. Freedson (2011). "Validation of wearable monitors for assessing sedentary behavior." Medicine and Science in Sports and Exercise **43**(8): 1561.

Kriska, A. (2000). "Ethnic and cultural issues in assessing physical activity." Research Quarterly for Exercise and Sport **71**(2 Suppl): S47.

Kristensen, P. L., N. Wedderkopp, N. C. Møller, L. B. Andersen, C. N. Bai and K. Froberg (2006). "Tracking and prevalence of cardiovascular disease risk factors across socio-economic classes: a longitudinal substudy of the European Youth Heart Study." Biomedcentral Public Health **6**(1): 20.

Kuppuswamy, V. C. and S. Gupta (2005). "Excess coronary heart disease in South Asians in the United Kingdom: The problem has been highlighted, but much more needs to be done." British Medical Journal **330**(7502): 1223.

Laaksonen, D. E., J. Lindstrom, T. A. Lakka, J. G. Eriksson, L. Niskanen, K. Wikstrom, S. Aunola, S. Keinanen-Kiukaanniemi, M. Laakso, T. T. Valle, P. Ilanne-Parikka, A. Louheranta, H. Hamalainen, M. Rastas, V. Salminen, Z. Cepaitis, M. Hakumaki, H. Kaikkonen, P. Harkonen, J. Sundvall, J. Tuomilehto and M. Uusitupa (2005). "Physical activity in the prevention of type 2 diabetes: the Finnish diabetes prevention study." Diabetes **54**(1): 158.

Lamb, M. M., C. A. Ross, H. L. Brady and J. M. Norris (2007). "Comparison of children's diets as reported by the child via the Youth/Adolescent Questionnaire and the parent via the Willett food-frequency questionnaire." Public Health Nutrition **10**(7): 663.

LaMonte, M. J., S. N. Blair and T. S. Church (2005). "Physical activity and diabetes prevention." Journal of Applied Physiology **99**(3): 1205.

Lawrence, J., E. Devlin, S. Macaskill, M. Kelly, M. Chinouya, M. Raats, K. Barton, W. Wrieden and R. Shepherd (2007). "Factors that affect the food choices made by girls and young women, from minority ethnic groups, living in the UK." Journal of Human Nutrition and Dietetics **20**(4): 311.

Lawton, J., N. Ahmad, L. Hanna, M. Douglas, H. Bains and N. Hallowell (2008). "‘We should change ourselves, but we can't’: accounts of food and eating practices amongst British Pakistanis and Indians with type 2 diabetes." Ethnicity and Health **13**(4): 305.

Lawton, J., N. Ahmad, L. Hanna, M. Douglas and N. Hallowell (2006). "‘I can't do any serious exercise’: barriers to physical activity amongst people of Pakistani and Indian origin with Type 2 diabetes." Health Education Research **21**(1): 43.

Lean, M., T. Han, H. Bush, A. Anderson, H. Bradby and R. Williams (2001). "Ethnic differences in anthropometric and lifestyle measures related to coronary heart disease risk between South Asian, Italian and general-population British women living in the west of Scotland." International Journal of Obesity **25**(12): 1800.

Lee, R. D. a. D. C., Nieman (eds) (2003). Nutritional Assessment. Toronto, Ontario, McGraw-Hill Higher Education. **3rd Edition**.

Liese, A. D., M. Schulz, F. Fang, T. Wolever, R. B. D’Agostino, K. C. Sparks and E. J. Mayer-Davis (2005). "Dietary glycemic index and glycemic load, carbohydrate and fiber intake, and measures of insulin sensitivity, secretion, and adiposity in the Insulin Resistance Atherosclerosis Study." Diabetes Care **28**(12): 2832.

Linos, E., W. C. Willett, E. Cho, G. Colditz and L. A. Frazier (2008). "Red meat consumption during adolescence among premenopausal women and risk of breast cancer." Cancer Epidemiology Biomarkers and Prevention **17**(8): 2146.

Lip, G. Y. H., I. Malik, C. Luscombe, M. McCarry and G. Beevers (1995). "Dietary-fat purchasing habits in whites, blacks and asian peoples in England - implications for heart-disease prevention." International Journal of Cardiology **48**(3): 287.

Livingstone, M. B. E. and P. J. Robson (2000). "Measurement of dietary intake in children." Proceedings of the Nutrition Society **59**(2): 279.

Lobstein, T. J., W. James and T. Cole (2003). "Increasing levels of excess weight among children in England." International Journal of Obesity **27**(9): 1136.

Ludwig, D. S., K. E. Peterson and S. L. Gortmaker (2001). "Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis." The lancet **357**(9255): 505.

Lutsey, P. L., L. M. Steffen and J. Stevens (2008). "Dietary Intake and the Development of the Metabolic Syndrome The Atherosclerosis Risk in Communities Study." Circulation **117**(6): 754.

Lytle, L. A., D. M. Murray, C. L. Perry and A. L. Eldridge (1998). "Validating fourth-grade students' self-report of dietary intake: results from the 5 A Day Power Plus program." Journal of American Dietetics Association **98**(5): 570.

Lytle, L. A., M. Z. Nichaman, E. Obarzanek, E. Glovsky, D. Montgomery, T. Nicklas, M. Zive and H. Feldman (1993). "Validation of 24-hour recalls assisted by food records in third-grade children." Journal of American Dietetics Association **93**(12): 1431.

Malik, V. S., M. B. Schulze and F. B. Hu (2006). "Intake of sugar-sweetened beverages and weight gain: a systematic review." American Journal of Clinical Nutrition **84**(2): 274.

Marshall, J. A., S. Hoag, S. Shetterly and R. F. Hamman (1994). "Dietary fat predicts conversion from impaired glucose tolerance to NIDDM: the San Luis Valley Diabetes Study." Diabetes Care **17**(1): 50.

Martin, A., M. McNeil, V. Penpraze, P. Dall, M. Granat, J. Paton and J. Reilly (2011). "Objective measurement of habitual sedentary behavior in pre-school children: comparison of activPAL with actigraph monitors." Pediatric Exercise Science **23**: 468.

Matthews, C. E. and G. Welk (2002). "Use of self-report instruments to assess physical activity." Welk, G. (Ed). Physical activity assessments for health-related research, Champaign, IL: Human Kinetics Publishers.

Matthys, C., I. Pynaert, W. De Keyzer and S. De Henauw (2007). "Validity and reproducibility of an adolescent web-based food frequency questionnaire." Journal of American Dietetics Association **107**(4): 605.

Mattocks, C., S. Leary, A. Ness, K. Deere, J. Saunders, K. Tilling, J. Kirkby, S. N. Blair and C. Riddoch (2007). "Calibration of an accelerometer during free-living activities in children." International Journal of Pediatric Obesity **2**(4): 218.

Mattocks, C., A. Ness, S. Leary, K. Tilling, S. Blair, J. Shield, K. Deere, J. Saunders, J. Kirkby and G. Smith (2008). "Use of accelerometers in a large field-based study of children: protocols, design issues, and effects on precision." Journal of Physical Activity and Health **5**: S98.

McKeigue, P., J. Ferrie, T. Pierpoint and M. Marmot (1993). "Association of early-onset coronary heart disease in South Asian men with glucose intolerance and hyperinsulinemia." Circulation **87**(1): 152.

McKeown, N. M., J. B. Meigs, S. Liu, E. Saltzman, P. W. F. Wilson and P. F. Jacques (2004). "Carbohydrate nutrition, insulin resistance, and the prevalence of the metabolic syndrome in the Framingham Offspring Cohort." Diabetes Care **27**(2): 538.

McPherson, R. S., D. M. Hoelscher, M. Alexander, K. S. Scanlon and M. K. Serdula (2000). "Dietary assessment methods among school-aged children: validity and reliability." Preventive Medicine **31**(2): S11.

Meyer, K. A., L. H. Kushi, D. R. Jacobs Jr, J. Slavin, T. A. Sellers and A. R. Folsom (2000). "Carbohydrates, dietary fiber, and incident type 2 diabetes in older women." American Journal of Clinical Nutrition **71**(4): 921.

Mhurchu, C. N., R. Maddison, Y. Jiang, A. Jull, H. Prapavessis and A. Rodgers (2008). "Couch potatoes to jumping beans: A pilot study of the effect of active video games on physical activity in children." International Journal of Behavioural Nutrition and Physical Activity **5**(1): 8.

Mitchell, J. A., C. Mattocks, A. R. Ness, S. D. Leary, R. R. Pate, M. Dowda, S. N. Blair and C. Riddoch (2012). "Sedentary behaviour and obesity in a large cohort of children." Obesity **17**(8): 1596.

Mosdøl, A., D. R. Witte, G. Frost, M. G. Marmot and E. J. Brunner (2007). "Dietary glycemic index and glycemic load are associated with high-density-lipoprotein cholesterol at baseline but not with increased risk of diabetes in the Whitehall II study." American Journal of Clinical Nutrition **86**(4): 988.

Mota, J., M. Valente, L. Aires, P. Silva, M. P. Santos and J. C. Ribeiro (2007). "Accelerometer cut-points and youth physical activity prevalence." European Physical Education Review **13**(3): 287.

Mushtaq, M. U., S. Gull, K. Mushtaq, U. Shahid, M. A. Shad and J. Akram (2011). "Dietary behaviors, physical activity and sedentary lifestyle associated with overweight and obesity, and their socio-demographic correlates, among Pakistani primary school children." International Journal of Behavioral Nutrition and Physical Activity **8**(1): 1.

