AN ECOLOGICAL APPROACH TO INCREASING PHYSICAL ACTIVITY IN PRIMARY SCHOOL CHILDREN

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Abstract

Background

Obesity amongst children and young people is increasing, and it is predicted that over half of the UK population will be obese by 2050. Daily physical activity is effective in preventing and treating overweight and obesity, yet many children do not participate in enough physical activity to be beneficial to health. Behaviour change interventions to increase children's physical activity have demonstrated limited impact which is not maintained over the longer-term. The social ecology model recognises that interventions are unlikely to work in the absence of environmental supports. This has led researchers to recommend multi-component interventions in schools, with support through school policies and strategies. This research addresses four key research questions:

1. What are the relationships between the social, economic, physical and political elements of the school environment and physical activity?
2. What are the views, perceptions and experiences of physical activity and the school environment amongst a sample of primary school children?
3. Will an ecological physical activity intervention increase physical activity levels in primary school children in the immediate and longer term (6 months)?
4. Will an ecological intervention change the relationships between pupil perceptions, the school environment, and physical activity?

Methods

A pragmatic cluster controlled trial approach was used. This research aimed to develop a primary school physical activity intervention using the Social Ecology Model and the Analysis Grid for Environments Linked to Obesity (ANGELO) theoretical frameworks to address political, economic, physical and socio-cultural elements of the environment. Eight primary schools were allocated to intervention or control arms of the study. Physical activity was measured in a random sample of school children at baseline ($n = 253$), post-intervention ($n = 245$) and six-months post-intervention ($n = 262$) using accelerometry, with counts per minute (CPM) as the outcome measure. Focus groups were also undertaken at baseline (30 pupils in seven groups) and post-intervention (32 pupils in seven groups) to explore pupils' perceptions of physical activity and school environment. An audit tool was developed to explore the relationship between the school environment and physical activity.

Results

Baseline physical activity findings showed no overall differences in CPM in control versus intervention schools (Week Day $p = .304$; School Day $p = .881$; School-related $p = .974$; Out of School $p = .515$). CPM in males was significantly higher than females (Week Day $p < .001$; School Day $p < .001$; School-related $p < .001$; $p < .039$). There was a non-significant downward trend in CPM as age increased, and BMI was significantly correlated with CPM in Week Day CPM ($p = .015$); School Day CPM ($p = .040$); and School-related CPM ($p = .034$). Audit scores showed quality of PE and school sport, and quality and provision of school facilities were

significantly correlated to physical activity. Focus group findings revealed that enjoyment, age appropriate activities, peer support, and quality and provision of facilities were facilitators of physical activity.

Baseline data were used to inform intervention development. The intervention focused on three key aims: increasing levels of physical activity amongst the female sample; increasing levels of activity amongst older children; and ensuring physical activity opportunities were appropriate for the whole school population. Main intervention components addressed quality of PE and school sport, use of space for physical activity, increasing and maximising activities on offer and physical activity and sports equipment, i.e., maximising existing resources to ensure intervention sustainability and generalisability.

Post-intervention measures showed that in intervention schools: CPM were higher than control across week day ($p < .001$), school day ($p = .001$), school related ($p = .006$) and out of school ($p = .005$); girls' CPM increased relative to baseline ($p < .001$); baseline differences which existed between males/females had disappeared ($p > .05$); older children's physical activity had increased across week day ($p = .001$), school day ($p = .041$) and school-related ($p = .025$) time periods. These findings were not evident in control schools. Increases in activity were sustained after six-months. Post-intervention audit scores were higher in intervention schools, and showed significant correlations between intervention in-school and school-related physical activity and all the sections of the audit. Focus groups revealed there were more perceived physical activity facilitators post-intervention, whilst perceived barriers had decreased.

Conclusion

This whole school intervention was successful in reducing gender and age discrepancies in physical activity. Recommendations for practice include: auditing schools to determine provision; consulting with pupils to ensure activities are age appropriate and are supported by policies; ensuring that facilities and provisions for physical activity are adequate; and ensuring that all school staff and stakeholders work collaboratively to promote physical activity within the school environment. The intervention development and mixed-methods approach to evaluation are original contributions of this research to work in this area. The intervention approach demonstrates that effective use of existing school resources can achieve a feasible and sustainable increase in physical activity levels.

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CHAPTER 1

Introduction and Overview of Thesis

Physical activity is widely regarded as a fundamental element of a healthy lifestyle, providing "male and females of all ages, including those with disability, with physical and mental health benefits, as well as with social relationships" (Kruk, 2009, p.721). Physical inactivity is a risk factor for the onset and progression of a number of chronic physical and mental health conditions, therefore physical activity needs to be promoted amongst the population (Kruk, 2009). Evidence has shown that "one third of all deaths are due to diseases which could be at least partly reduced by increased physical activity" (Allender, Foster, Scarborough, & Rayner, 2007, p.347).

Exact associations between physical activity and the development of disease are complex, and not completely understood (Blair & Morris, 2009). An understanding of these effects of physical activity on health requires 'precise methods of measurement' (Corder, Ekelund, Steele, Wareham, & Brage, 2008, p.977). This requirement has proved an ongoing challenge for researchers in this field, and is particularly true in the quest to understand physical activity behaviours in children.

1.1 Physical Activity and Public Health

The predominant causes of early death in the UK have shifted from infectious diseases to chronic lifestyle-related complaints (Biddle, Gorely, & Stensel, 2004). In the UK, recent evidence has found that cardiovascular diseases contributed to 37% of all deaths, and cancers a further 27% (Allender, Peto, Scarborough, Boxer, & Rayner, 2006). It is widely acknowledged that these diseases are caused at least partly by modifiable risk factors (Allender, et al., 2007), including physical inactivity (Baumer, 2007). Evidence demonstrates that physical inactivity is a significant risk factor for obesity and several related chronic health diseases including Type II diabetes, coronary heart disease, stroke and certain cancers, and together with the financial burden of these diseases creates a global public health concern (Zahner, et al., 2006). Levels of obesity in the UK are rising, with estimations that 60% of the population could be classified as obese by 2050 (Foresight, 2008).

The Department of Health (DoH) (2004) stated that participation in regular physical activity has the potential to reduce the risk of premature death in adults by up to 30%, and estimated that approximately 58% of all cases of Type II diabetes, 21% of cases of heart disease, and between eight and 42% of certain cancers (including breast, colon and endometrial) could be attributed to obesity, and by association, reduced by physical activity (DoH, 2007). The DoH estimated that the annual financial cost of physical inactivity, and the related expense of obesity in the United Kingdom (UK), could be up to £10.7 billion, which included the costs to the National Health Service (NHS) and to the economy (Department of Health, 2004). The direct cost of physical inactivity to the NHS has been calculated as £1.06 billion (Allender, et al., 2007).

Early associations between physical activity and health were first highlighted in the works of Morris, Heady, Raffle, Roberts and Parks (1953a; 1953b), and Paffenbarger, Wing and Hyde (1978). This pioneering research explored the relationship between physical activity and coronary health, and the impact of physical activity on other areas of physical health were subsequently asserted by Blair, et al. (1985) and Powell, Thompson, Caspersen and Kendrick (1987).

Since these early works, the association between physical activity and health has been well-documented. Regular physical activity can not only promote physical wellbeing and decrease the risks of developing chronic disease, but is also important for mental and social health and wellbeing (Zahner, et al., 2006). Physical activity provides numerous health benefits and increases strength and energy levels, and relieves stress and improves self-esteem (Mota, Santos, Guerra, Ribeiro, & Duarte, 2003; Zahner, et al., 2006).

Current physical activity recommendations state that adults should participate in at least 30 minutes of moderate to vigorous activity on at least five days of the week

(DoH, 2004). Despite the Health Survey for England (2008) showing that activity levels have risen since 1997 for men (from 32% to 42% in 2008) and since 1998 for women (from 21% to 31% in 2008), research has shown that current levels of physical activity amongst adults are still insufficient to prevent the rising trend of obesity (Cobiac, Vos, & Barendregt, 2009; DoH, 2004). Evidence has shown that around a third of adults were classified as inactive in 2008 (Health Survey for England, 2008). In addition to evident gender differences, levels of physical activity are also reported to be lower in areas of greater deprivation, with disadvantaged areas reporting higher levels of lifestyle-related complaints (Macintyre, 2007).

The Health Survey for England (2008) measured physical activity in adults using both self-report measures (n = 15102) and accelerometry (n = 4507). The self-report data showed that 39% of men and 29% of women age 16 and over met the minimum recommendations for physical activity, and that physical activity decreased with age. When comparing the self-reported with the objective measure of physical activity, the accelerometry data yielded considerably different findings, with only six per cent of men and four per cent of women meeting government recommendations for adult physical activity, with men and women aged between 16 and 34 most likely to meet these recommendations (11 and eight per cent, respectively). This example illustrates the difficulty of accurately measuring physical activity and this issue is explored in further detail in Chapter 2.1.2. The Health Survey for England (2008) showed significant associations between deprivation (lower physical activity in more deprived areas) and Body Mass Index (BMI) (lower physical activity with increased BMI), and these findings were evident in both the self-report and the accelerometry data.

Where the Health Survey for England captures a wide range of health indicators and explores the wider determinants of health, the Active People Survey specifically measures adult participation in sport and active recreation (formerly National Indicator 8), providing local area estimations for adult participation (16 years and over). This annual survey uses telephone interviews to obtain self-report measures of physical activity in a representative sample of the population, which is then extrapolated to provide estimates of population participation. This survey provides data on the percentage of the adult population who participate in sport and active recreation, at moderate intensity on at least 12 days out of the last four weeks, equivalent to 30 minutes on three or more days per week. These data are provided for each local area. Nationally, the most recent results (April 2010 to April 2011) showed that 26.2% of 16 to 34 year olds met this criteria, with 16.3% of 35 to 54 year olds and 7.4% of over 55 year olds achieving this criteria (Active People Survey 5, Quarter 2 results, 2011). Although this survey uses different methods of data collection and analysis, the trend of physical activity decreasing with age is similar to other research findings, such as the Health Survey for England.

Patterns of adult physical activity in the UK reflect those across Europe, with a study of 26,788 European citizens showing that despite 65% participating in some form of physical exercise at least once a week, a quarter of respondents reported being almost or completely physically inactive (Eurobarometer, 2010). Again, this study used self-report methods to measure physical activity, and the interview questions do not provide guidance for respondents to differentiate between light, moderate and vigorous physical activity. Although this study provides important guidance about physical activity participation across Europe, any inferences regarding intensity of activity cannot be made, which again highlights the difficulties in capturing accurate measures of physical activity (discussed in further detail in Chapter 2.1.2).

1.2 Physical Activity and Children's Health

Evidence illustrating the important role of physical activity in children's health emerged almost four decades ago and included examination of blood pressure and weight loss amongst obese adolescents (Rocchini, et al., 1988), weight control and nutrition (Mayer & Bullen, 1974), and the cause and management of obesity (Dietz, 1983). Indications that blood pressure and body mass were lower in physically active children were asserted (Treiber, Strong, Arensman, & Gruber, 1989), and researchers purported that physical activity from a young age supported habitual activity in later life (Paffenbarger, Hyde, Wing, & Steinmetz, 1984).

There are current concerns regarding the rise in childhood and adolescent obesity. Reports show that the prevalence of obesity doubled amongst boys in the UK, and increased by 50% amongst girls in the UK, between 1994 and 2005 (British Heart Foundation (BHF), 2008). Projected levels of obesity have been calculated to illustrate future obesity prevalence if a sustainable response to this problem is not found. Foresight modelling indicated that Britain could potentially be a predominantly obese society by 2050 (Foresight, 2007).

> "By 2050 ...... 60 % of adult men, 50 % of adult women and about 25 % of all children under 16 could be obese ...The NHS costs attributable to overweight and obesity are projected to double to £10 billion by 2050. The wider costs to society and business are estimated to reach £49.9 billion per year (at today's prices)".
>
> (Foresight, 2007, p.2)

In 2006, the National Health Service (NHS) reported that a third of all children in the UK aged between two and 15 were either overweight or obese, and this problem of childhood obesity has taken global public health precedence, being described as a 'global epidemic' (World Health Organisation, 2000). In order to tackle this problem, the UK Government announced the Public Service Agreement on Child Health and Wellbeing to

> "Reverse the rising tide of obesity and overweight in the population by ensuring that all individuals are able to maintain a healthy weight. Our initial focus is on children: by 2020 we will have reduced the proportion of overweight and obese children to 2000 levels."
>
> (HM Treasury, 2008; p.5)

Recommendations for the treatment and prevention of overweight and obesity suggest that "a combination of lots of healthy and varied food plus adequate daily physical activity would provide the best approach" (Fox, 2004, p. 37). Current physical activity recommendations state that children and adolescents should participate in at least one hour of moderate intensity activity each day, continuously or intermittently (DoH, 2004). Weight bearing activities should be included at least twice a week to improve flexibility, bone health and muscle strength (National Institute for Health and Clinical Excellence (NICE), 2009). However, studies have suggested that up to a third of boys, and a third to a half of girls are not participating in sufficient amounts of physical activity that will be beneficial to health, thus leading to a rise in obesity and the potential increase of the risk of chronic disease (BHF, 2008; DoH, 2004; Pedersen, 2007; Rukavina & Li, 2007; World Health Organisation, 2002). Patterns and levels of habitual physical activity during childhood and adolescence have shown a universal decrease with age, and evidence suggests that this decline is more significant in girls than in boys (Treuth, et al., 2007; Ward, et al., 2006). Research has indicated that young people who adopt a physically active lifestyle are more likely to be active in later life, with 50% of overweight children becoming overweight adults, and thus potentially affecting the longer-term health of the young (BHF, 2008; Mota, et al., 2003; Riddoch, 1998; Ward, et al., 2006).

It is widely agreed that physical activity has a fundamental impact on the biological and cognitive maturation, behavioural development, and physical growth of children (Nader, et al., 2008; Strong, et al., 2005). Play is recognised as a key opportunity for physical activity, and an important element of healthy child development (Ginsburg, 2007; NICE, 2009).

1.3 Physical Activity Promotion and Policy in the UK

The need to tackle the levels of overweight and obesity amongst children and young people has become a public health priority. NICE (2009) produced recommendations for promoting physical activity in children and young people, and highlighted a number of different issues for consideration. NICE (2009) stressed the importance of establishing and delivering multi-component interventions which involve schools, families and communities, and the support through high level policies and strategies.

Their recommendations for local strategic planning highlighted the role of schools as a key setting for physical activity promotion.

The previous Labour Government in the UK recognised the importance of placing sport and physical activity at the heart of every school, and pledged to build strong sporting links between community and school clubs. The Department for Culture, Media and Sport (DCMS) and Department for Education and Skills (DfES) introduced the Physical Education, School Sport and Club Links (PESSCL) scheme in 2002. PESSCL was developed to tackle obesity, improve children's fitness, and improve talent identification and pathways to elite sport for young people (Learning Through PE and Sport, 2003).

A Public Service Agreement (PSA) target, developed by DCMS and DfES, aimed to increase the number of children spending two hours per week in high quality PE and school sport, within and beyond the curriculum, to 75% by 2006 and to 85% by 2008 (from 25% in 2002) (High Quality PE and Sport in Young People, 2004; Learning Through PE and Sport, 2003). The PSA target 22 built upon this previous target. Following the successful bid to host the London 2012 Olympics, this target was to 'Deliver a successful Olympic Games and Paralympic Games with a sustainable legacy and get more children and young people taking part in high quality physical education (PE) and sport – through the creation of a world-class system for PE and sport' (Department for Communities and Local Government, 2007).

The DoH and DfES set their 2004 PSA target to link in with PESSCL and the DCMS and DfES PSA target to "halt the year on year rise in obesity among children under 11 by 2010, in the context of a broader strategy to tackle obesity in the population as a whole" (National Audit Office, Healthcare Commission and Audit Commission, 2006, p.25). The Child Weight Measurement Programme (CWMP) was developed to help measure success against this target. CWMP involves routine measurement of children aged four and 10 using BMI to determine underweight, normal, overweight and obese proportions of UK children in school. It has been criticised by some who disagree with the use of BMI as an indicator, as it is an indirect measure of obesity and does not consider bone structure, muscle mass or fat distribution (Evans, et al., 2008; Rothman, 2008).

Publications such as ‘Game Plan’ (2002) and the ‘National Framework for Sport in England’ (2004) provided the regionally assigned delivery framework for PESSCL. Overarched by a national framework, the nine PESSCL components were managed by different organisations who collaborated to deliver the programme regionally. Sport England, the Youth Sport Trust (YST), DfES and DCMS supported and distributed the plans through collaborating organisations. However, Sport England has been criticised for basing their regional delivery plans on limited baseline data and evidence, and it has been suggested that the measurement of performance has not been clearly defined, and the allocation of resources at local level have not been appropriately informed (Houlihan & Green, 2009).

The first two elements of PESSCL delivery involved the establishment of 400 School Sport Partnerships and Specialist Sports Colleges to create a national infrastructure for PE and school sport (Learning Through PE and Sport, 2003). These were developed and supported by YST to deliver the PESSCL aim to widen physical activity and sports participation for children and young people, and deliver high quality PE and school sport (Learning Through PE and Sport, 2003). At the time of the present research, School Sport Partnerships were comprised of geographically clustered schools which collaborated together to develop PE and sporting opportunities for children and young people. Each School Sport Partnership follows a regional delivery approach, as advised in previous recommendations (Game Plan, 2002). Each Cluster is led by a Partnership Development Manager, to develop and strengthen strategic relationships with significant sport and physical activity community partners. School Sport Coordinators, based at secondary schools within each cluster, are responsible for developing and widening PE and sporting opportunities. Primary Link Teachers, based at primary schools within each cluster, are responsible for developing PE and school sport within their own schools (Learning Through PE and Sport, 2003).

The seven remaining PESSCL components relate to the provisions required to ensure targets are met:

- Gifted and Talented: providing quality learning and teaching for young people, encouraging them to increase their skills, motivation and self-esteem, and encouraging the links between sports clubs and schools
- Qualifications and Curriculum Authority PE and School Sport Investigation: developing ways to improve and enhance PE and school sport within all schools in England
- Professional Development: a programme providing teachers and adults other than teachers with opportunities for development and support to improve the quality of teaching and learning in PE
- School/Club Links: improving and developing PE and sporting opportunities for children and young people, focusing on guiding pupils from schools to a range of accredited clubs linked to the School Sport Partnership
- Step Into Sport: promoting sports and physical activity leadership and volunteering opportunities for people of all ages and social backgrounds in programmes such as Community Leaders Awards and Playground Leaders Awards
- Swimming: developed to ensure that all children and young people have the opportunity to learn to swim

(Learning Through PE and School Sport, 2003)

These components cover a wide range of activities to promote mass participation in sport and physical activity, and to identify and support gifted and talented young people. However, this approach has been criticised by experts suggesting that

> "the claim that achieving sporting excellence and greater participation are mutually compatible policy objectives has not only endured over many years but also masked inherent difficulties in achieving both objectives.....it is hard to avoid the conclusion that elite sport development and achievement on the one hand and mass participation

> and club development on the other are deeply incompatible functions within the policy frameworks current in Australia, Canada and the UK"
>
> (Houlihan and Green, 2009, p.20-21).

Evaluation showed School Sport Partnerships have the potential to enhance PE and school sport, and provide greater provision for PE, school sport, extra-curricular and wider curricular activities (Ofsted, 2005). Those School Sport Partnerships which encouraged extra-curricular sporting activities with community coaches, junior and community sports leaders, and adults other than teachers, and had staff who were enthusiastic and committed to attaining PESSCL targets, were found to be most successful (Ofsted, 2006). However, evaluation also demonstrated disparities in PESSCL delivery, where clusters had misunderstood guidelines and failed to identify pupil needs, integrate PESSCL into core PE, the whole school or the wider curriculum, or improve teachers' knowledge (Ofsted, 2005). Many schools were found to still have limited physical and economical resources, including poor playground provision and space, insufficient physical activity facilities, accommodation and equipment (Ofsted, 2005).

A 'Five Hour Offer' was introduced in July 2007 by the Labour Government, which aimed to provide opportunities for young people to participate in five hours of PE and school sport each week. In 2008, the YST specified that schools must offer two hours of PE each week, two hours of sport in extra-curricular activities, and two hours of sport via community links. With a view to further improving PE and school sport for young people in England, the PE and Sport Strategy for Young People (PESSYP) was launched in 2008, and built on the successes of the PESSCL strategy. PESSYP improved the infrastructure for delivery of PE and school sport in England, to achieve the Five Hour Offer. Aims and delivery of the PESSCL strategy remained the same as the PESSCL strategy, whereby the DfES and DCMS supported and distributed plans for regional delivery by a variety of organisations. However, the work strands changed to comprise:

- Club Links
- Coaching
- Competition
- Continuing Professional Development
- Disability
- Extended Activities
- Gifted and Talented
- Infrastructure
- Leadership and Volunteering
- Swimming

The School Sport Partnerships were given more resources and additional responsibility for providing and enhancing links with community partners to assist delivery of the Five Hour Offer. The PESSYP strategy introduced Further Education Sport Co-ordinators to work alongside School Sport Co-ordinators in Secondary Schools. Further Education Sport Co-ordinators were piloted in 31 Further Education Colleges to ensure that 16-19 year olds also had opportunities to participate in sport and physical activities. The success of this pilot programme saw national delivery of Further Education Sport Educators through collaboration with School Sport Partnerships, County Sport Partnerships and Local Authorities. The PESSYP strategy saw greater responsibility placed on County Sport Partnerships, who led delivery of Extended Activities, and continued to lead on the Step Into Sport strand. National Sports Governing bodies continued to support delivery of Clubs Links and Competition Manager work strands.

The development of the PESSCL and subsequent PESSYP strategies have been criticised for narrowing the objectives of Sport England, in an effort to clarify ‘confused organisational objectives’, and described as an ‘oversimplification of a complex policy field’ (Houlihan & Green, 2009, p.21). The focus on both elite sport participation and promotion of mass lifelong participation in physical activity are separate entities which need consideration beyond the strands of the PESSYP strategy. The 2009 PE and Sport Survey demonstrated a positive impact of these Government led initiatives, showing an increased level of young people participating in a minimum of two hours high quality PE and sport each week, from 25% in 2002, to 90% in 2008. However, the PE and Sport Survey collected data using self-report methods from partnership schools using 11 questions to assess performance. The nature of this method may not provide the in-depth results required to ascertain an accurate picture of impact.

The modernisation of PE and school sport delivery worked alongside other school-based health initiatives devised by the previous Labour Government. The National Healthy Schools Programme was introduced by DoH and DfES in 1999, aiming to use the school environment to improve children's health, improve social inclusion and work towards a reduction in health inequalities (DoH, 2007). All schools were expected to have access to the National Healthy Schools Programme by 2002. The programme comprised 41 criteria which advocated a holistic approach to the health of young people, and considered physical and emotional health and wellbeing in four key areas: physical activity, healthy eating, emotional health and wellbeing, and personal and social health education. Obesity prevention directly related to 34 of the Healthy Schools criteria (DoH, 2007). Stricter guidelines were introduced in September 2005 which stated that Healthy Schools status could only be achieved by using a 'whole school approach', delivered in collaboration with wider school staff, and integrated into school curricula. The Healthy Schools Programme defines a whole school approach as working with pupils, teachers, staff other than teachers and other stakeholders to support and inform the delivery of health promotion in schools. This approach ensures that health promotion is considered consistently across the school, from all aspects of the curriculum, to all other school activities. Crucially, this approach allows schools to shape a non-prescriptive approach to health promotion which reflects the unique attributions of their environment.

A three year evaluation of the impact of the National Healthy Schools Programme was commissioned to include 200 primary and 200 secondary schools. Interim findings revealed that schools largely understood the purpose of the Programme, the ‘whole school approach’ was well received, and schools could implement the Programme in ways to suit them. The evaluation also revealed a number of positive impacts on curricula, including the structure and topics covered in PSHE, increased awareness of the need to better incorporate existing physical activity provisions, development of healthy eating promotion and policies, and a structured approach to emotional health and wellbeing (DoH, 2009). All policies are under review following the formation of the new coalition HM Government in May 2010.

1.4 Theoretical Framework, Rationale and Research Questions

Researchers have developed and implemented numerous physical activity interventions aimed at reducing or preventing overweight and obesity in children over the past 20 years, with varying degrees of success. Such interventions have been implemented either at prevention stage, such as targeting children with overweight or obese parents, or using a community based preventative approach, or targeting specific groups to reduce their levels of overweight and obesity (Summerbell, et al., 2006).

Researchers have recognised that schools provide the ideal setting to support Government initiatives and create programmes to increase motivation and opportunities for children to be physically active, with opportunities to draw on existing school-based resources to create supportive environments (Ward, et al., 2006). Children up to the age of 16 spend up to 45% of their waking time at school during term-time (Fox, 2004), and as a consequence the school can provide the optimum opportunity for influencing and promoting health and health behaviours in children (Ward, et al., 2006). School-based interventions have been criticised for disregarding the key role of the family in health promotion, and this issue is discussed in further detail in Chapter 2.2.1.

Most school-based physical activity interventions have targeted specific children aged six years and above in middle or secondary school settings (Bautista-Castano, Doreste, & Serra-Majem, 2004; Ward, et al., 2006; Wareham, Van Sluijs, &

Ekeleund, 2005; Zahner, et al., 2006), and few interventions have focused on children younger than six years old. However, the existing evidence that young people are more likely to be active in later life if physically active whilst young provides justification for the development of physical activity interventions in primary school children (Mota, et al., 2003; Ward, et al., 2006).

The majority of existing school-based physical activity interventions have tended to follow an educational or behavioural approach, focusing on modifying behaviours at an individual level, targeting changes in attitudes, health behaviour choices, beliefs and knowledge (Ward, et al., 2006). Following this model, school-based interventions have typically been delivered in isolation through either PE or related health curricula. However, the generalisability and sustainability of such interventions has been questioned following concerns regarding the delivery and longer-term success of the actual intervention (Fox, 2004; Summerbell, et al., 2006; Zahner, et al., 2006). A direct approach to individual behaviour modification may not be the most successful or sustainable implementation design, rather, a design which facilitates healthy behaviours at population level may be more appropriate.

A Cochrane Review (Summerbell, et al., 2006) of the effectiveness of interventions aimed at reducing and preventing obesity in children concluded that more research is needed to enable delivery of successful intervention programmes to reduce and prevent overweight and obesity. None of the studies reviewed considered an ecological approach, whereby the effects of other influential determinants of health behaviour could be considered. The authors of this Cochrane Review highlighted the significant impact and potential influence that determinants of the school environment could have on health behaviours (Summerbell, et al., 2006). Considering the environmental determinants of health using a collaborative facilitative whole-school ecological approach may provide the best opportunity for a successful and sustainable school-based physical activity intervention (Ward, et al., 2006). Evidence suggests that physical educators, health educators, community agencies, and other school staff can work collectively to create more effective intervention programs (Ward, et al., 2006).

The Social Ecology Model (Stokols, 1992, 1996, 2000) and the Analysis Grid for Environments Linked to Obesity (ANGELO) (Swinburn, Egger, & Raza, 1999) provide frameworks for identifying and understanding environments and promoting health behaviour change. Both frameworks present insight into the influential determinants of the environment, and how these act upon health behaviours. Social ecology theory asserts that behaviours are limited and controlled by the environment in which they occur, and provides a rationale for developing interventions which offer economic, social and emotional support, information and services to facilitate healthy behaviour choices using a collaborative approach (Breslow, 1996). See Chapter 2.3 for further detail regarding ecological approaches and further exploration of the Social Ecology Model and ANGELO frameworks.

Based on the existing evidence, this current study aimed to use a whole school ecological approach to increase the opportunities for primary school children to be physically active in and around the school day. A pilot physical activity intervention was developed based on the Social Ecology Model (Stokols, 1992, 2000), the ANGELO framework (Swinburn, et al., 1999) and within the context of the National Healthy Schools framework. This intervention aimed to address influential economic, physical, political and socio-cultural factors in addition to those of PE and health, including nutrition, emotional, social and psychological health and wellbeing. No intervention program has used the Healthy Schools framework to consider aspects of the school environment in relation to physical education and the wider curriculum, and specifically encourage and promote physical activity in schools.

1.5 Research Objectives

Aim

The present research aimed to develop an intervention to increase opportunities for children to be physically active at school by exploring the potential role of the school environment in promoting physical activity. Consistent with the Social Ecology

Model, there was a focus on behaviour modification through changes in the environment using a whole school approach.

Objectives

1. Undertake baseline assessment of the school environment, with regard to the identification of facilitators and barriers to physical activity (physical activity measures, environmental audit, focus groups)
2. Based on the above, design and pilot a school-based physical activity intervention, informed by the Social Ecology Model (Stokols, 1992, 1996, 2000), the Analysis Grid for Environments Linked to Obesity (ANGELO) (Swinburn, et al., 1999), and the National Healthy Schools Framework
3. Evaluate the impact of the intervention on physical activity levels of school children using a pragmatic cluster controlled trial approach

A mixed-methods approach of quantitative and qualitative methodologies was used to inform and develop a primary school-based pilot physical activity-related intervention. This mixed-methods approach was used to gain an in-depth understanding of aspects of the school environment that promote positive behaviour change. The intervention was developed and delivered in collaboration with school pupils, staff, parents/guardians, and school and community partners using a whole school approach. Informed by the work of Stokols (1992, 1996, 2000) and Swinburn et al. (1999) existing resources were drawn upon to create a supportive environment for the promotion of physical activity and health-related behaviours at physical, political and socio-cultural levels.

Study Timescale

Table 1 shows the timing of study activities, with brief explanation of each. See Chapter 3 for discussion of methodological approach and rationale for chosen methods.

Table 1: Timescale of Study Activities

Nov-06		Measurement of pre-intervention physical activity levels	
Dec-06			
Jan-07			
Feb-07			
Mar-07			
Apr-07			
May-07		Pre-intervention focus group interviews	Environmental audits
Jun-07			
Jul-07			
Aug-07			
Sep-07	Intervention		
Oct-07			
Nov-07			
Dec-07			
Jan-08			
Feb-08			
Mar-08			
Apr-08			
May-08			
Jun-08		Measurement of post-intervention physical activity levels	
Jul-08			Post-intervention focus group interviews and audits
Aug-08			
Sep-08			
Oct-08			
Nov-08			
Dec-08			
Jan-09			
Feb-09		Six-month post-intervention physical activity levels	
Mar-09			
Apr-09			

1.6 Thesis Structure

Chapter 1 provides an introduction to the thesis and includes an extensive review of the importance of physical activity for health, and of physical activity promotion and policy in the UK. This review provides the rationale for the thesis, and aids in the development of the methods and pilot physical activity intervention. Theoretical framework, rationale and research questions are outlined in this Chapter.

Chapter 2 outlines the epidemiology of physical activity and provides a critical review of the currently available objective and subjective measures of children's physical activity levels. The relationships between age and gender amongst children are also reviewed here. This Chapter also includes a review of the types of settings for physical activity interventions, the populations that have been targeted, and the methodological quality of such interventions. The varying types of theoretical frameworks, intervention approaches and process of the intervention implementation are also reviewed here. Finally, the efficacy and effectiveness of such interventions is discussed.

Chapter 3 discusses the overarching methodology, and provides a rationale for the chosen methods.

Chapter 4 discusses **Key Research Question 1**, exploring the relationships between the school environment and physical activity, and includes the rationale, development, methods, results and discussion of the environmental audit tool.

Chapter 5 discusses **Key Research Question 2**, exploring the exploring the views, perceptions and experiences of physical activity and the school environment. This includes the rationale, method, analysis and discussion of the focus groups.

Chapter 6 comprises the intervention phase of the research. This section includes the development and implementation of the intervention.

Chapter 7 considers **Key Research Question 3**, which concerns the measurement and summary of the baseline, post-intervention and six-month post-intervention physical activity levels.

Chapter 8 discusses **Key Research Question 4**, and considers the impact of the intervention on the perceptions of pupils and the school environment. The post-intervention audit and focus groups are discussed here.
Chapter 9 comprises the discussion section of the thesis.

CHAPTER 2

Literature Review

2.1 Epidemiology of Physical Activity in Children

2.1.1 Introduction

The maintenance of healthy weight relies on balanced nutritional intake and physical activity. A positive energy balance will result in an increased weight gain, and relates to energy intake becoming greater than the energy expended by an individual. A negative energy balance will result in a weight loss, and involves energy intake becoming less than the energy expended by an individual (Hill & Davies, 2001). Researchers have explored the distribution of obesity amongst the population, and the factors that influence or determine this distribution (Ogden, Yanovski, Carroll, & Flegal, 2007). Epidemiological data have attributed rising levels of obesity to decreasing energy expenditure and increasing energy consumption, and researchers have suggested that the rise in obesity is due to behavioural and environmental factors rather than biological factors (Stein & Colditz, 2004; Wang & Beydoun, 2007; Wyatt, Winters, & Dubbert, 2006). Research is yet to determine whether physical inactivity or energy intake is the biggest contributor towards obesity (Fox, 2004), but it is recognised that a complex nexus of behavioural, social and environmental factors influence obesity, and it is clear that participation in regular physical activity is key (Baranowski, Cerin, & Baranowski, 2009).

The most widely accepted definition of physical activity is “any bodily movement produced by the skeletal muscles which results in energy expenditure” (Caspersen, Powell, & Christenson, 1985, p.126). This includes activities of all types and intensity. The terms physical activity and exercise have often been used interchangeably, however there are distinct differences between the two. Exercise is defined as being a subcategory of physical activity which is structured, planned and includes repetitive movement, with the aim of improving or maintaining physical fitness (Caspersen, et al., 1985). The components of exercise comprise muscular strength and endurance; flexibility; cardiovascular fitness and body composition (Caspersen, et al., 1985). Habitual physical activity relates to any type of physical activity which is lifestyle-related, including activities of any intensity that are incorporated into a person's everyday life. Examples of habitual activity include walking, cycling, and running, in addition to work related or domestic physical activity such as gardening. It is widely acknowledged that habitual physical activity is imperative for health, and improves the possibility of physical activity being sustained by an individual for life (Netz, Zach, Taffe, Guthrie, & Dennerstein, 2008). Interventions aimed at improving health and wellbeing should target an increase in physical activity rather than being exercise specific only, and should work at building moderate and vigorous physical activity into the activities of everyday life (Tobias, Steer, Mattocks, Riddoch, & Ness, 2007). However, methodological problems exist regarding the accurate measurement and monitoring of physical activity, which affect our understandings of physical activity trends amongst the population (Dugdill & Stratton, 2007; Dugdill, Stratton, & Watson, 2009; Wareham, et al., 2005; Welk, 2002). Issues surrounding the accuracy of physical activity measurement are discussed in further detail in Chapter 2.1.2.

In order to design interventions to increase participation in physical activity, we need to understand this behaviour, however two key reviews of correlates of physical activity amongst young people have found conflicting results. A review of physical activity correlates by Sallis, Prochaska and Taylor, (2000) included 54 studies of children published between 1970 and 1998. This review found that variables consistently positively correlated with children's (aged between three and 12 years) physical activity were gender (being male), access to facilities and activities, physical activity preferences, time spent out of doors, and a healthy diet. Parental overweight was found to be a negative correlation with children's physical activity. Conversely, a subsequent review of studies published between 1999 and 2005 by Van Der Horst, Paw, Twisk and Van Mechelen (2007) found that physical activity amongst children (aged between four and 12 years) was significantly associated with gender (being male), parental physical activity (amongst males), self-esteem, and parental support. A further review found that parental obesity and lack of sleep at weekends were negatively correlated with obesity (Mei Liou, Liou, & Chang, 2010). Belanger and Godin (2010) stated that these conflicting findings reveal inconsistencies in our understandings of physical activity behaviours.

Belanger and Godin (2010) proposed that the studies included in previous reviews were not robust enough to draw any firm conclusions, and suggested that basing studies on sound theoretical frameworks would provide a more robust foundation on which to design interventions. Belanger and Godin (2010) selected the Theory of Planned Behaviour (Ajzen, 1991) as the basis for their exploration of determinants of intention and related key beliefs around physical activity. Previous studies had identified intention as a key determinant of physical activity (Rhodes, Brown, & McIntyre, 2006; Trost, et al., 2002), therefore Belanger and Godin (2010) focused on investigating "the determinants of intention and their related beliefs reflecting the cognitive foundation of the targeted behaviour" (Belanger and Godin, 2010, p.2). The authors explored the nature of physical activity determinants in more depth than previous research, finding that intentions to be physically active and self-identity were correlated with physical activity and explained 14.9% of variance of physical activity behaviours. The authors concluded that importance should be placed upon self-identity and the development of motivation, a previously overlooked approach to intervention development. However, the reliability of these findings are questionable, as the study used self-reported measures of physical activity. Subjective methods of physical activity measurement may yield inaccurate results due to recall error, misinterpretation of the question, or social desirability. Additionally, the mean age of participants (10.4 years), and the convenience sampling method employed, means that these findings may not be representative of the wider population. Despite these limitations, this study does highlight the importance of considering theoretical constructs when designing physical activity interventions.

2.1.2 Measurement of Physical Activity in Children

There has been debate within the literature regarding the frequency, intensity and type of physical activity recommended for optimum health benefits (Summerbell, et al., 2006), yet accurate assessment of children's activity patterns to determine and monitor progress towards such recommendations is notoriously difficult due to problems of reliability and validity of assessment techniques (Armstrong & Welsman, 1997), limitations of the methods employed, and the spontaneous and diverse nature of the activities pursued by children (Corder, et al.,, 2008; Zahner, et al., 2006). Young children tend to be spontaneously active, with a large part of their physical activity levels taking the form of play (Zahner, et al., 2006). Longitudinal and cross-sectional studies of childhood and adolescent physical activity have shown children tend to be physically active during play, moving constantly and spontaneously, and practicing new skills. Evidence shows that these types of behaviour decrease with age, and are replaced with the gradual adaptation of a more sedentary lifestyle, with more time spent in activities such as television watching or playing computer games (Graf, Pratt, Hester, & Short, 2009; Treuth, et al., 2007).

Accurate assessment of physical activity is required to provide a reliable and valid understanding of the amounts of physical activity that are beneficial to health, and to determine successful intervention components (Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005). Concerns in the literature relate to the subjectivity, objectivity, sensitivity, accuracy, validity and reliability of physical activity assessment tools. See Dugdill, Stratton, & Watson (2009) for an in-depth review of the strengths and weaknesses of physical activity measurement tools.

Subjective physical activity measures, including self-report questionnaires and surveys, vary by the types of questions that are asked, the complexity of the questions and the time frame for recall (for example questionnaires can ask about physical activity participation over the past seven days, or generally within lifestyles). They can comprise single component or multi-component open or closed questions, and the type of questions will be determined by the objectives of the study

(Thomas, Nelson, & Silverman, 2005). Self-report questionnaires can be administered to a wide range of the population, and are considered time and cost effective, however, there are concerns regarding the interpretation and understanding of the questions, the inability to accurately assess energy expenditure, and the reliability and validity of the respondent's results (Reilly, et al., 2008).

Objective measures are widely acknowledged to be more reliable and valid than subjective measures, and provide a more accurate understanding of physical activity levels and energy expenditure (Corder, et al., 2008). Doubly-labelled water and indirect calorimetry are considered gold-standard objective techniques of measuring energy expenditure. Doubly-labelled water is a biochemical procedure used to estimate energy expenditure through markers reflecting metabolism (Thomas, et al., 2005), whereas indirect calorimetry is a method of analysing respiratory gas analysis to measure carbon dioxide production and oxygen consumption over a period of time, either via the use of a face mask, or a metabolic chamber (Thomas, et al., 2005). Both methods are identified as precise and accurate measures of energy expenditure, but are laboratory based, and time and labour intensive. The cost of undertaking these procedures is also high, and therefore these methods are not feasible for most physical activity investigations.

More widely used objective measures of physical activity can be employed in a field setting. Heart rate monitors have been used to determine the physiological responses to physical activity, and can be used to estimate the intensity of activity. Heart rate is used as an indirect measure of energy expenditure and can be used to investigate the relationship between workload, physical activity intensity, heart rate and energy expenditure (Crouter, Albright, & Bassett, 2004). Heart rate monitoring is a cost and time effective method of measuring physical activity, and the relationship between physical activity intensity and energy expenditure in larger studies. However, heart rate monitors are affected by factors not related to physical activity, such as temperature, stress and eating. There have also been inconsistencies in the literature regarding the characteristics of heart rate, particularly in trained athletes, which affects the relationship between heart rate and activity intensity, and may provide inaccurate, unreliable findings (Crouter, et al., 2004).

Pedometers are an alternative method for measuring physical activity objectively. Pedometers are motion sensors which count the number of steps accumulated by an individual throughout the day. Pedometers are a cost effective and easy to administer method of measuring walking, and feedback regarding step count has been used to aid the promotion of health behaviour change (Bravata, et al., 2007; Tudor-Locke & Bassett, 2004). However, pedometers are designed to measure walking, and do not accurately assess other activities (Tudor-Locke & Bassett, 2004) as they are unable to capture the intensity of the movement, only frequency and sometimes duration.

Accelerometry

Where pedometers only count steps, accelerometers assess the intensity, frequency and duration of movement (Chen & Bassett, 2005). Accelerometers provide an objective method of measuring physical activity, and can assess the acceleration of the body in multiple dimensions. Tri-axial accelerometers work by measuring acceleration in three directions. Seismic or piezoelectric sensors measure acceleration in vertical, anterior-posterior, and medio-lateral directions (Chen & Bassett, 2005). Accelerometers are unobtrusive, small and light, and worn on an elastic belt around the hip. They are non-invasive and can provide data regarding intensity, frequency and duration of physical activity based on the wearer's movement over long periods of time. Body acceleration is the outcome measure of accelerometry, and is expressed as a count value. Each minute (or other specified unit of time), the intensity and frequency of the wearer's movement is captured as activity counts, and recorded per unit time (typically 60 seconds) in the accelerometer memory. Count data are then downloaded to a computer for analysis.

Accelerometers are considered to provide more reliable and valid results than heart rate monitoring (Halsey, et al., 2008). Evidence has shown accelerometry to be a valid and reliable tool for measuring levels of physical activity, validated against estimated energy expenditure generated by doubly-labelled water (Brage, et al., 2004; Ekelund, et al., 2001; Fairweather, Reilly, Grant, Whittaker, & Paton, 1999; Sirard & Pate, 2001; Trost, et al., 2002). Energy expenditure data from doubly-labelled water has been found to be significantly related to physical activity determined by accelerometer activity counts (total energy expenditure $r = 0.39$, $p < .05$; activity energy expenditure $r = 0.54$, $p < 0.01$; physical activity level $r = 0.58$, $p < 0.01$) (Ekelund, et al., 2001).

Although widely used in physical activity research, there are many limitations with accelerometers. They do not provide information regarding the type of activity, and are not waterproof so cannot be used to measure water based physical activities (Halsey, et al., 2008). Accelerometers are also relatively expensive and, therefore, often not viable for large population studies (Halsey, et al., 2008). There are also sources of variation in accelerometer protocols, in both data collection and processing. The placement of the accelerometer on the body has received some attention amongst the literature due to evidence that the placement of the accelerometer may affect measurements taken (Trost, McIver, & Pate, 2005; Welk, 2005; Yngve, Nilsson, Sjostrom, & Ekelund, 2003). Differences in accelerometer output have been compared with hip, arm, thigh, ankle and wrist measurements. If the accelerometer is placed on the hip it will not capture upper body movement, will not capture cycling movements, and is not able to take into consideration the carrying of any heavy load (Chen & Bassett, 2005). Accelerometer placement has been mostly compared in Actigraph monitors, and evidence has surmised that the hip site provides the most accurate estimates of physical activity (Cliff, Reilly, & Okely, 2009).

There are additional discrepancies within the literature regarding the criterion used to identify the intensity of physical activity, especially amongst children (Anderson, Hagströmer, & Yngve., 2005). Accurate data are required to enable detailed explorations of children’s physical activity and health. Thresholds have been developed to determine the intensity of activity in an attempt to capture time spent in activity of moderate/vigorous intensity (for example Puyau, Adolph. Volua, & Butte, 2002; Reilly, et al., 2006; Sirad, Trost, Pfeiffer, Dowda, & Pate, 2005; Trost, et al., 2002). Theoretically, if a threshold is able to accurately reflect the intensity of activity, then the time spent above and below this threshold (for example moderate intensity) can be calculated. However, different thresholds have been devised to define the intensity of physical activity in children which makes it difficult to ascertain an accurate reflection. Published intensity cut-off points differ greatly, with little consensus aside for a need for individual child calibration (Gidlow, Cochrane, Davey, & Smith, 2008; Stone, Rowlands, & Eston, 2009).

Thresholds for children's physical activity have been calculated by age, however, it has been argued that children of the same age will have different levels of growth, body mass and development, which affect energy expenditure during activity and resting metabolic rates (Treuth, Butte, Adolph, & Puyau, 2004). It has also been acknowledged that different activities have different considerations regarding energy expenditure, which will further affect the accuracy of the physical activity intensity calculations (Treuth, et al., 2004). Furthermore, various studies have proposed different age-related accelerometer thresholds to identify physical activity intensity (Mota, et al., 2007), where different approaches have been employed by researchers to calculate these physical activity intensity thresholds. Thresholds have been calculated from a variety of samples, including 26 children aged six to 16 years (Puyau, et al, 2002); 82 children aged three to four years (Reilly, et al., 2006); three groups of children aged three, four and five years (Sirard, et al., 2005); 74 girls aged 13 to15 (Treuth, et al., 2004); and 80 children aged six to eight (Trost, et al., 2002). Epoch times, activity intensity, and criteria for intensity have all differed in such studies. A wide range of threshold counts have been devised from these studies, reflecting the lack of consensus on the topic, and making comparisons between physical activity studies difficult. Varying conclusions have been reported regarding the prevalence of physical activity amongst children (Guinhouya, et al., 2006), hindering our understandings of age-related physical activity trends (Gidlow, et al., 2008).

The physical activity intensity thresholds derived by Trost, et al. (2002) and Puyau, et al. (2002) are both widely used in the literature. Intensity definitions derived from Trost, et al. (2002) are defined as counts per minute ≥ 424, 504, 590, 681, 777, 880, 990, and 1107 for children aged four to 11. These thresholds are used extensively for determining moderate-to-vigorous physical activity intensity in the literature. The moderate intensity threshold of counts per minute ≥ 3200 derived by Puyau, et al. (2002) are also used widely (Guinhouya, et al., 2006; Nilsson, et al., 2008; Treuth, Hou, Young, & Maynard, 2005). However, these two different thresholds (Puyau, et al., 2002; Trost, et al., 2002) yield significantly different findings. Comparison of the two thresholds results in differing conclusions regarding moderate-to-vigorous physical activity levels within the same sample (Trayers, et al., 2006).

Due to these problems, in the absence of individual calibration, other researchers have used counts per minute to calculate physical activity (Riddoch, et al., 2004; Schmitz, et. al., 2005; Simmons, Griffin, Steele, Wareham, & Ekelund, 2008; Treuth, et al., 2005). The use of counts per minute as a measure of physical activity has been validated against estimated energy expenditure by doubly-labelled water (Ekelund, et al., 2001).

2.1.3 The Role of Physical Activity in Childhood

It is important that children enjoy being physically active. As discussed, despite limitations in physical activity measurement, it is broadly recognised that physical activity levels decline as children get older. By encouraging physical activity at a young age, children will be more likely to lead a physically active lifestyle as they get older (Blair, LaMonte, & Nichaman, 2004), thus protecting them against sedentary lifestyle-related diseases such as obesity, heart disease and diabetes (Wilmore & Costill, 2005). Physical activity is incorporated into the lives of children in a variety of ways. Fox (2004) purported that children channel physical activity through three main areas: transport; sport and PE; and play.

The Importance of Play

Play is an important part of physical activity which should be included in the context of the health and wellbeing of children. Play is fundamental to the physical, emotional, social and cognitive development of children (Ginsburg, 2007). Children use play to understand and learn about the world through expression, exploration and make believe (Cole-Hamilton & Gill, 2002; Cunningham, 2002; Ginsburg, 2007; Ouvry, 2003). Play allows children to be expressive and active, and to communicate and interact with humans, animals and environment, indeed, "[play] has long been recognised as the key way in which children come to make their own sense of their often confusing world" (Ouvry, 2003, p9). Play provides opportunities for children to settle into a school environment (Ginsburg, 2007) and enhance readiness to learn (Elias & Arnold, 2006; McWayne, Fantuzzo, & McDermott, 2004; Pellegrini & Bohn, 2005). Unstructured play is also an opportunity to promote and encourage physical activity in children (Ginsburg, 2007).

Environments for Physical Activity and Play

The benefits of outdoor play versus indoor play have been debated, with outdoor play facilitating freedom of movement and space to be active with enthusiasm that may not be permitted indoors (Bilton, James, Marsh, Wilson, & Woonton, 2005; Children's Play Council, 2002; Ouvry, 2003). A survey of 1000 children in Leicester found that 94 % of children wanted to spend more time outside (Dunnett, Swanwick, & Woolley, 2002) and a survey of young people in Northamptonshire found that 80% of nine to 16 year olds preferred being outside than inside (Children's Play Council, 2002). Outdoor play also encourages children to learn about local spaces and natural environments (Ouvry, 2003). Bilton, et al, commented "There is evidence that children who regularly have access to outdoor provision experience better health" (Bilton, et al, 2005, p.45).

Despite preferences for outdoor physical activity, the quality of environment is important (Thomas & Thompson, 2004). Worpole (2003) found two-thirds of nine to

11 year olds and 81% of 15 and 16 year olds were unhappy with the quality of outdoor play facilities. Time spent by children playing outdoors has declined (Worpole, 2005) thought to be due to a reduction in public play facilities, poor maintenance and quality in public play facilities, reduced time for exploratory play in school, and increased parental perceptions of risk (mainly stranger danger and road safety) (Ginsburg, 2007). Many public play areas attract anti-social behaviour, vandalism, and graffiti (Worpole, 2003), and financial and safety issues have seen public playground equipment and staff be removed. It has been argued that the needs and preferences of children have been overlooked, that "attitudes towards children and outdoor play are increasingly being driven by the needs of working parents, the educational requirements of politicians and businesses, health and safety legislation, consolidated by the wider commercialisation of all aspects of public leisure" (Worpole, 2005, p.6). Safety, finances and regeneration have influenced the changes made to play spaces in schools and local communities. The removal of community play spaces away from residential areas by developers and planners has led to a reduction in children's play areas (Worpole, 2005).

This evidence provides further justification for the promotion of physical activity through play within school environments. Challenging, exciting and adventurous play environments are required to motivate children to be physically active (Worpole, 2003). The Children's Play Council acknowledged that: "if it [play] is not exciting and attractive to them [children], then it will fail, no matter how 'safe' it is" (The Children's Play Council, 2004, p.3). Children thrive on the opportunity for adventurous play, where they are able to discover, learn and explore risk, as explained by Lindon (2001, p. 46) "If their [the child's] play environment is made too safe and sanitised, the children will either slump into uninspired and repetitive play or they will find some way to spice up their play environment, probably through energetic games or risky behaviour that adults do not like". It is the responsibility of adults to provide environments which are controlled to an appropriate degree, to enable children to learn about risk without any unnecessary danger (Children's Play Council, 2002). Recognition of the importance of play led to the government publishing a Play Strategy (2008), providing a ten year commitment to improving play opportunities for children and identifying a number of themes such as improving play opportunities in residential areas, parks and open space, improving the routes to children's play spaces, and consulting with children and young people in the development of their play spaces, and has also led to the development of new types of school play areas (Worpole, 2003).

School Environments for Physical Activity

School playgrounds have seen a substantial turnaround in recent years. In light of the benefits of outdoor play, numerous key agencies and local authorities are providing the opportunity for nurseries and schools to develop their outdoor spaces enabling them to create an interesting and exciting environment which stimulates children to play and learn (Bilton, et al, 2005). In 2001, the UK government and the YST implemented the development of the primary school playground initiative 'Zoneparcs' throughout England, which was incorporated into the PESSCYL (and subsequent PESSYP) target of increasing opportunities for children and young people to be physically active within and beyond the school curriculum.

The Sporting Playgrounds programme incorporated the 'Zoneparc' model as an approach to encourage physical activity in primary school children, and improve levels of behaviour, by 'zoning' primary school playgrounds into coloured areas for various types of activity. The Zoneparc model incorporated new and exciting playground equipment and introduced leadership volunteering opportunities for young people to be responsible for the organisation of playtime activities and equipment as Playground Leaders. Following on from the success of the initial pilot programmes, DCMS provided funding of £10 million to develop another 600 primary school playgrounds, with support from the YST to implement the Zoneparc model. In April 2005, DCMS provided a further £2 million funding to develop 90 Zoneparc programmes within 30 School Sport Partnerships (YST, 2007). The YST highlighted the benefits of Zoneparcs in reducing social and behavioural issues, creating opportunities for children and young people to be physically active, and increasing children's confidence and self-esteem as a by-product of taking responsibility for the development and leadership of their playground activities.

Schools provide ideal places for play provision, offering an environment in which children and their parents feel they are protected from danger and crime (Dunnett, et al.,, 2002). Children spend increasing time within the school environment, with the introduction of before and after school clubs, as well as break times and lunch times. Evidence has shown that outdoor play in schools increased levels of daily physical activity amongst children (Ridgers, Stratton, & Fairclough, 2005; Ridgers, Stratton, Fairclough, & Twisk, 2007; Zask, van Beurden, Barnett, Brooks, & Dietrich, 2001). Focusing investment in these areas offers children an outdoor environment which is a stimulating and exciting place for discovery and learning. The benefit here is that all the children are given the opportunity to use the play facilities, regardless of their socio-economic status and community background.

It is important and beneficial to create exciting play opportunities within schools, however, it is also evident that these should not replace playground developments and regeneration within the communities. If children can learn to enjoy play within their school environment this may have a positive impact on their play behaviours outside of school time (Worpole, 2003).

2.2 Review of Physical Activity Interventions in Children and Adolescents

Given the high prevalence of overweight and low levels of physical activity among children, a better understanding of physical activity behaviour is an important step in intervention planning. The following is a review of literature relating to interventions delivered to try to increase physical activity amongst children and young people.

2.2.1 Intervention settings

Interventions for preventing and/or reducing levels of overweight and obesity amongst children and adolescents have been implemented at various levels. They have targeted groups at a secondary prevention stage, such as those children who may be overweight or obese; targeted individuals at a selective prevention stage, such as those children with overweight or obese parents; or used a population approach, such as community, family or school-based physical activity interventions (Muller, Dnielzik, & Pust, 2005).

School-Based Interventions

Schools have been recognised as the ideal setting for increasing physical activity and health-related behaviours (Fox, 2004; Weschler, Devereaux, Davis, & Collins, 2000), potentially reaching a wide range of children and draw on a wide variety of resources in a supported and cost-effective manor (Sharma, 2006; Ward, et al., 2006). NICE (2009) also highlighted the important role of schools as a setting to increase physical activity levels in children. Evidence shows that confidence and understanding of physical activity should be fostered from an early age, and that schools play a key role here (NICE, 2006). It is widely agreed that interventions aimed at children of a younger age will be more effective in embedding healthy behaviours (Dowda, et al., 2009).

An international review of school-based physical activity interventions suggested that primary school-based programs ‘made sense’ due to the fact that healthy behaviour choices are still being developed, and intervention at the younger age provides the greatest impact for longer-term influence (Sharma, 2006). This author concluded that there was a lack of prevention programmes considering the scale of the childhood obesity problem (Sharma, 2006). The majority of school-based interventions reviewed were based in primary schools. Of the 21 studies reviewed, nine were aimed at modifying nutritional behaviours; seven targeted both nutrition and physical activity, and the remainder targeted just one issue, such as increasing physical activity during recess, or reducing carbonated drink consumption. Each of these studies implemented active interventions which required participants to voluntarily make efforts to change their behaviour. Active interventions have been criticised for placing too much onus on the individuals to change their behaviour, and for being unsustainable in the longer-term (Stokols, 1996). The importance of the environment on the behaviour choices of children and young people was highlighted by the authors of these reviews, who also acknowledged that the effects of the school environment required further research to understand how various environmental factors influence behaviour choices (Biddle, et al., 2004; Sharma, 2006).

A review by Van Sluijs, McMinn and Griffin (2007) included 33 studies that were undertaken with children (classified as under 12 years of age). Only 15 out of the 33 studies had over 250 participants, and only 10 had a follow up of six-months or longer. Seven studies were based within the UK, with the majority based in the USA (n = 18). Measurement of physical activity differed between the studies, reflecting the lack of consensus regarding accurate physical activity measurement. Overall levels of physical activity were measured in 19 of the 33 child based studies. Eight studies measured school-based physical activity and six measured out of school physical activity levels. Physical activity was measured using self-report questionnaires in 18 studies; objective measures of physical activity in 12 studies; and observation in three studies. The settings for the physical activity interventions in children were largely school-based (27 of the 33), with 13 confined to the school environment only. The 27 school-based interventions lasted between one month and three years. Interventions of this type included increasing levels of physical activity in PE lessons, educating pupils about health, nutrition and physical activity behaviours, and introducing playground markings to increase physical activity during recess. The review provides limited evidence to support environmental interventions, and inconclusive evidence to support multi-component interventions, with more high quality research required in this area to strengthen and confirm these conclusions (Van Sluijs, et al., 2007).

A number of other primary school-based interventions include the ‘Peer Modelling and Rewards’ intervention; a single component intervention delivered in the UK (Horne, et al., 2004) to children between the ages of five and 11 years of age that aimed to improve nutrition-related behaviours only. This intervention was based on the theory that children can learn behaviours through observational learning, or modelling (Horne, et al., 2004). Children were assigned to either an intervention or control group, where the children in the intervention group watched videos of children eating fruit and vegetables over a sixteen day period. Success was measured in the form of fruit and vegetable intake only, and findings illustrated that lunch time, snack time, and at home fruit and vegetable intake significantly increased. Fruit and vegetable intake had declined at four month follow-up, but still remained higher than intake at baseline (Horne, et al., 2004). However, the maintenance of these healthy eating behaviours beyond four months was not measured; therefore it is unclear how sustainable this intervention would be over the longer-term. Additionally, measurement of fruit and vegetable intake at home was reported by parents, which may be affected by recall and social desirability, and therefore may not be accurate accounts of consumption. The study was undertaken in two schools, so findings may not be generalisable to the wider population.

The Active Programme Promoting Lifestyles Education in School (APPLES), a multi-component intervention, was implemented in 634 seven to 11 year old children in 10 primary schools in the UK (Sahota, et al., 2001a, 2001b). This intervention was based on the theory that a multi-component, holistic approach would be effective in promoting health to children. The intervention was delivered by teachers, involving teacher training and modifications to the existing PE and health-related curricula, snack shops, and playground activities, and ran over one academic year. BMI, physical activity, and fruit and vegetable consumption were measured, and findings illustrated no significant changes in BMI or physical activity, although fruit and vegetable consumption increased by 0.3 portions in those children who were assigned to the intervention group. School level-changes to the curriculum, environment and attitudes were successfully implemented, but this did not translate to individual behaviour change (Sahota, et al., 2001a, 2001b). This study supports the need for multi-component interventions, but also highlights that carefully selected additional support and resources are required to further support change. Given the recommendations that interventions should be implemented at a young age, the impact of this study may have been more effective if the study had included primary school children below the age of seven.

The school-based interventions included in the review by Van Sluijs, et al. (2007) provide limited evidence to support their effectiveness, and primary school-based interventions have had a tendency to target children in the older year groups. However, the ‘Movement and Activity Glasgow Intervention in Children’ (MAGIC) trial, based in the UK, targeted children who were aged three and four years of age. This randomised controlled trial design comprised a single component intervention which aimed to increase levels of physical activity and improve motor skills via the delivery of a physical activity session three times a week (Reilly & McDowell, 2003). Children were randomly assigned to an intervention group (n = 220) or the control group (n = 220) for this 24 week programme. Physical activity sessions were delivered at nursery by nursery school staff, and focused on motor skill development (30 minutes three times per week) and at home (participating families received resources and materials to guide physical play at home). A range of anthropological measurements were taken from all children at baseline, six-months and one year, and included BMI, body fat distribution, blood pressure and body composition, in addition to physical activity measurement using accelerometry, and motor skill development. Positive reactions were given to the ease of the implementation and acceptance of the intervention by the nursery school staff, and follow up data revealed a significant increase in physical activity levels by 40 % on the days that the intervention was delivery, and 29 % on the days it was not (Reilly & McDowell, 2003). However, these changes were not replicated in a later study (Reilly, et al., 2006). The study authors suggest that a multi-component intervention, considering other factors that affect physical activity, may be more effective. This study provides some support for implementing interventions at pre-school age children, but consideration of the environment, education, and a whole school approach to increasing opportunities for physical activity is required.

A number of school-based studies have focused on playground interventions aiming to increase physical activity levels during school playtime. Playtime comprises a relatively large proportion of the school day, and coupled with the evidence that children are more likely to be physically active whilst engaging in free play with peers, means that this part of the school day must not be overlooked (Ginsburg, 2007). Fittingly, researchers have highlighted the importance of school playtime as an opportunity to increase levels of daily physical activity (Ridgers, et al., 2005; Ridgers, et al., 2007; Zask, et al., 2001). A study investigating the impact of playground markings on children's physical activity during playtime concluded that this was a cost-effective way of increasing levels of physical activity during playtime (Stratton & Mullan, 2005). A further study investigating zonal multi-coloured playground markings and physical structures concluded these to be effective in significantly increasing children's levels of physical activity during playtime (Ridgers, et al., 2007). Importantly, these studies highlighted that these interventions were effective in the longer-term and not merely a short-term effect because the equipment is new and exciting. A review of non-curricular school-based physical activity interventions demonstrated some support for the efficacy of interventions to promote increased physical activity during recess (Jago & Baranowski, 2004).

Limitations of School Based Interventions

A range of school-based interventions have been undertaken globally, but direct comparison is often challenging due to the wide variations of these interventions depending on the target group, the delivery, the measurement and the evaluation of the intervention. This is true for the health-related and obesity prevention interventions undertaken in schools UK, which do not follow set designs. Evidence supports the need for school-based interventions to include children of a younger age, as well as those in older year groups (Reilly & McDowell, 2003; Reilly, et al., 2006).

Reviews of health-related physical activity in children and adolescents have highlighted how interventions based within a school setting are typically delivered via modifications to the physical education and related health curricula (Biddle, et al., 2004; Summerbell, et al., 2006). The authors of these reviews argued that changes to physical education alone could not provide adequate improvements in physical activity for health benefits (Biddle, et al., 2004; Summerbell, et al., 2006). These reviews questioned whether physical activity could be increased enough during physical education to make a significant contribution to health, and suggested that interventions must be designed to accommodate the messages that students received during time spent at school, and also at evenings and weekends (Biddle, et al., 2004). Fundamentally, the authors highlight the important role of the environment on the behaviour choices of children and young people, and acknowledged that the effects of the school environment require further research to understand how various environmental factors influence behaviour (Biddle, et al., 2004; Summerbell, et al., 2006). Schools require policies to ensure that health can be promoted across the school, and require committed staff to support a whole school approach (Summerbell, et al., 2006).

Although the school provides an opportunity to reach a wide range of children and young people, physical activity interventions have shown only modest effects that have not demonstrated sustainability over the longer-term. School-based interventions have been criticised for not supporting behaviour change in other key environments such as the home.

The Role of Parents and Families

Parents have been identified as having a key role in the development of children's health behaviours (Alderman, Benham-Deal, & Jenkins, 2010; Anderssen, Wold, & Torsheim, 2006; Lindsay, Sussner, Kim, & Gortmaker, 2006). The early years of a child's life provide the 'foundation for dietary habits and nutritional adequacy over a lifetime' (Lindsay, et al., 2006, p.170). Parents are responsible for modelling behaviours, as well as for determining many obesity-related activities in children, such as the amount of time spent outdoors, encouragement of physical activities, nutritional intake, and time spent in sedentary activities (Bois, Sarrazin, Brustad, & Trouilloud, 2005**;** NICE, 2006; Sallis, et al., 2000). The role of parents in encouraging and supporting healthy behaviours is critical, and has been identified as a limitation of school-based interventions which often do not incorporate a family element (Alderman, et al., 2010). Interventions to support behaviour change should act to educate parents and families, to ensure that positive health behaviours during school time are not reversed in the home environment.

Parental physical activity behaviours have been found to be significantly related to their children's physical activity behaviours. A study examining the association between physical activity levels of parents and children aged between four and seven years found that children with active parents were almost six times more likely to be physically active than children of sedentary parents (Hood, et al., 2000). However, the relationship between parent and child physical activity has been shown to decrease with age, with parental influences being much stronger during the pre-school years than during adolescence (Alderman, et al., 2010).

Belanger and Godin (2010) examined correlates and determinants of physical activity in 313 children (mean age 10.4 years) and their parents. Parental support was found to be significantly related to children's self-efficacy, perceptions of being active or sporty, and positive attitudes, but parental physical activity was not found to predict children's physical activity. The influence of parental physical activity was found to be mediated by their child's cognitions and these findings suggest that promoting parental positivity around being active could alone encourage participation in physical activity (Belanger & Godin, 2010).

Given the key role that parents have in supporting the behaviours of their children, a number of family-based interventions have been developed to find an effective and sustainable way of increasing physical activity in children. The review by Van Sluijs, et al. (2007) examined 57 published trials, five of which were family-based interventions. Four of these interventions were aimed at children, of which three were defined as small high quality randomised controlled trials. All four interventions involved parents being educated around nutrition, physical activity and health, and/or family activity sessions. Only one of the four child-based studies reported any significant intervention effects, which was towards the control group.

The one family-based intervention aimed at adolescents was defined by the review authors as a high quality randomised controlled trial, and involved intervention families attending 12 after school sessions incorporating exercise, nutrition behaviour management, education; this study showed no intervention effects. The authors of the review concluded that there was no evidence support the implementation of family-based physical activity interventions for children or adolescents (Van Sluijs, et al., 2007). However, studies incorporating family-based components into a school-based intervention were identified as showing promise (Van Sluijs, et al., 2007).

School-based Interventions with Family Components

Fourteen of the interventions included in the review by Van Sluijs, et al. (2007) were school-based studies aimed at children, which incorporated a family component. These interventions comprised of health education and/or increased physical activity through PE lessons during school time, and intervention activities were supplemented by family activities or individual support. The interventions lasted between 12 weeks and six years. Two of these were defined by the review authors as high quality randomised controlled trials, one of which demonstrated a positive intervention effect. Six interventions in the review were aimed at adolescents, and were school-based studies incorporating a family component, which included family based activities and parent education. Three of these studies were defined as large high quality randomised controlled trials, two of which showed significant intervention effects. The authors concluded that there was strong evidence to support school-based interventions which include a family component (Van Sluijs, et al., 2007).

Other school-based interventions which comprised a family component, but were not included the review by Van Sljuis, et al. (2007) include ‘Be Smart’ (Warren, Henry, Lightowler, Bradshaw, & Perwaiz, 2003), delivered in three primary schools in the UK, to children between five and seven years of age. Warren, et al. (2003) acknowledged that schools are the ideal setting for interventions for childhood obesity, but that a family component may increase effectiveness. Here, behavioural intervention opportunities were provided for children to participate in physical activity, taste healthy foods, and to improve self-efficacy and knowledge, and encouraged parents to assist in the development and encouragement of healthy behaviours (Warren, et al., 2003). Levels of overweight and obesity were measured, along with intake and knowledge of fruit and vegetables. Findings showed no significant improvements in levels of overweight or obesity, but did find that fruit and vegetable intake significantly increased along with a significantly improved knowledge of nutrition. However, children's physical activity levels were measured via self-report questionnaires and parental questionnaires, and children's nutrition was also measured using parental questionnaires. The use of objective methods would provide more sensitive measures, and increase the reliability and validity of this study.

Summary

Many of the implemented physical activity interventions that have been undertaken in the UK suggest that primary school-based interventions provide the optimal setting for health behaviour change. The health behaviours of children are still being developed, and intervention at a younger age may provide the greatest impact for longer-term influences. Research indicates that children who adopt a physically active lifestyle are expected to continue this active into later life (BHF, 2008; Mota, et al., 2003; Riddoch, 1998; Ward, et al., 2006). Despite this, previous school-based interventions have shown only modest or inconsistent evidence of an increase in physical activity during the school day. Those studies which demonstrated an increase in levels of physical activity during the school day did not adequately assess the maintenance of this physical activity increase. The type of intervention design is crucial to its effectiveness, where multi-component interventions appear to show potential, but require additional support and resources to promote sustainable behaviour change.

2.2.2 Type of Intervention

Individual behaviour change approaches to health promotion have been criticised for their focus on modifying individual patterns of unhealthy behaviours, and emphasising active interventions which require individuals to voluntarily sustain a change in their behaviour (Stokols, 1996). Behaviour change models have also been criticised due to the lack of consideration for other variables which predict and influence behaviour, such as social, cultural and economic constraints (Stokols, 1996). The influence that the physical and social environment has on health behaviours suggests that health promotion interventions should focus on population level change, considering relationships between the environment and the population, rather than focusing solely on individuals (Stokols, 1992). This focus on population level change is potentially the most effective way to design interventions, and it is this premise on which the present intervention was developed. Environmental interventions have the potential to be "more powerful" than behaviour change interventions because they "have the capacity to benefit all persons exposed to an environment rather than focusing narrowly on improving the health of one person at a time" (Stokols, 1996, p.285).

Environmental and social physical activity interventions have been advocated as an effective way of modifying the health behaviours of a large population, using "passive" rather than "active" interventions (Stokols, 1996). Although national health promotion frameworks exist to inform public health at an environmental level, particularly amongst the field of tobacco control, such interventions have only recently been applied to the field of physical activity. In 1998, Sallis and colleagues produced research evidence advocating and supporting the use of environmental and social physical activity interventions (Sallis, Baumann, & Pratt, 1998), however, the types and settings for physical activity interventions have varied.

As discussed in Chapter 2.2.1 the majority of previous school-based interventions have targeted individual level health behaviours, rather than providing opportunities to support and facilitate behaviour change amongst groups. Active interventions have been criticised, as the responsibility for behaviour change lies with the individual (Stokols, 1996). The evidence so far illustrates that more research is required in this area to identify sustainable and successful behaviour change interventions. The limited school-based interventions which have incorporated a political or environmental approach have been found to be more effective than interventions which deliver curriculum approaches only (Timpero, Salmon, & Ball, 2004).

In the review of physical activity interventions by Van Sluijs, et al., (2007), half used an educational approach (n = 19), but only four educational interventions reported a significant positive effect. Therefore the review authors concluded that there was no overall evidence to support the use of an educational intervention. Four of the children's physical activity interventions included within the review targeted changes to the environment. Two of the interventions were randomised controlled trials of low quality, and both of these reported significant changes to physical activity. The review demonstrates some evidence to support the use of environmental interventions, but clearly shows the need to focus on developing studies and intervention design of better quality.

A third of the children's physical activity interventions reviewed by Van Sluijs, et al. (2007) used a multi-component approach to increase physical activity. Three of these 10 studies were randomised controlled trials classified by the authors of the review as being of a high quality, but only one reported a positive change in physical activity levels, leading the review authors concluded that the evidence to support multi-component interventions was inconclusive. Multi-component approaches show promise, and have been advocated as presenting the greatest potential for positive health behaviour changes. However, such multi-level approaches to increasing physical activity need to be explored in further detail, and further research in this field is required (Duncan, Duncan, Strycker, & Chaumeton, 2004). Examining the interaction of population level factors with social and environmental factors provides the opportunity to explore influences on physical activity across various contexts but

Marcus, et al. (2006) caution that incorporating these factors into an intervention presents a challenge (Marcus, et al., 2006).

2.2.3 A Critique of Individual Behaviour Change Theories

The importance of theory in the design and development of physical activity interventions has not always been considered by researchers. Early physical activity research was not commonly based upon any theoretical paradigms; however, more recent research has predominantly employed a theoretical basis on which to develop interventions (Marcus, et al., 2006). There are a number of models based upon social cognitions which are employed within physical activity intervention research.