Myers, L., P. K. Strikmiller, L. S. Webber and G. S. Berenson (1996). "Physical and sedentary activity in school children grades 5-8: the Bogalusa Heart Study." Medicine and Science in Sports and Exercise **28**(7): 852.

Nelson, M., M. Atkinson and J. Meyer (1997). A photographic atlas of food portion sizes, London: Ministry of Agriculture Fisheries and Food Publications.

Ness, A. R. and J. W. Powles (1997). "Fruit and vegetables, and cardiovascular disease: a review." International Journal of Epidemiology **26**(1): 1.

Nettlefold, L., H. A. Mckay, D. E. R. Warburton, K. A. McGuire, S. S. D. Bredin and P. J. Naylor (2011). "The challenge of low physical activity during the school day: at recess, lunch and in physical education." British Journal of Sports Medicine **45**(10): 813.

Nicklas, T. A., L. S. Webber, S. R. Srinivasan and G. S. Berenson (1993). "Secular trends in dietary intakes and cardiovascular risk factors of 10-y-old children: the Bogalusa Heart Study (1973-1988)." American Journal of Clinical Nutrition **57**(6): 930.

Niemeier, H. M., H. A. Raynor, E. E. Lloyd-Richardson, M. L. Rogers and R. R. Wing (2006). "Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample." Journal of Adolescent Health **39**(6): 842.

Nilsson, A., L. B. Andersen, Y. Ommundsen, K. Froberg, L. B. Sardinha, K. Piehl-Aulin and U. Ekelund (2009). "Correlates of objectively assessed physical activity and sedentary time in children: a cross-sectional study (The European Youth Heart Study)." Biomedcentral Public Health **9**: 322.

Nilsson, A., S. A. Anderssen, L. B. Andersen, K. Froberg, C. Riddoch, L. B. Sardinha and U. Ekelund (2009). "Between- and within-day variability in physical activity and inactivity in 9- and 15-year-old European children." Scandinavian Journal of Medicine and Science in Sports **19**(1): 10.

Nilsson, A., U. Ekelund, A. Yngve and M. Sjöström (2002). "Assessing physical activity among children with accelerometers using different time sampling intervals and placements." Pediatric Exercise Science **14**(1): 87.

North East Public Health Observatory (2012). Health profile 2012: Middlesbrough. Available from>http://www.apho.org.uk/resource/view.aspx?RID=50215&SEARCH=middlesbrough&SPEAR=
North East Public Health Observatory (2012). "Health Profile 2012: Stockton." <Available from<http://www.apho.org.uk/resource/view.aspx?RID=50215&SEARCH=stockton&SPEAR= [accessed 28 July 2012]

Olympic.org (2012). Saudi Arabia joins Brunei Darussalam and Qatar in sending female athletes to London 2012. Available from>http://www.olympic.org/news/saudi-arabia-joins-brunei-darussalam-and-qatar-in-sending-female-athletes-to-london-2012-all-nocs-will-now-have-been-represented-by-women-at-olympic-games/167962 [accessed 7 July 2013]

Owen, C. G., C. M. Nightingale, A. R. Rudnicka, D. G. Cook, U. Ekelund and P. H. Whincup (2009). "Ethnic and gender differences in physical activity levels among 9-10 year-old children of white European, South Asian and AfricanCaribbean origin: the Child Heart Health Study in England (CHASE Study)." International Journal of Epidemiology **38**(4): 1082.

Owen, C. G., C. M. Nightingale, A. R. Rudnicka, N. Sattar, D. G. Cook, U. Ekelund and P. H. Whincup (2010). "Physical activity, obesity and cardiometabolic risk factors in 9-to 10-year-old UK children of white European, South Asian and black African-Caribbean origin: the Child Heart And health Study in England (CHASE)." Diabetologia **53**(8): 1620.

Owen, C. G., C. M. Nightingale, A. R. Rudnicka, E. M. F. van Sluijs, U. Ekelund, D. G. Cook and P. H. Whincup (2012). "Travel to School and Physical Activity Levels in 9–10 Year-Old UK Children of Different Ethnic Origin; Child Heart and Health Study in England (CHASE)." PLoS One **7**(2)ce30932.

Page, A. S., A. R. Cooper, P. Griew, L. Davis and M. Hillsdon (2009). "Independent mobility in relation to weekday and weekend physical activity in children aged 10-11 years: The PEACH Project." International Journal of Behavioural Nutrition and Physical Activity **6**(2).

Page, A. S., A. R. Cooper, P. Griew and R. Jago (2010). "Independent mobility, perceptions of the built environment and children's participation in play, active travel and structured exercise and sport: the PEACH Project." International Journal of Behavioural Nutrition and Physical Activity **7**(1): 17.

Pallan, M., J. Parry and P. Adab (2012). "Contextual influences on the development of obesity in children: A case study of UK South Asian communities." Preventive Medicine **54**(3-4): 205.

Pangrazi, R., A. Beighle, T. Vehige and C. Vack (2003). "Impact of Promoting Lifestyle Activity for Youth (PLAY) on children's physical activity." Journal of School Health **73**(8): 317.

Parsons, T. J., C. Power, S. Logan and C. D. Summerbell (1999). "Childhood predictors of adult obesity: a systematic review." International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity **23**: S1.

Pate, R. R., R. Ross, M. Dowda, S. G. Trost and J. Sirard (2003). "Validation of a 3-day physical activity recall instrument in female youth." Pediatric Exercise Science **15**(3): 257.

Pereira, M. A., A. I. Kartashov, C. B. Ebbeling, L. Van Horn, M. L. Slattery, D. R. Jacobs and D. S. Ludwig (2005). "Fast-food habits, weight gain, and insulin resistance (the CARDIA study): 15-year prospective analysis." The Lancet **365**(9453): 36.

Perks, S. M., J. N. Roemmich, M. Sandow-Pajewski, P. A. Clark, E. Thomas, A. Weltman, J. Patrie and A. D. Rogol (2000). "Alterations in growth and body composition during puberty. IV. Energy intake estimated by the youth-adolescent food-frequency questionnaire: validation by the doubly labeled water method." American Journal of Clinical Nutrition **72**(6): 1455.

Pfeiffer, K. A., K. L. Mciver, M. Dowda, M. Almeida and R. R. Pate (2006). "Validation and calibration of the Actical accelerometer in preschool children." Medicine and Science in Sports ans Exercise **38**(1): 152.

Pollard, J., D. Greenwood, S. Kirk and J. Cade (2001). "Lifestyle factors affecting fruit and vegetable consumption in the UK Women's Cohort Study." Appetite **37**(1): 71.

Pollard, T. and C. Guell (2012). "Assessing physical activity in Muslim women of South Asian origin." Journal of Physical Activity and Health **9**(7): 970.

Pomerleau, J., P. M. McKeigue and N. Chaturvedi (1999). "Relationships of fasting and postload glucose levels to sex and alcohol consumption. Are American Diabetes Association criteria biased against detection of diabetes in women?" Diabetes Care **22**(3): 430.

Prentice, A. M. and S. A. Jebb (1995). "Obesity in Britain: gluttony or sloth?" British Medical Journal **311**(7002): 437.

Puyau, M. R., A. L. Adolph, F. A. Vohra and N. F. Butte (2002). "Validation and calibration of physical activity monitors in children." Obesity Research **10**(3): 150.

Puyau, M. R., A. L. Adolph, F. A. Vohra, I. Zakeri and N. F. Butte (2004). "Prediction of activity energy expenditure using accelerometers in children." Medicine and Science in Sports and Exercise **36**(9): 1625.

Rabash, J., W. Browne and B. Prosser (2005). "A user's guide to MLwiN: Centre for Multilevel Modelling." University of Bristol.

Race for Opportunity (2010). Regional fact sheet: Ethnic minorities in the UK – North East. Available from <http://www.bitcdiversity.org.uk/document.rm?id=896. [accessed 28 July 2012]

Raynor, H. A., R. W. Jeffery, A. M. Ruggiero, J. M. Clark and L. M. Delahanty (2008). "Weight loss strategies associated with BMI in overweight adults with type 2 diabetes at entry into the Look AHEAD (Action for Health in Diabetes) trial." Diabetes Care **31**(7): 1299.

Reilly, J. J., J. Coyle, L. Kelly, G. Burke, S. Grant and J. Y. Paton (2003). "An objective method for measurement of sedentary behaviour in 3-to 4-year olds." Obesity **11**(10): 1155.

Reilly, J. J., V. Penpraze, J. Hislop, G. Davies, S. Grant and J. Y. Paton (2008). "Objective measurement of physical activity and sedentary behaviour: review with new data." Archives of Disease in Childhood **93**(7): 614.

Reynolds, K. D., T. Baranowski, D. B. Bishop, R. P. Farris, D. Binkley, T. A. Nicklas and P. J. Elmer (1999). "Patterns in child and adolescent consumption of fruit and vegetables: effects of gender and ethnicity across four sites." Journal of the American College of Nutrition **18**(3): 248.

Riboli, E., K. Hunt, N. Slimani, P. Ferrari, T. Norat, M. Fahey, U. Charrondiere, B. Hemon, C. Casagrande and J. Vignat (2002). "European Prospective Investigation into Cancer and Nutrition (EPIC): study populations and data collection." Public Health Nutrition **5**(6b): 1113.