Behaviour change interventions aim to prevent disease by replacing unhealthy behaviours with healthier ones, or by modifying patterns of unhealthy behaviour (Stokols, 1996). Theories of social influence have been widely used to guide health promotion interventions, and purport that individual's thoughts and actions can be modified in response to the feelings and actions of others (Stokols, 1996). A number of behaviour change theories involve consideration of the symbolic and cognitive process that mediate personal behaviour change (Stokols, 1996).

Social Learning Theory and Social Cognitive Theory

The Social Learning Theory (Bandura, 1977) and Social Cognitive Theory (Bandura, 1986) are two widely used theoretical strands which have been applied to physical activity intervention research. Although there are several Social Learning Theory theorists (for example Akers, 1985; Mischel, 1968; Rotter, 1954; Sears, 1951), Bandura (1977) is most widely referenced as developing the theory. The Social Learning Theory (Bandura, 1977) was developed in an effort to understand behaviour, and posits that behaviour is learned by observing others. The Social Learning Theory also suggests that individuals model their behaviours on people they identify with most, and purports that learning occurs when an individual undertakes the observed behaviour (Bandura, 1977).

The Social Cognitive Theory (Bandura, 1986) suggests that learning is integrated into an individual's environment, and was devised to explain the acquisition and maintenance of behavioural patterns, designed around people, the environment, and their behaviours (Glanz, Rimer, & Lewis, 2002). The Social Cognitive Theory recognises that the complex multi-faceted and reciprocal interactions between people, behaviours and the environment differ according to the individual and the situation, and perceptions change over time as a function of age and development (Bandura, 1977). The use of both the Social Learning Theory and Social Cognitive Theory in physical activity research purports that if children and adolescents observe physical activity behaviours within their environment they may subsequently view physical activity as a positive entity, and may increase their levels of habitual physical activity as a consequence. However, interventions based on the Social Learning Theory and Social Cognitive Theory have shown limited effectiveness and sustainability in the longer-term (Horne, et al., 2004; Warren, et al., 2003).

The 'Peer Modelling and Rewards' is an example of an intervention which used the Social Learning Theory as a framework on which to develop an intervention aimed at improving nutrition amongst children (Horne, et al., 2004). This single component intervention involved assigning children to either an intervention or a control group, where children in the intervention group viewed videos of 'peer role models' consuming fruit and vegetables over a sixteen day period, with the hypothesis that these observations would ultimately change behaviour (Horne, et al., 2004). The results suggested that this method was effective in significantly increasing levels of fruit and vegetable intake at lunch time, snack time and at home. However, the sustainability of this approach was not measured beyond four months, and the fruit and vegetable intake at home was reported by parents. An objective measurement of fruit and vegetable intake would have improved the reliability and validity of these findings. The 'Be Smart' intervention (Warren, et al., 2003) is an example of physical activity research which employed the Social Cognitive Theory as a framework on which to develop the intervention. This intervention encouraged children to participate in physical activity and to experiment with the tastes of healthy foods. Parents were also involved in this intervention and encouraged children to develop healthy behaviours. This study did not see any changes in levels of overweight or obesity. Findings did reveal a significant intake of fruit and vegetables and an improved knowledge of nutrition, however these were measured using self-report and parental questionnaires, therefore the accuracy of these findings is questionable.

The Health Belief Model

The Health Belief Model is a behaviour change model which has been employed to try to predict and explain health behaviours, based upon the attitudes of an individual (Becker, 1974; Rosenstock, 1966). The Health Belief Model was developed to explain the health-related actions taken by an individual, and the thought processes that related to these actions (Rosenstock, 1966). The Health Belief Model asserts that health-related actions are dependent on an individual's perceptions of whether a negative health condition could be avoided, has a belief that taking the action will lead to positive consequences, and has a belief that they can successfully undertake the health-related action (Rosenstock, 1966).

The Health Belief Model comprises four main components to explain what is termed as an individual's 'readiness to act'. These four components relate to how susceptible a person believes they are to a certain health condition, how severe they perceive this susceptibility to be, what they perceive the benefits of a health action to be, and what they perceive the barriers to successfully undertaking this health action to be (Rosenstock, 1966). 'Cues to action' was later added to explain a person's readiness to change their behaviour, and 'self-efficacy' was also added in later years to explain an individual's perceived confidence in their ability to undertake an action (Glanz, et al., 2002). A review of the use of the Health Belief Model found no evidence to support its use in understanding influences of environmental, social or economic factors on health (Taylor, et al., 2007). This review also found the application of the model to be inconsistent, with "weak predictive power in most areas of health-related behaviour" (Taylor, et al., 2007p. 4).

Theory of Planned Behaviour and Reasoned Action

The Theory of Planned Behaviour and Reasoned Action are other theories that have been widely applied to the promotion of health and physical activity behaviours. The Theory of Reasoned Action was developed to explain how an individual's performance of certain behaviours is determined by that individual's intention to perform it (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The individual's intentions are theorised to be determined by the individual's perceptions of the behaviour, and the influence of the individual's environment (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975).

The Theory of Planned Behaviour built upon the Theory of Reasoned Action in an effort to incorporate factors of perceived control over the skills, resources and opportunities that were available to enable the performance of behaviour (Azjen, 1985, 1988). The Theory of Planned Behaviour has been used in physical activity research to measure attitude, subjective norm, perceived behavioural control and behavioural intentions to predict the maintenance of physical activity (Armitage, 2005; Everson, Daley, & Ussher, 2006; Fila & Smith, 2006).

The accuracy of these predictions has been tested in physical activity interventions, and findings have shown that perceived control and intention towards increasing physical activity behaviours have failed to predict physical activity levels and increased physical activity levels (Hardeman, Kinmonth, Michie, & Sutton, 2011). Furthermore, studies undertaken to predict the validity of the Theory of Planned Behaviour were based on self-reported measures of physical activity, which have numerous limitations and may not yield accurate findings (Armitage & Conner, 2001). Studies testing the effectiveness of the Theory of Planned Behaviour have been criticised for having short follow-up periods which cannot accurately assess the longer-term effectiveness of its use (Hardeman, et al., 2011).

Transtheoretical Model of Behaviour Change

The Transtheoretical Model of Behaviour Change has also been widely used within the field of physical activity and health research (Hutchison, Breckon, & Johnson, 2008). The Transtheoretical Model presents a five stage process to explain an individual's readiness to change their behaviour (Prochaska & DiClemente, 1982; 1984). The five stages of behaviour change are precontemplation, contemplation, preparation, action and maintenance. This theory has been used to develop physical activity interventions by ascertaining a person's readiness to change their behaviour, and implementing an appropriate intervention to match this (Marcus & Owen, 1992). It is suggested that a physical activity intervention may be developed to target people who are not yet contemplating physical activity, to help them contemplate beginning an activity programme. This will then develop across the stages until an individual is prepared to take action (Juniper, Oman, Hamm, & Kerby., 2004). The five stage process to explain behaviour change is often not linear, and has been described as a cyclical process (Prochaska, DiClemente, & Norcross, 1992).

The majority of interventions which employed the Transtheoretical Model to increase physical activity have not considered all of its dimensions, making it impossible to determine its effectiveness (Hutchison, et al.,, 2009). This model has received criticism in the literature for having limited effectiveness and little influence on physical activity in the longer-term (Hutchison, et al., 2009). The Transtheoretical Model has also been criticised for focusing on personal motivations for behaviour change, and overlooking the influence of wider factors, such as physical and social environmental factors.

Summary

Behaviour change interventions have demonstrated limited impact in increasing physical activity (Stokols, 1996), and it has been suggested that changes are required at wider environmental levels (Bauman, 2005). The inconsistent use of behaviour change theories and their relevance to intervention outcomes has been criticised

(NICE, 2007). In their recommendations for behaviour change, NICE (2007) argue that the literature show multiple adaptations of behaviour change models, poor study design, and failure to account for all confounding factors, and evidence does not support the use of a particular model. Additionally, the contexts in which theoretical models have been employed have varied greatly. Many studies have implemented methods that are loosely based on theoretical frameworks, rather than employing a specific theoretical model. This makes direct comparisons between interventions difficult, in turn making it difficult to choose one intervention over another based on efficacy (Kahn, et al., 2002). Behaviour change models have been criticised for being unsustainable as efforts to modify health behaviours rely solely on the individual (Stokols, 1996).

The Institute of Medicine (2001) stated that social cognition models do not adequately explain the role of mediators that may affect the outcome of a physical activity intervention, and overlook the processes which cause initiation and maintenance of health-related behaviour. More recently, a transdisciplinary approach to physical activity promotion has been advocated, to allow an understanding which reaches beyond an individual level understanding (King, Stokols, Talen, Brassington, & Killingsworth, 2002). Research of this type has aimed to explore a multi-level approach to improving physical activity interventions, by considering physical, social, political and economical aspects of the environment (e.g. Sallis, Kraft, & Linton, 2002; Sallis, et al., 2006). Such ecological approaches consider multi-component and environmental factors which have not been considered in previous social cognition models. This shift is in keeping with the NICE (2007) recommendation that behaviour change interventions should focus on generic models, rather than specific models, thus taking into account the social, environment and economic context of behaviours.

This review has highlighted that interest in environmental determinants of physical activity has increased in recent years, in response to the finding that behaviour change models of health promotion have not provided a sustainable or long-term solution to improve diet and physical activity. It has been suggested that environmental attributes, including measures of the school environment, are key to understanding how to manipulate health-related behaviours (Bauman, 2005), thus forming the theoretical rationale for the present intervention.

2.3. An Ecological Approach to Increasing Physical Activity

"The environment can serve as an enabler of health behaviour" (Stokols, 1996).

2.3.1 Introduction

Researchers have more recently acknowledged the potentially significant role of environmental determinants of physical activity (Biddle, et al., 2004; Sharma, 2006), and Sallis, et al. (1998) discussed the advantages of adopting an environmental approach to delivering physical activity interventions. Environments and policies can influence behaviours by promoting, encouraging, demanding, discouraging or prohibiting certain behaviours, and potentially reaching a larger number of people than more traditional physical activity promotion. Understanding the complexity of physical activity influences will be achieved by adapting the most promising theoretical foundation of an ecological approach (Ball, Timperio, & Crawford, 2006). Global recommendations on physical activity for health stress the need to ensure that supportive environments are provided to encourage physical activity participation (World Health Organisation, 2010).

Sallis, et al. (1998) suggested that physical activity interventions should ensure that the environment is conducive to physical activity behaviours, and should be considered prior to any educational intervention being implemented. The authors cautioned that an educational intervention would not be effective or sustainable in the longer-term without an environmental intervention in place. The authors also stated that political changes would need to take place in order for an environmental intervention to be delivered and received effectively (Sallis, et al., 1998). The notion of adapting school physical activity policies is now a key health promoting initiative (Samdal, 2008).

Despite evidence and recommendations, understandings of how policy and the environment can influence physical activity remain limited (Ferreira, et al., 2007). An early paper examining how the school environmental factors could influence health behaviours in America stated that the most extensively studied health influences were physical activity and nutrition related, with little or no research attention focused on other environmental components (Weschler, et al., 2000). Weschler, et al. (2000) examined the potential influence of the whole school environment, and considered factors such as physical activity facilities, recess, intramural programs, psychosocial support, staff as role models, and foods available on school grounds, and how these could be modified to facilitate positive behaviour changes. The authors stated that the effect of such environmental influences had received limited research attention, and that implementing an approach which modifies the contribution of these individual environmental factors could have a significantly strong effect on the health behaviour choices of children and young people (Weschler, et al., 2000). This work echoes recommendations produced by NICE (2009) which stress the importance of multi-component interventions in schools using a whole school approach. Two key theoretical models within this field are the Social Ecology Model (Stokols, 1992, 1996, 2000) and the Analysis Grid for Environments Linked to Obesity (ANGELO) (Swinburn, et al., 1999).

The Social Ecology Model

The Social Ecology Model provides a theory to understand and explain the impact of the environment on physical activity behaviours and theorises that the environment is multi-levelled and asserts various layers of influence onto individuals (Stokols, 1992, 1996, 2000). The interactions between personal, biological, economic and socio-cultural environments have all been identified as important influences of health behaviours. Stokols (1992) suggested that health promotion interventions would not be successful unless environmental resources were addressed, and that educational interventions would not work unless the environment supported health behaviour change. Further, this theoretical model considers health behaviours in the context of groups of people and their environment, rather than focusing on the individual

(Stokols, 1992, 1996, 2000). In essence, this model aims to change health behaviours of a population rather than in individuals. Behaviour change theories have been criticised for expecting the individual to motivate themselves to change their behaviour, whilst ignoring external processes, such as economic, social and cultural factors. An ecological approach to behaviour change suggests that creating an environment which supports and facilitates behaviour at economic, social and cultural environmental levels creates a passive intervention which will be effective and sustainable in the longer-term (Stokols, 1996). Recommendations for behaviour change have advocated that environmental, economic, social and legislative factors need to be addressed, as these have a key impact on people's ability to change their behaviour (NICE, 2007).

The Social Ecology Model considers the various levels of an environment, and also highlights how the environment can be characterised not only by its actual qualities but by its perceived qualities (Stokols, 1992). This is particularly relevant to the development phases of an intervention, and supports the need to explore the perceived attributes of an environment with the population within it. Indeed, NICE (2009) acknowledge the different values of actual versus perceived environments, and stress that the qualities of an environment may be perceived in different ways. NICE (2009) outline the importance of consulting with children and young people to understand their perceptions of their environment to explore factors that help or prevent them to be physically active, and identify what they enjoy about physical activity. The Social Ecology Model classifies the various levels of environment into physical, economic, social and political facets (Stokols, 1992, 1996, 2000). Segregating the environment into the four areas allows greater insight into the types of environmental factors which influence behaviour. This insight can then be used to develop interventions specifically targeted towards our understandings of that particular environment.

The Analysis Grid for Environments Linked to Obesity (ANGELO) Framework

Swinburn, et al. (1999) recognised the limited success of behavioural approaches to tackle obesity, and stated that they were not effective because “people struggle against environments which increasingly promote a high energy intake and sedentary behaviours” (Swinburn, et al., 1999, p.563). In response, Swinburn, et al. (1999) developed a social ecology model specifically for the identification of obesogenic factors within the environment. Swinburn, et al. (1999) recognised that it was important to understand the ‘driving forces of obesity’, as opposed to individual responses to such forces, and asserted that obesity was

> “the net result of multiple influences which impact on fat mass by acting through the mediators of energy intake (especially energy-dense food) and/or energy expenditure (especially physical activity).”
>
> Swinburn, et al. (1999), p.564.

Swinburn, et al. (1999) stated the importance of being able to dissect the environment into elements which can be modified and measured in an intervention. The ANGELO framework provides a tool for classifying and measuring environments. Swinburn, et al. (1999) explained the three influences of obesity in the diagram of their model (Figure 1). The behavioural and biological influences are considered ‘host’ factors, and the focus for most of the research undertaken into the causality of obesity. Swinburn, et al. (1999) suggested that these host factors ‘explain’ individual differences within a particular environment, however, the focus of the model was not on individual differences, but on what the authors termed the ‘driving forces’ behind them (Swinburn, et al., 1999).

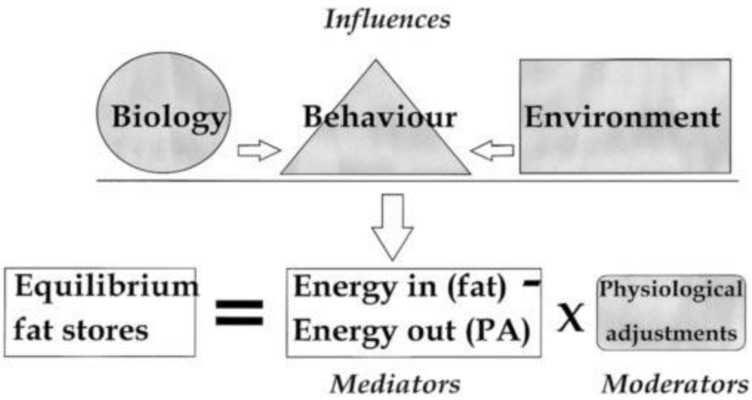

Figure 1: An Ecological Model for Understanding Obesity (Swinburn, et al., 1999, p. 564)

Swinburn, et al. (1999) recognised a number of advantages of using the ANGELO framework to develop obesity-related interventions, supporting Stokol's (1992, 1996, 2000) assertions that environmental changes will be more effective and sustainable because they will be incorporated into "structures, systems, policies and sociocultural norms" (Swinburn, et al., 1999, p.564). Additionally, Swinburn, et al. (1999) suggested that environmental changes would be more cost-effective than behaviour change interventions, and minimise the direct messages about body size to populations.

Similar to the Social Ecology Model (Stokols, 1992, 1996, 2000), the ANGELO framework classifies the environment into four different components: physical; socio-cultural; political and economic, and both Stokols (1992, 1996, 2000) and Swinburn, et al. (1999) provide explanations for these environmental components. The physical environment represents availability and provision of facilities, and the availability of opportunities to be physically active; the political environment represents the rules and regulations which impact on the behaviours of the people within that environment; the socio-cultural environment represents the attitudes and beliefs of the people within an environment, and is influenced by "gender, age, ethnicity, traditions, religion and sub-group affiliations" (Swinburn, et al., 1999, p. 567); the economic environment represents the costs related to the provision of physical activity. Swinburn, et al. (1999) also classifies the environment by scale, and theorises that the environment can be defined as both a 'macro-environment', relating to services and industries within a wider population, operating at regional or national levels, and a 'micro-environment', relating to a setting whereby individuals could potentially influence small populations (such as schools and the workplace).

The ANGELO framework has been piloted at population level where contents within the physical, socio-cultural, political and economic environments were generated through qualitative work with the local population, and a list of obesogenic elements were generated and considered in terms of validity (for evidence that the elements have an influence on physical activity or energy intake); relevance (how large is the problem); and potential changeability (Swinburn, et al., 1999). This work revealed a set of prioritised interventions that could be used to develop an intervention relevant to a specific population, and can be replicated for use with other populations in environments such as schools.

In Practice

The Social Ecology Model is not a new emerging theory, but has evolved over two decades. However, its implementation in the development of physical activity interventions has not been widespread. Whilst models have been developed for application to health behaviours, studies of the environmental correlates of physical activity have not unpicked the relative importance of social, personal and environmental influences on physical activity (Sallis, et al., 2006). NICE (2009) make recommendations for promoting physical activity amongst children and young people, and discuss the need to incorporate interventions which address political and environmental changes, particularly in the school environment. Interventions should include education and advice regarding the importance of physical activity, whilst ensuring that the school environment supports new opportunities for physical activity throughout the school day (NICE, 2009). Healthy behaviours of children at school can be influenced positively or negatively, depending on the provisions for and attitudes towards physical activity in and around the school day (Carter &

Swinburn, 2004), and NICE (2006) assert that obesity treatment and prevention will be effective if a whole school approach is taken to develop lifelong healthy behaviours.

Important influences, such as how the combination of economic, socio-cultural, and physical environments can affect health behaviour have not been addressed in previous school-based interventions in the UK. The Social Ecology Model (Stokols, 1992, 1996, 2000) and ANGELO framework (Swinburn, et al., 1999) acknowledge that the multi-factorial nature of the relationships between environmental factors and physical activity and health behaviours makes studying these influences difficult. Behaviour modification depends upon multiple interrelated factors, in which numerous influences act upon individuals, where some factors become modified by the action of others, to create constantly changing dynamics. Researchers have advocated the need for further investigation into the magnitude of environmental factors, and exactly how environmental influences affect physical activity and health behaviours (Booth, et al., 2001). Elder, et al. (2007) outlined the potential of addressing aspects of the school environment for the support of health behaviour changes, and highlighted the need for attention to be paid to this area. Specifically, Elder, et al. (2007) highlighted components of the school and school environment which could be modified to influence healthy behaviour choices. These included school playtimes, choice and environment of available food and beverages available in school (including the school meals); types of PE and physical activity programmes; provisions for PE, physical activity and sports; and personal, social and emotional support for physical activity and healthy eating. Elder, et al. (2007) suggested that the implementation of successful practices and policies in these areas could potentially provide sufficient incentive to facilitate healthy behaviour choices.

The Trial of Activity for Adolescent Girls (TAAG) (Elder, et al., 2007; Young, et al., 2008) used the Social Ecology Model (Stokols, 1992, 1996, 2000) as a framework for the development of a physical activity intervention for adolescent girls in 36 middle schools in America. This intervention was designed to address the recommendations set out in the Social Ecology Model (Stokols, 1992, 1996, 2000).

The multi-component intervention was delivered by project staff and teachers, and involved intervention at various levels, including TAAG PE, instructions and workshops for PE teachers to encourage active participation of PE amongst girls; TAAG health education, workshops and instructions for health education teachers and related staff in the development of physical activity related behavioural skills; TAAG physical activity programmes, creating physical activity opportunities outside of PE in collaboration with school, university and community agencies; and TAAG promotions, social marketing activities to encourage physical activity and promote TAAG related programmes (Young, et al., 2008). Process and outcome evaluation of the intervention delivery demonstrated that collaboration with outside agencies had a positive response, with collaboration doubling since the start of the intervention. The teacher delivered approach showed various success levels depending on their interest and motivation in the intervention. However, the reported intervention dose was high throughout the schools (Young, et al., 2008). Results of the process evaluation showed that 18 of the 56 TAAG goals were completely met at the end of the two year implementation stage, and 17 goals were within 10% of being completed (Young, et al., 2008). The outcome evaluation showed that girls in the intervention schools had higher levels of physical activity than girls in control schools after two years, equivalent to 1.6 more minutes of daily moderate to vigorous physical activity, or 80 kilocalories per week (mean difference 10.9 MET-weighted minutes of MVPA) (Webber, et al., 2008). There were no differences in body fat or levels of fitness at follow-up, but the authors concluded that a multi-component school-based, community linked intervention modestly improved physical activity in girls (Webber, et al., 2008).

The important role of the perceived environment is outlined in the Social Ecology Model (Stokols, 1992). A meta-analysis of physical activity and environmental characteristics (Duncan, Spence, & Mummery, 2005) reviewed 16 studies which measured characteristics of the perceived environment in relation to physical activity using logistic regression analysis. Although this review did not pertain specifically to the school environment, their findings imply that a significant association exists between physical activity and the perceived environment, where proximity to physical activity facilities, pavements, shops and services, and traffic not being a problem, can all have positive associations with physical activity. This evidence provides key learning for the development of future interventions which could be transferred to the school environment. Duncan, et al. (2005) suggest that identification and modification of environments promoting physical activity behaviours could assist interventions by promoting and sustaining positive physical activity behaviour change. Specifically, changes to policy could impact physical activity by mandating increases to school physical education and increasing the provision of physical activity facilities and opportunities. This review highlights the importance of considering both the actual and the perceived environment in the development of physical activity interventions.

This notion was examined in an American school environment intervention, which used the Social Ecology Model to devise an innovative multi-component approach to increasing physical activity (Ward, et al., 2006). The intervention targeted ninth-grade adolescent girls in 24 high schools in America, which were pair-matched at baseline by size and other demographics, and randomly assigned to intervention and control groups. The intervention was implemented over a two year period, and used components of their national Co-ordinated School Health Programme (the equivalent of the UK Healthy Schools Programme) as channels through which to deliver their intervention, an approach not previously implemented. Such School Health Programme channels included PE, health education, healthy school environment, school health services, staff health promotion, and family and community involvement, with modifications specific to each school (Ward, et al., 2006). A combination of project staff and school staff delivered the components of the intervention, with support from school staff and related agencies. This successful approach facilitated physical activity and health behaviour change using a passive intervention approach, rather than actively directing participants them. This study used a non-prescriptive implementation method which directed modifications depending on each of the schools unique characteristics. The authors suggested that taking a system level approach at the policy, school and individual level provided the greatest opportunities for a school-based intervention to be successful (Ward, et al., 2006). Implementation of a lifelong approach to physical activity, ensuring classes were enjoyable and fun, increasing the level of physical education in school, and displaying messages regarding physical activity in school were all important aspects of this programme. This innovative research has important implications for the development of effective intervention programmes, and could be utilised to generate a whole school approach to increasing physical activity, rather than targeting only girls.

The evidence presented in this review of ecological approaches to increase physical activity indicates that multi-component ecological interventions are required to challenge modifications at social, political and environmental levels. It is vital that interventions address the influencing role of the environment. Opportunities to support and facilitate behaviour change amongst children need to be provided by using a whole school approach, and the inclusion of family and community agencies should be considered in the development and delivery of intervention level components, where all school staff including staff other than teachers, collaborate to facilitate a passive intervention. This evidence was used to inform the development of the present intervention, with reference to the Social Ecology Model (Stokols, 1992, 1996, 2000) and ANGELO framework (Swinburn, et al., 1999), and a number of tools to consult with a wide range of stakeholders. This approach enabled consideration of the political, physical, social and economic aspects of the environment, and ensured that a whole school approach was adopted to facilitate physical activity amongst the representative primary school populations.

2.3.2 Review of Physical Activity Related Environmental Audit Tools

In response to the need for consideration of environmental influences on physical activity, a number of audit tools have been developed to assess the physical environment. In their recommendations for the treatment and prevention of obesity, and the promotion of physical activity, NICE (2006, 2009) discuss the need to adequately assess the provision of space and facilities, particularly within the school environment. The ethos of the school has also been highlighted as a key influence of health behaviours (NICE, 2006). NICE (2009) advocate the need to assess the actual environment, whilst also consulting with young people to explore factors they enjoy about their environment, and remove barriers to physical activity.

A number of environmental audit tools have been developed to capture the walkability and bikeability of the 'neighbourhood' physical environment, which enable identification of potential weaknesses and areas for development. However, there has been less research exploring the micro-environmental characteristics of schools. Moudon and Lee (2003) suggested that tailoring environmental audit tools to match specific environments and the purpose of the physical activity would be a more effective way of assessing the environment. Developing environmental audit tools in this way would allow for a more controlled evaluation of micro-environments, such as schools, that are often more amenable to modification than neighbourhood environments.

An environmental audit tool for schools was developed by Moon, et al. (1999) to assess the Wessex Healthy Schools Award Scheme by evaluating process and policy change, and health education and health promotion in school following implementation (Moon, et al., 1999). This audit tool was designed for use in conjunction with a number of other qualitative and quantitative data collection tools which included pupil questionnaires, focus group interviews, and interviews with teachers and staff other than teachers (Moon, et al., 1999). It comprised the nine key areas developed by The Healthy Schools Award Scheme: the curriculum; the wider community; smoke-free environments; healthy food choices; physical activities; taking responsibility for self; healthy workplace for staff; stimulating, clean, safe, tidy environment; equal opportunities and access to health education (Moon, et al., 1999). The audit was completed in collaboration with the school Head Teacher, PE teacher and Personal, Social and Health Education teacher. Each question was allotted a total of five points and findings revealed that scores for all key areas increased following the award scheme, with the exception of physical activity and taking responsibility for self (Moon, et al., 1999). The authors cautioned that the findings could not be attributed purely to the Healthy Schools Award Scheme, as changes may have been ‘dependent on local factors, such as school staff and management issues’, and stated that the audit tool was not a reliable indicator of change (Moon, et al., 1999, p.121).

Since the development of Moon, et al’s (1999) school environmental audit tool, the focus of the research regarding the impact of the environment on physical activity has largely considered the built environment. Research of this type is relatively new and still emerging, and development of reliable and valid tools is still in progress (Hoehner, Ivy, Brennan-Ramirex, Meriwether, & Brownson, 2006). A number of environmental audit tools exist which are peer-reviewed, and there are a number available over the Internet which have not been peer-reviewed (Brownson, et al., 2004). Existing audit tools predominantly aim to assess the built environment at street level, and community scale factors which may influence physical activity (Pikora, et al., 2002). Such environmental audit tools generally examin environmental factors which are associated with walking and cycling behaviours (Gebel, et al., 2005).

Saelens, Sallis, Black and Chen (2003) developed an environmental audit to measure the relationship between environmental characteristics and physical activity in a Neighbourhood Environment Walkability Scale. Saelens, et al. (2003) developed a survey which considered residential density, proximity to and ease of access to non-residential land uses such as restaurants and retail stores, street connectivity, walking and cycling facilities such as sidewalks and pedestrian and bike trails, aesthetics, traffic safety, and crime safety. Physical activity levels were measured in residents from non-adjacent ‘high’ and ‘low’ walkability neighbourhoods. Accelerometers were worn for seven days by 107 residents (54 in the high walkability neighbourhood and 53 in a low walkability neighbourhood). Findings revealed that the scale demonstrated strong test-retest reliability. Residents in the high walkability neighbourhood were found to have participated in higher levels of physical activity (52 minutes of moderate intensity activity more) than residents in low walkability neighbourhoods. High walkability was reported by residents to be attributed to spending more time walking to work and for everyday tasks (Saelens, et al., 2003).

However, low recruitment to the study and differences in demographic characteristics limit the generalisability of the findings from this study.

The development of the Neighbourhood Environment Walkability Scale (NEWS) has demonstrated test-retest reliability in a number of other studies (Leslie, Saelens, & Frank, 2005). Cerin, Saelens, Sallis and Frank (2006) evaluated the construct validity of the Neighbourhood Environment Walkability Scale and aimed to develop an abbreviated version of the measure (NEWS-A). Participants were stratified into more detailed cluster samples than previously used, and Geographic Information System (GIS) data was used to define walkability. A larger sample size was also employed (n = 1286). The construct validity of the measure was supported in this study, however, findings of the abbreviated measure NEWS-A were not equivocal to the standard measure NEWS, and the authors suggested that specific recommendations were required regarding the scoring of each measure. Cerin, et al., (2006) also suggested that scoring recommendations were made specific to the purposes of the study, such as using cluster level and individual level measures to differentiate between perceptions of the environment and objective environmental characteristics.

Cerin, et al. (2006) cautioned that the NEWS and NEWS-A measures needed to be cross validated across a variety of geographical locations before the measure could be deemed as generalisable to other populations. The authors expressed concern that the findings of this study, although more thorough in population and geographic detail, may be specific to the settings used in the study. Cerin, et al. (2006) suggested that the relationship between environmental characteristics may differ according to urban and rural settings.

A review of environmental audit tools found 31 peer-reviewed audit instruments which related to the walkability and bikeability of the physical environment (Moudon & Lee, 2003). The purpose of these environmental audits was to assess either the aspects of the environment which would be conducive to physical activity (i.e. walking or cycling) or the transportability of the environment (irrespective of physical activity). Almost 200 variables were used across the 31 audit tools to measure environmental factors. The authors of this review stated that this large number of variables "indicates a lack of knowledge about the effect of single variables on walking and bicycling" (Moudon & Lee, 2003, p.33). The findings of this review demonstrated that there was a dearth of accurate and detailed measures of the environment, and no single environmental audit tool which comprised all aspects of the built environment (Moudon & Lee, 2003). The authors of this review concluded that the number of variables used to measure environmental factors needed to be reduced, and greater levels of validation were required (Moudon & Lee, 2003). Suggestions for future research included tailoring environmental audit tools to match the specific physical environment and the purposes of the physical activity within in (Moudon & Lee, 2003).

A large proportion of the environmental audit tool literature has been dominated by researchers at the Prevention Research Centres Healthy Aging Research Network (PRC-HAN) in America. In 2004, members of PRC-HAN published research which compiled 36 existing peer-reviewed environmental audit tools into one database to create one new environmental audit tool (Brownson, et al., 2004). The majority were included in the earlier review (Moudon & Lee, 2003). Items on the environmental audit tool included characteristics of the street, pavement, bike lanes and roads; building use; physical disorder; signage; and social environment (Brownson, et al., 2004). Individual audit tool segments were classified into eight broader environmental categories: visible modes of alternative transport; visibility of diverse land uses; visibility of public recreational facilities; visibility of public recreational equipment; visibility of attractive features; visibility of comfort features; visibility of physical disorder; and visibility of people (Brownson, et al., 2004). An in-depth analytic version of the audit tool was created, along with a checklist audit tool for use by community members (Brownson, et al., 2004). A total of 475 street segments were audited, with a further randomly sampled 150 segments re-audited by different observers using the same audit, to test for agreement. This study reported a moderate to poor agreement amongst the eight segments representing the categories of the audit tool. However, audit tool segments relating to transportability and land-use demonstrated high agreement. Social environment and aesthetics items demonstrated moderate to fair agreement. The authors concluded that this tool was reliable and particularly suitable for auditing transportation and land-use elements of the environment. The reliability of the tool was tested as part of a different study, using a ‘high-walkability’ city versus a ‘low-walkability’ city (Hoehner, Brennan-Ramirez, Elliot, Handy, & Brownson, 2005). Here, perceived environmental factors versus objective environmental factors were examined using a collation of 36 existing environmental audit tools, and considered land-use, recreational facilities, transport use and aesthetics. Perceived measures were collected using telephone interviews. This study found that transport use within an environment was negatively associated with perceived and objective environmental aesthetics. Findings also illustrated positive associations between the recreational environment and perceived access to recreational facilities (Hoehner, et al., 2005).

Members of PRC-HAN have developed an environmental audit tool, aimed at qualitatively and quantitatively assessing community and street level factors which influence walking behaviours, specifically in older adults (Lang, Anderson, & LoGerfo, 2006). Contents of the audit tool included measurement of land use, building types, building spaces, food-related facilities, retail-related facilities, recreational facilities, pavements and road junctions (Lang, et al., 2006). Members of PRC-HAN have piloted environmental audit analysis was still underway at the time of the present research, and the finalised audit tool has not yet been published.

The Active Neighbourhood Checklist is a community level audit tool developed by members of PRC-HAN in America, aimed at examining aspects of the neighbourhood environment which are conducive to physical activity (Brownson, Handy, Hoehner, Brennan-Ramirez, & Ivy, 2007). This audit tool examined the quality of the physical environment for the pedestrian, characteristics of land use, pavements and bicycle lanes, and the street (Brownson, et al., 2007). This audit tool demonstrated strong levels of inter-tester reliability, however the authors recommended further research be undertaken with different types of users in different settings (Brownson, et al., 2007).

Spittaels, et al., (2009) identified a lack of consensus regarding which environmental audit would be most appropriate for use in a European setting, given the differences in the built environments across Europe, America and Australia. The researchers reviewed the literature to identify how best to capture environmental influences on physical activity within European settings. The authors identified 15 published and eight unpublished studies which matched their search criteria. The NEWS measure was found to be the most commonly used or adapted tool. However, none of the measures used were considered by the authors to be appropriate for use in a European context. The authors developed a new measure, the ALPHA environmental questionnaire, based upon selected themes and items from other questionnaires (Spittaels, et al., 2009). Themes covered types of residences in the neighbourhood, distance to local facilities, walking and cycling infrastructure in neighbourhood, maintenance of infrastructure in neighbourhood, neighbourhood safety, pleasantness of neighbourhood, cycling and walking network, home environment and workplace or study environment. Two versions of the questionnaire were developed; a 49 item version for research purposes, and an 11 item version for monitoring purposes. The ALPHA environmental questionnaire was then tested for reliability and validity in various languages and in different European countries (Spittaels, et al., 2010). The tool demonstrated moderate to good reliability, predictive validity and feasibility. However, the authors acknowledged that further testing would be required to improve the generalisability of the measure to other European countries, and encourage other researchers to also further investigate the use of this tool (Spittaels, et al., 2010).

Despite the development of a number of environmental audit tools, researchers have acknowledged the need to further examine the environment across multiple levels to enhance our understandings of the influence of social, economic and political elements of the micro-environment (Sallis, Owen & Fisher, 2008). Ecological models have the potential to support the development of interventions which reach beyond only those individuals who choose to take part (Stokols, 1992, 1996), and experts have stressed the importance of considering both objective and subjective perceptions of the environment (Cerin, et al., 2006). Consultation with people from the target population will allow exploration of perceived barriers and facilitators to physical activity, and allow intervention development to address issues to adequately support physical activity behaviours. This evidence shaped the development of the present intervention, whereby an audit tool was developed to consider characteristics of the school environment, alongside the subjective perceptions and views of people in the target population.

2.4 Summary of Evidence

Habitual physical activity is a vital component of a healthy lifestyle (Netz, et al., 2008). It is widely agreed that physical activity levels amongst children and young people are insufficient for health, although common reliance on self-reported physical activity is a limitation. It has been suggested that interventions to increase activity should focus on building physical activity into daily life, rather than targeting an increase in exercise (Tobias, et al., 2007), however, our understanding of how best to improve physical activity amongst children is limited (Belanger & Godin, 2010). Studies have reported conflicting findings when investigating determinants of physical activity in children (for example Sallis, et al., 2000; Van Der Horst, et al., 2007).

It has been suggested that schools are the ideal environment in which to promote and increase levels of habitual physical activity amongst children (Fox, 2004; Ward, et al., 2006). Although school-based interventions have been criticised for overlooking the key role of parents and families (Alderman, et al., 2010), primary schools have been identified as particularly good environments for developing behaviours from a young age (Sharma, 2006). Various interventions have been delivered in a school setting, however, such interventions have had limited success, and have not shown sustainability in the long-term (Summerbell, et al., 2006). Whilst school settings are clearly most appropriate, no one method of intervention has demonstrated sustainability in the longer-term, and the evidence suggests that population-level ‘passive’ interventions in primary schools may be more effective than individual-level ‘active interventions. Ecological approaches to improving physical activity have shown promise, and research suggests that different components of the whole school environment should be considered for an effective intervention (Stokols, 1996). Physical, political, social, cultural and economic aspects of the environment could potentially be modified to facilitate healthy behaviour choices (Elder, et al., 2007). Environmental audits to assess the environment have been identified as extremely useful for the development of interventions, yet the majority of environmental audit tools have focused on the walkability and bikeability of physical environments of neighbourhoods. There is a need to further develop environmental audit tools for use in smaller, specific micro-environments, such as schools (Moudon & Lee, 2003). Evidence supports the need to also explore the perceived environment in the development phases of an intervention.

The accurate measurement of physical activity is problematic, particularly in children (Zahner, et al., 2006). Accelerometry has shown to be a valid and reliable tool for the objective measurement of physical activity (Brage, et al., 2004). However, methods for interpreting accelerometry data have been widely debated amongst researchers. Thresholds designed to measure the intensity of activity have been derived from different epoch times, activity intensity and criterion for intensity (for example Puyau, et al., 2002; Reilly, et al., 2006; Sirard, et al., 2005; Treuth, et al., 2004; Trost, et al., 2002). None of these studies have derived similar findings, resulting in conflicting reports of the children's physical activity levels. One solution has been to discount the use of thresholds to estimate intensity of activity, and to alternatively employ counts per minute. This option has been employed in a number of studies (for example Riddoch, et al., 2004; Schmitz, et al., 2005; Simmons, et al., 2008), and has been validated against estimated energy expenditure by doubly labelled water (Ekelund, et al., 2001). However, issues such as appropriate accelerometer placement, duration required to provide accurate results, and conflicting methods of raw data analysis, suggests this should not be relied upon solely as a measure of intervention impact.

2.5 Evidence Based Approach

The development of this pilot physical activity intervention incorporated all elements of the available evidence:

- This pilot intervention was delivered over one academic year (10 months), based within primary schools and founded on an ecological theoretical approach

- School staff, school pupils, parents/guardians and staff from other relevant agencies (such as the School Sports Partnership) were consulted in the development of the pilot intervention

- School staff, school pupils, parents/guardians and staff from other relevant agencies (such as the School Sports Partnership) were involved in the delivery of the pilot intervention, to enhance sustainability

- A number of methods were used in triangulation to
  a) measure baseline activity levels
  b) inform the development of the pilot intervention

  - Accelerometry was chosen to objectively measure physical activity levels pre- and post- intervention

  - An environmental audit tool was developed to explore the relationship between physical activity and the school environment. Again, these data were used to inform the development of the pilot intervention, and to also assess its impact.

  - Focus group interviews with school staff, school pupils, and parents/guardians were used to develop the pilot intervention, and to also assess its impact

2.6 Key Research Questions

Overarching Research Question

Will an ecological approach to increasing physical activity in primary school children be effective?

Key Research Question 1

What are the relationships between the social, economic, physical and political elements of the school environment and physical activity?

Key Research Question 2

What are the views, perceptions and experiences of physical activity and the school environment amongst a sample of primary school children?

Key Research Question 3

Will an ecological physical activity intervention developed using a range of quantitative and qualitative methods be effective in increasing the physical activity levels in primary school children in the immediate and longer (six-months) term?

Key Research Question 4

How has the intervention changed the relationships between pupil perceptions, the school environment, and physical activity?

CHAPTER 3

Methodology

This Chapter provides an overview of the methodological approach. See Chapter 1.5 for a timeline of events.

3.1 Mixed-methods

A mixed-methods approach was chosen as the most appropriate way to both develop and measure the pilot physical activity intervention. The mixing of methods or data, or 'triangulation' (Olsen, 2004), provides the ability to assess various viewpoints, establish consistency of results, further develop methods, and provide new insight and depth to findings (Greene & Caracelli, 1997). The term 'mixed-methods' has been criticised by researchers who have argued that the terms 'mixed methodologies' or 'mixed models' may provide more appropriate descriptions of the integration of various methods (Tashakkori & Teddlie, 1998; Caracelli & Greene, 1997).

Historically, mid-20th Century social and behavioural science was dominated by positivism, whereby researchers believed that only directly observable and measurable factors could be studied (Bazeley, 2004). Guba and Lincoln (1994) described how this approach was promoted in an effort to form respectability amongst scientists. In later years, the positivist paradigm was challenged when the importance of constructed social realities and subjective experience had researchers (for example Denzin, 1970, 1979, 1989; Kuhn, 1963; Lincoln & Guba,1985) assert strong associations between paradigms, methodologies and chosen methods (Bazeley, 2004, Olsen, 2004). Post-positivist approaches, the most common form being critical realism, acknowledge and accept that all research has some degree of error, and that theory can be revised. It is thought that most positivists are constructivists, believing that individual's perceptions shape our understandings of reality (Bazeley, 2004).

Subjectivist and objectivist research approaches are distinct paradigms. Subjectivists believe reality is internal, that it is borne out of individualistic views. Conversely, objectivists believe reality is biased, and so approach research by choosing methods to overcome this bias (Bazeley, 2004). Importantly, post-positivist research urges the use of multiple subjectivist and objectivist methods, each with various types of error, and use of triangulation to form our understandings of reality (Denzin, 1970). However, different paradigmatic approaches to research have led some researchers to argue that triangulation is not possible (Bazeley, 2004), and this issue has not been resolved. However, Bazeley (2004) describes how undertaking research pragmatically is more important than the philosophical variations and the purity of the beliefs. The key to triangulation is deciding how the methodologies and methods can be linked within study design (Bazeley, 2004). Further rationale for the triangulation of methods is provided by Stokols (1992) who proposed that the Social Ecology Framework should integrate diverse methodologies and methods of analysis.

In order to truly embrace a ‘mixed-methods’ approach, the relationship between the quantitative and qualitative research must be more than to merely confirm or contradict the findings (Yin, 2006). To ensure mixed-methods research is as robust as possible, it is important that complementary research processes are employed, with the quantitative and qualitative methods examining the relationships between the variables in harmony with one another, each addressing some aspect of the process and outcome questions (Yin, 2006).

A complete and detailed account of methods is provided within the audit tool chapters (Chapter’s 4.1.3 and 8.1.2), the focus group chapters (Chapter’s 5.1.2 and 8.2.1), and the measurement of physical activity chapters (sections 7.1.1, 7.2.1 and 7.3.1). An overview of study design and methods is given here.

3.2 Study Design and Sample Selection

A pragmatic cluster controlled trial design was used. The determination of sample size and selection formed part of a wider study to increase physical activity in an urban community (see Davey, Cochrane, Gidlow, Fairburn, & Smith, 2008, for a detailed description of the wider study). Briefly, the 160 lower layer Super Output Areas (SOAs) which form Stoke-on-Trent were considered in terms of deprivation, churn rate of population, and redevelopment. Eligible for inclusion in the study were 79 SOAs. These SOAs fell within the bottom 40% most deprived (as measured by IMD score, 2004), had a churn rate below 20%, and were not undergoing any housing market renewal. The 79 SOAs were clustered into non-adjacent areas and matched according to IMD scores (2004) and population characteristics (Davey, et al., 2008), 10 SOAs (five Intervention; five Control) were then selected from this sample.

Subsequent to this, eight primary schools were selected which were as close to or within each of the SOAs and invited to participate in the study. These schools were allocated into intervention and control groups in accordance with the allocation of the relevant SOA. Control and intervention schools are outlined below, along with the school code names. One of the schools (Gladstone) had separate Infant and Junior school sites, approximately one mile apart, so a total of nine school sites were visited.

Intervention Schools		**Control Schools**	
Gladstone Infants Gladstone Juniors	**GL**	Clarice Cliff	**CC**
Heron Cross	**HC**	Holden Lane	**HL**
Sandford Hill	**SH**	Priory	**PR**
The Willows	**TW**	Sneyd Green	**SG**

Figure 2 is a deprivation map of Stoke-on-Trent showing the location of all schools in the city. The locations of those involved in the current study are highlighted in blue on the map.

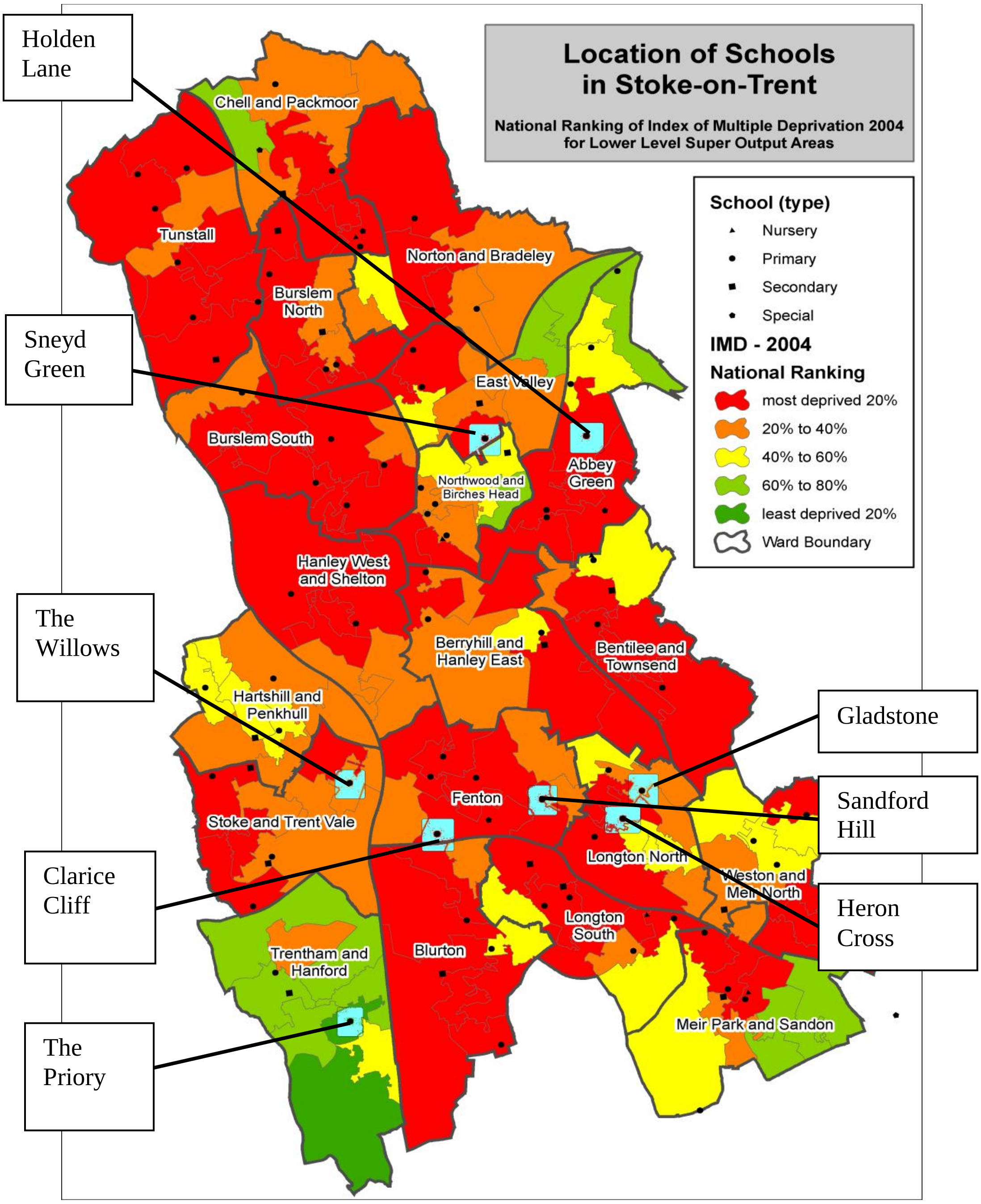

Figure 2: Deprivation Map of Stoke-on-Trent Showing Locations of Participating Schools

Sample selection was facilitated by the North and South Stoke-on-Trent School Sports Partnership, and a large focus was placed upon minimising the burden placed on participating schools. Like many school-based intervention studies, the normal approach to sampling involved randomisation to the different treatment arms at school level rather than pupil level (Harris, Kuramoto, Schulzer, & Retallack, 2009; Stephenson, et al., 2008; van Sluijs, et al., 2007). The intervention effect is therefore measured on account of the variance between schools. Pupils within schools cannot be regarded as independent, which means there is a reduction in the power of the test of the treatment effect. Calculating intra-class correlations determines the number of schools required per treatment arm to detect the effect of the intervention.

To determine the exact estimated variance, and the power of the test of the treatment effect at a given level, an accurate sample size calculation is required. One fundamental aspect of estimating sample size is to consider the interdependence of the pupils within the schools, by obtaining exact estimates of intra-class correlations. The intra-class correlation coefficient is a measure of the homogeneity within a group, such as that within a school or a school class. The intra-class correlation co-efficient explains the ratio of the variance due to schools or school classes, to the total variance for all of the individual pupils.

For this study, a representative sample of schools was selected. The primary schools were located within or proximal to one of the 10 study areas selected for the wider study. The sample size for the school-based physical activity intervention was determined using the method suggested by Raudenbush (1997), where an effect size of 0.35 was assumed, with a school (within-cluster) population of 35, intra-class correlation of 0.027 was estimated from a pilot study using 10 schools, with a type I error rate of 0.05, and a power of 0.8, which yielded a requirement for a minimum of 8 primary school clusters (four intervention and four control). University Ethical Approval was granted at the start of the project. All researchers involved in the data collection had Enhanced Criminal Records Bureau clearance.

Ethical Considerations

Ethical approval was granted by Staffordshire University Ethics Committee at the outset of the research and all researchers involved in the intervention and data collection had Enhanced Criminal Records Bureau clearance. A range of ethical considerations are required when measuring physical activity; Stratton (2006) outlined the key principles which were all adhered to in the present study. Firstly, voluntary and informed consent must be obtained from research participants aged 16 years and above. Participants under the age of 16, along with vulnerable adults, require assent from both participant and the parent/carer. Participants must be provided with a Participant Information Sheet. For the current research, the information sheet outlined the purpose of the research, methods to be used, the nature of participants' involvement, the time required, their right to withdraw from the research at any time, and the contact details of researchers in case further information was required (see Appendix 1). A parental consent form was provided to ensure that parents/carers were fully informed of the purpose of the study, the information that would be collected, the nature of involvement for their child, and what the information would be used for (see Appendix 2).

Measurements of height and weight followed recommendations provided in the Operational Guidance of the National Child Measurement Programme (DCSF and DoH, 2007). Children were measured in an available room (such as a school nurses office) or a screened-off area in a large room (such as the school hall, library or a classroom) where the results could not be seen or heard by anyone not involved in taking the measurements to ensure confidentiality and to put children at ease. A Leicester Portable Height Measuring Unit was assembled on a firm and level surface against a wall, and weight was measured using calibrated digital weighing scales. The scales display window was concealed from the participant and others using a piece of cardboard held in place over the window. The researcher was able to raise the edge of the card to take the reading, whilst ensuring the display remained concealed to others. Measurements were recorded on a data collection sheet which coded pupil information by UPN (see Appendix 3). No information was provided to the pupils, teachers or others regarding the weight and height of the participants to ensure confidentiality and anonymity of data.

3.3 Environmental Audit of the School Environment: Undertaken at Baseline and Post-intervention

Following collection of baseline physical activity levels, audits of the school environments were undertaken in each primary schools involved in the study. This explored the relationship between the micro-environment and physical activity, and was used to inform the pilot physical activity intervention. The components of the environmental audit tool were chosen to reflect the key domains of the Healthy Schools standards relating to the prevention of obesity (DoH, 2007) (see Appendix 4): physical activity, health eating, emotional health and wellbeing, and personal and social health education (see Chapter 4.1.3 for a detailed explanation of audit tool methods).

3.4 Focus Group: Undertaken at Baseline and Post-intervention

Focus groups were undertaken with school children, school staff and parents/guardians of pupils from the schools selected to receive the intervention. Focus groups generated information regarding attitudes, behaviours, knowledge and experiences of perceived environmental determinants of physical activity, wellbeing and health promotion within their school (see Chapter 5.1.2) for a detailed explanation of focus group methods).

3.5 Physical Activity Levels: Measured at Baseline, Post-intervention and Six-Months Post-intervention

Physical activity was measured over a seven day period using minute-by-minute accelerometry. Current recommendations suggest that children and young people aged five to 18 years should accumulate 60 minutes of moderate to vigorous physical activity per day, however, discrepancies in the classification analyses led to the main physical activity outcome measure to be accelerometer counts per minute (see Chapter 2.1.2 for a detailed explanation of accelerometry measurement and Chapter 7.1.1 for a detailed explanation of methods).

CHAPTER 4

Key Research Question 1

What are the relationships between the social, economic, physical and political elements of the school environment and physical activity?

4.1 Assessing the Influence of the School Environment: Audit Tool

4.1.1 Rationale

The environment has been identified as an important determinant of physical activity, and evidence suggests that modifying the school environment to support and increase physical activity levels may be effective (see Chapter 2.3). The purpose of the audit tool was to explore the relationship between children and their school environment, to identify how the various aspects of the school environment potentially influence physical activity behaviours and choices. Subsequent focus groups were also used to provide further insight for the intervention development (see Chapter 5), supplementing audit data.

4.1.2 Tool Development

The development of the environmental audit tool and pilot physical activity intervention applied the theories behind the Social Ecology Model (Stokols, 1992, 1996, 2000) and ANGELO Framework (Swinburn, et al., 1999) (See Chapter 2.3). The environmental layers described by Stokols (1992, 1996, 2000) and Swinburn, et al. (1999) were adapted for the purposes of the present research (see Table 2). The central focus of the audit tool was the micro-environment of the school, as this level can be modified into a sustainable and supportive environment to influence behaviour change (Swinburn, et al., 1999). Characteristics of the school environment for inclusion in the audit tool were considered at each of the environmental levels (Table 2). To enable further in-depth understanding of the school environment, the components of the environmental audit tool were further disaggregated into the key domains of the Healthy Schools standards that related to the prevention of obesity (DoH, 2007) (see Chapter 1.3 and Appendix 4 for further detail). School characteristics, Healthy School status and local, regional and national activities (such as Primary Playground Leaders, Walking Bus and Multi-skills FUNdamentals) were also recorded in the audit. A draft of the audit tool was discussed with Sports Partnership Development Managers to ensure all issues considered were appropriate, and to provide opportunity for comment; no changes were made following discussion (see Appendix 5 for a copy of the audit tool). The main components of the audit tool (Table 2) were assessed in terms of quality and/or quantity.

Table: 2 Main Components of Environmental Audit Tool Derived for this Study

	Micro-environment *School Environment (Central Focus of this Audit)*	***Macro-environment*** *Local, Regional, National*
Physical	-Size, age of school -Number of pupils on role -Characteristics of pupils on role (including ethnicity, percentage free school meals) -Functionality and provision of play space and resources to support active play	-Town, city, county country where school is located (including deprivation score, levels of ethnicity) -Community links -National school curriculum
Economic	-School budget/grants supply and demand -School Governors	-Local Education Authority -Local/regional levels of deprivation
Policy	-School policies (e.g. health eating and schools nutrition programmes, physical activity policies, school travel plan, after school activities	-National Healthy Schools Programme -County Sports Partnership
Socio-Cultural	-Attitudes of school staff and pupils -Whole school ethos -Ethnicity/religion	-Local/regional levels of ethnicity, deprivation

Piloting the Tool

The audit tool was piloted in three primary schools that were not involved in any element of the study, to ensure that the design of the audit tool was appropriate for gathering all required data, and to confirm that the scoring approach was appropriate. To ensure that the audit tool provided consistent scores, the test-retest reliability for all the items was estimated. Three schools were independently audited by three different observers. As scoring for all items of the audit tool were Likert-scaled (on a scale of one to five), intraclass correlation coefficients (Cronbach's alpha) were calculated to determine the strength of the correlations between the independent audit scores. All of the scores demonstrated a reliability co-efficient of > .70, therefore internal consistency was deemed to be high. No changes were made to the elements of the audit tool, the method of collecting the data, or the analysis as a result of the pilot.

4.1.3 Method

Each of the eight primary schools involved in the research were audited at baseline and were visited once for the purpose of the audit. Completing the audit involved the researcher observing physical characteristics of the school environment, for example functionality and provision of play space. Some aspects of the audit tool, such as political factors, required consultation with school staff, mainly the main link member of staff (such as the Primary Link Teacher, or the Deputy Head). Each audit took approximately one hour, depending on the availability of staff to provide information that was not readily accessible. The audit was implemented after the baseline physical activity measures had been taken, which was a deliberate approach, as the researcher was familiar with the school environment and school staff. As a result, obtaining permissions and arranging a convenient time for the audit to be undertaken was not difficult.

The various domains of the audit tool (Appendix 5) were rated on a scale of one to five, providing a score for each category, and an overall score for each school. These findings were normalised by expressing them as a percentage of the possible overall score for each section (Physical Activity, Healthy Eating, Emotional Health and Wellbeing, and Personal and Social Health Education). Following this, the physical activity section was examined in further detail. Elements relating to physical activity could be clearly categorised into physical education (PE) and school policy, school facilities, PE and school sport activities and curriculum, and quality of PE and school sport.

Spearman's Rank Correlation was used to identify significant correlations between the various aspects of the school environment and baseline physical activity counts per minute (referred to as CPM for the remainder of this Chapter) (detailed presentation of baseline physical activity data are presented in Chapter 7.1). This analysis was used to determine which aspects of the school environment were correlated with higher physical activity. This information could then be used to develop a pilot physical activity intervention which was tailored specifically to the needs of each school (see Appendix 6 for raw data).

4.1.4 Results

Pupils in all participating schools had access to Infant and Junior playgrounds and 'soft' playing areas such as a playing field (seven schools) or a 'red ash' pitch. The audit tool indicated that the majority of the schools had Playground Leaders or an alternative, such as a Smile Squad. Schools had access to physical activity resources such as TOP Activity, but many did not have sufficient resources for the whole school (e.g., one activity pack per school). The normalised audit scores (expressed as a percentage) for each section of the school environmental audit (Physical Activity; Healthy Eating; Emotional Health and Wellbeing; and Personal and Social Health Education) in addition to the overall normalised audit score, are shown in Table 3. CPM across the relevant sampling periods, along with average BMI for each school, is also presented.

Table 3: Audit Scores for Each Individual Category (with Physical Activity (PA) and BMI)

School	Audit Scores					Mean PA				Average BMI
	Total Score	PA	Healthy Eating	Emotional Health and Wellbeing	PSHE	Week Day CPM	School Day CPM	School-Related CPM	Out of School CPM	
CC	71.6	70.6	55	80	94.2	607.31	702.7	679.93	497.45	16.2
GL	71.6	70.6	55	80	94.2	597.27	618.46	634.29	570.15	17.13
HC	78.3	74.5	87.5	90	94.3	564.57	614.98	618.15	500.94	17.59
HL	71.1	67.4	72.5	85	94.3	508.87	531.95	544.61	504.07	16.89
PR	82.2	77.4	95	100	97.1	594.58	623.37	622.34	528.83	17.09
SG	85.4	82.9	85	100	100	632.84	535.42	581.07	671.22	17.41
SH	92.3	91.6	90	95	100	564.28	574.95	572.58	557.77	17.18
TW	74.5	69	90	90	97.1	557.04	580.1	581.07	526.13	17.94

Mean audit scores were significantly higher for the intervention schools than the control schools (79.2 versus 77.6), $t(220) = -4.850$, $p < .000$, CI_{95} -6.634, 2.800).

Spearman's Rank Correlation using the whole sample data revealed that there were no significant correlations between any of the audit tool sections (Total score; Physical Activity; Healthy Eating; PSHE) and physical activity levels across any of the sampling periods (Week Day CPM, School Day CPM, School-Related CPM, Out of School CPM). There were also no significant correlations found between any of the audit tool sections and BMI (using whole sample data).

The audit scores were subsequently explored for the intervention and control schools separately. There were no significant correlations between BMI and audit tool sections in the intervention or the control samples. There were no significant correlations between CPM at any of the sampling time points and any aspects of the individual audit tool sections.

To gather further information about the school environment, the physical activity section of the audit tool was broken down into those questions relating to PE and school sport policies, facilities, activity and curriculum, and quality of PE and school sport. Normalised results, expressed as a percentage of the overall possible score for the section, are shown in Table 4.

Table 4: Audit Scores for Physical Activity Categories (with Physical Activity (PA) and BMI

School	Audit Scores					Mean PA				Average BMI
	PA	Policy	Facilities	Activities	Quality	Week Day CPM	School Day CPM	School-Related CPM	Out of School CPM	
CC	70.6	70	81.5	53.8	64	607.31	702.7	679.93	497.45	16.2
GL	74	70.8	79.3	74.6	63	597.27	618.46	634.29	570.15	17.13
HC	74.5	56.6	88.9	55.4	82	564.57	614.98	618.15	500.94	17.59
HL	67.4	66.6	74.4	55.4	66	508.87	531.95	544.61	504.07	16.89
PR	77.4	90	72.6	85	68	594.58	623.37	622.34	528.83	17.09
SG	82.9	88.3	87.4	73.8	76	632.84	535.42	581.07	671.22	17.41
SH	91.6	91.6	94.8	90.8	84	564.28	574.95	572.58	557.77	17.18
TW	69	75	66.7	75.4	60	557.04	580.1	581.07	526.13	17.94

Data were checked for normal distribution and statistical analysis of the physical activity audit data using the whole sample data revealed a significant positive correlation between Week Day Physical Activity and Policy (Spearman's Correlation = .161, p = 0.017) and Out of School Physical Activity and Policy (Spearman's Correlation = .152, p = 0.024). The higher the policy score, the higher the level of week day physical activity, and out of school physical activity.

Again, audit scores were subsequently explored for intervention and control schools separately. Analysis of the intervention sample showed no significant correlations to link any aspect of the physical activity audit tool sections with either BMI or CPM at any of the sampling time points. However, control sample analysis showed significant correlation between BMI and the facilities aspect of the audit tool (Spearman's Correlation = .217, p = .027).

Whole day physical activity (in CPM) was significantly correlated with the policy aspect of the physical activity section of the audit tool (Spearman's Correlation = .274, p = .005). In school physical activity (in CPM) was significantly correlated with the facilities aspect of the physical activity section of the audit tool (Spearman's Correlation = .304, p = .002). There were no significant correlations between school-related CPM and any aspects of the physical activity section of the audit tool. Finally, there was a significant correlation between out of school physical activity and the facilities aspect of the physical activity section of the audit tool. (Spearman's Correlation = .236, p = .016).

Intervention schools had slightly higher baseline audit scores than control schools, despite no significant differences in baseline physical activity between the intervention and the control schools. However, the results showed that schools which scored highly on the facilities and policy elements on the audit (regardless of scoring on any other elements) were more likely to have higher physical activity levels. Independent t-tests revealed some significant differences between some aspects of the audit tool in the intervention and control school samples. Intervention and control audit scores are displayed in Table 5.

Table 5: Comparison of Audit Scores for Control and Intervention Schools

Audit Scores	Group	Mean	± SD
Total Audit Score	Control	77.46	6.55
	Intervention	82.18	7.78**
Physical Activity	Control	74.80	6.86
	Intervention	80.01	8.46**
Policy	Control	87.20	10.99
	Intervention	84.85	8.01
Activities	Control	76.76	15.36
	Intervention	83.34	10.95**
Quality	Control	82.50	11.89
	Intervention	84.83	11.78
Facilities	Control	72.07	4.68
	Intervention	79.04	10.43**
Healthy Eating	Control	78.99	15.74
	Intervention	80.23	12.55
Emotional Health and	Control	89.33	7.63
Wellbeing	Intervention	93.64	4.06**
PSHE	Control	95.73	1.43
	Intervention	97.53	2.84**

** Denotes significant at $p < .001$ Level

4.1.5 Discussion

The audit revealed that all schools had access to physical activity resources but did not have sufficient resources for distribution across the whole school. Auditing the availability of equipment such as activity packs is a quick and easy way to determine school provision. Some schools had more or less activity packs than school staff initially thought, for example some class teachers did not have access to things such as Top Activity Packs, and thought this was because there were none in the school, whereas class teachers from the same school had a copy of the pack in their desk drawer. The audit allowed the identification of such issues that could remedied easily. In the intervention schools, such activity packs could be either redistributed throughout the school to enable more effective use, or additional copies were provided in schools where few were available. Providing a greater number of resources could be easily addressed, with the potential to increase pupil participation in physical activities.

Although there were no correlations between any of the whole sample or intervention schools and the elements of the audit tool, learning from the audit tool scores could be applied in the development of the intervention. The environmental audit demonstrated that the quality of school policies and facilities were important correlates of physical activity (in the control sample). This provided an understanding of which environmental elements should be changed to create a health-promoting environment.

Children participated in more physical activity over the whole school day if they attended a school with high scores for the physical activity policies. Previous research has demonstrated that focusing policies towards initiatives that support and promote physical activity can be successful (Lee, Burgeson, Fulton, & Spain, 2007). Further, Haug, Torsheim and Samdal (2010) purported that local school policies, specific to the micro-environment, would have a positive impact on physical activity levels.

Additionally, children participated in more physical activity both in school and out of school if they attended a school which received high scores for the facilities element of the audit. The availability and provision of physical activity facilities has been found to be a strong predictor of physical activity in previous studies (Scott, Evenson, Cohen, & Cox, 2007; van der Horst, et al., 2007).

There were no overall differences identified between baseline physical activity levels in intervention and control schools, despite higher average environmental audit scores in the intervention schools. However, baseline findings showed that the environmental audit tool was able to identify specific individual school differences in the physical activity environment (relating to facilities and policy) which reflected differences in physical activity levels.

Although there were no significant correlations between the quality and the activities elements of the physical activity section of the audit tool, it was still important to address any low scoring elements, and improve these scores through the pilot intervention. The environmental audit findings provided important insight for development of the pilot physical activity intervention. Fundamentally, focusing on improving the quality and provision of school facilities, and the quality of PE and school sport emerged as an important means of influencing levels of physical activity.

CHAPTER 5

Key Research Question 2

What are the views, perceptions and experiences of physical activity and the school environment amongst a sample of primary school children?

5.1 Assessing the Influence of the School Environment: Focus groups

5.1.1 Rationale

Qualitative interviewing was undertaken to add depth to the process and outcome questions, supplementing quantitative data from the audit. This approach was deemed necessary to offer insight into the subjective worlds of children, enabling the generation of in-depth information into how the school environment can impact on children's physical activity and health behaviour choices.

The quantitative aspects of this research alone could not enable an effective assessment of the efficacy of intervention process and outcome. A mixed-methods design allowed for the triangulation of findings to establish the consistency of the results, clarify the findings from one method to another, further develop methods, and provide new insights and depth to the findings (Greene & Caracelli, 1997) (see Chapter 3 for methodology details).

The views of the children were fundamental to the success of this intervention. The discourse of children has often been underrepresented in research, with many studies researching 'on' children, as opposed to researching 'with' children. It has been acknowledged that children's views are indeed a central aspect of our understandings, and encourage that children's views must be central to research (France, 2004).

In the delivery of physical activity and health care interventions it is important to understand children's wants and needs and in this regard the qualitative methodologies in this research were fundamental. This qualitative element was undertaken in the four intervention schools, as sampling for Grounded Theory required the selection of participants who had specific experience of the area under study (Glaser, 1978; Strauss & Corbin, 1990). It has been suggested that involving the intervention population in the development of the intervention itself may increase the likelihood of success (Halpern, Bates, Beales, & Heathfield, 2004), therefore, qualitatively investigating the role children feel they played, and the level of control they had in the management of their school environment, would potentially help to successfully promote behaviour change.

Children's perception of control over their environment can be important in determining their health behaviour choices (Plotnik, 1996). Empowering children in changing the shape of their environment can lead children to make positive decisions through their choice, and not one which has been imposed onto them. Individuals who feel control over their environment have been found to have higher levels of self-efficacy and self-esteem (Anderson, Hattie, & Hamilton, 2005). Asking children whether they felt they had any control over situations happening within their school environment helped understandings of how to actively involve children in the changes made during the intervention. Ultimately, it was hoped that encouraging the children to have an involvement in the decision making process regarding changes to their school environment would help them feel confident about making positive health behaviour changes.

Various approaches to qualitative analysis have been developed, taking different perspectives. Phenomenology, Grounded Theory, and narrative approaches are methods which enable discourse to take a central focus, and through which interpretations and meanings can be developed (France, Bendelow, & Williams, 2000). To determine the personal experiences of these people, and identify any imposed barriers that are perceived to influence children's physical activity behaviours and choices, an interpretive Grounded Theory method was adopted for the purpose of this qualitative investigation.

Grounded Theory

Grounded Theory is a methodology which aims to develop theory (Mills, Bonner, & Francis, 2006) using an interpretive research methodology (Charmaz, 2000). The nature of Grounded Theory research allows the development of theory, based on the views and experiences of participants. This method provides a structured approach to collecting and analysing data, and was deemed most appropriate for developing and formulating theories from within the data. Narrative and phenomenological approaches aim to develop in-depth and detailed understandings of the entity under study, whereas Grounded Theory generates theory. It was the generation of theory that was sought in the present research.

Symbolic Interaction provided the foundations on which Grounded Theory was developed. Blumer (1937) invented the term Symbolic Interaction to describe a process of self-awareness and shaping of behaviour according to particular situations. Symbolic Interaction assumes that people are in control of their actions and addresses how people create and change meanings constructed through self and social reality (Charmaz, 2000). However, Symbolic Interactionism has been criticised for ignoring social processes and structures at the macro level (Dennis & Martin, 2005). The current research explored the subjective experiences of children and the way their experiences are constructed through interaction with their environment. Care was taken not to discount any larger social forces acting at macro level that were identified by the participants.

Grounded Theory methodology was developed by Glaser and Strauss (1967) with the aim of developing a theory grounded in the data, with no predicted preconceived ideas of how the theory should transpire. Grounded Theory was borne out of a synthesis of the positivist background of Glaser, together with the Symbolic Interactionist perspectives of Strauss (Neal, 2009). At the time of its development, Grounded Theory gave credibility to the analysis of qualitative data at a time when research was dominated by positivist and quantitative approaches (Neal, 2009).

Grounded Theory is developed from data encompassed in a core category with related categories and concepts. McCann and Clark (2003) described how the Grounded Theory research process develops from an inductive to deductive approach, where the researcher initially takes an empathic approach to data collection, aiming to explore meanings, feelings, experiences and perceptions fully, which then changes to an outsider's perspective to provide explanations and interpret meanings for behaviour choices. Glaser and Strauss (1967) recognised the development of two different types of theories through the Grounded Theory process; formal theory, generalised from a broad topic area; and substantive theory, relating to the explanation of social meanings limited to a specific topic area.