Riddoch, C. J., L. B. Andersen, N. Wedderkopp, M. Harro, L. Klasson-Heggebo, L. B. Sardinha, A. R. Cooper and U. Ekelund (2004). "Physical activity levels and patterns of 9-and 15-yr-old European children." Medicine and Science in Sports and Exercise **36**(1): 86.

Riddoch, C. J. and C. Boreham (1995). "The health-related physical activity of children." Sports Medicine (Auckland, NZ) **19**(2): 86.

Riddoch, C. J., C. Mattocks, K. Deere, J. Saunders, J. Kirkby, K. Tilling, S. D. Leary, S. N. Blair and A. R. Ness (2007). "Objective measurement of levels and patterns of physical activity." Archives of Disease in Childhood **92**(11): 963.

Ridgers, N. D., L. M. Carter, G. Stratton and T. L. McKenzie (2011). "Examining children's physical activity and play behaviours during school playtime over time." Health Education Research **26**(4): 586.

Ridgers, N. D., S. J. Fairclough and G. Stratton (2010). "Variables associated with children's physical activity levels during recess: the A-CLASS project." International Journal of Behavioural Nutrition and Physical Activity **7**(1): 74.

Ridgers, N. D., G. Stratton and S. J. Fairclough (2006). "Physical activity levels of children during school playtime." Sports Medicine **36**(4): 359.

Riste, L., F. Khan and K. Cruickshank (2001). "High Prevalence of Type 2 Diabetes in All Ethnic Groups, Including Europeans, in a British Inner City Relative poverty, history, inactivity, or 21st century Europe?" Diabetes Care **24**(8): 1377.

Rodriguez, G., L. Béghin, L. Michaud, L. Moreno, D. Turck and F. Gottrand (2002). "Comparison of the TriTac-R3D accelerometer and a self-report activity diary with heart-rate monitoring for the assessment of energy expenditure in children." British Journal of Nutrition **87**(6): 623.

Rogers, I., A. Ness, K. Hebditch, L. Jones and P. Emmett (2007). "Quality of food eaten in English primary schools: school dinners vs packed lunches." European Journal of Clinical Nutrition **61**(7): 856.

Rowlands, A. V. and R. G. Eston (2005). "Comparison of Accelerometer and Pedometer Measures of Physical Activity in Boys and Girls, Ages 8-10 Years." Research Quarterly for Exercise and Sport **76**(3): 251.

Rowlands, A. V. and R. G. Eston (2007). "The measurement and interpretation of children's physical activity." Journal of Sports Science and Medicine **6**(3): 270.

Rowlands, A. V., E. L. Pilgrim and R. G. Eston (2008). "Patterns of habitual activity across weekdays and weekend days in 9–11-year-old children." Preventive Medicine **46**(4): 317.

Rowlands, A. V., S. M. Powell, R. Humphries and R. G. Eston (2006). "The effect of accelerometer epoch on physical activity output measures." Journal of Exercise Science and Fitness **4**(1): 52.

Russell, B. (2002). Research methods in Anthropology: qualitative and quantitative methods, Walnut Creek, CA: AltaMira Press.

Saksvig, B. I., D. J. Catellier, K. Pfeiffer, K. H. Schmitz, T. Conway, S. Going, D. Ward, P. Strikmiller and M. S. Treuth (2007). "Travel by walking before and after school and physical activity among adolescent girls." Archives of Pediatrics and Adolescent Medicine **161**(2): 153.

Sallis, J. F., M. J. Buono, J. J. Roby, F. G. Micale and J. A. Nelson (1993). "Seven-day recall and other physical activity self-reports in children and adolescents." Medicine and Science in Sports and Exercise **25**(1): 99.

Sallis, J. F., W. L. Haskell, P. D. Wood, S. P. Fortmann, T. Rogers, S. N. Blair and R. S. Paffenbarger (1985). "Physical activity assessment methodology in the Five-City Project." American Journal of Epidemiology **121**(1): 91.

Sallis, J. F., J. J. Prochaska and W. C. Taylor (2000). "A review of correlates of physical activity of children and adolescents." Medicine and Science in Sports and Exercise **32**(5): 963.

Sallis, J. F., J. J. Prochaska, W. C. Taylor, J. O. Hill and J. C. Geraci (1999). "Correlates of physical activity in a national sample of girls and boys in Grades 4 through 12." Health Psychology **18**(4): 410.

Sallis, J. F. and B. E. Saelens (2000). "Assessment of physical activity by self-report: Status, limitations, and future directions (vol 71, pg 1, 2000)." Research Quarterly for Exercise and Sport **71**(4): 409.

Salmeron, J., J. E. Manson, M. J. Stampfer, G. A. Colditz, A. L. Wing and W. C. Willett (1997). "Dietary fiber, glycemic load, and risk of non-insulin-dependent diabetes mellitus in women." Journal of the American Medical Association **277**(6): 472.

Salmon, J., L. Arundell, C. Hume, H. Brown, K. Hesketh, D. W. Dunstan, R. M. Daly, N. Pearson, E. Cerin and M. Moodie (2011). "A cluster-randomized controlled trial to reduce sedentary behavior and promote physical activity and health of 8-9 year olds: The Transform-Us! Study." BMC Public Health **11**(1): 759.

Sardinha, L. B., T. Baptista and U. Ekelund (2008). "Objectively measured physical activity and bone strength in 9-year-old boys and girls." Pediatrics **122**(3): 728.

Schneider, J. M., M. L. Fujii, C. L. Lamp, B. Lönnerdal, K. G. Dewey and S. Zidenberg-Cherr (2008). "The use of multiple logistic regression to identify risk factors associated with anemia and iron deficiency in a convenience sample of 12–36-mo-old children from low-income families." American Journal of Clinical Nutrition **87**(3): 614.

Schneider, P. L., S. E. Crouter, O. Lukajic and D. R. Bassett (2003). "Accuracy and reliability of 10 pedometers for measuring steps over a 400-m walk." Medicine and Science in Sports and Exercise **35**(10): 1779.

Schuman, H. and S. Presser (1981). Questions and answers in attitude surveys, Academic Press New York.

Scraton, S. and A. Flintoff (Eds.) (2002). Gender and Sport: A reader, London: Routledge.

Sevak, L., P. M. Mckeigue and M. G. Marmot (1994). "Relationship of Hyperinsulinemia to Dietary-Intake in South Asian and European Men." American Journal of Clinical Nutrition **59**(5): 1069.

Sfeir, L. (1985). "The status of Muslim women in sport: conflict between cultural tradition and modernization." International Review for the Sociology of Sport **20**(4): 283.

Shaw, A. (2000). Kinship and continuity: Pakistani families in Britain, London: Routledge.

Sigal, R. J., G. P. Kenny, D. H. Wasserman and C. Castaneda-Sceppa (2004). "Physical activity/exercise and type 2 diabetes." Diabetes Care **27**(10): 2518.

Sigal, R. J., G. P. Kenny, D. H. Wasserman, C. Castaneda-Sceppa and R. D. White (2006). "Physical activity/exercise and type 2 diabetes: a consensus statement from the American Diabetes Association." Diabetes Care **29**(6): 1433.

Simmons, D., D. R. R. Williams and M. J. Powell (1992). "Prevalence of Diabetes in Different Regional and Religious South Asian Communities in Coventry." Diabetic Medicine **9**(5): 428.

Simmons, D. and R. Williams (1997). "Dietary practices among Europeans and different South Asian groups in Coventry." British Journal of Nutrition **78**(1): 5.

Simons-Morton, B. G., G. S. Parcel, T. Baranowski, R. Forthofer and N. M. O'Hara (1991). "Promoting physical activity and a healthful diet among children: results of a school-based intervention study." American Journal of Public Health **81**(8): 986.

Sirard, J. R. and R. R. Pate (2001). "Physical activity assessment in children and adolescents." Sports Medicine **31**(6): 439.

Slavin, J. L. (2005). "Dietary fiber and body weight." Nutrition **21**(3): 411.

Slingerland, M., L. B. Borghouts and M. K. C. Hesselink (2012). "Physical Activity Energy Expenditure in Dutch Adolescents: Contribution of Active Transport to School, Physical Education, and Leisure Time Activities." Journal of School Health **82**(5): 225.

Smith Z, Knight T, Sahota P, Kernohan E and B. M. (1993). "Dietary patterns in Asian and Caucasian men: differences and implications for health education." Journal of Human Nutrition and Dietetics **6**: 323.

Sproston, K. and J. E. Mindell (2006). Health Survey for England 2004: The health of minority ethnic groups. London: HM Stationary Office.

Sriskantharajah, J. and J. Kai (2007). "Promoting physical activity among South Asian women with coronary heart disease and diabetes: what might help?" Family Practice **24**(1): 71.

Office of National Statistics (2001). "Ethnic group [Internet] 2001 Census / Census Area Statistics" Available from<http://www.neighbourhood.statistics.gov.uk/dissemination/LeadTableView.do?a=7&b=276813&c=middlesbrough&d=13&e=16&g=385906&i=1001x1003x1004&m=0&r=1&s=1253790728160&enc=1&dsFamilyId=87 [accessed 28 July 2012].

Steele, R. M., E. M. F. van Sluijs, S. J. Sharp, J. R. Landsbaugh, U. Ekelund and S. J. Griffin (2010). "An investigation of patterns of children's sedentary and vigorous physical activity throughout the week." International Journal of Behavioural Nutrition and Physical Activity **7**: 88.