Different approaches to Grounded Theory have been taken by researchers to reflect varying epistemological frameworks. The Grounded Theory method proposed by Glaser and Strauss (1967) is very much positive in nature, and framed by a 'critical realist ontology' (McCann & Clark, 2003), however, the Grounded Theory approach has developed considerably since conception. Many researchers have reported the different directions that Grounded Theory has since followed (Neal, 2009). Where Glaser (1978) assumed an objective external reality, Strauss and Corbin (1990) moved towards a post-positivist paradigm (Heath & Cowley, 2004). Strauss' Symbolic Interactionist beliefs shaped the Grounded Theory approach evolved by Strauss and Corbin (1990), maintaining that theory is constructed through reflection of the lived world (Neal, 2009).

Symbolic Interactionism maintains that "people can and do think about their actions rather than respond mechanically to stimuli" (Charmaz, 2006, p.7). Conversely, Glaser's objective frameworks remain embedded in positivism, believing that the role of research is to uncover the existing reality, and that these findings represent the true reality (Neal, 2009).

Central to Strauss and Corbin's (1990) approach to Grounded Theory is the tenet that the perspectives and thoughts of the lived world of participants are key to the development of theory. The qualitative element of the current research embedded a post-positivist approach to gain knowledge rather than test knowledge, and embraced the belief that theory is constructed through the interpretations of the researcher. It was therefore clear that the Strauss and Corbin (1990) approach to Grounded Theory would be most appropriate.

Further rationale for adopting the Strauss and Corbin (1990) approach to Grounded Theory stemmed from the opposing beliefs of how existing literature should be dealt with. Traditional Grounded Theory does not advocate examining existing literature, as this is thought to potentially taint or hinder the ability of the researcher when coding the data (Glaser, 1992). Conversely, Strauss and Corbin (1990, 1998) actively encourage considering literature from the start of the research process, suggesting that this assists in stimulating and supporting the researcher to construct theory. It was not possible for the researcher of this current study to separate themselves from their existing knowledge of the literature, and the researcher therefore embraced these particular elements of Grounded Theory research outlined by Strauss and Corbin (1990, 1998).

The interactive nature of data collection and analysis is fundamental to all types of Grounded Theory. It is important to acknowledge that approaches to Grounded Theory can be modified from the positivist perspectives to reflect a more flexible approach (Charmaz. 2002, 2006). Charmaz (2002) developed a constructivist approach to Grounded Theory, founded upon subjectivist epistemology and relativist ontology. Constructivist Grounded Theory postulates that all knowledge is constructed rather than discovered, and aims to provide an ‘interpretation’ of the world rather than accurate description of it (Charmaz, 2002). Crucially, this approach sees the role of the researcher change from that of an ‘expert’, into that of a ‘researcher’, where essentially the researcher is an outsider with the aim of learning about the topic under study.

There were elements of the constructivist approach to Grounded Theory that related to the purposes of the current research, such as the concept of the researcher immersing themselves into the world of the participants, and discovering reality through the reconstruction of experiences. However, it was felt that the constructivist approach of understanding subjective representations and experiences without accepting any objective assumptions was not appropriate to the current research.

It was anticipated that using Strauss and Corbin's (1990) Grounded Theory approach in this research would further develop understandings of children's physical activity and health behaviour choices.

5.1.2 Method

Qualitative semi-structured and unstructured interviews are the primary data collection method for Grounded Theory research (Charmaz, 2002). Focus groups were used as this study aimed to create a shift from targeting individual's specific behaviours to recognising and positively influencing the actions and behaviour choices of groups. A fundamental aspect of focus groups is to keep discussions informal and conversational to create an environment in which participants can open up and discuss, in-depth, the issues and experiences which are important to them (Vaughn, Shay Schum, & Sinagub, 1996). Grounded Theory interviewing differs from other in-depth interviewing because the research proceeds through a range of topics to gather specific data for the emerging theory (Charmaz, 2006). Strauss and Corbin's (1990) approach to interviewing and facilitation of focus groups recognises that knowledge is produced through the reflections of the lived world, and constructed through the interpretations of the researcher. Initially, focus groups begin as relatively unstructured, led by a list of topics to be discussed during the interview to enable the participants to determine the course of the focus group and to discuss their experiences and actions. As the data collection progresses, the researcher asks more specific questions balancing the structure of the interview with flexibility for the participants to discuss their own experiences of the topic area. To ensure that the experiences of the participants shape the development of theory it is vital to consider the nature of the questions and avoid forcing responses from participants (Strauss and Corbin, 1990).

Participants

Thirty pupils participated in seven focus groups. The groups were comprised of between four and six members and of mixed gender, to ensure there was a representative sample, as recommended by Zeller (1993). It was necessary that the data collection for the quantitative assessment of children's physical activity patterns was randomised, however, as the purpose of the focus groups was to gather further in-depth information about the school environment, random selection was not necessary. To ensure that the child focus groups were constructive, the class teacher pre-selected some children who were able to communicate and express their views in a competent manner as recommended by Vaughn, et al. (1996). Participant details for each focus group are outlined below.

Focus group 1: 4 girls, 1 boy (aged 10 / 11);
Focus group 2: 2 boys, 2 girls (aged 10 / 11);
Focus group 3: 4 girls, 2 boys (aged 6 / 7);
Focus group 4: 2 boys, 3 girls (9 / 10);
Focus group 5: 2 boys, 3 girls (aged 6 / 7);
Focus group 6: 3 girls, 2 boys (aged 10 / 11);
Focus group 7: 3 boys, 2 girls (aged 6 / 7).

Materials

Six topic areas were covered in the focus group discussions, based on work by Patton (2002). They included questions regarding feelings towards health promotion within the school; influences on health behaviour change; attitudes towards school playgrounds, play spaces and facilities; attitudes towards physical education; attitudes of school staff towards health and health promotion; food provided by the school; and methods of travel to and from school. The structure of the discussion aimed to encourage participants to introduce issues about their own concerns and experiences (Morgan, 1996; Vaughn, et al.,1996).

It was important that the information obtained from the focus groups was used to investigate the children's motivations for health behaviours, and their beliefs about health and physical activity. Examining how and why the children explained their behaviours helped gain an understanding of how best to promote behaviour change. The focus groups helped to comprehensively examine children's reasoning behind their health-related behaviours, but it was important to recognise that they may not be aware of certain motivators to behaviour, or be able to appropriately articulate their understanding of their behaviours (Falikowski, 2002). The focus group conversations with the children of a younger age (six to seven years) were not as sophisticated as with older children (ten to 11 years) but it was important to include them as their views were equally important. The focus group questions were based around the following topics based upon the Healthy Schools framework (2007) that had been used to inform the audit tool (see Appendix 5):

- Do you think your school promotes a healthy lifestyle?
- What do you think of your school playgrounds, play spaces and facilities?
- Do you enjoy your PE lessons?
- Do the staff at your school encourage you to be healthy?
- Do you like the food provided by the school?
- How do you travel to and from school?

Prompts were included to keep the answers focused if required (see Appendix 7), as recommended by Patton, (2002). Glaser (1998) advised caution when choosing to use pre-designed interview topics, and warned that this may introduce leading ideas into the discussion. However researchers have since recognised the importance of having a loose agenda on which to structure the discussion (Charmaz, 2002; Patton, 2002).

Procedures

Focus groups were undertaken with school children from the four schools selected to receive the intervention. The researcher had prior experience of conducting focus groups with school children in a school setting, and undertook all of the focus groups herself. The researcher was female, in their late twenties, and wore casual clothes to each interview to encourage participants to feel relaxed.

Each focus group session was audio-taped and lasted approximately 20-45 minutes (Patton, 2002). Each interview began with a detailed explanation of reasons for the focus group, along with the procedures and rules. The importance of honest answers and the confidentiality and anonymity of the focus groups were also emphasised, and participants were given the chance to opt out if they wished.

A pilot study was undertaken in two primary schools that were not participating in the main study. Two focus groups interviews were piloted in each of these schools, one group with children from the younger primary school years, and a second with children from the older primary school years. These were audio-taped and transcribed verbatim, and data used to confirm that procedures and questions were appropriate and useful, and that proposed methods of analysis were sufficient.

Informed written consent was sought from each primary school Head Teacher, from parents and pupil assent was sought from participants of the focus group discussions. Consent forms were sent to parents once the participants had been chosen (see Appendices 8, 9 and 10 for copies of these information and consent forms).

5.1.3 Rationale for Analysis

It has been established that Grounded Theory does not need to be prescriptive, however the methodology did require the researcher to follow a structured approach to the analysis (Strauss & Corbin, 1990). Regardless of whether the Strauss and Corbin (1990, 1998) or Glaser (1978, 1992) approach is followed, there are characteristics which are common to all Grounded Theory research: sensitivity, sampling, comparative analysis, coding and categorising, using literature as a data source, integration of theory, and theoretical memos, as identified by McCann and Clark, (2003).

Sensitivity refers to the way in which a researcher will already have initial assumptions and ideas about the phenomenon under investigation (Charmaz, 2002; McCann & Clark, 2003). These assumptions and concepts motivate the pursuit of ideas and empirical enquiry and shape the initial development of the research (McCann & Clark, 2003). However, it is important that Grounded Theory is shaped by the data collection, and these assumptions and concepts are used only to develop, but not limit, the theory (Strauss & Corbin, 1990). Initial literature reviews have been thought to result in an impartial understanding of theory, leading to potentially flawed theories (McCann & Clark, 2003). Glaser (1992) postulated that no literature be consulted, however Strauss and Corbin (1990) encouraged the consideration of existing literature to only what is necessary. This approach was adopted in the current study.

Sampling for Grounded Theory research requires selecting participants who have prior experience of the topic area (Glaser, 1978; Strauss & Corbin, 1990). Theoretical sampling for Grounded Theory refers to preliminary data collection and analysis informing the sampling based on the theory emerging from the data (Strauss & Corbin, 1990). Here, emergent categories are identified, and the researcher returns to the data collection to refine their properties until no new categories emerge (Strauss & Corbin, 1990). Theoretical saturation occurs when no new categories emerge and data on which to develop theory is sufficient (Charmaz, 2006; Strauss & Corbin, 1990).

Comparative analysis is a fundamental concept for Grounded Theory, where the collection and analysis of data are done concurrently alongside one another (McCann & Clark, 2003; Strauss & Corbin, 1990). Coding of data is done throughout data collection, and categories and relationships between categories are constantly compared (Strauss & Corbin, 1990).

Coding and categorising of data are central to the development and generation of theory (McCann & Clark, 2003; Strauss & Corbin, 1990). Two levels of coding are initially described by Glaser and Strauss (1967), which precedes Strauss and

Corbin's (1990, 1998) three pronged coding paradigm that allows for reconstruction of a Grounded Theory that is representative of structure and process. This three pronged approach to coding was not advocated by Glaser (1992), who did not agree that it allowed for the development of theory but merely described the data. Despite this, the process developed by Strauss and Corbin (1990, 1998) has been supported by many researchers. It had been suggested that this approach provides a clear process for the coding and categorisation of the data (McCann & Clark, 2003). The three pronged approach developed by Strauss and Corbin has been described as providing opportunity for influences to be identified at both macro and micro-environmental level (McCann & Clark, 2003; Strauss & Corbin, 1990). This was a key element of the current research, and further justified following the approach advocated by Strauss and Corbin (1990).

The coding approach developed by Strauss and Corbin (1990, 1998) involves open, axial and selective coding. Open coding involves identifying concepts as they emerge from the data through the perceptions and the experiences of the participants. Line-by-line coding separates the data into concepts, which are then compared for similarities and differences. Concepts become grouped into categories, each of which represents an issue felt to be important to the participants. Categories are developed through the constant comparison with data.

Axial coding refers to the relating of categories to sub-categories. Axial coding starts to integrate all of the collected data, where categories started to become 'related' to one another, rather than just compared. This element of the methodology is fundamental to the process of the generation of theory, and starts to generate understandings of the situations in which the experiences and perceptions of participants occur. The processes involved relate to the interactions that occur by a person, organisation or social setting in response to a certain issue.

Once the axial coding process has generated categories, sub-categories, and relationships and interactions between them, selective coding is the process of refining the theory, and integrating this in into existing literature. A core category is identified which is deemed representative of the overall focus of the research, and is central and has relationships with all other categories. The whole Grounded Theory coding process was not linear, rather flows through coding at each of the different stages, employing constant comparisons with each level of data, each category, each sub-category and ideas, experiences and perceptions (Strauss & Corbin, 1990). In Grounded Theory methodology, as categories are developed and ideas about theory start to generate, the researcher can review the literature with consideration to emergent themes (Strauss & Corbin, 1990). The researcher has to ensure that only literature related to their categories and emergent theory are reviewed, and be careful not to let unrelated but dominant theories cloud judgement (Strauss & Corbin, 1990). In this sense the literature became a source of data.

The integration of theory involves reviewing the literature once the coding process is complete, and links existing research and theory with the properties and constructs of the emergent theory (McCann & Clark, 2003). The findings then take the form of a theory only once all of the major categories and findings have been integrated as a set of interrelated concepts, and not merely a list of themes (Strauss & Corbin, 1990, 1998).

Finally, theoretical memos are the notations made spontaneously throughout the whole research process, simultaneous to data collection, to reflect the researcher's generation and extraction of theory as it develops (McCann & Clark, 2003; Strauss & Corbin, 1990). This is a crucial aspect of Grounded Theory research, as the analysis and coding of data provides a basis for further research questions for the researcher, and ensures a true theoretical saturation of the data (Charmaz, 2006). This process enables the coding of categories by defining and understanding the concepts of a category as it arises (Charmaz, 2006; Strauss & Corbin, 1990).

5.1.4 Analysis

The focus groups were transcribed immediately after the interviews took place, and coded to maintain the confidentiality and anonymity of the participants and their schools. The data were inductively analysed using a Grounded Theory approach, (Glaser & Strauss, 1967), following the systematic procedures recommended by Strauss and Corbin (1990) (see 'Rationale for Analysis').

The interview transcripts were read and re-read to allow familiarisation with the information (Strauss & Corbin, 1990). Following the recommendations by Strauss and Corbin (1990), the information from focus group data were coded systematically by the interviewer into categories and sub-categories. The initial categorisation process involved line-by-line coding of each question, which enabled the identification of key concepts, which were then compared for similarities and differences. The interview transcriptions were read by an independent researcher within the field of Health Psychology. Initial categories and sub-categories identified here were discussed, verified and confirmed. As the focus groups continued they were constantly compared to identify where new, emerging and repeated categories and sub-categories could fit. The focus groups were undertaken until the point when the data began to saturate and new categories and themes ceased to emerge (Kreuger & Casey, 2000).

All of the key concepts identified were eventually grouped together into a particular theme that was important to the participants, before analysis of the categories began. The analytic process involved trying to create an understanding of the circumstances in which health behaviours and choices were made. This involved relating the interactions that occurred between the participants and the school environment, in response to their physical activity and health-related behaviours. This coding paradigm considered why the participants' physical activity behaviours responded to various environmental factors in different ways, the interactions that occurred between participants and their school environment, and the consequences of these interactions. It was clear that each category could be defined as either a barrier of facilitator to physical activity, and that the categories could be attributed to four different elements of the environment. These elements were clearly related to the social, the decision making, the economic, and the physical aspects of the environment (see Appendix 11 for an example of the coding process).

Reviews of the literature found that the emerging categories and themes from this research were comparable to findings in research which had explored the impact of the environment on behaviour. Theories were found that considered different elements of the environment, and purported that exploration of each element enables understanding of its influences on behaviours, predominantly the Social Ecology Theory (Stokols, 1992, 1996, 2000). The final level of coding aimed to interpret the categories and develop them into a theory comprising of core categories which were representative of the main themes of the research, and central to all other categories. Each of the categories and sub-categories of the environment were related to either the physical, social, political or economic aspects of the environment, and were further defined as either barriers or facilitators to physical activity.

Once the coding process had been completed the literature was reviewed, and existing research theory was linked with the properties and constructs of this emergent theory. Although the barriers and facilitators were not conceptualised in this way in any of the existing literature, the emergent theory was found to explain the conditions that arise out of the social, physical, economic and political settings, and illustrated in the social ecology model (Stokols, 1999). Diagrams are advocated in Grounded Theory research as a method of illustrating the relationships amongst theoretical categories, during the higher level analysis (Strauss, 1987). Throughout the analysis phases of this research it was anticipated that diagrams would be used for this purpose if the data allowed; diagrams have been used to explain the findings.

5.1.5 Open Coding of Data

Line by line coding revealed that the data could be grouped together into a number of categories. Several processes emerged from the data as integral to the health behaviours of the school pupils. Health was viewed as being free of illness and disease, and healthy eating was a central theme which featured in each focus group amongst participants of all age ranges. When asked whether the school promoted a healthy lifestyle, the children viewed the school as an important provider of healthy food. The children demonstrated their understanding of food and health, with the both older and younger participants demonstrating an understanding of the healthy types of food choices.

> Interviewer: Do you think your school promotes a healthy lifestyle?
> J: Well we have healthy dinners, where we have fruit and carrots and peas and we have a tuck break where we get fruit
> T: And we have to have fruit, we get a fruit break as well
> J: Oh yeah in the afternoon we have a fruit break
> I: Do you think that promotes a healthy lifestyle?
> S: Yes because we don't have chips every day
>
> Yr 6 Pupils

Physical activity was also viewed as important to health, with many of the participants discussing PE lessons and exercise during the focus group interviews. The older children showed an understanding of the importance of physical activity in relation to the prevention of disease.

> R: It's about so you keep doing PE and not having as many chips
> M: Oh yeah we done it in the class and it said we have to do PE and sport and it helps us stay strong and then we have to eat less chips and eat greens
>
> Yr 2 Pupils

> Interviewer: Do you think your school promotes a healthy lifestyle?
> C: We do that a lot, like rounders and stuff like that in PE
> I: So why do you think it's important that you are healthy?
> B: So you can keep fit and erm help you have a better lifestyle
>
> Yr 6 Pupils

> C: We do about the heart and the lungs
> H: And how to keep healthy

> A: Yeah we did about disease and what causes illness and how to try and not to get ill
>
> Yr 5 Pupils

The playground environment was viewed as a fun space and a time to play games. Participants named the different types of activities that they do during playtime, such as football, skipping, handstands, and playing with hoops, balls and parachutes. The older girls (in Year 5) preferred to sit and chat rather than get involved with games, as these were seen as something that the boys or the younger children would do.

> A: We go to the chat zone most of the time……
> S:…..We could have like monkey bars and a big slide or stuff to climb on
> H: But I reckon we'd still stay in the chat zone and the boy's be on the stuff all the time.
>
> Yr 5 Pupils

The older boys (aged between nine and eleven) tended to play football, and it seemed apparent that there may be a gap for a playground initiative that appealed to all children, but specifically to the older girls aged between nine and eleven. Few participants mentioned playtime as a time for exercise and physical activity, rather play or social activity were discussed. The older girls liked to sit and talk with their friends because that's what they felt that break time was for, rather than be active and play games.

Enjoyment of PE and physical activities in school differed by age and gender and were determined largely by gender and social support. Availability, choice and type of playground equipment and apparatus were of fundamental importance for playtime activities. Playground Leaders and the Smile Squad (another pupil led playground initiatives) were seen as positive, supplying pupils with games and equipment rather than being viewed as encouraging pupils to be active). However one focus group did speak of Playground Leaders and the difference they make to the games that they play.

> I: Do you think they (the Playground Leaders) make a difference to the sorts of games that you play?
>
> H: Yeah
>
> B: It'd make you more active and keep fitter.
>
> Yr 6 Pupils

Weather was also an important factor where enjoyment of playtime activities was concerned. All focus group participants demonstrated a dislike of wet play time, and discussed the activities they would like to do.

> H: Well outside we play better games than wet play
>
> R: We had wet play yesterday it's boring
>
> H: We had to do craft but we wanted balls and that
>
> Yr 2 Pupils

The participants had positive views about PE lessons, and enjoyed PE more than other lessons. It was apparent that choice was important to the pupils, and that if they couldn't choose the activities for their PE lessons, they would like to be consulted about this:

> I: Would you change anything about your PE lessons?
>
> A: I think if we could choose what we could do
>
> C: Yeah we could have a choice and we choose what we do!
>
> Yr 5 Pupils

It was also evident that children did not like being placed into groups during PE lessons, but would prefer to choose their own.

> C: I like it but not when we go in groups cos we can never choose who we go with. Yr 5 Pupil

Appropriateness of PE activities, determined largely by age, emerged as integral to the pupil enjoyment of PE lessons. The younger children tended to enjoy the activities where the emphasis was on fun, rather than technical ability. Gymnastics was one activity which was regarded more negatively.

> "Gymnastics is hard", Yr 2 Pupil
> "I'm scared of heights", Yr 6 Pupil

The participants viewed the school staff as important providers of good school food and PE. The role of the teachers was also viewed as important for teaching the children about health and disease.

> T: They teach us stuff
> L: We learn about being healthy
>
> Yr 6 Pupils

Participants also felt that teachers encouraged participation in sports and extra-curricular activities.

> A: Yeah the teachers do loads of clubs and get us to go along and get involved and it's good
> H: I think cos they set up the clubs they want us to take part and its about being fun
>
> Yr 5 Pupils

Friends and siblings were viewed by participants as people to play games with and to be active with.

> "My brother plays with me outside and we do football and tennis",
> Yr 2 Pupil

School food was deemed to be healthy, with adequate choice on offer. The school dinners and tuck were viewed as positive, as were the environments. One focus group discussed the environment of their eating environments, and the display of pupils work on the walls.

> Interviewer: Is it a nice space?
> H: Yeah we got posters that we done they're up on the walls
>
> Yr 2 Pupils

Most of the children discussed their parents, with many parents making the choice of whether participants took sandwiches from home, or ate school dinners.

> "I have sandwiches…….just what me Mum makes", Yr 6 Pupil.

> "Me Mum says I have to have 'em (school dinners) 'cos she can't have time to make me a dinner every day", Yr 2 Pupil.

Other school staff members were also perceived as important factors. Participants made connections with the food they ate at dinner times and the dinner ladies who worked at the school. Children felt that the dinner ladies had a role to play in the food that they ate and in encouraging them to eat healthily.

> R: If we don't eat 'em (vegetables) they ask us why
> I: They ask you why haven't you eaten them?
> R: Yeah
> I: Who asks?
> R: The dinner ladies!..... So they make us be a bit healthy cos of school dinners.
>
> Yr 2 Pupil

The older pupils showed awareness of walking and cycling to school promotions. Although the information given was not specific, the participants demonstrated an understanding of why these initiatives had taken place, and the relationship with activity and health. The very young children were not aware of any travel initiatives within the school.

> C: Didn't we have a walk to school day or week or something?
> S: Yeah just to see how many people could start walking to school, that was a health thing as well Miss, get people walking and that.
>
> Yr 5 Pupils

> B: Yeah we have a Walk to School Week
> I: What is that?
> S: Erm, it's a record of how active people are
> B: Yeah to get them to walk to school more
> I: Okay, is that often?
> B: I don't know, like once a year or every term
>
> Yr 6 Pupils

When discussing mode of travel to and from school the majority of participants travelled by car and none cycled to school. Only those participants who lived nearby walked into school.

In an effort to understand the circumstances in which the health behaviours and choices are made, the key concepts identified can be categorised into either whole school environmental facilitators of physical activity (i.e. enjoyment, choice, support from parents, siblings and peers, age appropriate activities, PE and playground facilities and resources, equipment, Playground Leaders and weather) or barriers (such as gender stereotyping, weather, competition, negative experiences of school environment and emphasis on team sports).

5.1.6 Development of Theory

Development of theory involved relating the categories and subcategories through a coding paradigm and subsequently refining the theory. Within the coding paradigm existed the conditions that arose out of social, physical, economic and cultural settings, explaining why a group responds in a certain way; the interactions that occurred in individuals or groups as a response to the issues, problems and happenings arising under those conditions; and the consequences of what happened as a result of the interactions, or the failure of an individual or group to respond to a situation. The coding paradigm allowed consideration of the ways in which the categories related to one another.

Open coding analysis of initial focus groups revealed that themes were related to economic, decision making, social and physical aspects of the environment, and could also be categorised as either facilitators or barriers to physical activity. When these findings were reviewed with consideration of the existing literature, categories emerging from open coding were similar to other research into the impact of the environment on behaviour. The initial categorisation of the economic, social, decision making and physical aspects of the environment were congruent with the Social Ecology Model (Stokols, 1992, 1996, 2000) (see Chapter 2.3)

The Social Ecology Model provided confirmation of similarities between the theory emerging from this data and literature. The elements of the emerging theory and of the Social Ecology Model had been identified and categorised either as political, physical, social or economic components of the environment. Further, the emergent theory grounded in the data from the current study could be categorised as either facilitators or barriers to physical activity.

Themes emerging from the current data which related to whole school environmental physical activity facilitators were categorised as relating to either PE and school sport policies, social, physical or physical and economic aspects of the environment. Themes relating to PE and school sport policy were enjoyment of PE and other school-based physical activities, choice of activities, and appropriateness of activities for different age groups. Specifically, young children (aged six and seven) preferred activities that emphasised fun and enjoyment over technical activities and competition. Older children aged between nine and eleven preferred activities that employed elements of skill acquisition and competition. Themes relating to social aspects of the environment were support from parents, siblings and peers, and were consistently associated with participation in physical activity. The theme relating to the physical aspect of the environment was weather, where warm and dry weather enabled the children to play outside and on the school field (in schools where this was an option). Wet play time resulted in children participating in craft type activities, where they would prefer to play games with equipment in an indoor environment. Themes that related to both physical and economic aspects of the environment were PE and playground facilities and resources, including equipment and presence of Playground Leaders. Children enjoyed participating in games with specific equipment, such as balls, hoops and a parachute, and enjoyed the direction and ideas given by the Playground Leaders. Diagrams illustrating the relationships between the theoretical categories were developed as part of the higher level analysis. An explanatory model of whole school environmental facilitators to physical activity explains the theoretical processes (Figure 3).

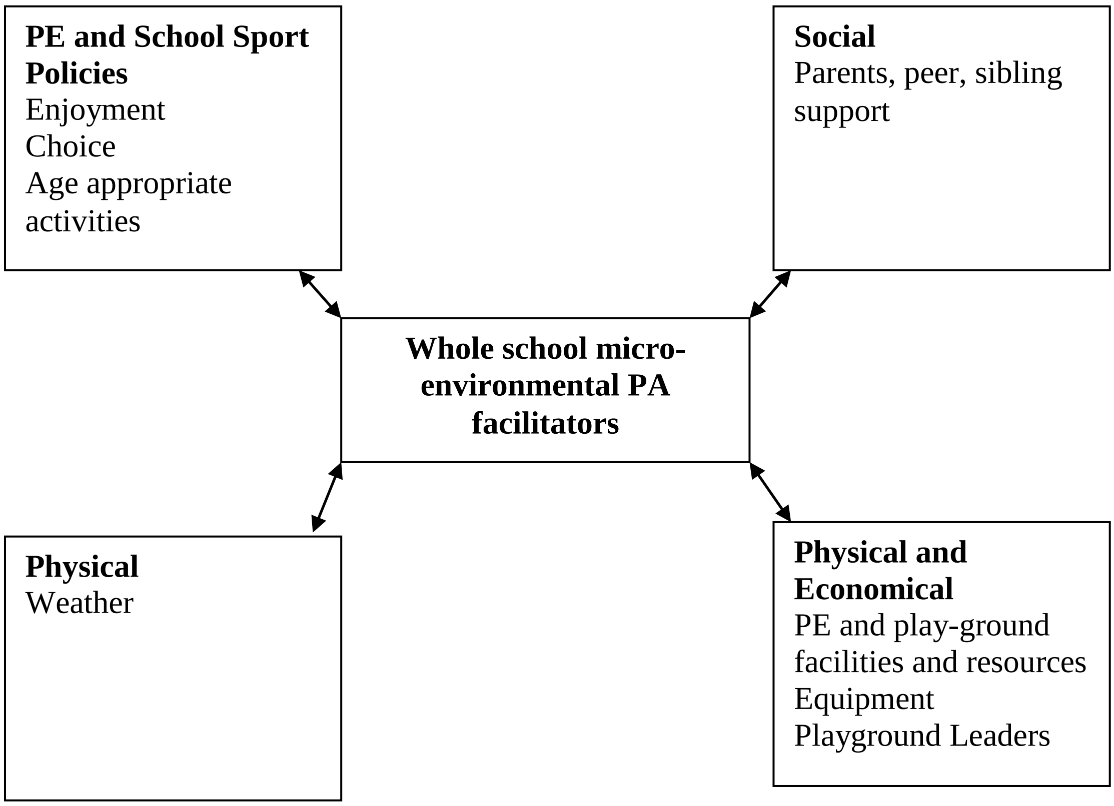

Figure 3: Conceptual Model of Environmental Facilitators to Physical Activity

Themes relating to the whole school environmental barriers to physical activity could be categorised as relating to PE and school sport policies, social, and physical and economic aspects of the environment (Figure 3). Themes relating to PE and school sport policies were competition and team sports, where the younger children in particular (aged six and seven) did not enjoy activities where there was an emphasis on competition or team sports, and school policies could support these issues.

Themes relating to both PE and school sport policies and social aspects of the environment were parent, peer and sibling support, where gender stereotyping was raised as a particular issue. Here, girls in particular would have liked an opportunity to participate in ‘boys’ games such as football during break time. Themes relating to both physical and economic aspects of the environment were negative experiences of the school environment, specifically poor (or non-existent) changing room facilities, sports facilities and lack of equipment. Lack of equipment was a particular problem where there was a mixed quality of apparatus (for example low quality and sometimes broken tennis racquets mixed with a limited number of newer metal racquets). This evidently created competition and antagonism within a class, and strategies were required to ensure the equipment was used fairly. Collectively, these processes comprise an explanatory model of whole school environmental barriers to physical activity (Figure 4).

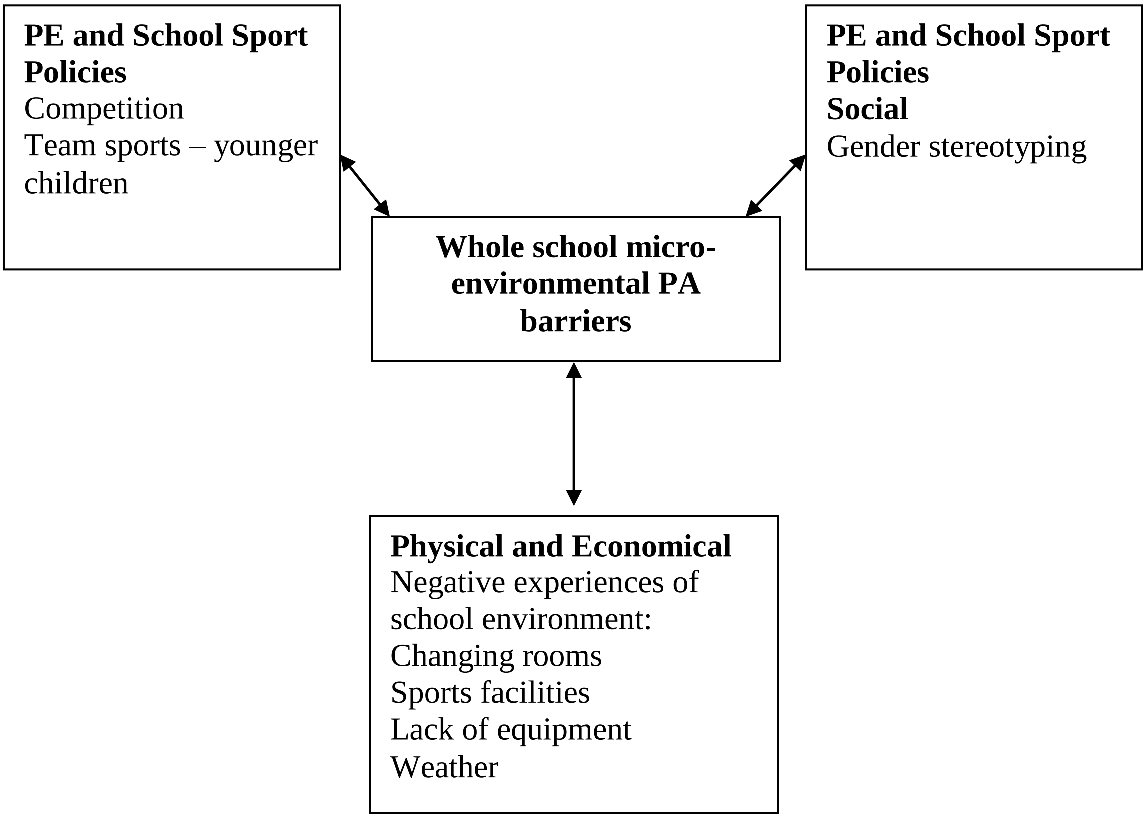

Figure 4: Conceptual Model of Environmental Barriers to Physical Activity

5.1.7 Discussion

The findings from the focus group interviews were integrated into the Social Ecology framework to enable the examination of the interactions between the economic, physical, political and social aspects of the environment and health and physical activity behaviours. The Social Ecology Model (Stokols, 1992, 1996, 2000) was used to identify and understand the obesogenicity of the school environment, to enable the effective promotion of behaviour change. These findings gave insight into the complexity of the determinants of physical activity and health behaviours within the school micro-environment. This analysis of the school environment provided an understanding of the gaps, barriers and facilitators to physical activity embedded in the political, economic, physical and social situations of the school environment. It was clear from the findings that the environmental determinants of physical activity were influenced by political, economic, physical and social resources. These environmental resources acted upon the individuals within the school environment, and impacted upon their physical activity and health behaviour needs, goals, desires, and ability to cope with their environment. The majority of identified barriers and facilitators to physical activity supported findings from previous, predominantly quantitative literature. Identification of these barriers and facilitators within a qualitative environmental model through the present study offers a unique contribution to the evidence base.

Micro-environmental facilitators to physical activity

Weather was identified as a physical aspect of the school micro-environment that was a facilitator to physical activity, as participants discussed their enjoyment of undertaking activities outdoors. This supports previous research which found that low levels of rainfall were related to higher levels of physical activity (Broderson, Steptoe, Williamson, & Wardle, 2005) however, findings regarding the influence of weather conditions on physical activity have been conflicting. Some research suggests that hot and sunny weather causes a decrease in physical activity amongst children (Baranowski, Thompson, DuRant, Baranowski, & Puhl, 1993; Broderson, et al., 2005), where others found no association between weather and physical activity (Gordon-Larson, McMurray, & Popkin, 2000; Sirard, Ainsworth, McIver, & Pate, 2005).

The findings that enjoyment, choice and social support were important facilitators of physical activity supported previous findings regarding uptake and maintenance of physical activity in previous studies (Cale & Harris, 2006; Green, 2004; Sherwood, et al., 2008). Evidence has demonstrated that providing options for physical activity increases the likelihood that children enjoy participating in activity (Sherwood, et al., 2008). In addition, support from parents, siblings and peers has been found to increase the likelihood that children enjoy and maintain participation in physical activity (Sherwood, et al., 2008). Age appropriateness of activity was also a facilitator to physical activity, and again existing evidence has shown that children who participate in age-appropriate physical activities have an increased likelihood of enjoying and maintaining participation in physical activities (Strong, et al., 2005).

Choice, enjoyment and age appropriateness of physical activity were classed as political factors of the school micro-environment that were facilitators to physical activity, and could be addressed within this intervention. School physical activity policies should endeavour to ensure that children are provided with physical activity options which are appropriate to their age. Research has identified the significant role that political factors have on the amount and type of physical activity that children receive at school, supported by an extensive examination of education frameworks and policies in Canada. This research identified that public health policies are strongly related to the physical activity policies in schools (Gladwin, Church, & Plotnikoff, 2008). Here, political physical activity drivers were examined and it was identified that successful physical activity programmes worked because the individuals and groups influencing policy at both macro and micro levels understood and advocated their potential. Political drivers at macro level would be the education ministers, for example, whereas political drivers at micro level include the School Sport Partnerships and their related staff, school head teachers, teachers, and staff other than teachers. The research undertaken by Gladwin, et al., (2008) identified that the beliefs of the education minister, and the school head teacher, teachers and staff other than teachers were the reasons why in school daily physical activity was mandated in schools. It was identified that interventions need to ensure that the policy at macro and micro level supports initiatives, are led by politically strong organisations, and are viewed as an important priority amongst educators (Gladwin, et al., 2008).

Social support was identified as a social aspect of the school micro-environment that was a facilitator to physical activity. The social environment relates to the constraints on perceived availability of choices, opportunities to participate in activities, patterns of social control, norms, and the production or reduction of stress upon the individual (Institute of Medicine, 2003). Broadly defined, social support relates to the resources provided by other people (Cohen & Syme, 1985). The finding that social support was a facilitator to physical activity is similar to previous research that identified social support as a correlate of physical activity (Biddle, et al., 2004; Fox, 2007; Sallis, et al., 2000; Strauss, Rodzilsky, Burack, & Colin, 2001). Social support and social networks have been identified as one dimension of the social environment that influences health-related behaviour (McNeil, Kreuter, & Subramanian, 2006). The relationships between social support and health-related behaviours have been well reported in models and theories (see Chapter 2.2.3).

Physical activity and PE facilities and resources, including equipment and presence of Playground Leaders, were identified as facilitating aspects of the school micro-environment. These factors were classified as both physical (as physical contexts of the environment) and economic (as dependent on financially ability to provide such resources) aspects of the school micro-environment. The availability and quality of equipment was a theme of particular importance to the children. Sallis, et al. (2002), and Fein, Plotnikoff, Wild and Spence (2004) also found that a wide availability and good functionability of physical activity equipment for PE, play time and other physical activities were associated with higher levels of physical activity amongst children. The relationship between playground markings, equipment and physical activity has also shown to be positive (Stratton & Mullan, 2005), and this was a recurring theme during focus groups. Conversely, Zask, et al. (2001) found no association between physical activity levels and the availability and quality of playground equipment.

Micro-environmental barriers to physical activity

Team sports and competition were identified as two political aspects of the micro-environment that were barriers to physical activity. Several research papers identified that team games were often favoured within the curriculum, and were generally competitive in nature (Cale & Harris, 2005; Fairclough, Stratton, & Baldwin, 2002; Green & Thurston, 2002). Curricular and extra-curricular provisions for physical activity tend to be competitive team games, and concerns have been raised regarding the physical activity provisions for those children who dislike team games and competitive sports (Boyle, Jones, & Walters, 2008). Boyle, et al., (2008) examined the delivery of PE in schools through the views of heads of PE and head teachers. Several participants in this qualitative study discussed their desire to offer a wider range of physical activities within school, but had time constraints (for example no free evening to deliver additional activities to cater for a wider range of children). The authors discussed their concerns that only a minority of pupils who were talented at sport were being catered for, and the lack of physical activity provision for all (Boyle, et al., 2008). Other papers provided support for the notion that although a wide range of opportunities were available for children to participate in physical activity, the minority of pupils who were gifted and talented at sport tend choose to participate (Green & Thurston, 2002; Sallis, et al., 2002; Moe, Pickerel, & McKenzie, 2006).

Negative experiences of the school environment were classified as both physical and economic aspects of the micro-environment that were barriers to physical activity; physical because of their physical context, and economic given the reliance on financial resources. Inadequate changing room facilities were an identified barrier. Not having a suitable area to change into PE kit made children less willing to participate in PE or other curricular/ extra-curricular activities. O'Dea (2003) similarly found that inadequate changing room facilities provided a barrier to physical activity, and proposed restructuring the physical environment. The finding that a lack of equipment was a barrier to physical activity is supported by a review of correlates of physical activity behaviours (Van der Horst, et al., 2007). Gender stereotyping was a barrier to physical activity that was classified as both a social and political factor of the school micro-environment. It was particularly raised by female pupils, who wished to participate in a wider range of activities in PE, during play time and during other physical activities. Gender stereotyping was classified as a political aspect of the school environment due to the school sports policies imparted by teaching staff and staff other than teachers, which advocated which sports, exercises and activities were undertaken in PE lessons, and in and around the school day. This issue was also classified as a social aspect of the school environment because of the beliefs of the peers attaining to traditional views of PE and sport.

CHAPTER 6

Intervention Design

6.1 Introduction

The environmental determinants of health have been well documented (see Chapter 2.3). The aim of the pilot physical activity intervention was to increase opportunities for children to be physically active in and around the school day by creating a whole school environment that promoted and facilitated physical activity, rather than focusing on individual behaviour change (Weshler, et al., 2000). This pilot physical activity intervention was designed to draw on existing resources available to schools, to promote sustainable behaviour change. It was important to make use of existing resources to increase the chances of the intervention being sustained and to minimise additional costs.

The main tenets of this intervention were:

- Ecological theoretical approach
- Assessment of the micro-environment
- Main focus on policy, and provision and quality of activities and facilities
- Collaborative (in terms of both development and delivery) with school staff, pupils, relevant stakeholders
- Effective and efficient use of existing resources

Intervention aims

Based upon previous research, associated recommendations for future research, and baseline measures of this research, the intervention specifically aimed to:

- Increase physical activity levels amongst girls to reduce the gender discrepancy (whilst increasing physical activity levels in boys also)

- Increase physical activity levels of older children to reduce the age-related decline in physical activity levels of the younger children (whilst increasing physical activity levels in younger children also)

- Ensure that physical activity opportunities are accessible to all children, with no differences in the physical activity levels of children with higher and lower BMI scores.

6.2 Development of the Pilot Physical Activity Intervention

Evidence from the Social Ecology Model (Stokols, 1992, 1996, 2000), the ANGELO Framework (Swinburn, et al., 1999) and related research (for example Elder, et al., 2007; Ward, et al., 2002; Weschler, et al., 2000) was applied to inform the development of this intervention. In line with recommendations, the intervention considered actual and perceived qualities of the school environment (Stokols, 1996) at the micro-environment level (Swinburn, 1999) using focus groups with the relevant population and an audit tool in each school (see Chapter 4 for audit tool details and Chapter 5 for focus group details). The resulting data revealed elements to address in the intervention (Table 6).

Table 6: Overview of Intervention Elements Developed from Perceived and Actual Measures of Micro-environment

Environmental Level	**Related Environmental Elements to be Addressed by Intervention**
Physical and Economic	Distribution of activity resources PE and playground facilities and resources Playground leaders Availability and quality of environment
Policy	Enjoyment Choice Age appropriate activities (consideration of competition and team sports with age) Gender-stereotyping
Socio-cultural	Parents, peer, sibling support Gender-stereotyping

The main components of the intervention involved improving the quality of PE and school sport by considering the preferences of participants, and the provision and quality of available equipment; determining the best use of space for physical activity within each school; addressing the type and time of activities on offer within each school; and assessing quality and availability of the physical activity and sports equipment. Informed by the literature, the audit tool and the focus group findings, these activities initially aimed to include: a playground intervention to encourage physical activity during recess; better use of PE time, increased provision of extra-curricular activities, addition of lunchtime activities, increased provision of physical activity and sports equipment and better use of space for PE and physical activities. School policies existed to support active travel. Although all schools had policies relating to wet playtime, schools were supported to use classroom activity resources such as Top Activity DVDs during wet playtime. The intervention focused on using school resources more efficiently, effectively and economically, to ensure intervention sustainability and generalisability.

Once the fundamental components of the intervention had been determined, meetings were held with Primary Link Teachers, Head Teachers, Deputy Head

Teachers, PE staff, Learning Mentors, Home-School Workers, and School Sports Partnership Development Managers to discuss the implementation of the intervention. These meetings were used to discuss potential intervention delivery strategies that would be both effective and sustainable within each school. All-staff school meetings were also attended by the researcher to discuss the pilot intervention and practical implications for school staff. Staff were encouraged to share their views, ideas and opinions about how the intervention could be delivered within their school.

Case Study Example

Following a meeting at one of the intervention schools to discuss the intervention, the Head Teacher showed the researcher one of the lofts within the school building. The loft was accessed via a very small passageway through a cupboard. Once in the loft, the Head Teacher showed the researcher a large number of packages containing, for example, brand new, unused Mini-tennis sports equipment (tennis racquets, balls and nets). The Head Teacher said this equipment had been in the loft for over a year. The only reason it had not been used was because school staff did not really know how to use it and so had not incorporated this into their teaching activities. The Head Teacher was keen for the equipment to be used and for school staff to learn how to make the most out of it. This provided the basis for introducing Mini-tennis as an intervention activity in all of the intervention schools within PE lessons and as an extra-curricular activity.

The delivery of the intervention was flexible and non-prescriptive, using existing resources within each school to create a supportive environment for physical activity and health-related behaviour. The emphasis, therefore, differed in each school depending on: existing provision for PE and school sport; types of activities already on offer at each school; physical space available for physical activity; and the quality and availability of existing physical activity and sports equipment.

As the intervention focused on using existing resources all available resources (including equipment, facilities and staff) were considered. Existing activities were examined to determine how they could be changed to encourage children to be more physically active (such as PE lessons, or after school clubs). Organisers of after school clubs (Kids Clubs) were asked to consider alternatives to current activities. For example, ‘Kids Clubs’ organisers were asked to include at least one physical activity game into every session, rather than having two physical activity games per week and the rest arts and crafts activities. This meant that every Kids Club incorporated some type of physical activity. The researcher liaised with school staff to determine available equipment for use by the Kids Club organisers, and discussed potential games and activities with Kids Club Organisers, such as those included in multi-skills activities (games to improve coordination, agility and balance).

Once existing activities had been identified and information required to increase opportunities for physical activity was provided, the times and days for new additional sessions and activities was organised. School staff provided a list of times and days for delivery. Existing sessions had staff in place (such as PE lessons / Kids Clubs). However, the researcher was required to ensure that all new additional sessions were organised at a time which was convenient to the schools, and to ensure that volunteers were available to lead the sessions.

To complement the maximising of existing activities, a wide range of new activities were introduced using existing equipment. Activities specific to each of the intervention elements are outlined in Figure 5, showing relationships between the theoretical underpinnings of the intervention (under Theory: Micro-environment), the related key intervention aims (see Chapter 2.6), and the main intervention activities. The audit results (see Chapter 4.1.4) and focus group results (see Chapter 5.1.5) for each school were used to guide the allocation of intervention activities in each school. Tables 7, 8 and 9 illustrate the breakdown of activities in each of the intervention schools.

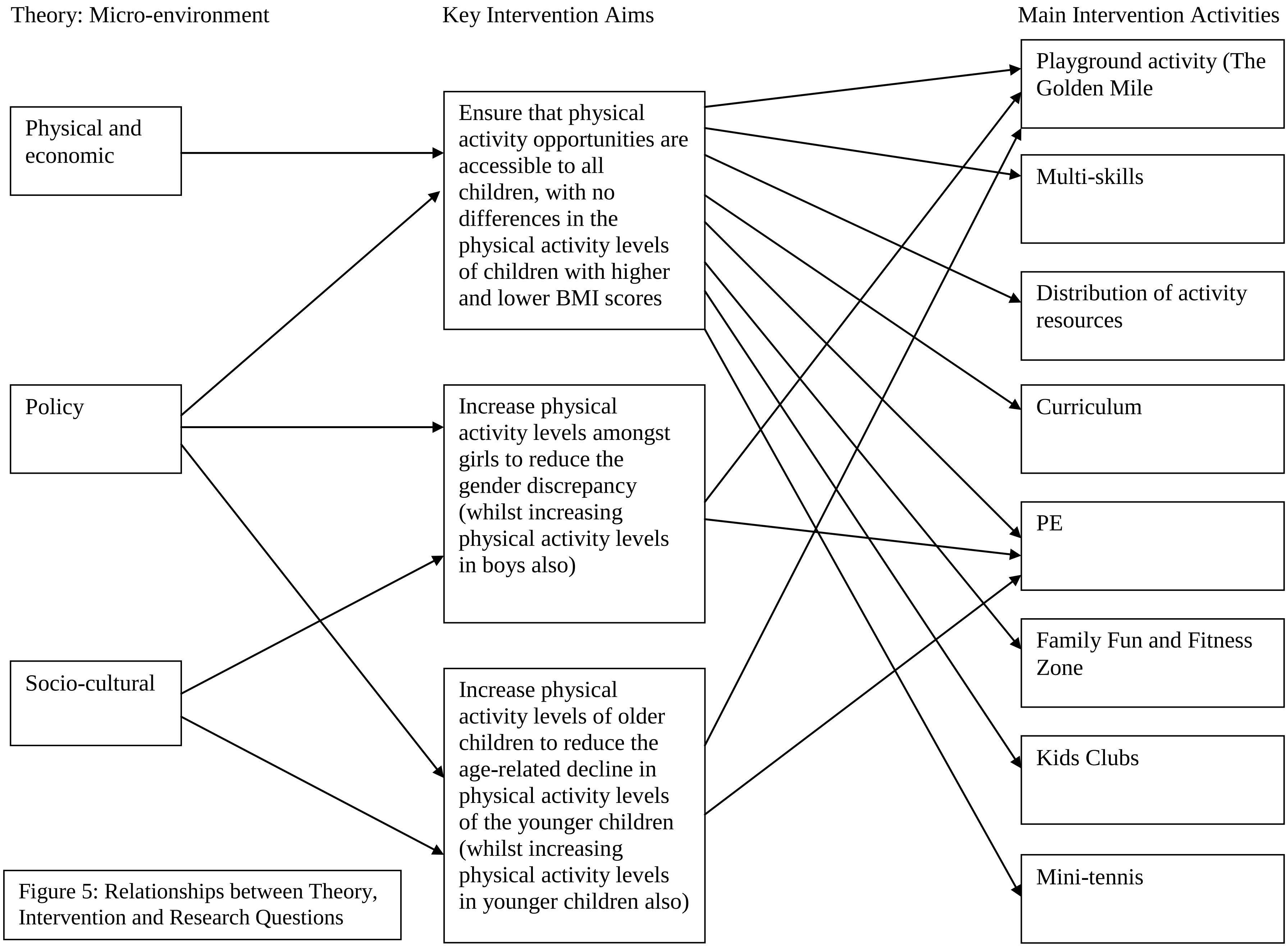

Figure 5: Relationships between Theory, Intervention and Research Questions

The intervention comprised various elements (Figure 5), many of which were required to run concurrently to enable effective delivery, and to maximise potential benefits. The researcher worked with schools to coordinate the delivery of additional sessions, and as well as existing staff, utilised a number of Undergraduate University Students who were already involved in a Level 3 (3^{rd} Year) Coaching Placement Module and had been allocated various places in delivering elements of the intervention. These students already had an interest in Coaching, and some had a range of qualifications. In addition, an email was sent to all Sport and Exercise students, inviting them to contact the researcher if they were interested in volunteering to deliver a variety of activities sessions to local primary school children. Interested students were given further details with a follow-up one-to-one meeting between the student and the researcher. A number of students came forward many had coaching qualifications but others did not. Those without coaching qualifications were assigned to assist with the sessions delivered by appropriately qualified staff. The researcher wanted to provide as many activity sessions as possible in each of the intervention schools. Hence, all students who expressed an interest to become a volunteer were included, either to lead or assist in the delivery of sessions. All volunteers had Extended CRB clearance, and provided details of their coaching qualifications and experiences. Volunteers were also asked to provide their preference of the types of activities they would most like to be involved with, and the age range of the children they would like to work with. Many volunteers chose the activities and age ranges that they had previous experience of working with. Volunteers were then asked to provide preferences of school locations and provided details regarding their availability for the upcoming school term period. The researcher then matched the preferences and experiences of the volunteers with the available activity slots in each of the schools. A total of fourteen students were placed within intervention schools. This sustainable approach provided an opportunity for Staffordshire University Placement Students to gain experience, and provided further support for schools to maximise their delivery of physical activities in and around the school day.

The North and South Stoke-on-Trent School Sport Partnership Development Managers and Primary Link Teachers were heavily consulted in the development phase to ensure the intervention strategies within each school were manageable and sustainable. The Primary Link Teachers, based in each primary school, and responsible for enhancing PE and school sport in their own respective school, were also key staff members heavily consulted in the development of this intervention.

It was not feasible to evaluate, with full rigour, all of the individual elements that comprised this multi-faceted intervention in which several smaller components were combined to yield an overall effect. Rather, the overall impact of the intervention on physical activity levels was assessed in each of the study trial arms, pre- and post-intervention.

6.3 Implementation of Intervention Activities

Baseline data were collected between November and July of the academic year 2006/2007. The pilot intervention was delivered over one academic year, starting in September 2007 and ending in July 2008 (see Chapter 1.5 for timeline). The initiatives delivered were non-prescriptive, and depended on the individual characteristics and needs of each of the intervention schools.

Activity timetables (Tables 7 and 8) provide an overview of the range and frequency of activities delivered within the interventions schools. Activities provided before school and throughout the school day are identified as being undertaken throughout the week in all schools. Additional activities were also provided, and are identified by school in brackets. Further details including rationale and delivery are then discussed.

Table 7: Overview of Intervention Activities Delivered Autumn/Winter 2007-08

	Monday	Tuesday	Wednesday	Thursday	Friday
Activities delivered to all pupils before school and throughout the school day (throughout the week in all schools)	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) PE
10-11am					
Lunchtime					Boys Football (TW)
1-2pm				Mini-tennis (HC) Yr 1	Mini-tennis (HC) Yr 6
2-3pm				Mini-tennis (HC) Yr 2	Mini-tennis (HC) Yr 6
Extra-Curricular Activities	Youth Club (GL) KidZone (SH, TW)	Family Fun and Fitness Zone (GL) KidZone (SH, TW) Mini-tennis (SH Group 1)	KidZone (SH, TW) Mini-tennis (SH Group 2)	KidZone (SH,TW)	Youth Club (SH KS2) KidZone (SH,TW)

Table 8: Overview of Intervention Activities Delivered Spring/Summer 2008

	Monday	Tuesday	Wednesday	Thursday	Friday
Activities delivered to all pupils before school and throughout the school day (Throughout the Week in All Schools)	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) Fitzy PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) Fitzy PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) Fitzy PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) Fitzy PE	Golden Mile Multi Skills Take 10 Fit to Succeed DVD Jump Rope for Heart Curriculum (Healthy Eating and Exercise in PSHE and PE) Fitzy PE
10-11am					
Lunchtime					Multi-Skills
1-2pm				Mini-tennis (TW)	Mini-tennis (HC) Yr 6
2-3pm				Mini-tennis (TW)	Mini-tennis (HC) Yr 6
Extra-Curricular Activities	Youth Club (GL) KidZone (SH, TW)	KidZone (SH, TW) Mini-tennis Workshops (GL, SH)	KidZone (SH, TW) Mini-tennis Workshops (GL, SH)	KidZone (SH) Netball Club (SH, TW)	Youth Club (SH KS2) KidZone (SH, TW) Netball Club (HC)

Additional Curricular & Extra-Curricular Activities and Resources (throughout academic year) are displayed in Table 9.

Table 9: Additional Curricular and Extra-Curricular Activities and Resources Available to Schools throughout the Academic Year

School				
GL	SH	HC	TW	Other Resources
Girls and Boys football club	Netball club	Yr 6 Dance workshop	Netball club	Fitzy Playground Markings
Athletics, rounders and swimming	Hockey club	FS & KS1 Street dance workshop	Hockey club	Magical Markings
Dance Morning	Football club	Street Dance Club Yrs 3, 4, 5 & 6	Football club	S-o-T School Sport Partnership Website
Health and Development Youth Club	Cross-country club	Yr 5 & 6 Healthy lifestyles – Ron Case	Cross-country club	Newsletter
Family Fun & Fitness Zone	Athletics club	Football club	Athletics club	Community Sports Leader Links
Cook & Eat	Gymnastics club	Netball club	Gymnastics club	
Dad's Group	Rounders club	Cricket club	Rounders club	
Take 10 Fit to Succeed resources	Mini-tennis resources	Mini-tennis resources	Martial arts workshops	
Martial arts workshops	Y5 cycle training	Martial arts workshops	Dance workshops	
Dance workshops	Martial arts workshops	Indoor Athletics Packs for Junior Sports Leaders	Indoor Athletics Packs for Junior Sports Leaders	
Indoor Athletics Packs for Junior Sports Leaders	Dance workshops	Health Week	Health Week	
Health Week	Indoor Athletics Packs for Junior Sports Leaders			
	Health Week			

6.3.1 Playground Intervention

Research has shown that playtime provides a valuable opportunity to increase levels of daily physical activity in children. Almost a quarter of the average primary school day is spent in playtime (Ridgers, et al., 2005). Stratton (2000) calculated that children can have up to 600 playtimes a year. Children are also more likely to be physically active whilst engaging in free play with peers (Ridgers, et al., 2007), therefore playtime has the potential to provide a key source of daily physical activity.

In 2001, the UK government and the Youth Sport Trust implemented the primary school playground initiative ‘Zoneparcs’ throughout England. This initiative has since been incorporated into the PESSCL, and subsequent PESSYP target of increasing opportunities for children and young people to be physically active within and beyond the school curriculum. However, a large number of schools did not have Zoneparc’s playgrounds at the time of intervention planning. A number of UK interventions aimed at increasing physical activity, and/or reducing levels of overweight and obesity, have targeted the playground, with positive effects (Ridgers, et al., 2005; Ridgers, et al., 2007). None of the schools involved in the research had any type of playground intervention in place. The school playgrounds were unappealing and not necessarily conducive to physical activity (Images 1 and 2). Therefore, the inclusion of a playground intervention within the context of this wider pilot intervention was justified.

Image 1: Example Playground (School 1)

Image 2: Example Playground (School 2)

Golden Mile

The Golden Mile was selected as an appropriate playground initiative. The Golden Mile is a physical activity initiative which encourages children of all ages and fitness abilities to increase their levels of activity within their own school environment (The Golden Mile Club, 2007). The appeal of the Golden Mile as a component of the intervention was the ease and flexibility of administration, and the simplicity of its implementation. The baseline findings influenced the choice of this intervention; in particular, the findings showed lower levels of physical activity in girls (than boys) and in older children (than younger children) (see Chapter 7.1.2). Baseline focus groups revealed that children have different interests and motivations to be physically active (see Chapter 5.1.5). The Golden Mile provided the opportunity for children to walk the Golden Mile course and chat with friends at the same time, or to be competitive with their peers if they wished. This was particularly important in encouraging the older girls to be more physically active. Focus group findings suggested this group preferred to sit at benches or on grass (as appropriate to their school) and chat with their friends (see Chapter 5.1.5). This initiative provided them with the opportunity to become involved in an initiative, but use it to suit their preferences.

Implementation of this initiative involved representatives from the Golden Mile Club 'measuring' Golden Mile courses in the playgrounds of each school, in collaboration with the researcher and the Head or Deputy Teacher of the school. The circumference of all usable outdoor physical activity spaces at the school were measured and recorded. The Golden Mile courses were measured in all possible outside physical activity spaces that could be used by the pupils, meaning that each school had a minimum of three courses that could be used by the pupils (for example a top playground, a bottom playground and an Astroturf).

The pupils were provided with information about each of the Golden Mile courses available to them, and given information about how many laps of the course they would need to complete to have done one mile. School staff were encouraged to support the children in participating in the Golden Mile before and after school, and as part of break time, lunch time and curriculum time, to use the Golden Mile flexibly, and incorporate it into the school day wherever possible. Pupils were responsible for counting how many 'laps' they achieved in each session and were warned that they were accountable for their recordings and that they were being trusted to report their progress honestly. Each pupil was provided with an individual progress card, and an A3 wall chart was provided for each classroom, for pupils to report their progress. Children were given a bronze certificate when they achieved ten miles, a silver certificate when they achieved twenty-five miles, and a gold certificate when they achieved fifty miles. It was anticipated that fifty miles could be comfortably achieved by pupils during one academic year (see Appendix 12 for Golden Mile activity materials).

6.3.2 Led Activities to Increase Physical Activity

A fundamental element of this intervention was to increase the opportunities for children to be physically active in and around the school day. Pupils were asked in the focus groups about the types of activities in which they would like to participate. This information was used to help to select the nature and timing of activities that were offered to pupils. Activities were implemented as part of school PE lessons (to encourage increased levels of physical activity during PE), and as part of extra-curricular school and lunch time activity clubs.

Multi-Skills and Mini-tennis sessions were delivered during the before and after school clubs, and within the curriculum, in addition to regular PE sessions and after-school clubs. The times, days and delivery of the sessions were co-ordinated and organised by the researcher.

Multi-skills activity sessions were introduced at before and after school clubs, and within the curriculum. These sessions incorporated activities to build balance, agility and co-ordination within a physically active and fun environment (Youth Sport Trust, 2006) and were delivered by University students, school staff and Kids Zone staff in addition to regular PE lessons. Mini-tennis sessions were introduced at the request of a Head Teacher at one of the intervention schools. None of the intervention schools provided Mini-tennis, so this was introduced in PE lessons and also as an after school club, in addition to regular PE lessons and after-school clubs. The PE lessons were held with both Key Stage 1 and 2 children and teachers were encouraged to participate and observe the sessions so that they could make use of the equipment and carry out the sessions after the intervention had finished. The after school clubs were held with Key Stage 2 children and ran for six week periods. Football sessions were also held once a week during lunch times for Key Stage 2 boys.

6.3.3 Activities to Include and Improve Family Health and Behaviour Choices

Although an intervention could provide opportunities for children to participate in physical activities and make healthy behaviour choices during school, it is harder to control health behaviour choices out of school time. The role of the family has long been regarded as a fundamental influence on the health and physical activity behaviours of children and young people (see Chapter 2.2.1). Therefore, it was important to include activities which would encompass a family approach. It was decided that sessions incorporating a whole family approach would be more beneficial than tackling the health behaviours of the parents/guardians alone. Sessions were developed for all family members that comprised an educational section on varying topics, such as physical activity and healthy eating. It was also anticipated that each session would comprise opportunities for families to participate in different types of physical activities currently available within the local community.

The Family Fun and Fitness Zone was piloted in two of the intervention schools and delivered in collaboration with the school Learning Mentors, Home-School workers, School Nurse and Community Sports Leaders. Two hour sessions were held every Tuesday after school, for six weeks (from 3.30-5.30pm). All families were invited to participate in the Family Fun and Fitness Zone, with a maximum of twelve being able to attend. Twelve families responded and were invited to attend the sessions, and all twelve continued to attend for the six-week period. A mixture of school pupils, siblings, parents, grandparents and school staff participated. The sessions comprised a 15-minute introductory discussion session, encouraging the families to share how they had found their previous week, a 15-minute presentation on an aspect of health (such as advice on physical activity importance and ideas to incorporate into daily routines and healthy but economic shopping), a 30-minute practical session where families received hands-on experience of creating something they could take home at the end of the session (for example ‘healthy packed lunches’, ‘grow your own veg’, ‘make your own smoothies’, ‘make your own pizza’), and a 30-minute activity session (alternating dance and ‘fun’ circuits (comprising activities such as mini-golf and football penalty taking). Each session finished with a question and answer session, and finally everyone participated in a TOP Activity dance DVD.

At the culmination of the six-week programme, all families were presented with a folder containing information gathered over the duration of the Family Fun and Fitness Zone. This included healthy eating recipes, healthy lunchbox ideas, information about growing fruit and vegetables, and a list of physical activity opportunities that were available to them within the local communities, such as dance sessions, and Lads and Dads football sessions.

Dancing session

‘Grow your Own Veg’ session

6.3.4 Integration of Physical Activity into Curriculum

The concept of integrating physical activity throughout the school curriculum is relatively new (Oliver, Schofield, & McEvoy, 2006). Such an approach includes educating children about physical activity and health-related behaviour through a variety of ways. The pilot physical activity intervention encouraged teachers to use physical activity and health-related references throughout the curriculum, from maths to art. Some school halls, corridors and classrooms used displays of food to educate children in counting and incorporated pictures of unhealthy foodstuffs (e.g., sausages or cakes). Where this was evident, teachers were encouraged to change the displays to incorporate healthier foods (e.g., apples or bananas). Year 6 pupils at one school were involved in a newspaper competition as part of their English lessons, where pupils were instructed to develop a newspaper which was all about PE, school sport, physical activity and healthy behaviour choices in their school. Meetings were held with school staff to provide ideas for PE lessons and after school clubs. Equipment was provided to enable more children to participate in after school clubs (such as Mini-tennis equipment).

A Health Week was implemented in each of the intervention schools during the summer term. Many of these took an ‘Olympic theme’. For this week, the curriculum was based around physical activity, healthy eating and wellbeing. Activity sessions and games were held each day for the children (such as Multi-Skills). Staff were encouraged to provide health-related activities for the children within the curriculum. Such activities included designing posters (which were displayed around the school), designing a newspaper, learning about the history of the Olympic Games, and learning about the sports and countries represented in the Olympic Games. Activity taster sessions were provided for school children and staff, and included dance and martial arts sessions.

CHAPTER 7

Impact of Intervention on Physical Activity Levels

Key Research Question 3

Will an ecological physical activity intervention developed using a range of quantitative and qualitative methods be effective in increasing the physical activity levels in primary school children in the immediate and longer (6 months) term?

7.1 Measurement and Summary of Baseline Physical Activity Levels

7.1.1 Method

Measurement of Physical Activity

Physical activity was measured over a seven day period using minute-by-minute accelerometry. Actigraph GT1M accelerometers were used to record physical activity at 60-second epochs, which provided levels of physical activity in counts per minute (see Chapter 2.1.2 for a detailed review of physical activity measurement).

Pilot data revealed that a minimum of 30 participants would be required from each school (See Chapter 3.2 for study design and sample selection). Two schools were involved in data collection at a time, in the matched pairs. A total of 45 participants from each school were randomly selected to wear an accelerometer (see Appendix 13 for data collection timetables and ethical approval). A total of 90 accelerometers were split into two batches marked ‘A’ and ‘B’. Each accelerometer was engraved with their batch number, and also numbered 1 to 45. It was then possible to record which accelerometer had been given to each participant. The two schools involved in the data collection each week were allocated with either accelerometers ‘A’ or ‘B’ prior to data collection, to ensure that the data collection sheets could be organised in advance.

Participants were randomly selected (computer randomisation using Microsoft Excel formula) from the school register in liaison with a School Sports Co-ordinator or Primary Link Teacher. To allow for non-consent and absences on the day of data collection 60 participants were sampled from each school. Unique pupil numbers (UPN) were used to identify participants and pupil names were not stored. The UPN is a unique code which identifies all school pupils in England. Each individual's UPN remains with a pupil throughout their school career and is used to report information about pupil's to the Local Education Authority, Department for Children, Schools and Families, or to the Qualifications and Curriculum Authority (Department of Education and Skills (now known as Department for Children, Schools and Families, 2004).

The School Sport Co-ordinator or Primary Link Teacher who assisted with the random sampling retained a copy of the selected participants which contained their UPN, along with pupil names. Each sampled participant was given an information sheet (see Appendix 1 for an example) and a parental consent form (see Appendix 2 for an example). Participants were also given an envelope in which to return their consent form, which was addressed to the designated member of staff (e.g., the Primary Link Teacher). The information sheets, consent forms and return envelopes were provided in sealed envelopes, marked with the UPN. The School Sport Co-ordinator or Primary Link Teacher was then able to match the UPN to their list of corresponding names for distribution.

Data Collection Procedure

Two schools were visited on the same day. It was not possible to have synchronous data collection times on both sites due to logistical reasons. The researcher was required to be present for the fitting of all the accelerometers to ensure that the protocols were followed and correct data was collected. However, in order to gather as much physical activity data as possible, it was important that data collection took place early in the school day (e.g., school 1 visit would be at 8.45am and school 2 visit at 10.30am). This also minimised the time between the last accelerometer fitting at one school, and the first accelerometry fitting at the second school (approximately 30 minutes).

It was necessary for school staff to assist with data collection, as UPNs were used to randomise and identify the children. Prior to the school visit, a designated member of school staff (in most cases this was the Primary Link Teacher) had already collected the consent forms, knew which pupils were participating and which class they were in. In many cases, the member of school staff would send a group of older children to collect the other children involved in the study, and bring them to the designated area. Data collection took place in an available room, such as the school hall, library or empty classroom. Each group of participants was given an introduction to the researcher, and a verbal explanation of the study, appropriate to their age (for example, for the younger children, the accelerometer was introduced as a 'special belt' which would measure their activity through the week). Participants were reminded to undertake their daily activities as normal.

The designated member of school staff was able to introduce each child to the researcher using their UPN. Once the child had been located by their UPN on the data collection sheet (see Appendix 3 for an example of this) their data could be recorded. Sample characteristics, including date of birth, gender, ethnicity and postcode, were provided by the school in advance. On the day of data collection, height was measured to the nearest 0.1cm, using a Leicester Portable Height Measuring Unit. Weight was measured to the nearest 0.1kg, using digital weighing scales. Levels of overweight and obesity within the sample were calculated using the United Kingdom National BMI percentile classification (Cole, Freeman & Preece, 1990), corresponding to the present standards for monitoring obesity within the UK population (Department of Health, 2008).

The accelerometers were then fitted to the child and the accelerometer batch and number were recorded. Although placement of the accelerometer has received some attention in the literature, researchers have suggested that placing the accelerometer on the hip will ensure a comparable consensus of data (Cliff, et al., 2009). The accelerometer was fitted to the right hip and each participant was shown how to fasten and unfasten the clip. Participants were also shown how to adjust the size of the belt. As some were very young, they were also told to ask a member of school staff or their parent/guardian if they needed assistance in adjusting the size of their belt. Each participant was told to wear their accelerometer during all waking hours for seven days, but to remove it for swimming, bathing or showering, as it was not waterproof. Participants were told to remove their accelerometers when they went to bed, and to put it on first thing in the morning. Participants were told that the researcher would be returning the following week, and asked to remember to bring their monitor in on this day. An information sheet was provided to all participants, which summarised all of this information (see Appendix 14).

Finally, a reminder sheet was given to participants to take home and give to the person who looked after them. This sheet contained a picture of the accelerometer worn on the right hip, with written instructions for wearing and the date that the researcher was returning to collect it. All participants were told that they would receive a certificate to thank them for their participation after the week of data collection had finished. To maximise the number of accelerometers returned reminder by the children, letters were provided by researchers and distributed by school staff two days before data collection. Following initial analysis, each participant was given a summary sheet of their physical activity. A summary sheet was also given to Primary Link Teachers, which provided average levels of physical activity within their school. See Appendix 15 for examples of these activity summary documents.

Data processing

Once accelerometers had been collected, data were downloaded using the ActiLife desktop analysis software program. In accordance with previous literature, participants who recorded less than 500 minutes/day of activity counts on at least three days in the week and one weekend day were excluded from analysis (Simmons, et al., 2008; Ekelund, Griffin, & Wareham, 2007). A customised program was used for data reduction and further analysis, whereby activity data were also cleaned for periods when the accelerometer was not worn by excluding consecutive strings of zero-count epochs lasting upwards of 20 minutes (MAHUffe: www.mrc-epid.cam.ac.uk). This program was developed by the Medical Research Council Epidemiology Unit and is widely used for reducing and analysing accelerometry data (for example Ekelund, et al., 2005; Ekelund, et al., 2007; Owen, et al., 2009; Purslow, van Jaarsveld, Semmler & Wardle, 2009; Simmons, et al., 2008).

Following significant discrepancies within the literature regarding the criterion used to classify the intensity of physical activity according to accelerometer counts (see Chapter 2.1.2), the primary physical activity outcome variable was counts per minute (total body movement) (Riddoch, et al., 2004; Schmitz, et. al., 2005; Simmons, et al., 2008; Treuth, et al., 2005). Accelerometer counts per minute (CPM) were averaged for each day and explored for various sampling periods. The priority of this pilot intervention was to increase physical activity levels in and around the school day. Therefore sampling periods were:

a) Week day physical activity (CPM over whole day)
b) In school physical activity (CPM within school day 9am – 3pm)
c) School-related physical activity (CPM before 4pm)
d) Out of school physical activity (CPM before and after school day 8am-4pm)

Data were checked for normal distribution using histograms. A number of descriptive and inferential statistical tests were used:

- Descriptive statistics were calculated pertaining to age, gender, weight, ethnicity, and deprivation quintile. Independent t-tests were undertaken to compare CPM in intervention versus control schools across the sampling periods. One way ANOVAs were undertaken to test for differences in CPM across the schools.