Stein, A. D., S. Shea, C. E. Basch, I. R. Contento and P. Zyberf (1992). "Consistency of the Willett semiquantitative food frequency questionnaire and 24-hour dietary recalls in estimating nutrient intakes of preschool children." American Journal of Epidemiology **135**(6): 667.

Steinberger, J. and S. R. Daniels (2003). "Obesity, insulin resistance, diabetes, and cardiovascular risk in children an American Heart Association scientific statement from the atherosclerosis, hypertension, and obesity in the young Committee (Council on Cardiovascular Disease in the Young) and the Diabetes Committee (Council on Nutrition, Physical Activity, and Metabolism)." Circulation **107**(10): 1448.

Stone, M. A., J. Bankart, P. Sinfield, D. Talbot, A. Farooqi, M. J. Davies and K. Khunti (2007). "Dietary habits of young people attending secondary schools serving a multiethnic, inner-city community in the UK." Postgraduate Medical Journal **83**(976): 115.

Strath, S. J., D. R. Bassett, A. M. Swartz and D. L. Thompson (2001). "Simultaneous heart rate-motion sensor technique to estimate energy expenditure." Medicine and Science in Sports and Exercise **33**(12): 2118.

Szajewska, H. and M. Ruszczyński (2010). "Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe." Critical Reviews in food Science and Nutrition **50**(2): 113.

Tan, S., R. Wenlock, D. H. Buss, R. A. McCance, E. M. Widdowson and G. Britain (1985). Immigrant Foods: The Composition of Foods Used by Immigrants in the United Kingdom: Second Supplement to McCance and Widdowson's The Composition of Foods, HM Stationery Office.

Todd, K. S. and M. J. Kretsch (1986). "Accuracy of the self-reported dietary recall of new immigrant and refugee children." Nutrition Research **6**(9): 1031.

Trayers, T., A. Cooper, C. Riddoch, A. Ness, K. Fox, R. Deem and D. Lawlor (2006). "Do children from an inner city British school meet the recommended levels of physical activity? Results from a cross sectional survey using objective measurements of physical activity." Archives of Disease in Childhood **91**(2): 175.

Tremblay, M. S., M. E. Kho, A. C. Tricco and M. Duggan (2010). "Process description and evaluation of Canadian Physical Activity Guidelines development." International Journal of Behavioural Nutrition and Physical Activity **7**: 42.

Tremblay, M. S., A. G. LeBlanc, M. E. Kho, T. J. Saunders, R. Larouche, R. C. Colley, G. Goldfield and S. C. Gorber (2011). "Systematic review of sedentary behaviour and health indicators in school-aged children and youth." International Journal of Behaviour Nutrition and Physical Activity **8**: 98.

Tremblay, M., D. Warburton, I. Janssen, D. Paterson, A. Latimer, R. Rhodes, M. Kho, A. Hicks, G. LeBlanc and L. Zehr (2011). "New Canadian physical activity guidelines." Applied Physiology, Nutrition, and Metabolism **36**(1): 36.

Treuth, M. S., K. Schmitz, D. J. Catellier, R. G. Mcmurray, D. M. Murray, M. J. Almeida, S. Going, J. E. Norman and R. Pate (2004). "Defining accelerometer thresholds for activity intensities in adolescent girls." Medicine and Science in Sports and Exercise **36**(7): 1259.

Treuth, M. S., N. E. Sherwood, T. Baranowski, N. F. Butte, D. R. Jacobs, B. McClanahan, S. Gao, J. Rochon, A. Zhou, T. N. Robinson, L. Pruitt, W. Haskell and E. Obarzanek (2004). "Physical activity self-report and accelerometry measures from the Girls health Enrichment Multi-site Studies." Preventive Medicine **38**: S43.

Trost, S. G. (2007). "State of the art reviews: measurement of physical activity in children and adolescents." American Journal of Lifestyle Medicine **1**(4): 299.

Trost, S. G., P. D. Loprinzi, R. Moore and K. A. Pfeiffer (2011). "Comparison of accelerometer cut-points for predicting activity intensity in youth." Medicine and Science in Sports and Exercise **43**(7): 1360.

Trost, S. G., K. L. McIver and R. R. Pate (2005). "Conducting accelerometer-based activity assessments in field-based research." Medicine and Science in Sports and Exercise **37**(11): S531.

Trost, S. G., R. R. Pate, P. S. Freedson, J. F. Sallis and W. C. Taylor (2000). "Using objective physical activity measures with youth: How many days of monitoring are needed?" Medicine and Science in Sports and Exercise **32**(2): 426.

Trost, S. G., R. R. Rosenkranz and D. Dzewaltowski (2008). "Physical activity levels among children attending after-school programs." Medicine and Science in Sports and Exercise **40**(4): 622-629.

Trost, S. G., D. S. Ward, S. M. Moorehead, P. D. Watson, W. Riner and J. R. Burke (1998). "Validity of the computer science and applications (CSA) activity monitor in children." Medicine and Science in Sports and Exercise **30**(4): 629.

Tucker, P. and J. Gilliland (2007). "The effect of season and weather on physical activity: a systematic review." Public Health **121**(12): 909.

Tudor-Locke, C., S. M. Lee, C. F. Morgan, A. Beighle and R. P. Pangrazi (2006). "Children's pedometer-determined physical activity during the segmented school day." Medicine and Science in Sports and Exercise **38**(10): 1732.

Tudor-Locke, C., S. B. Sisson, T. Collova, S. M. Lee and P. D. Swan (2005). "Pedometer-determined step count guidelines for classifying walking intensity in a young ostensibly healthy population." Canadian Journal of Applied Physiology **30**(6): 666.

Valanou, E., C. Bamia and A. Trichopoulou (2006). "Methodology of physical-activity and energy-expenditure assessment: a review." Journal of Public Health **14**(2): 58.

Van der Horst, K., M. Paw, J. W. R. Twisk and W. Van Mechelen (2007). "A brief review on correlates of physical activity and sedentariness in youth." Medicine and Science in Sports and Exercise **39**(8): 1241.

Van Horn, L. V., N. Gernhofer, A. Moag-Stahlberg, R. Farris, G. Hartmuller, V. I. Lasser, P. Stumbo, S. Craddick and C. Ballew (1990). "Dietary assessment in children using electronic methods: telephones and tape recorders." Journal of American Dietetics Association **90**(3): 412.

van Sluijs, E. M. F., P. M. L. Skidmore, K. Mwanza, A. P. Jones, A. M. Callaghan, U. Ekelund, F. Harrison, I. Harvey, J. Panter, N. J. Wareham, A. Cassidy and S. J. Griffin (2008). "Physical activity and dietary behaviour in a population-based sample of British 10-year old children: the SPEEDY study (Sport, Physical activity and Eating behaviour: Environmental Determinants in Young people)." Biomedcentral Public Health **8**: 388.

Voorhees, C. C., D. Murray, G. Welk, A. Birnbaum, K. M. Ribisl, C. C. Johnson, K. A. Pfeiffer, B. Saksvig and J. B. Jobe (2005). "The role of peer social network factors and physical activity in adolescent girls." American Journal of Health Behaviour **29**(2): 183.

Vyas, A., A. Greenhalgh, J. Cade, B. Sanghera, L. Riste, S. Sharma and K. Cruickshank (2003). "Nutrient intakes of an adult Pakistani, European and African-Caribbean community in inner city Britain." Journal of Human Nutrition and Dietetics **16**(5): 327.

Warburton, D. E., C. W. Nicol and S. S. Bredin (2006). "Health benefits of physical activity: the evidence." Canadian Medical Association Journal **174**(6): 801.

Ward, D. S., K. R. Evenson, A. Vaughn, A. B. Rodgers and R. P. Troiano (2005). "Accelerometer use in physical activity: best practices and research recommendations." Medicine and Science in Sports and Exercise **37**(11): S582.

Welk, G. (Ed.) (2002). Physical activity assessments for health-related research, Champaign, IL: Human Kinetics Publishers.

Welk, G. J. (2005). "Principles of design and analyses for the calibration of accelerometry-based activity monitors." Medicine and Science in Sports and Exercise **37**(11): S501.

Welk, G. J., S. N. Blair, K. Wood, S. Jones and R. W. Thompson (2000). "A comparative evaluation of three accelerometry-based physical activity monitors." Medicine and Science in Sports and Exercise **32**(9): S1 489.

Welk, G. J., J. A. Schaben and J. R. Morrow (2004). "Reliability of accelerometry-based activity monitors: A generalizability study." Medicine and Science in Sports and Exercise **36**(9): 1637.

Whincup, P., C. Nightingale, A. Donin, A. Rapala, D. Joysurry, M. Prescott, A. Donald, E. Ellins, C. Owen, A. Rudnicka, D. Cook and J. Deanfield (2011). "Ethnic Differences in Cardiovascular Risk in Childhood: Comparison of Uk South Asian, African-Caribbean and European Children." Journal of Epidemiology and Community Health **65**: A312.

Whincup, P. H., J. A. Gilg, O. Papacosta, C. Seymour, G. J. Miller, K. G. M. M. Alberti and D. G. Cook (2002). "Early evidence of ethnic differences in cardiovascular risk: cross sectional comparison of British South Asian and white children." British Medical Journal **324**(7338): 635.

Williams, D., N. J. Wareham, B. D. Cox, C. D. Byrne, C. N. Hales and N. E. Day (1999). "Frequent salad vegetable consumption is associated with a reduction in the risk of diabetes mellitus." Journal of Clinical Epidemiology **52**(4): 329.

Williams, E. D., E. Stamatakis, T. Chandola and M. Hamer (2011). "Assessment of physical activity levels in South Asians in the UK: findings from the Health Survey for England." Journal of Epidemiology and Community Health **65**(6): 517.

Williams, R. and M. Shams (1998). "Generational continuity and change in British Asian health and health behaviour." Journal of Epidemiology and Community Health **52**(9): 558.

Woodfield, L., M. Duncan, Y. Al-Nakeeb, A. Nevill and C. Jenkins (2002). "Sex, ethnic and socio-economic differences in children's physical activity." Pediatric Exercise Science **14**(3): 277.

Wray, S. (2002). "Connecting ethnicity, gender and physicality: Muslim Pakistani women, physical activity and health." In Scraton, S. and A. Flintoff (Eds.) Gender and Sport: A reader, London: Routledge.

Wyke, S. and J. Landman (1997). "Healthy eating? Diet and cuisine amongst Scottish South Asian people." British Food Journal **99**(1): 27.

Yates, T., M. Davies, L. Gray, D. Webb, J. Henson, J. Gill, N. Sattar and K. Khunti (2010). "Levels of physical activity and relationship with markers of diabetes and cardiovascular disease risk in 5474 white European and South Asian adults screened for type 2 diabetes." Preventative Medicine **51**(3): 290.

Appendices

A. School recruitment letter

B. Parent/guardian study information letter

C. Staff study information letter

D. Study consent form (child)

E. Study booklet

F. Parent/guardian cover/interview recruitment letter

G. Parent /guardian questionnaire

H. Multiple Pass Diet Recall Protocol

I. Data collection sheets (diet)

J. Data collection sheets (physical activity)

K. Physical Activity Questionnaire for Children

L. Interview consent form (parent)

Appendix A: School Recruitment Letter

Address
Name of Head

I am a researcher based in the Medical Anthropology Department at Durham University and part of a small research team investigating health behaviours of White British and British Pakistani populations. I am contacting you to invite your school to be a part of a study that is investigating diet and activity levels of primary school girls on Teesside. This research is taking place due to an increase in childhood diabetes and other lifestyle related health problems. It is believed that a poor diet and low levels of physical activity play an important role in the onset of these diseases. It is also understood that health behaviours such as these are developed early in life and that girls in particular begin to display low levels of physical activity at this age.

This research aims to gather a range of information about diet and physical activity in girls and involves the girls wearing activity monitors for 5 days and recalling their activity and their diet over three days. For the girls that have already taken part in this study it has had a positive effect on their awareness and understanding of their own health behaviour. Children have proven to be very responsive to this type of research and really enjoy taking part. Each child will receive a certificate of appreciation and a graph print out of their physical activity. Once all the data has been collected and analysed, each school will receive a written report of findings and we are also happy to discuss findings and provide feedback with parents and staff.

This study is funded by the Medical Research Council. The research itself is already well underway, successfully involving a number of schools in the Stockton and Middlesbrough area.

I hope this study is of interest to your school and potentially your students and would be grateful if we could arrange a meeting, under no obligation, to discuss the research further. Further brief details can be found by searching dur.ac.uk/anthropology/research/project id466. I look forward to your response.

Yours faithfully,

Yvonne Hornby-Turner (Lead Researcher)
Email: y.c.hornby@durham.ac.uk
Tel: 0191 3340259

**Diet and Activity in White British and British South Asian Girls
Aged 9-11 Years on Teesside**

Your child has been asked to take part in a research study looking at diet and physical activity in girls of white British and South Asian origin.

What is the research about?

Type 2 diabetes is increasingly common in both adults and children in the UK, particularly in those of South Asian origin. It is important find out why this is and how much diet and physical activity may contribute to this problem. Previous studies suggest girls of South Asian origin are less physically active than other groups. Therefore, this study aims to look into the diet and activity habits of white British and British South Asian girls aged 9-11 years across a number of primary schools in the Teesside area.

Who is doing the research?

Ms Yvonne Hornby is a postgraduate researcher in the Medical Anthropology department at Durham University. Dr Tessa Pollard is her supervisor.

Aim of this research

This part of the study will gather information about physical activity and dietary habits of these groups. Further research will explore the differences in family beliefs and practices and how they may affect diet and activity habits of children.

Who can take part?

All girls in year groups five and six have been asked to take part in the research.

What does the research involve?

Children will be asked to take part in a number of child friendly tasks over six days. These include the following:

Activity Monitoring

The activity monitor has a small device inside called an accelerometer, this tells us how active the children have been. Each child will wear a monitor for six days, starting on a Friday and finishing the following Wednesday.

Diet and Activity Recalls

Each child will take part in three diet and activity recalls, which involve them telling us everything they have eaten and drunk and all the activities they have took part in the day before. For example, in Monday's recall the child will tell us everything they had to eat and drink on Sunday (the day before). Recalls will take place at school on a Monday, Tuesday and Wednesday.

Diet Records

Each child will be asked to fill out a diet record of things they have to eat and drink over 3 days, Sunday to Tuesday. These records will help children with recall sessions at school, as well as helping us gain a better picture into their dietary habits. The diet records have also been designed to be a fun activity for the children to do.

Physical Activity Questionnaire

On the last day of the study each child will be asked to fill out a physical activity questionnaire, this has 10 multiple choice questions about their physical activity over the last week.

What is the parent's role?

If you are happy for your child to take part in the study, we ask you to fill out, sign and return your child's consent form as soon as possible. We also ask parents to complete a short questionnaire to provide us with a little background information about the child's family. Activity monitors may also require the help of parents to make sure they are worn correctly. An information session about this study will be held at (location, date & time) should parents wish to find out more, parents are encouraged to attend this session, although this is not compulsory for children to take part.

We also hope to recruit a number of parents to take part in a friendly interview about diet and activity habits within the household. If you are interested please come along to the information session or fill in and return the slip that will be sent home with each child at the start of their part in the study.

What are the benefits of taking part?

Each child will be rewarded with a certificate of appreciation. Children should also enjoy taking part in this study as we aim to make it fun for them. Once the research is complete, the school will receive a written report of the findings, which will also be available to parents upon request.

What are the ethical considerations?

This study will be carefully explained to each, who will also be made fully aware that they can withdraw at any time without further questioning. All information received will be kept strictly private and confidential. Only members of the research team will be able to discuss and have access to the information. Results of this study may be discussed at conferences and published in academic journals; however participants' identity will remain anonymous. For further information please attend the information session or you can contact us through the following means.

Appendix C: Staff Study Information Letter

Diet and Activity in White British and British South Asian Girls Aged 9 to 11 Years on Teesside

Your school has agreed to take part in a research study that will look at the diet and activity in white British and British South Asian Girls of primary school age. This information sheet will explain the research, its importance and what will be asked of staff and their students who have chosen to take part.

What is the research about?

Type 2 diabetes is increasingly common in both adults and children in the UK, particularly in those of South Asian origin. It is important find out why this is and how much diet and physical activity may contribute to this problem. Previous studies suggest girls of South Asian origin are less physically active than other groups. Therefore, this study aims to look into the diet and activity habits of white British and British South Asian girls across a number of primary schools in the Teesside area.

Who is doing the research?

Ms Yvonne Hornby is a postgraduate researcher in the Medical Anthropology department at Durham University. Dr Tessa Pollard is her supervisor.

Aims of this research

This part of the study will gather a wide range of information about physical activity levels and habits of these two groups and the nutritional make up of their diets. This study will also explore any differences in beliefs and practices of children and their families in relation to diet and physical activity.

Who has been asked to take part?

All girls in year groups 5-6 have been asked to take part in the research.

What does the research involve?

Each week six children will take part in a number of tasks over a six day period.

These include the following:

Activity Monitoring to provide accurate measurements of children physical activity levels. The small red device will be given to participating children on a Friday afternoon. They will then wear it each day until the following Wednesday. Children are asked to wear the monitors at all times apart from bathing, swimming and sleeping. We ask that monitors are given to teachers for safe keeping during swimming sessions and returned to the child immediately after. It is important that the child wears the monitor at all other times so we can gain an accurate picture of their activity habits.

Diet and Activity Recalls which require each child to tell us everything they have eaten and drunk and all activities they have been a part of during the day before the recall. For instance, on Monday the child will tell us everything they had to eat and drink and all the activities they took part in on the Sunday. Recalls will take place during school hours over three days, Monday, Tuesday and Wednesday, therefore participating children may need to be taken from class for approximately 20-30 minutes on each of these days. This information will be used to gain accurate accounts of nutrient intakes and help us to further investigate children's diet and activity habits.

Three Day Diet Records will also be used to help the children during recalls remember what they have eaten and drunk during the previous day. They will also help us to gain a better understanding into participants' dietary habits. Children are asked to record everything they eat and drink for three days, Sunday, Monday and Tuesday.

Physical Activity Questionnaires will provide information on children's activity levels over the previous seven days. It is made up of 10 multiple choice questions to be completed at the end of the study.

What are the benefits of taking part? Children should find this an enjoyable experience as we try to make it as fun as possible and each child will be rewarded with a certificate upon completion. The information gathered from this study will play an important role in the understanding of children's diet and activity habits within wider field of health research. Once the research is complete each school will receive a written report of the findings. Information and results collected during this research may also be discussed at conferences and reported in academic journals.

Finally, thank you for taking the time to read about this study. We hope that you are happy for the children to take part and we thank you in advance for your patience and understanding in allowing them to be relieved from class during research. If you require any further information or have any questions please do not hesitate to contact us.