- Independent t-tests were undertaken to compare differences in male versus female CPM across the whole sample, and intervention and control schools, and across the sampling periods.

- Pearson product-moment co-efficient was used to explore correlations between BMI and CPM across the sampling periods. See Appendix 16 for raw data.

There were three main aims of this intervention. These were firstly to increase physical activity levels amongst girls to reduce the gender discrepancy (whilst increasing physical activity levels in boys also); secondly to increase physical activity levels of older children to reduce the age-related decline in physical activity levels of the younger children (whilst increasing physical activity levels in younger children also); and thirdly to ensure that physical activity opportunities were accessible to all children, with no differences in the physical activity levels of children with higher and lower BMI scores (see Chapter 6). The pre and post-intervention physical activity results are presented accordingly: by school and sampling periods, by gender, by year group, and by BMI.

7.1.2 Baseline Results

Sample Characteristics

Data were initially collected from a total of 325 participants (average 40.6 per school). Initial exclusion of participants recording less than 500 minutes/day of activity counts for at least three days in the week and one day at the weekend, followed by further data reduction and cleaning using the customised MAHUffe programme, resulted in a final sample of 253 participants (average 31.6 per school). This level of usable data had been anticipated, and failure rates were considered during sampling to provide a minimum average of 30 participants per school for analysis. Characteristics of the final sample are detailed in Table 10.

Table 10: Baseline Sample Characteristics

		n	%
Age (years)	Range	3.4 – 11.2	-
	Mean (±SD)	7.54 (± 2.23)	-
Gender	Male	131	51.77
	Female	122	48.22
Weight	Normal	184.7	73%
	Overweight or Obese	60.7	25%
	Obese	6.7	10%
Ethnicity	White British	234	92.5
	Pakistani	6	2.4
	Other	13	5.1
Deprivation[1] quintile	1 (most deprived)	99	42.5
	2	77	33
	3	40	17.2
	4	13	5.6
	5 (least deprived)	1	0.4
	Unknown	3	1.3

[1]Home postcodes were used to determine deprivation at Lower Super Output Area level (LSOA) using the Index of Multiple Deprivation (IMD) 2007 (Department for Communities and Local Government, 2007). The IMD combines a number of indicators covering seven domains that include income, education/training, employment, housing and services, and health/disability. The lower scores indicate increased levels of deprivation.

Teaching activities in schools varied depending on Year Group and Key Stage. All pupils in state schools in England are taught in accordance with the National Curriculum. The National Curriculum comprises blocks of years, or ‘Key Stages’. In Primary Schools there are 3 Key Stages: Early Years Foundation Stage (Reception Year); Key Stage 1 (Years 1 and 2); and Key Stage 2 (Years 3, 4, 5 and 6). Due to differences in physical activity curricula, data are represented by School Year (ranging from Reception to Year 6) and Key Stage rather than age. Participant representation across Year Groups and Key Stages are presented in Table 11.

Table 11: Baseline Participant Distribution Across School Year and Key Stage

School Year	%	Key Stage	%
R[1]	16.2	F[2]	16.2
1	10.8	1	28.4
2	17.6	1	
3	11.3	2	55.4
4	13.1	2	
5	12.2	2	
6	18.9	2	

[1] Reception Year

[2] Foundation Stage

Almost one-quarter of the participants were classified as overweight or obese, which is representative of national levels of overweight and obesity (Department of Health, 2004b) (Table 12).

Table 12: Further Summary of Baseline Weight Category

	Boys	Girls	Total
Number of children assessed:	131	122	253
Underweight (< 5th %ile)	4%	2%	3%
Normal BMI (5th - 85th %ile)	72%	74%	73%
Overweight or obese (≥ 85th %ile)*	24%	25%	25%
Obese (≥ 95th %ile)	10%	10%	10%

Approximately equal numbers of boys and girls participated in the study. Almost half lived within the most nationally deprived wards, and most were classified as White British (Table 10). This is representative of the widespread levels of deprivation and relatively low levels of ethnic diversity within Stoke-on-Trent. Reasons for non-participation (n=80) included absence on the day of data collection, refusal of consent, unreturned consent forms, or the children no longer attending the school.

Baseline Physical Activity across Schools and Sampling Periods

A one way ANOVA testing for physical activity differences among the eight schools showed that week day CPM did differ significantly across schools (F (8, 243) = 2.004, p = .047). School day CPM also differed significantly between schools (F (8, 243) = 2.690, p = .008). School-related CPM did not differ significantly between the schools (F (8, 243) = 1.659, p = .110) (Figure 6).

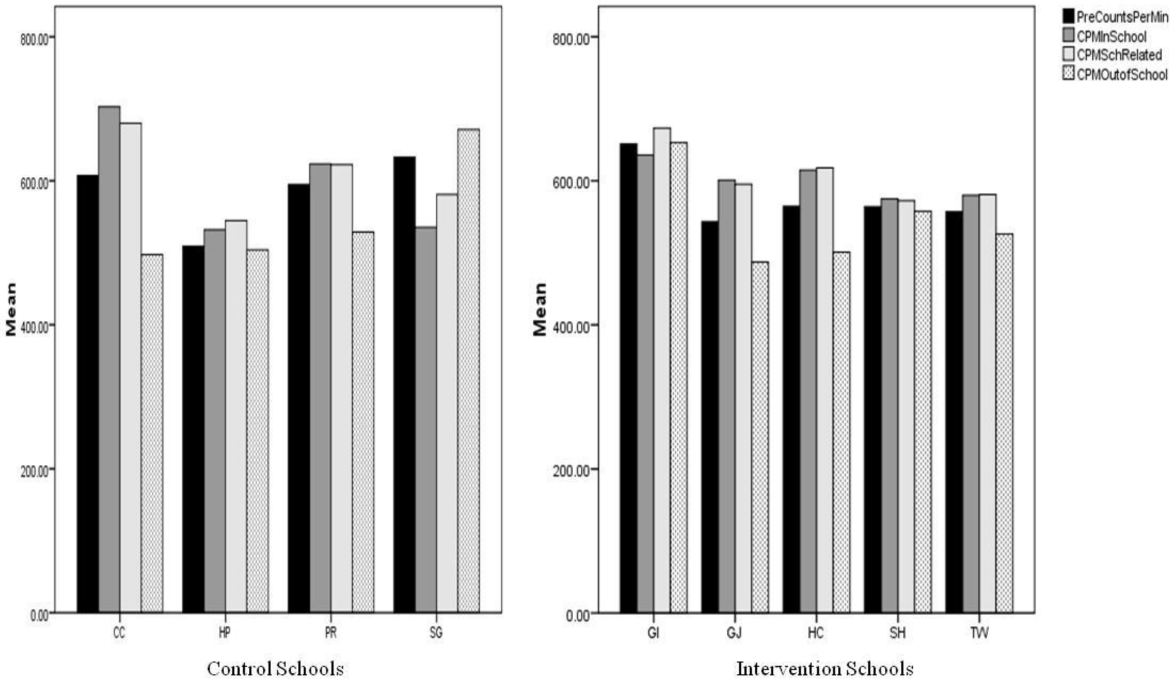

Figure 6: Baseline Physical Activity Across Sampling Periods, By School

Despite inter-school differences, there were no significant between-group differences in intervention versus control schools at any of the sampling periods (Week Day t(252) = .1031, p = .304; School Day t(252) = .150, p = .881; School-related t(252) = .421, p = .974; Out of School t(252) = .651, p = .515).

Activity CPM were highest between the hours of 8am – 9 am (622.54 ± 71.93); 12pm – 1pm (795.36 ± 158.52); and 3pm – 4pm (736.94 ± 111.05). This pattern was evident in the intervention and control schools (Figure 7), and reflects physical activity commuting to and from school, and at lunchtime.

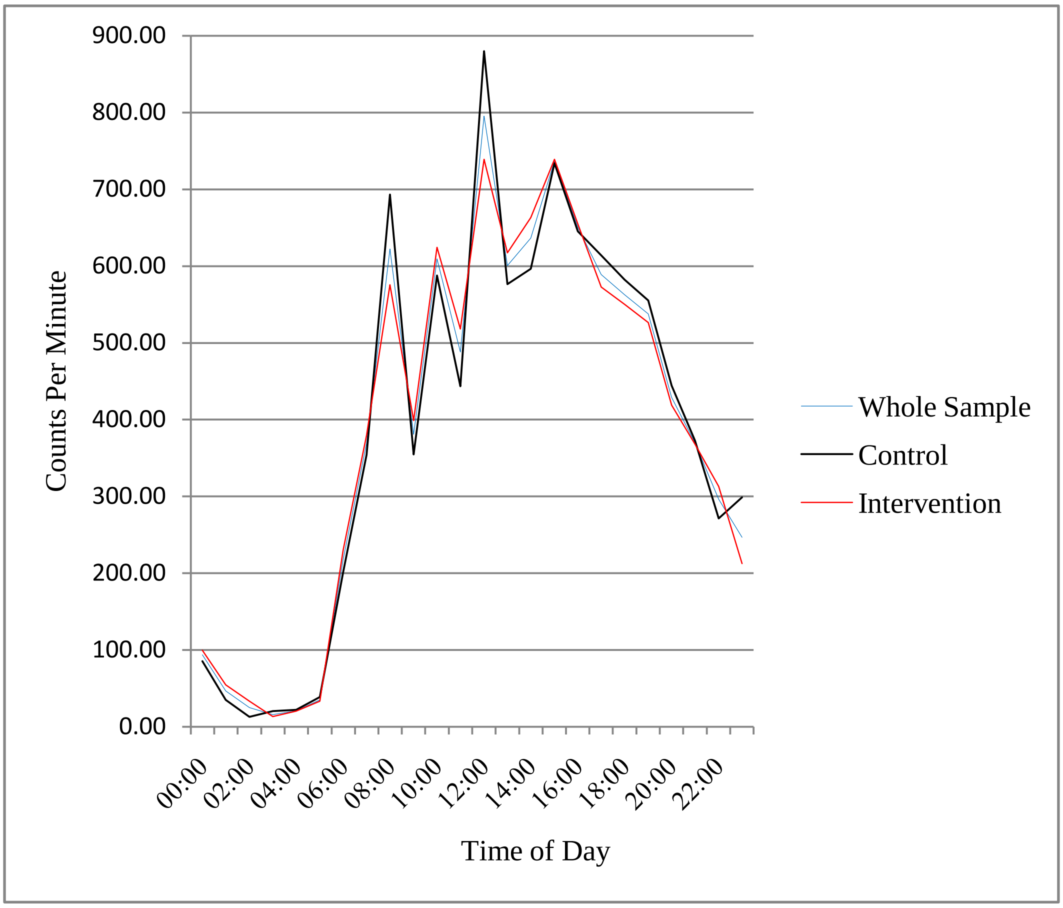

Figure 7: Baseline Counts Per Minute by Time of Day

Baseline Physical Activity by Gender

A key aim of the intervention was to increase physical activity levels amongst girls to reduce the commonly reported gender discrepancy (see Chapter 1.2), whilst increasing the physical activity levels of the boys. This section examines the pre-intervention physical activity levels of males and females.

Data in Table 13 demonstrate that across the whole sample males were significantly more physically active than females in all of the sampling periods (Week Day $t(252)$

= 5.466, p < .001; School Day t(252) = 6.069, p < .001; School-related t(252) = 6.146, p < .001; Out of School t(252) = .2.075, p < .039).

In the control sample males were significantly more physically active than females in the following sampling periods: Week Day t(130) = 3.718, p < .001; School Day t(130) = 3.591, p < .001; School-related t(130) = 3.556, p < .001. There were no significant differences between males and females in the Out of School time period (t(130) = 1.863, p = .065).

In the intervention sample males were significantly more physically active than females in the following sampling periods: Week Day t(121) = 3.897, p < .001; School Day t(121) = 5.016, p < .001; School-related t(121) = 5.141, p < .001. There were no significant differences between males and females in the Out of School time period (t(121) = 1.135, p = 2.59).

Table 13: Baseline Physical Activity in Counts Per Minute

	Whole Sample						Control Sample						Intervention Sample					
	M			F			M			F			M			F		
Week Day	623.20	±	137.02	523.58	±	134.45**	634.25	±	147.83	525.10	±	134.9**	611.96	±	125.40	522.42	±	135.19**
School Day	657.06	±	151.36	534.29	±	149.95**	667.25	±	161.34	515.18	±	144.25**	646.69	±	141.18	548.78	±	153.7**
School-related	663.00	±	154.45	538.26	±	147.71**	677.08	±	162.83	521.29	±	142.01**	648.67	±	145.48	551.12	±	151.76**
Out of School	567.09	±	192.84	508.65	±	226.04*	573.20	±	201.19	518.01	±	293.03	560.87	±	185.57	501.56	±	159.97

*Significant difference between males and females at p <. 05 level

** Significant difference between males and females at p <. 001 level

When mean CPM of the different sampling periods were compared for the whole sample, there were no significant differences between school day and school-related CPM ($t(252) = -1.871$, $p = .063$, CI_{95} -10.210, 0.27). School day CPM were significantly higher than out of school CPM ($t(252) = 3.798$, $p < .001$, CI_{95} 28.08, 88.68). School-related CPM were also significantly higher than out of school CPM ($t(252) = 4.311$, $p < .001$, CI_{95} 34.39, 92.32).

However, when analyses were repeated by gender, this pattern was only evident in the male sample:

- In School Vs School-related CPM ($t(129) = -1.305$, $p = .194$, CI_{95} -14.96, 3.08);
- In School Vs Out of School CPM ($t(129) = 4.435$, $p < .001$, CI_{95} 49.78, 3130.16);
- School-related Vs Out of School CPM ($t(129) = 5.060$, $p < .001$, CI_{95} 58.35, 133.47)

There were no significant differences between CPM in the female sample:

- In School Vs School-related CPM ($t(122) = -1.484$, $p = .141$, CI_{95} -9.26, 1.33);
- In School Vs Out of School CPM ($t(122) = 1.121$, $p = .265$, CI_{95} -19.70, 70.98);
- School-related Vs Out of School CPM ($t(122) = 1.33$, $p = .185$, CI_{95} -14.42, 73.63)

Baseline Physical Activity by Year Group

The second key aim of the intervention was to increase physical activity levels of older children to reduce the age-related decline in physical activity levels, whilst increasing physical activity levels in younger children. This section examines the pre-intervention physical activity levels by year group.

There were no clear age-related trends in the relative contributions of in school and out of school physical activity. School-related activity compared to out of school activity by year group is illustrated in Figure 8.

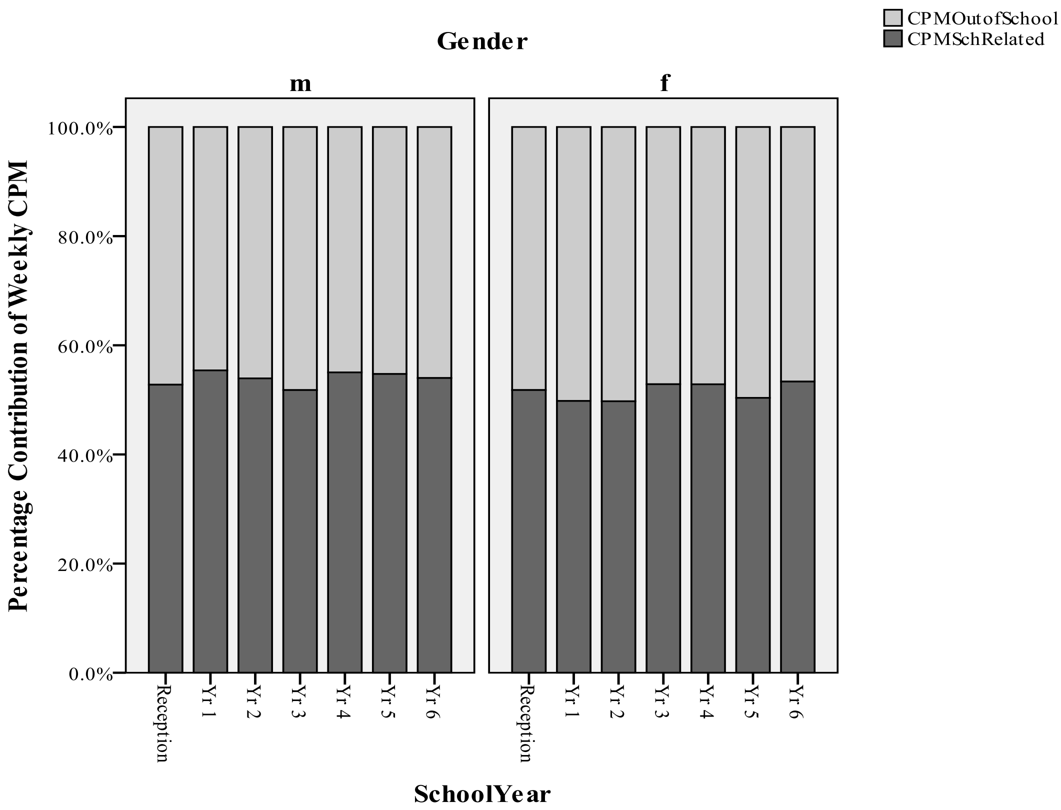

Figure 8: Relative Baseline In-School and Out of School CPM by School Year and Gender (Percentages Displayed Within Bars)

Despite a downward trend in physical activity as Year group increases (Figure 9), a one-way ANOVA using whole sample data showed that there were no significant differences between the Year Groups in week day CPM (F (8, 251) = 1.570, p = .157), school day CPM (F (8, 251) = .699, p = .651), school-related CPM (F (8, 251) = .885, p = .507) or out of school CPM (F (8, 251) = .1.304, p = .256).

This pattern was evident in the male and female samples:

Male:

- Week day CPM (F (6, 125) = 1.167, p = .329);
- School day CPM (F (6, 125) = .695, p = .655);
- School-related CPM (F (6, 125) = .720, p = .635);
- Out of school CPM (F (6, 125) = .645, p = .694),

Female:

- Week day CPM (F (6, 116) = 2.090, p = .061);
- School day CPM (F (6, 116) = .828, p = .551);
- School-related CPM (F (6, 116) = 1.247, p = .289);
- Out of school CPM (F (6, 116) = 1.327, p = .252).

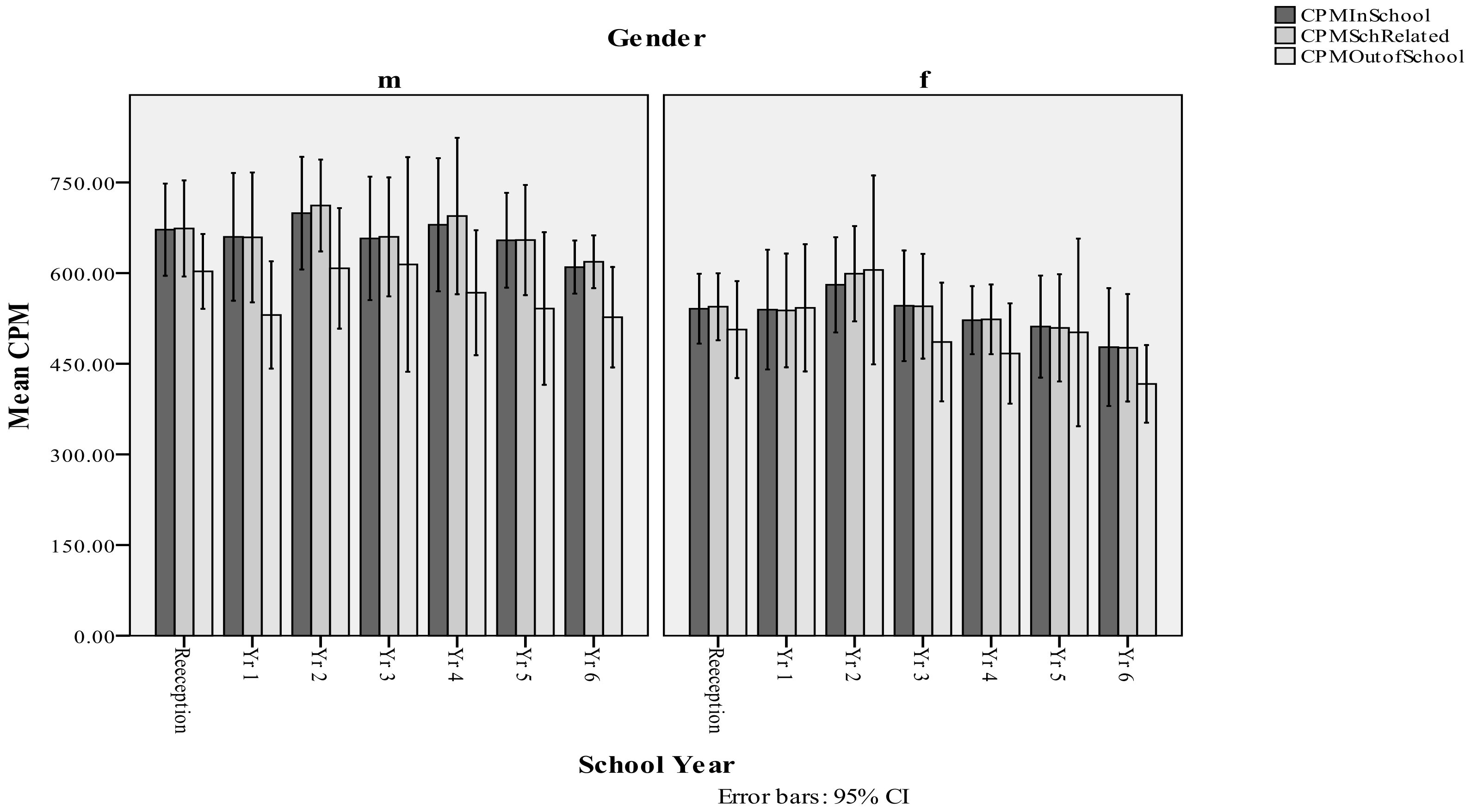

Figure 9: Baseline Physical Activity (CPM) by School Year and Gender

Baseline Physical Activity by BMI

The final key aim of the intervention was to ensure that physical activity opportunities were accessible to all children, with no differences in the physical activity levels of children according to BMI. This section examines the pre-intervention physical activity levels of participants, by BMI.

A Pearson product-moment correlation coefficient found that BMI was significantly correlated with Week Day CPM (r = -.163, n = 253, p = .015); School Day CPM (r = -.138, n = 253, p = .040); and School-related CPM (r = -.143, n = 253, p = .034). There was no significant correlation between BMI and Out of School CPM (r = -.088, n = 253, p = .194). Children with a higher BMI had lower levels of physical activity (Figure 10).

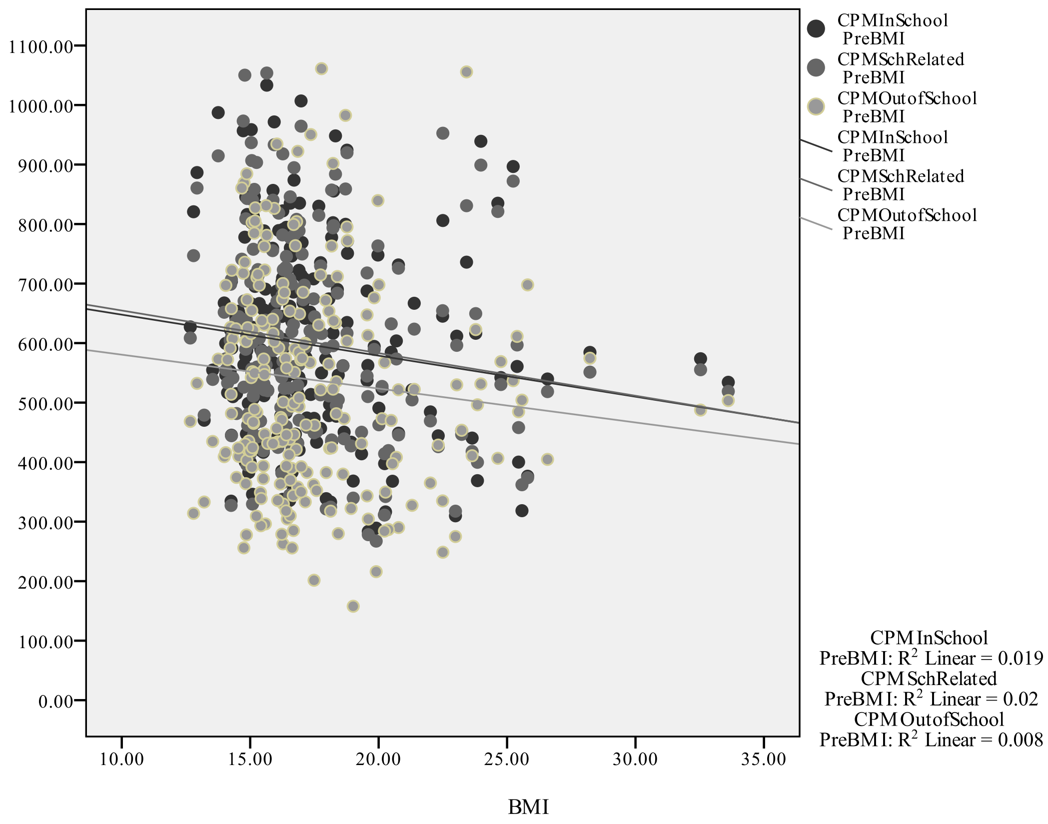

Figure 10: Baseline Counts Per Minute by Body Mass Index

Moderate to Vigorous Physical Activity

Key literature has highlighted problems associated with thresholds developed to identify moderate and vigorous physical activity (see Chapter 2.1.2). Using the physical activity intensity cut-off points derived by Trost, et al. (2002), 100% of primary school children in this sample appeared to achieve the recommended 60 minutes of moderate-to-vigorous physical activity (MVPA) per day. However, when alternative intensity cut-off points were applied, derived by Puyau, et al. (2002), less than 4% of primary school pupils met the recommended levels of physical activity. This finding highlights how the use of activity thresholds is problematic, echoes findings from previous research (Guinhouya, et al., 2006), and vindicates use of counts per minute as the main physical activity outcome.

7.1.3 Discussion of Baseline Physical Activity

Data showed the control and intervention schools provided a good baseline; despite some inter-school differences, there was no overall difference in physical activity in the control versus intervention schools. Consistent with previous research (Broderson, Steptoe, Boniface, & Wardle, 2007; Nader, et al., 2008; Riddoch, et al., 2007), males were significantly more physically active than girls across all of the four time periods of interest: week day; school day; school-related; and out of school. This was true when data for control and intervention samples were disaggregated, with the exception of out-of-school physical activity.

Across the whole sample, levels of out-of-school physical activity (per unit time) were significantly lower than in school and school-related activity. There was no significant difference between in school and school-related activity. This finding highlights the important role of the physical activities undertaken out of the school day, but before 4pm, such as extra-curricular activities and travelling home from school. The important contribution of these activities towards overall weekly physical activity reflects similar previous research findings (Cooper, Andersen, Wedderkopp, Page, & Froberg, 2005; Cooper, Page, Foster, & Qahwaji, 2003). This pattern of activity was only evident in the male sample, which suggests that the school is providing the majority of opportunities for males to be physically active. Females on the other hand had lower physical activity during the school day, and were not compensating for this with any more physical activity out of school. These findings support the notion that more opportunities need to be provided for children, especially girls, to increase their physical activity levels during school time. Previous researchers have highlighted the potential contribution of physical activity during the school day on total weekly physical activity (Fairclough & Stratton, 2005; Ridgers, et al., 2005). Evidence from Dale, Corbin and Dale (2000) suggested that establishing opportunities for physical activity during school time has a positive effect on physical activity levels outside of school. This study also found that limiting physical activity during school time reduced the amount of physical activity undertaken outside of school (Dale, et al., 2000).

A non-significant trend in physical activity was evident between year groups, decreasing from younger to older children. It was expected that levels of physical activity would be lower in the older Year Groups (Bravata, et al., 2007; Sherar, Esliger, Baxter-Jones, & Tremblay, 2007; Shrima & Min Lee, 2010).

Patterns of activity were clustered around key time points within the school day. Activity peaked between 8am and 9am, when children would be travelling to school; between 12pm and 1pm, during the school lunchtime period; and between 3 and 4pm, when it would be expected that children would be travelling home from school or participating in extra-curricular school activities. Again, the importance of active travel modes, recess periods, and extracurricular physical activity is inferred (Cooper, et al., 2005).

As suggested by previous research, the application of different MVPA thresholds yielded remarkably different results. Using the thresholds derived by Trost, et al. (2002), it appeared that 100% of the participants achieved the recommended 60 minutes per day of MVPA. This is similar to previous research which also used the same thresholds (Riddoch, et al., 2004; Trayers, et al., 2006). However, when the data were analysed using the MVPA cut-offs derived by Puyau, et al. (2002), less than 4% of the sample met the recommended physical activity guidelines.

This finding is similar to previous research findings (see Chapter 2.1.2). It is widely acknowledged that the application of thresholds to calculate MVPA requires further examination. Intensity thresholds/cut points that were commonly used, until recently, were often derived from age, and did not account for height or weight, which could potentially influence the calculations of MVPA (Sirard, et al., 2005). The nature of the relationships between height, weight and gait need to be further examined, as height and body composition cannot be generalised across age groups. Preferably, this would enable a general consensus to be agreed upon within the literature that would determine MVPA, taking these criteria into account (Gidlow, et al., 2008).

In the absence of consensus, cut points derived from individual calibrations for each child have been used (Mattocks, et al., 2007). However, resource implications meant that such calibration was not feasible in this study, nor in many large scale studies. Despite the conflicting reports of time spent in MVPA, it was evident that the overall contribution of school physical activity could be increased to a larger proportion. Physical activity undertaken immediately after school appeared to make a substantial contribution to overall physical activity, and this needed to be highlighted and maximised within primary schools.

7.2 Measurement and Summary of Post-intervention Physical Activity Levels

7.2.1 Method

The method for the post-intervention measurement of physical activity levels followed the same procedures as the pre-intervention phase; additional procedures are explained here (see section 7.1.1 for a full description and rationale of chosen methods).

Given the intervention focus on physical activity in and around the school day, physical activity was measured over a five day period (Monday to Friday), again using minute-by-minute accelerometry (see Chapter 2.1.2 for an in-depth review of physical activity measurement methods and Appendix 17 for post-intervention data collection timetable). A larger than expected number of non-consent and absences were seen during the pre-intervention phase, therefore it was decided to sample 75 pupils from each school (rather than the 60 sampled at the pre-intervention phase), to ensure every school had a minimum of 30 participants.

The post-intervention phase aimed to include as many of those individuals who participated in the pre-intervention phase as possible. All of the previous Year 6 pupils were removed from the post-intervention data collection list, as these pupils had progressed to Secondary School. The UPNs of remaining pupils who participated in the pre-intervention phase were positioned at the top of the data collection sheets for each school, and marked with a star. Additional participants were randomly selected from the school register in liaison with a Primary Link Teacher or other designated member of staff (using the same method for selecting the whole sample invited to participate in the pre-intervention phase).

The data collection followed the exact procedures as at baseline (see Chapter 7.1.1 for an in-depth overview, and Appendix 17 for post-intervention data collection timetable). Many of the school staff were familiar with the data collection process, due to their involvement in the pre-intervention phase. The researcher was also familiar with many of the pupils and staff in the intervention schools, following the delivery of the intervention activities. The post-intervention data collection ran smoothly as a result.

Analysis

Collected data were again downloaded using the ActiGraph GT1M compatible ActiLife desktop analysis software programme and processed using the MAHUffe software (www.mrc-epid.cam.ac.uk), and employing the same criteria for data inclusion (less than 500 minutes/day of activity counts on at least three days in the week, and excluding consecutive strings of zero-count epochs lasting upwards of 20 minutes).

Physical activity was again expressed as accelerometer counts per minute, which were averaged for each day and explored for the same sampling periods: Week day physical activity; School day physical activity; School-related physical activity; Out of school physical activity. Data were tested for normal distribution and the descriptive and inferential statistical tests used at baseline were repeated, in addition to Analysis of Covariance (ANCOVA), which was used to explore differences in pre-intervention and post-intervention physical activity measures. Adjusting for the pre-test measure included as a covariate enabled the detection of differences in post-test measures between intervention and control groups. It is possible that a significant treatment effect may be detected using ANCOVA, while the t-test does not, and vice-versa.

Where data were selected to compare groups within groups, the degrees of freedom are small. For example, although appropriate estimations were calculated to determine the sample size required, comparisons between schools, and amongst males and females in the intervention and control schools mean that the degrees of freedom were small. However, in the male and female groups, the confidence intervals for the differences between the means and the width of these confidence intervals suggest that statistical significance can be inferred where $p < .005$ (see Appendix 18 for raw data). The results are presented by schools and sampling periods, by gender, by year group, and by BMI, to enable clear exploration of the intervention aims (see Chapter 6).

7.2.2 Post-intervention Results

Sample Characteristics

Data were initially collected from a total of 353 participants post-intervention (average 47.75 per school). Following exclusions for incomplete data and data reduction, the final sample comprised 245 participants (an average of 30.6 per school) (Table 14).

Table 14: Post-intervention Sample Characteristics

		n	%
Age (years)	Range	5.0 – 11.8	-
	Mean	7.54 ± 2.23	-
Gender	Male	120	48.6
	Female	125	51.4
Weight	Normal	185.3	75%
	Overweight or Obese	56.8	23%
	Obese	5.6	10%
Ethnicity	White British	228.5	92.5
	Pakistani	6.1	2.5
	Other	11.2	4.5
Deprivation quintile[1]	1 (most deprived	106	43
	2	78	31.4
	3	44	18
	4	13	5.6
	5 (least deprived)	1	0.4
	Unknown	4	1.6

Representation across Year Groups and Key Stages is presented in Table 15.

Table 15: Post-intervention Participant Distribution Across School Year and Key Stage

School Year	%	Key Stage	%
R	6.5	F	6.1
1	11.7	1	26.7
2	15	1	
3	18.2	2	66.8
4	18.2	2	
5	17	2	
6	13.4	2	

R[1] = Reception Year
F[2] = Foundation Stage

Approximately equal numbers of boys and girls participated in the post-intervention phase of this study. The distributions of ethnicity and deprivation changed very little from the pre-intervention phase of the study, low ethnic diversity and overrepresentation of children from deprived areas.

Post-intervention Physical Activity across Schools and Sampling Periods

Physical activity levels in the intervention schools were significantly higher than in the control schools across all of the sampling periods (Table 16).

Table 16: Post-intervention Control and Intervention CPM

	Control			Intervention			Significance
Week Day	689.56	±	91.08	734.05	±	72.89	$t(245) = 4.240, p < .001$
School Day	560.69	±	148.54	623.21	±	154.59	$t(245) = 3.241, p = .001$
School-related	583.91	±	162.46	641.78	±	163.14	$t(245) = 2.793, p = .006$
Out of School	643.99	±	354.06	762.77	±	304.35	$t(245) = 2.828, p = .005$

An ANCOVA was used to further explore the effect of the intervention between overall measures of pre and post physical activity. Levene's was not significant ($F(1,244) = 3.197, p = .075$), therefore assumptions of homogeneity of variance were met. Having accounted for the pre-intervention variance in the post-measures, findings were still significant ($F(1,244) = 14.323$, $p < .001$), indicating that there was a significant difference in the change in physical activity between the control and intervention participants, even after pre measures had been accounted for. The estimated marginal means showed that the intervention group physical activity measures were higher (734.21, CI_{95} 718.06, 750.36) than the control group measures (690.33, CI_{95} 674.18, 706.48).

Amongst the intervention schools significant differences were found between the pre- and post-intervention physical activity levels for whole day physical activity ($t(115) = -10.917$, $p < .001$, CI_{95} -198.41, -137.41), school-related physical activity ($t(115) = -2.270$, $p = .025$, CI_{95} -98.12, -6.61), and out of school physical activity ($t(115) = -6.652$, $p < .001$, CI_{95} -312.44, -168.93).