Appendix D: Study Consent Form (child)

Diet and Activity in White British and British South Asian Girls Aged 9-11 Years on Teesside.

To be completed by parent and child. Please read the following, then sign and return if you would like to take part in this study.

1. I understand that taking part in this study is completely voluntary and we can withdraw at any time, without giving any reason.
2. I understand that all results will remain anonymous and confidential, and that only members of the research team will have access to the data.
3. I confirm that I have read the information sheet and have understood what the study involves.
4. I have had the opportunity to ask questions about the study.
5. I understand that the information collected in this study may be published in academic journals and discussed at conferences, but the identity of those taking part will remain strictly private and confidential.
6. I understand that I can make contact either in person, by phone or email with any member of the research team if I have any questions concerns regarding this study.

Name of participant (child)…………………………………………………….

Child's signature………………………………………………………………….

Name of parent/guardian of child……………………………………………….

I give permission for my child (named above) to take part in this research.

Signed …………………………………………………………………………

Please print name …………………………………………………………………..

Date ……………………………………………………………………………

Study Pack

Diet and Activity

of Girls Aged 9-11 Years

on Teesside

Thank you for taking part in this study.

Please read through this study pack carefully with your parent / guardian.

Introduction

This research is going to look at your diet (food and drink) and physical activity.

This will be done by asking you to take part in a number of tasks over the next 6 days.

These include the following:

- Wear your activity monitor for 6 days
- Fill out your 3 day food & drink record
- Carry out your 3 food, drink and activity recalls at school
- Complete the physical activity questionnaire at school
- Make sure your parents complete and return the parent's questionnaire

Study Pack Contents — Page

Introduction 1
Study Time Table 2
Activity Monitor Instructions 3
Food & Drink Record Instructions & Example .... 4 - 5
Food & Drink Record Sheets & Fun Time Activities .... 6 - 10
Food, Drink & Activity Recall & Questionnaire Information 11
Contact Information 12
Activity Monitor Log 13

Study Time Table

Friday / Day One	Saturday / Day Two	Sunday / Day Three	Monday / Day Four	Tuesday / Day Five	Wednesday / Day Six
Introduction to Study					
Receive Your Study Pack					
Receive & Wear Your Activity Monitor	Wear Your Activity Monitor	Wear Your Activity Monitor	Wear Your Activity Monitor	Wear Your Activity Monitor	Wear & Return Your Activity Monitor to School
Read Study Pack With Your Parent/Guardian					
		Complete Your Food & Drink Record at Home	Complete Your Food & Drink Record at Home & School	Complete Your Food & Drink Record at Home & School	
			Food, Drink & Activity Recall at School	Food, Drink & Activity Recall at School	Food, Drink & Activity Recall at School
Ask Your Parent/ Guardian to Fill Out the Parent's Questionnaire			Return Your Parent/Guardian's Completed Questionnaire		Complete Your Physical Activity Questionnaire at School

This time table shows you what tasks we would like you to do on what days.

Activity Monitor Instructions

You have been asked to wear an activity monitor for 6 days, starting today (Friday) and finishing next Wednesday.

Please try to wear your activity monitor at all times, except for bathing, swimming and sleeping.

During this time it is important that you carry on with all your activities as normal, so please don't try to change your activity habits.

Description

The activity monitor has a small device inside called an accelerometer, this will tell us when you have been active, how long you have been active for and how hard or easy the activity was. Your activity monitor is water resistant, but NOT water proof, therefore you will need to take it off before bathing, showering and swimming. But please remember to put it straight back on afterwards. It is important that you wear your activity monitor at all times whilst you're awake, so we can get a true picture of all your activities.

Placement

The monitor should be worn around your hips using the elastic belt provided. The monitor itself should be on your left hip with the face pointing outwards. The elastic belt can be made bigger or smaller to fit if necessary, however the monitor should remain firmly in place so it doesn't move around too much when you're being active.

You may need an adult to help you when putting on and taking off your activity monitor, as this can be quite fiddly.

Please Note

If you forget to wear your activity monitor at any time don't worry, just put it on as soon as you can. When taking off your activity monitor store it in a safe place, but also somewhere you can see it to remind you to put it back on.

Please fill out the log on page 13 to record when you take off and put on your monitor.

Food & Drink Record Instructions

Filling out your food & drink record will help you with your recalls next week at school and help us get a better idea of what you eat. Please try to write down everything you eat and drink on **Sunday, Monday** and **Tuesday**.

There are two record sheets for each of these days, so be sure to use the right ones.

During this time please **don't** try to change what you eat, carry on eating and drinking as you normally would.

Remember that no one else will be allowed to see your food & drink record, so try to complete it as honestly as possible.

Your food & drink record sheet is divided into four separate columns.

- The first column is for you to write down the time you have eaten your meal or snack.
- The second column is for you to write down what it is that you have eaten at that time. Please include all the items that made up your meal, as well as any snacks, fruit or treats you may have had throughout the day.
- The third column asks you to write down the brand names of the items you have had.
- The fourth column is for you to write down how each item was cooked.

Example

Time	Items of food & drink	Brand name	Cooking method
9.00	Strawberry jam	Tesco's	
	Brown bread	Warburton's	Toasted
	Chocolate milkshake	Nesquik	
12.30	Chips	McCain's	Deep fried
	Fish fingers	Asda's	Grilled
	Chocolate digestive	McVitties	
	Orange juice & water		
5.45	White chapatti	Home made	Tawa
	Chicken curry	Home made	Fried in a pan then cooked in oven
	with onions & tomatoes		
	Toffee yogurt	Muller	

Items of Food & Drink:

In this column of your food & drink record sheet please list all the main items that were included in your meal/dish. That is all the items that made up your meal or were put on your plate.

For example: Stewed beef, carrots, onion and mash potato OR lamb curry in a tomato & onion sauce and white chapatti.

Please try to make a note of all the food and drink you have, including any snacks, treats, fruit and drinks of water.

Brand names:

Have a look at the packets of food to find out who made it. For instance: a loaf of bread may have Warburton's or Hovis printed on the packaging OR a drink of cola may have Diet Pepsi printed on the side of the can or bottle.

Cooking Methods:

Try to find out how your food was cooked. It may be helpful for you to watch the person who is making the food to see what they are doing or you could talk to them during meal times to find out how the different items were cooked. For instance, potatoes can be boiled, baked and roasted, chips can be grilled, baked and fried, and carrots could be steamed, boiled and stewed. What we would also really like to know is if something has been fried during preparation or cooking.

Don't forget to bring your food & drink record with you to school on Monday, Tuesday and Wednesday to help with your recalls.

Food & Drink Record Sheet
Day One / Sunday

Time	Items of Food & Drink	Brand Name	Cooking Method

Fun Time!
Can you find all the different foods in this word search?

GRAPES SAMOSA CARROTS

RICE CAKE ORANGE

ROTI KEEMA ROAST CHICKEN

PIZZA PASTA CURRY

FISH AND CHIPS BISCUIT

APPLE CHAPATTI

SAUSAGE AND MASH

SPAGHETTI BOLOGNESE PEAS

G	Q	A	S	D	E	W	R	S	H	K	W	B	A	T	Y
R	Z	P	U	Y	R	W	A	P	A	S	T	A	F	C	R
A	C	S	G	R	D	C	H	A	P	A	T	I	H	U	C
P	B	F	G	O	K	A	M	G	M	P	D	N	Q	R	M
E	M	L	J	A	U	R	I	H	B	P	E	O	E	R	U
S	A	M	O	S	A	R	T	E	U	L	T	R	Y	Y	G
X	P	V	R	T	L	O	Z	T	K	E	E	M	A	B	C
R	T	C	B	C	P	T	F	T	Q	W	Y	I	O	J	F
U	J	M	G	H	U	S	R	I	W	P	I	Z	Z	A	G
R	I	C	E	I	T	N	E	B	L	A	P	X	X	J	S
A	S	D	F	C	E	D	H	O	R	A	N	G	E	V	N
C	V	P	G	K	Q	J	X	L	S	Y	N	C	A	K	E
R	T	E	B	E	B	L	R	O	T	I	W	J	S	O	K
W	E	A	M	N	O	Y	K	G	R	U	P	X	R	L	G
S	D	S	P	I	H	C	D	N	A	H	S	I	F	T	B
Z	X	C	M	B	P	S	G	E	A	O	O	T	N	Y	E
B	I	S	C	U	I	T	K	S	D	V	P	R	X	H	E
P	V	S	A	U	S	A	G	E	A	N	D	M	A	S	H

Diet Record Sheet
Day Two / Monday

Time	Items of Food & Drink	Brand Name	Cooking Method

Fun Time!
Draw a picture of your favourite meal. Don't forget to label what's on your plate.

Diet Record Sheet
Day Three / Tuesday

Time	Items of Food & Drink	Brand Name	Cooking Method

Food, Drink & Activity Recalls

Next week you will be asked to take part in 3 food, drink and activity recalls. This will involve you telling us everything you have eaten and drunk and all the activities you took part in the day before. For instance, in Mondays recall session we will ask you about everything you have eaten and drunk and all the activities you took part in on Sunday (the day before). Recalls will take place in school on Monday, Tuesday and Wednesday and should take about 20-30 minutes to complete.

Please remember to bring your food & drink record to school with you each of these days to help you with your recalls.

Physical Activity Questionnaire

On Wednesday we will ask you to fill out a physical activity questionnaire, this has 10 multiple choice questions about your activity over the last 7 days.

Parent's Questionnaire

We have sent home with you a questionnaire for your parent / guardian to fill out and return with you to school on Monday. This questionnaire will give us a little bit of background information about your family.

Well done and thank you for completing you food & drink record & study pack!

Please remember to bring your study pack with your completed food & drink records and your activity monitor back to school to receive your certificate!

If you have any problems or concerns during the study please contact us:

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Activity Monitor Log

This page is for you to write down any times you take off your activity monitor and put it back on.

Please also note the reason for doing so.

Example	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday
Got Up/Put On 7.30 Swimming 1.30 - 2.30 Bath 7.15 - 7.40 Bed 8.15						

Appendix F: Parent/guardian cover/interview recruitment letter

Diet and Activity in White British and British South Asian Girls Aged 9-11 Years on Teesside

Dear Parent/guardian

Thank you for allowing your child to take part in this study. We have sent home with your child a study pack, an activity monitor and a parent's questionnaire. We ask you and your child to read through the information in the study pack together and please follow instructions carefully to ensure that the activity monitor is worn correctly and diet records are completed properly. We also ask if you could spare a few moments of your time to complete and return the parent's questionnaire, to provide us with a little background information into the families of children who take part in the study.

If you or your partner would like to be involved in this study, we are looking to recruit a small number of parents to take part in a friendly, informal interview about diet and activity habits within your household. Interviews will take place within your home and will be carried out by the main researcher Yvonne Hornby. Interviews will take about 30-40 minutes of your time. If you are interested in taking part please complete and return the slip below as soon as possible.

Thank you again for your help with this research. If you have any questions about the interviews or the study please contact us through the following.

Best wishes,

Yvonne Hornby.

<u>Main Researcher</u>: Contact details removed

<u>Supervisor</u>: Contact details removed

I ………………………………………………………………………………… the mother / father / guardian

of …………………………………………………………………………… would like to take part in an interview.

Telephone number (for appointment only) ………………………………………………………………………

Address……

Please circle what time of day would be most suitable to you.

Morning / Afternoon / Evening

Appendix G: parent/guardian questionnaire

Parent/Guardian Questionnaire

Child's Name ……………………………………………………………………………………………

School ……………………………………………………..

Class…………………………………………………………….

Parents please can you take a few minutes to answer these questions; this will provide us with some important background information about the children who take part in this study. Information received from these questionnaires will remain strictly private and confidential, so please try to answer the questions as accurately as possible.

Thank you

Please circle one. Are you the **mother / father / parent guardian** of the child taking part in this study?

Q1 **What is your current marital status?**

Married or Co-habiting	
Single	
Separated or Divorced	
Widowed	

Other, please state ………………………………………………….

Q2

What is your ethnic group?	**You**	**Partner**	**Child**
White			
British			
Irish			

Other white background, please state ……………………………………………..

Asian or Asian British			
Pakistani			
Indian			
Bangladeshi			

Other Asian background, please state …………………………………………….

Black or Black British			
Caribbean			
African			

Other Black background, please state …………………………………………….

Mixed			
White & Black African			
White & Black Caribbean			
White & Asian			

Other mixed background, please state ……………………………………………

Chinese or other ethnic group			
Chinese			

Other ethnic background, please state

Q3 **What is your country of birth?**

Please state ………………………………………………….

If not the UK, how many years have you lived here? ……...

What is your husband/wife/partner's country of birth?

Please state ………………………………………………….

If not the UK, how many years have they lived here? ……..

Q4 **Please tick your 1st language**

	You	Partner	Child
English			
Punjabi Urdu			
Gujarati			
Bengali			
Urdu Hindi			
Cantonese			

Other, please state …………………………………..……..

Q5 How many children (under 18) live in your house with you? Please state ……….

Q6 Please tick highest level of education if relevant.

	You	Partner
GCSEs/ O Levels or equivalent		
A Levels/ Btec/NVQ or equivalent		
Access/Foundation to higher education		
Degree/ postgraduate degree or equivalent		

Other, please state ………………………………………

Q7 How old were you when you left full time education? Please state ………………..

Q8 **Please tick current occupation?**

	You	Partner
Work full time		
Work part time		
Look after home		
Full time education		
Unemployed		
Unable to work due to long term sickness or disability		

Other please state …………………………………………………….

Q9 Have you or anyone in your family ever been diagnosed by a doctor with diabetes or heart disease? Please circle your answer.

YES / NO

If YES, what is their relationship to you?

Please state ………………………………………………………….

Q10 Who does the main cooking in your house?

Please state ……………………………….…

Q11 Do you take part in any regular physical activity?
This means 30 minutes or more of exercise that makes you feel tired or out of breath on a weekly basis (for instance, brisk walking, running, gym, workout videos, sports activities).

Please tick which applies,	**You**	**Partner**
1 - 2 times a week		
3 - 4 times a week		
5 or more times a week		
No activity at all		

Thank you for taking the time to complete this questionnaire, please return it with your child to school on Monday.

Previous Day Multiple Pass Diet Recall Protocol (Adapted from Nelson et al. The low income diet and nutrition survey (LIDNS) team, Dietetic Department, King's College London.

Protocol for the completion of a food consumption record:

Individual previous day diet recall

The following instructions provide detailed prompts for obtaining information in the individual previous day recall of food and drink consumption. Please follow the sequence carefully. Where words appear in upper case inside parentheses, supply the appropriate word (e.g. if DAY appears, say the name of the appropriate day of the week). Words that appear inside square brackets are instructions to you.

Introduction at beginning of first previous day recall

[Where interview being conducted with parent/carer on behalf of child, insert child's name as appropriate]

I am going to ask you about everything that (NAME OF CHILD) ate and drank

yesterday. By this I mean, 24 hours from midnight to midnight. I would like to know exactly what was eaten and drank and how much (NAME OF CHILD) had.

Introducing portion size estimation

THE INTERVIEWER SAYS:

1. When I ask you how much food and drink you/(NAME OF CHILD) had, I would like you to tell me in as much detail as possible in terms of the size of the package for example half a tin of baked beans. In this case also tell me the size of the tin for example a 420g tin.

2. Or in terms of household utensils for example a glass of milk. In this case I

would like you to tell me how big the glass was. Or number of spoons, in which case I would ask you for the size of spoon. This is a life size photograph of a teaspoon, dessertspoon and tablespoon [show photograph of spoons]

3. To help you to tell me how much of a food you/(NAME OF CHILD) ate, I have a book here with photographs of different amounts of foods.

[Show book and open book at page 1 (photograph of rice)]

As you can see there are eight photographs. I will ask you to pick **one**

photograph that looks like the amount you/(NAME OF CHILD) had to eat.

4. This is a life size photograph of the plate used in most of these photographs.

[Show photograph of 10" plate]

[Show other photographs of plates, as necessary during recall]

5. Have a look at a few more photographs and then we can start.

[Allow subject to flick through book if they want and start when they are ready].

6. If you/(NAME OF CHILD) ate any homemade dishes for example a stew, I would like you to tell me the ingredients and how much was used. If you do not know the ingredients I may need to ask whoever prepared and cooked the dish.

Previous day recall

THE INTERVIEWER SAYS:

I would like you to tell me everything that you had to eat and drink yesterday. By yesterday I mean, from midnight to midnight. Include everything that you/(NAME OF CHILD) had to eat and drink at home and away from home, including snacks, tea, coffee, sweets, soft drinks

.

- First we'll make a list of the foods you/(NAME OF CHILD) ate and drank all day yesterday (DAY).

- Next I'll ask you about the foods including amounts and then I'll ask you a few questions.

- we will use your food record to help you remember what you/(NAME OF CHILD) ate yesterday;

- So… if you would like to start at midnight at the beginning of (DAY).

[COMPLETE QUICK LIST WITHOUT INTERRUPTION]

[WHEN SUBJECT STOPS ASK]

- What else?

2. [Say to child] Can you think of anything else that you had to eat or drink yesterday?

[ADD ITEMS INTO QUICK LIST AT APPROPRIATE POINTS]

[THEN ASK]

- What else?

[CONTINUE UNTIL NO FURTHER ADDITIONS]

3. There are some foods that people often forget. In addition to what you have already told me about, did you/(NAME OF CHILD) have any:

・・ Coffee, tea, soft drinks or milk

・・ Alcoholic drinks

・・ Biscuits, cakes, sweets, chocolate bars or other confectionery

・・ Crisps, peanuts or other snacks

- · Sauces, dressings,
- · Anything you have not already told me about?

4. Now I would like to go through the list you have just given me and ask you some details about each item of food and drink. If while we are talking you remember anything else that you/(NAME OF CHILD) had to eat or drink, please tell me.

Ask child to name each eating occasion (i.e. breakfast, lunch, dinner, supper, snack)

Was (FIRST FOOD FROM QUICK LIST) the first thing that you/(NAME OF CHILD) had to eat/drink yesterday?

IF YES: [work through steps in box]

IF NO: What was the first thing you/(NAME OF CHILD) had to eat or drink yesterday?

[RECORD ITEM NAMED ON MAIN LIST]

Was (NEXT ITEM FROM QUICK LIST) the next thing you/(NAME OF CHILD) had to eat/drink?

[CONFIRM IF FOOD IS OBVIOUSLY PART OF SAME MEAL (e.g. milk on cereal)

[CONTINUE UNTIL ALL FOODS ON QUICK LIST HAVE BEEN TICKED]

a. TRANSFER ITEM FROM QUICK LIST AND TICK BOX.

b. *(If necessary)* ***ASK:*** About what time was that?

c. RECORD TIME (in 24-hour clock format e.g. 18.00 for 6pm)

d. ASK FOR DETAILED DESCRIPTION (USE THE FOOD DESCRIPTIONS LISTED AT THE BEGINNING OF THE RECORD SHEET AND THE FOOD DESCRIPTION PROMPT SHEET)

e. RECORD 'DESCRIPTION'

f. ASK FOR BRAND NAME

g. RECORD 'BRAND NAME' (if recalled at first request)

h. ASK FOR AMOUNT (USE PHOTOS, HOUSEHOLD MEASURES OR WEIGHTS)

i. RECORD 'AMOUNT'

j. *(If necessary)* ***PROMPT FOR RECIPES. (Record on recipe pages including amounts of ingredients)***

k. Before moving on to the next meal/snack:

l. ASK ABOUT SECOND HELPINGS. (Record on separate line)

m. ASK ABOUT LEFTOVERS (Record in Leftovers column).

n. *(If necessary)* ***PROMPT FOR ADDITIONS (USE COMMONLY CONSUMED ADDITIONAL FOOD PROMPTS)***

REVIEW

5. Let's see if I have everything. I would like you to try and remember anything else that you/(NAME OF CHILD) had to eat or drink yesterday that you have not already told me about, including anything that you/(NAME OF CHILD) had to eat or drink while you were preparing a meal or waiting to eat.

[USE THE FOLLOWING PROMPTS TO ELICIT ADDITIONAL FOODS]

5a. Did you/(NAME OF CHILD) have anything to eat or drink between midnight yesterday and (TIME / NAME OF FIRST OCCASION)?

5b. At (TIME / NAME OF OCCASION) you/(NAME OF CHILD) had

(FOODS/DRINKS).

5c. Did you/(NAME OF CHILD) have anything to eat or drink between

(TIME / THIS OCCASION) and (NEXT OCCASION)?

[REPEAT STEPS 5b TO5c UNTIL LAST OCCASION / TIME]

5d. At (TIME / NAME OF OCCASION) you/(NAME OF CHILD) had

(FOODS/DRINKS). Do you recall (NAME OF CHILD) having anything

else to eat or drink?

5e. Did you/(NAME OF CHILD) have anything else to eat or drink between

(THIS OCCASION) and midnight last night?

PLACE NAMES

6. I would like to ask you to give me a place name for each occasion at which you/(NAME OF CHILD) ate or drank something.

[FOR EACH OCCASION / TIME ASK:]

6a. Where did you/(NAME OF CHILD) eat/drink that?

6b. ***[ENTER "PLACE" LETTER]***

7 ***[WHERE BRAND HAS NOT BEEN RECALLED AT FIRST REQUEST BUT RESPONDENT HAS PRODUCT IN CUPBOARD, FRIDGE ETC, ASK IF YOU CAN CHECK PRODUCT AND ENTER BRAND NAME ON RECALL]***

Appendix I: Data Collection Sheets (Diet)

24 HR Multiple Pass Recall - Data Collection Form

Participant Name:__________________________ Participant Number _______ Monitor No ______Class____________.
Day of recall: Sun / Mon / Tue Date recalled:_____________

Place Code (H = Home; S = School; TA = Take Away; F = Family; FR = Friends R = Restaurant)
Cooking Method Codes (B = Boiled; G = Grilled; F = Fried; DF = Deep Fried; S = Steamed; B = Baked; R = Roasted;)

Quick List

Time	Place Code	Description of food or drink	Cooking Method Code	Brand	Amount		Left Over’s	WISP Code	Amount (g)
					Code from Atlas	Unit			

Quick List

Time	Place Code	Description of food or drink	Cooking Method Code	Brand	Amount		Left Over's	WISP Code	Amount (g)
					Code from Atlas	Unit			

Quick List

Time	Place Code	Description of food or drink	Cooking Method Code	Brand	Amount		Left Over’s	WISP Code	Amount (g)
					Code from Atlas	Unit			

24 HR Multiple Pass Activity Recall - Data Collection Form

Name__________________________ Accelerometer Number:__________ Year Group ________ Participant No_______.
Date recalled:____________ Day of recall: Sun /Mon /Tue

Quick List	Time	Location/ with	Description of Activity	Activity Intensity			Duration of Activity Minutes	Monitor On
				Light/ Easy	Moderate/ Little tired	Hard/ Very tired		

Was this a usual amount of physical activity for you? Y / N

If NO what was the reason for this? …………………………………….............

What time did you go to bed last night? ……………………………What time did you go to sleep last night? …………………………..……..

If not strait away what were you doing? e.g. reading, playing on DS, talking? …………………………………………………………………

What time did you wake up this morning? ……………………………………………………………………..…………………………………..

How did you travel home from school last night? (If applicable)……………………………………………………………………………….

How did you travel to school this morning? ……………………………………………………………………………………………….

Appendix K: Physical Activity Questionnaire for Children (PAQ-C)

Name___________________________ Participant No______ Accelerometer No _______
School/Year Group _________________ Age ______.

We are trying to find out about your level of physical activity from ***the last 7 days*** (in the last week). These includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like skipping, running, climbing, and others.

There are no right and wrong answers, so please answer all the questions as honestly and accurately as you can as this is very important.

1. Have you done any of the following activities in your spare time during the past 7 days (This includes break & lunch times, after school or at the weekend)? If yes, how many times? (Tick only one circle for each activity)

	0	1-2	3-4	5-6	7+
Skipping	○	○	○	○	○
Gymnastics ……...............................	○	○	○	○	○
Rolla skating / blading.........................	○	○	○	○	○
Tig …..	○	○	○	○	○
Walking for exercise	○	○	○	○	○
Bicycling	○	○	○	○	○
Jogging or running	○	○	○	○	○
Swimming	○	○	○	○	○
Skateboarding/ scooter........................	○	○	○	○	○
Dance	○	○	○	○	○
Football	○	○	○	○	○
Badminton / tennis............................	○	○	○	○	○
Bowling …….....................................	○	○	○	○	○
Rounders …….....................................	○	○	○	○	○
Volleyball	○	○	○	○	○
Cricket …….......................................	○	○	○	○	○
Basketball/ netball	○	○	○	○	○
Trampolining	○	○	○	○	○
Karate/Judo ………….	○	○	○	○	○
Ice skating …………………………	○	○	○	○	○
Aerobics …………………………... .	○	○	○	○	○
Hockey ...…………………………....	○	○	○	○	○
Other: __________________________	○	○	○	○	○

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Tick one only)

I don't do PE ....….. ○
Hardly ever .... ○
Sometimes .... ○
Quite often .... ○
Always .... ○

3. In the last 7 days, what did you do most of the time *at break*? (Tick one only)
Sat down (talking, reading, doing schoolwork)…… ○
Stood around or walked around .... ○
Ran or played a little bit .... ○
Ran around and played quite a bit .... ○
Ran and played hard most of the time .... ○

4. In the last 7 days, what did you do most of the time *at lunch*? (Tick one only)
Sat down (talking, reading, doing schoolwork)…… ○
Stood around or walked around .... ○
Ran or played a little bit .... ○
Ran around and played quite a bit .... ○
Ran and played hard most of the time .... ○

5. In the last 7 days, how many days *straight after school*, did you do sport, dance, or play games where you were very active? (Tick one only)
None ....…… ○
1 time …..……... ○
2 or 3 times ………….. ○
4 times ………….. ○
5 times ………….. ○

6. In the last 7 days, on how many *evenings* did you do sports, dance, or played games where you were very active? (Tick one only)
None .... ○
1 time …………... ○
2 or 3 times ………….. ○
4 or 5 times …... ○
6 or 7 times ………….. ○

7. Last weekend, how many times did you do sports, dance, or played games where you were very active? (Tick one only)
None .... ○
1 time …………... ○
2 or 3 times ………….. ○
4 or 5 times …... ○
6 or more times …..…... ○

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

A. All or most of my free time was spent doing things that involved hardly any physical effort .... ○

B. I sometimes (1 — 2 times) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics) .... ○

C. I often (3 — 4 times) did physical things in my free time .... ○

D. I quite often (5 — 6 times) did physical things in my free time .... ○

E. I very often (7 or more times last week) did physical things in my free time .... ○

9. Tick how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) on each day of the last 7 days.

	None	Little bit	Medium	Often	Very often
Wednesday	○	○	○	○	○
Tuesday	○	○	○	○	○
Monday	○	○	○	○	○
Sunday	○	○	○	○	○
Saturday	○	○	○	○	○
Friday	○	○	○	○	○
Thursday	○	○	○	○	○

10. Were you ill last week, or did anything stop you from doing your normal physical activities? (Tick one)

Yes .... ○
No .... ○

If Yes, what prevented you? ________________________________

Appendix L: Interview Consent Form (Parent)

Diet and Activity in Girls Aged 9-11 Years on Teesside.

Please read the following statements and sign if you are willing to take part in an interview for this study.

I understand that my participation in an interview is completely voluntary and I may withdraw at any time, without further reasoning.

I understand that all my interview data will remain anonymous and confidential, and that only members of the research team will have access to the data.

I confirm that I have read the information sheet and understood what is required from me as a participant upon agreeing to take part.

I have had the opportunity to ask questions either in person, by telephone or by email.

Name: ……………………………………………………………………………….

Signature: ……………………………………………………………………………

Date: ………………………………………………………………………………….