Amongst the control schools significant differences were found between the pre- and post-intervention physical activity levels for the whole day physical activity ($t(128) = -6.073$, $p < .001$, CI_{95} -139.76, -70.95) and out of school physical activity ($t(128) = -2.125$, $p = .036$, CI_{95} -185.69, -6.40). Despite these significant changes in physical activity amongst some of the sampling periods, levels were still higher in the intervention schools than in the control schools (Table 16).

School day physical activity was also examined by school, to explore the impact on the intervention on individual schools. School day physical activity in the control schools had not changed significantly post-intervention, with the exception of school CC, where children's physical activity levels had decreased significantly. School day physical activity in the intervention schools had increased post-intervention, with the exception of school TW, whose physical activity levels had decreased, although not significantly (Figure 11). However, comparison of groups within groups such as schools within intervention and control groups means the degrees of freedom were small. The significance of individual school findings must, therefore, be treated with caution. Intervention and control group data provide a more robust exploration of intervention impact.

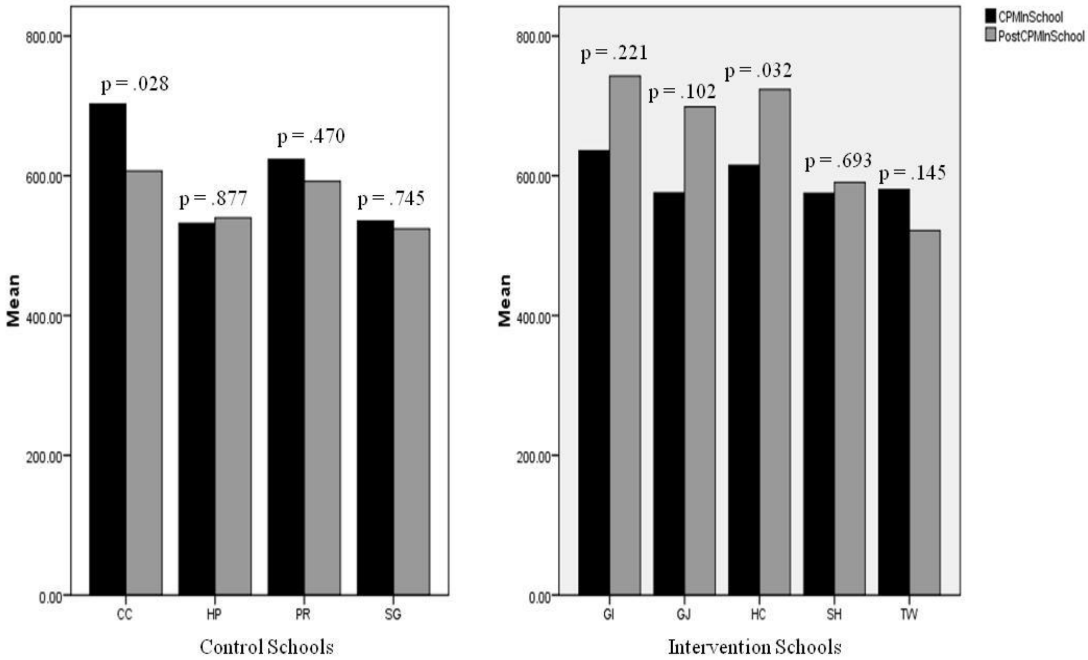

Figure 11: Post-intervention Physical Activity by School

Physical activity CPM were also explored again by time of day. The pre-intervention time of day analysis revealed that physical activity levels across the whole sample were highest between the hours of 8am – 9 am (622.54 ± 71.93); 12pm – 1pm (795.36 ± 158.52); and 3pm – 4pm (736.94 ± 111.05), and that this pattern was evident in both the control and the intervention schools (Figure 7). This finding reflected physical activity levels commuting to and from school, and during lunchtime. The post-intervention time of day explorations also revealed peaks in physical activity commuting to and from school, and also at lunchtime and after school (Figure 12). Clear differences can be seen between the intervention and control schools, with the intervention schools demonstrating higher physical activity levels particularly at lunchtime and after school, and reflecting the break-time, lunchtime and extracurricular intervention activities (Figure 12).

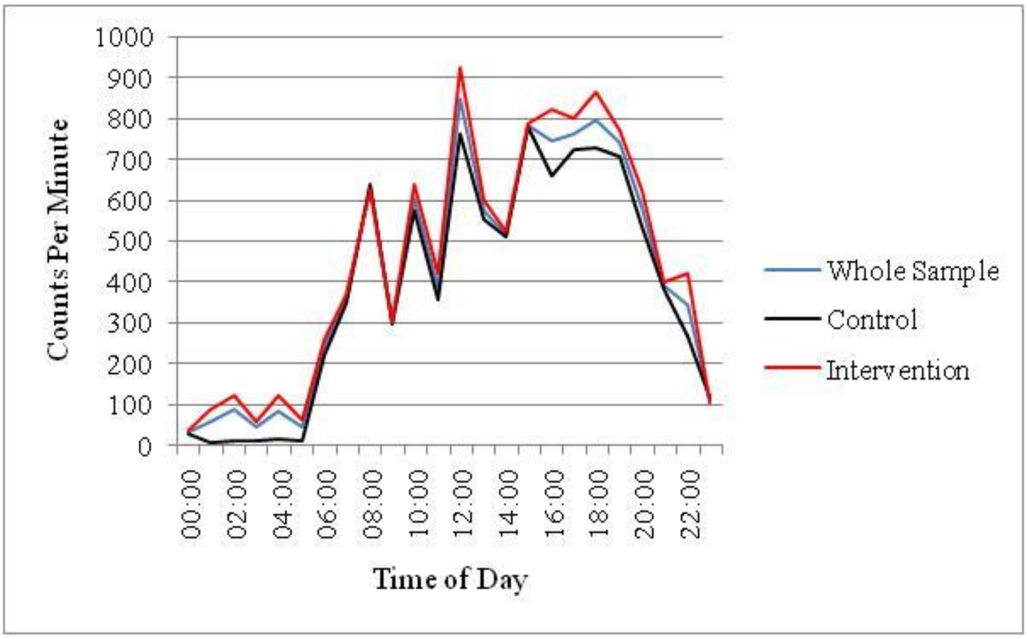

Figure 12: Post-intervention Counts Per Minute by Time of Day

Post-intervention Physical Activity by Gender

This section addresses the intervention aim to increase physical activity levels in girls to reduce the gender discrepancy, whilst also increasing physical activity levels in boys.

Physical activity in mean CPM is presented for pre and post-intervention sampling periods for the total control schools; and intervention schools (Table 17). The results of independent T-tests are presented alongside any significance of differences between physical activity levels in males and females.

Table 17: Post-intervention Physical Activity in CPM (Presented with Pre-Intervention Data for Comparison)

Pre-Intervention

	Control Sample						Intervention Sample					
	M			F			M			F		
Pre-Week Day	634.25	±	147.83	525.10	±	134.9**	611.96	±	125.40	522.42	±	135.19**
Pre-School Day	667.25	±	161.34	515.18	±	144.25**	646.69	±	141.18	548.78	±	153.7**
Pre-School-related	677.08	±	162.83	521.29	±	142.01**	648.67	±	145.48	551.12	±	151.76**
Pre-Out of School	573.20	±	201.19	518.01	±	293.03	560.87	±	185.57	501.56	±	159.97

Post-Intervention

	Control Sample						Intervention Sample					
	M			F			M			F		
Post-Week Day	705.43	±	90.25	675.40	±	90.15	735.67	±	82.81	732.47	±	62.43
Post-School Day	572.32	±	140.32	550.32	±	155.85	634.57	±	135.87	612.21	±	171.15
Post-School-related	596.02	±	155.74	573.09	±	168.69	652.89	±	149.41	631.02	±	175.95
Post-Out of School	713.78	±	417.69	581.72	±	274.28*	760.37	±	291.99	765.08	±	318.19

*Significant difference between males and females at p <. 05 level
** Significant difference between males and females at p <. 001 level

In the intervention schools the post-intervention physical activity levels in males were significantly higher than pre-intervention for whole school physical activity ($t(56) = -6.722$, $p < .001$, CI_{95} -202.34, -109.24) and out of school physical activity ($t(56) = -4.488$, $p < .001$, CI_{95} -316.96, -120.98). Post-intervention physical activity levels in females were also significantly higher than pre-intervention for whole school physical activity ($t(58) = -8.792$, $p < .001$, CI_{95} -220.55, -138.58), and out of school physical activity ($t(58) = -4.884$, $p < .001$, CI_{95} -369.04, -154.11).

In the control schools the post-intervention physical activity levels in males were significantly higher than pre-intervention for whole school physical activity ($t(61) = -5.248$, $p < .001$, CI_{95} -183.76, -81.99), and out of school physical activity ($t(61) = -2.356$, $p = .023$, CI_{95} -307.53, -24.38). Post-intervention physical activity in females was significantly higher than pre-intervention for whole school physical activity ($t(68) = -3.400$, $p < .001$, CI_{95} -127.00, -32.75). These findings showed that apparent changes for the total sample were evident in both sexes when analysed separately.

In contrast to the pre-intervention results, there were no significant differences between physical activity levels of males and females in the intervention sample (Table 17). Physical activity levels were lower in the female control sample than the female intervention sample. Physical activity levels in the female intervention sample were now comparable to the physical activity levels in the male intervention sample (Figure 13). This finding demonstrated that the intervention had a positive impact on the physical activity levels of females, one of the three intervention aims (Chapter 6).

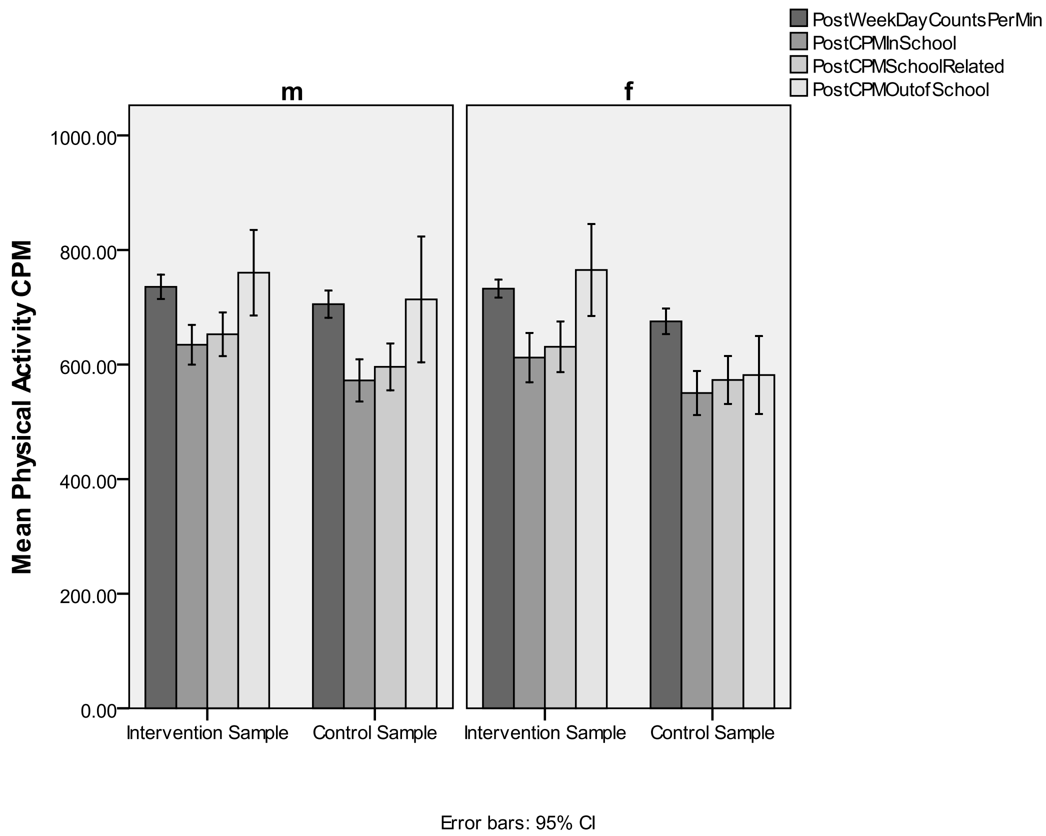

Figure 13: Post-intervention CPM for Intervention and Control Schools, by Gender

Post-intervention Physical Activity by Year Group

This section explores the physical activity levels of older children, and the impact of the intervention on the age-related decline of physical activity in older children. The intervention schools showed significant differences between the Year Groups in week day CPM (F (6, 123) = 4.172, p = .001); school day CPM (F (6, 123) = 2.275, p = .041); and school-related CPM (F (6, 123) = 2.519, p = .025) (using a one-way ANOVA). Rather than physical activity levels being lower in the older Year Groups as expected, physical activity levels of Years 1, 3, 4, 5, and 6 were significantly higher than Reception and Yr 2.

The control schools showed no significant differences between the physical activity levels amongst the Year Groups (week day CPM (F (6, 116) = 1.531, p = .174); school day CPM (F (6, 116) = 1.134, p = .347); school-related CPM (F (6, 116) = 1.798, p = .105); and out of school CPM (F (6, 116) = .904, p = .495) (using a one-way ANOVA) (Figure 14).

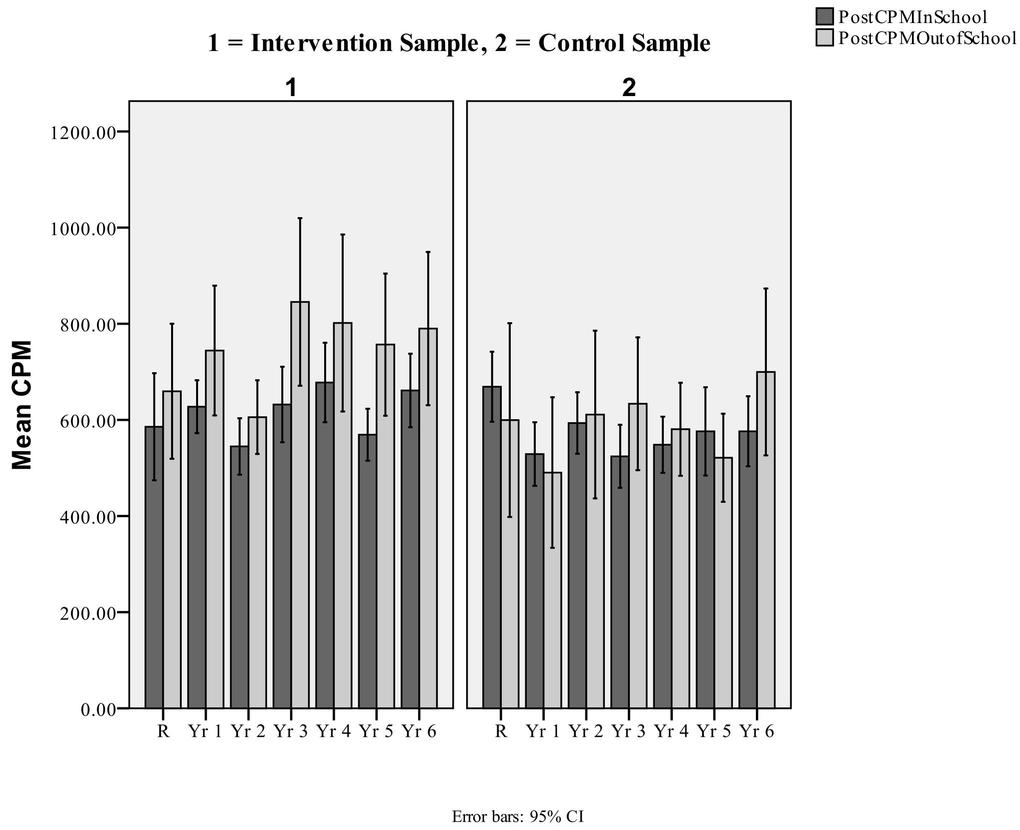

Figure 14: Post-intervention Intervention and Control Sample Differences in CPM, by School Year Group

There were no differences between physical activity levels of school year groups in the male intervention sample (week day CPM (F (6, 56) = 1.375, p = .242); school day CPM (F (6, 56) = 969, p = .455); school-related CPM (F (6, 56) = .608, p = .723); and out of school CPM (F (6, 54) = .368, p = .896) (using a one-way ANOVA).

However, differences between physical activity levels of school year groups were significant in the intervention female sample (week day CPM (F (6, 58) = 4.358, p = .001); school day CPM (F (6, 58) = 2.966, p = .014); school-related CPM (F (6, 58) = 2.732, p = .021). There were no significant differences between year groups and out of school CPM (F (6, 58) = 1.482, p = .201) (using a one-way ANOVA). These differences are shown in Figure 15.

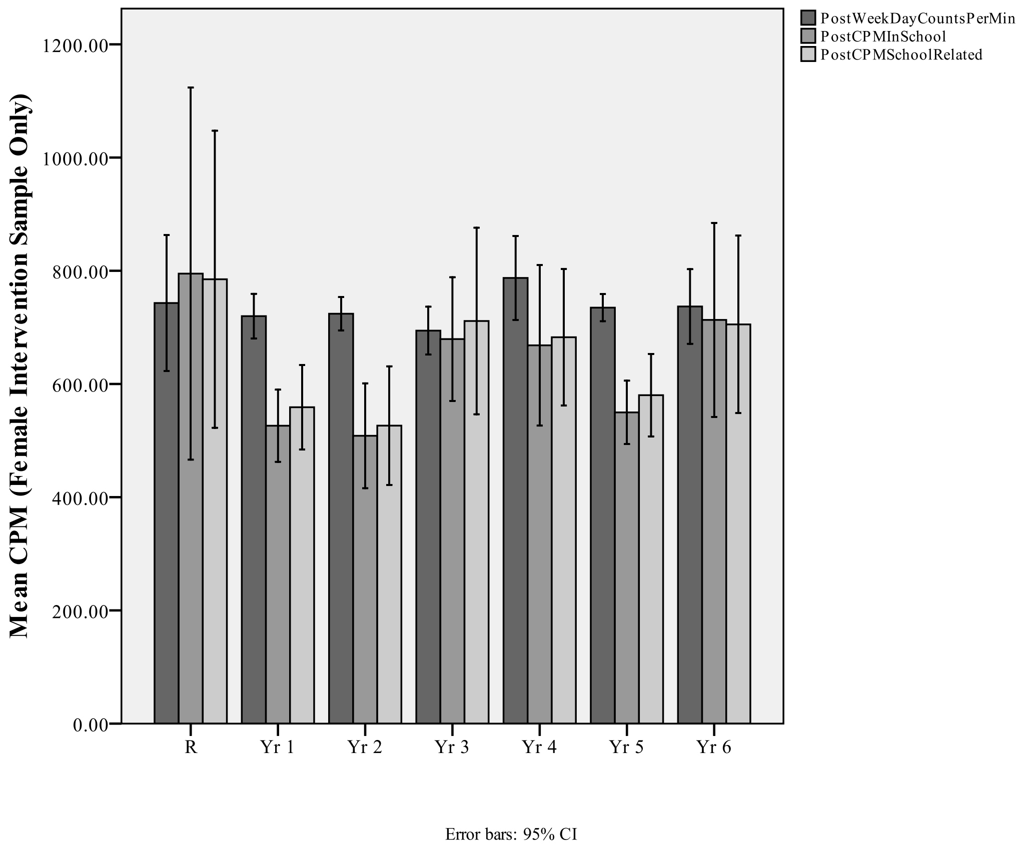

Figure 15: Post-intervention Differences in Physical Activity by School Year in the Female Intervention Sample

Post-intervention Physical Activity by BMI

A key intervention aim was to ensure that all children had the opportunity to participate in physical activity, regardless of BMI. Paired t-tests showed a significant change in BMI in the intervention sample, whereby mean BMI before the intervention was higher (17.76 ± 3.63) than BMI post-intervention (16.52 ± 2.68) ($t(115) = 2.662$, $p = .009$). In the control group, there was no significant difference in BMI between the pre- (17.13 ± 2.74) and post- measures (16.86 ± 2.77) ($t(128) = .679$, $p = .499$).

A Pearson product-moment correlation coefficient was used to explore correlations between physical activity and BMI in the intervention and control samples. In the intervention sample, there were no significant correlations between BMI and post-intervention Week Day (CPM) (r = -.003, n = 116, p = .977); In School CPM (r = -.045, n = 116, p = .629); School-related CPM (r = -.037, p = 691); and Out of School COM (r = -.006, p = .952).

In the control sample, significant correlations were found between BMI and In School CPM (r = -.339, p < .001); and School-related CPM (r = -.330, p < .001) (Figure 16). This finding showed that in the control schools, there was an inverse association between BMI and physical activity.

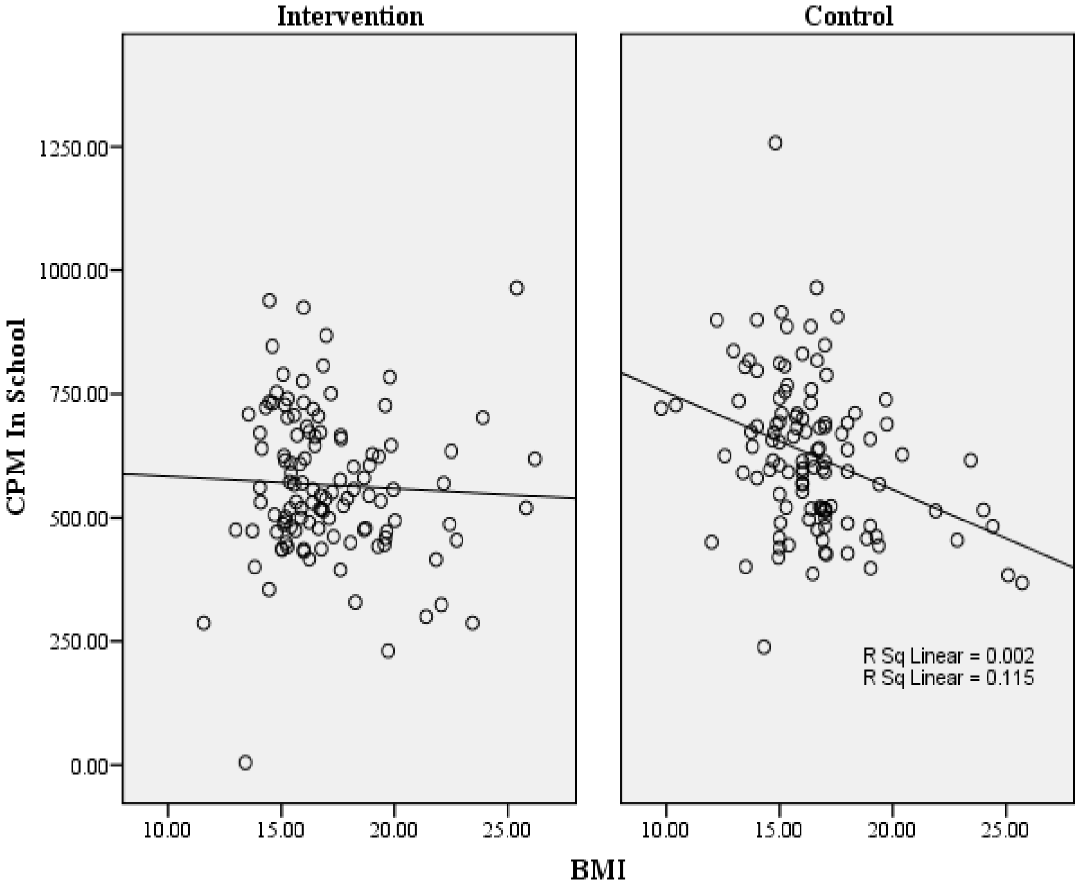

Figure 16: Post-intervention Relationship Between BMI and In School Physical Activity, by Intervention and Control Sample

7.2.3 Discussion of Post-intervention Physical Activity

Changes in Physical Activity

Post-intervention physical activity data revealed that across all of the sampling periods, physical activity was significantly higher in the intervention schools than in the control schools, after adjusting for baseline levels; i.e. the change in physical activity was greater in intervention than control schools. Interesting findings related to the changes in physical activity by gender, school year, and BMI.

Gender

Physical activity levels before the intervention were higher in males than in females, consistent with previous evidence (Broderson, et al., 2007 Nader, et al., 2008). At follow-up, this pattern was still evident in the control school across some of the sampling periods, but not in the intervention schools (for any of the sampling periods). In the intervention schools, levels of both male and female physical activity had significantly increased, but with no significant difference between the two groups. The intervention had aimed to address the unbalanced levels of physical activity between the boys and the girls. The focus group interviews provided the opportunity for girls (particularly older girls) to discuss what they liked and disliked about PE, and opportunities for physical activity in their school. To further enhance this understanding, the environmental audit provided the opportunity to observe and examine how the environment may impact on girls. Some of the intervention initiatives were specifically designed to help encourage girls in particular to be more physically active, and these findings suggest this has been successful.

Age

Pre-intervention physical activity levels showed lower physical activity across increasing School Year Groups. Based on previous evidence this finding was to be expected (Brevata, et al., 2007; Sherar, et al., 2007; Shiroma & Min Lee, 2010). In the post-intervention exploration there were no significant differences found between Year Groups and physical activity levels in the control sample. Conversely the intervention sample did show significant differences in physical activity levels between Year Groups in the opposite direction; physical activity levels of Years 1, 3, 4, 5, and 6 were significantly higher than Reception and Yr 2. One of the aims of the intervention was to address the unbalanced levels of physical activity between the older and younger primary school children. Whilst the younger primary school children found much of their physical activity in spontaneous play, the focus groups found that activities addressed towards older children needed to be tailored to their desires in both activity type and delivery.

The results showed that this element of the intervention was successful in increasing the physical activity levels in the older school years. However, it would have been ideal to have found higher levels of physical activity across all the school Year Groups, with no differences across amongst these levels.

BMI

The findings of this current study showed that, in the control sample, physical activity was negatively correlated with BMI, echoing findings from previous research (Cherkas, et al., 2008). However, in the intervention sample there were now no significant correlations between physical activity and BMI.

The intervention aimed to provide opportunities for physical activity that were accessible and tailored towards all of the school children. The purpose of the intervention was to provide a whole school approach to physical activity, changing the environment to encourage and support all children to be physically active. Whilst obesity is an important factor related to physical activity, this intervention recognised the importance of ensuring that all children are physically active, rather than targeting only obese or overweight children.

7.3 Measurement and Summary of Six-Month Post-intervention Physical Activity Levels

It is widely acknowledged that the effects of a health promotion intervention cannot be clearly understood without measuring the target behaviour over a longer-term (Donnelly, et al., 2009; Hardman, et al., 2009; Pate, et al., 2007). To this end, physical activity measurements were repeated six-months after the intervention had finished.

7.3.1 Method

The method for the six-month post-intervention measurement of physical activity levels followed the same procedures as the post-intervention phase (see Chapter 7.1.1 for a full description and rationale of these chosen methods).

Analysis

To enable effective comparison, the data were again downloaded using the same ActiGraph GT1M compatible ActiLife desktop analysis software programme. The same procedures for data reduction and further analysis were followed as baseline (Chapter 7.1.1) and post-intervention (Chapter 7.2.1). Physical activity was again expressed as accelerometer counts per minute, which were averaged for each day and explored for the same sampling periods: Week day physical activity; School day physical activity; School-related physical activity; Out of school physical activity. Data were tested for normal distribution, and the same descriptive and inferential statistical tests repeated as at post-intervention (see Chapter 7.2.1). It is also important to again note that where data were selected to compare groups within groups, the degrees of freedom are small. Results are presented by schools and sampling periods, by gender, by year group, and by BMI, to enable clear exploration of the intervention aims (see Appendix 19 for raw data).

7.3.2 Results

Sample Characteristics

Data were initially collected from a total of 338 participants (average 42.3 per school). As with the pre- and post-intervention phases, participants who did not record 500 minutes/day of activity counts for at least 3 days were excluded. Further data reduction and cleaning resulted in a final sample of 262 participants (Table 18).

Table 18: Six-month Post-intervention Sample Characteristics

		n	%
Age (years)	Range	4.4 – 11.8	-
	Mean	7.52 ± 2.26	-
Gender	Male	128	49.1
	Female	131	50.9
Weight	Normal	199.1	76%
	Overweight or Obese	62.8	24%
	Obese	6.3	10%
Ethnicity	White British	241.8	92.3
	Pakistani	6.5	2.5
	Other	12.1	4.6
Deprivation quintile	1 (most deprived)	115	43.9
	2	84	32.1
	3	45	17.2
	4	14	5.3
	5 (least deprived)	1	0.4
	Unknown	3	1.1

Approximately equal numbers of boys and girls participated in the six-month post-intervention phase of this study. The distributions of ethnicity and deprivation changed very little since the pre-intervention phase of the study with low levels of ethnic diversity and high deprivation that were representative of Stoke-on-Trent.

Six-Month Post-intervention Physical Activity across Schools and Sampling Periods

Physical activity in counts per minute (CPM hereafter) is presented across the sampling periods for the total control schools; and intervention schools (Table 19). Post-intervention data are also presented here to allow for comparison.

Table 19: Six-month Post-intervention Physical Activity in CPM (Presented with Post-Intervention Data for Comparison)

Post-intervention

	Control Sample						Intervention Sample					
	M			F			M			F		
Post-Week Day	705.43	±	90.25	675.40	±	90.15	735.67	±	82.81	732.47	±	62.43
Post-School Day	572.32	±	140.32	550.32	±	155.85	634.57	±	135.87	612.21	±	171.15
Post-School-related	596.02	±	155.74	573.09	±	168.69	652.89	±	149.41	631.02	±	175.95
Post-Out of School	713.78	±	417.69	581.72	±	274.28*	760.37	±	291.99	765.08	±	318.19

Six-month Post-intervention

	Control Sample						Intervention Sample					
	M			F			M			F		
Post-Week Day	701.98	±	79.39	672.72	±	96.62	728.03	±	78.87	722.46	±	57.28
Post-School Day	565.25	±	130.9	547.40	±	152.72	622.57	±	133.82	602.70	±	150.03
Post-School-related	585.68	±	139.08	573.23	±	168.73	647.97	±	145.13	624.67	±	162.45
Post-Out of School	644.82	±	337.99	571.22	±	271.93	743.98	±	243.70	746.03	±	282.32

*Significant difference between males and females at p <. 05 level

** Significant difference between males and females at p <. 001 level

Physical activity is also examined by school, to explore further the impact of the intervention (Figure 17). The sample sizes of the school groups within the intervention arms were not large enough to explore the significance of the differences. Six-month Post-intervention physical activity levels in the control schools had decreased since the baseline measures. Conversely, the six-month physical activity levels were higher than baseline in all of the intervention schools, with the exception of one school, TW. The sample sizes of the groups mean that the intervention and control group data must be looked to for robust exploration of the impact of the intervention.

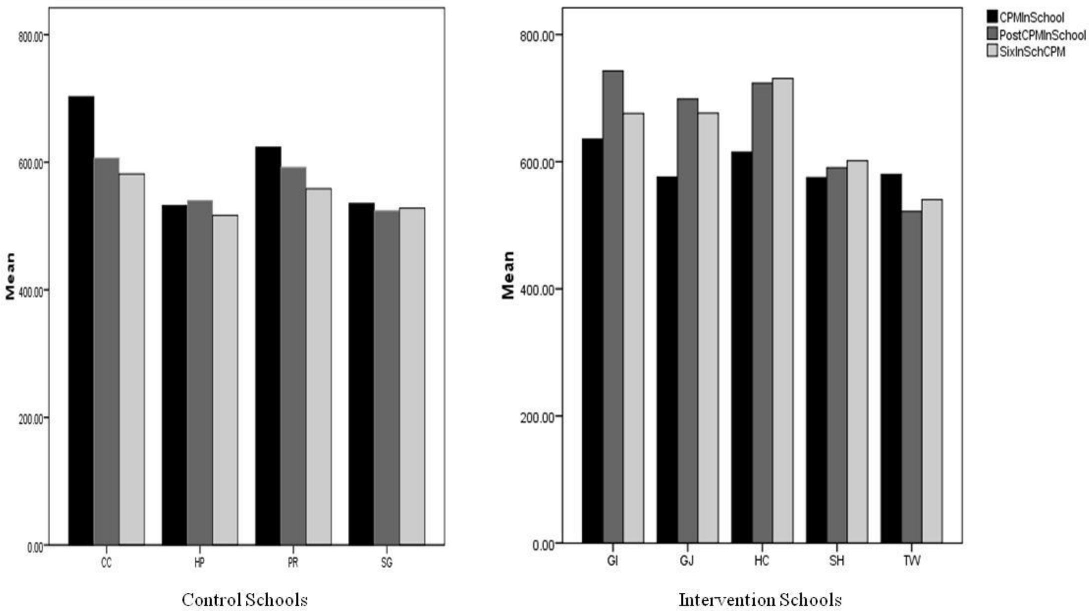

Figure 17: Pre, Post and Six-month Post-intervention Physical Activity by School

Six-Month Post-intervention Physical Activity by Gender

There were no significant differences found between the physical activity levels of the males and females in the intervention or the control samples (Table 19, Figure 18).

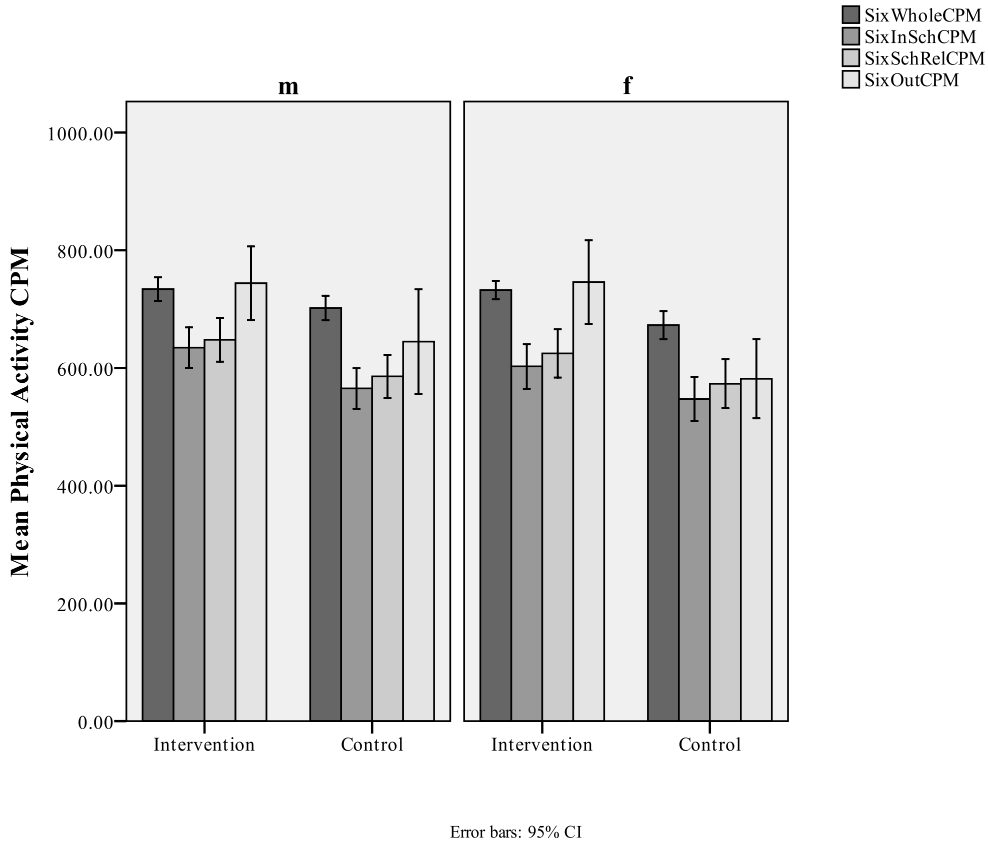

Figure 18: Six-month Post-intervention Sample Differences

There were no significant differences between post-intervention and six-month post-intervention physical activity levels in the intervention schools, across any of the sampling periods. The control sample showed a significant difference between the post-intervention (mean CPM = 554.05 ± 354.06) and six-month post-intervention (mean CPM = 505.18 ± 305.18) physical activity levels in out of school CPM ($t(129) = 2.170$, $p = .032$) (Figure 19 and Figure 20).

Post-intervention CPM

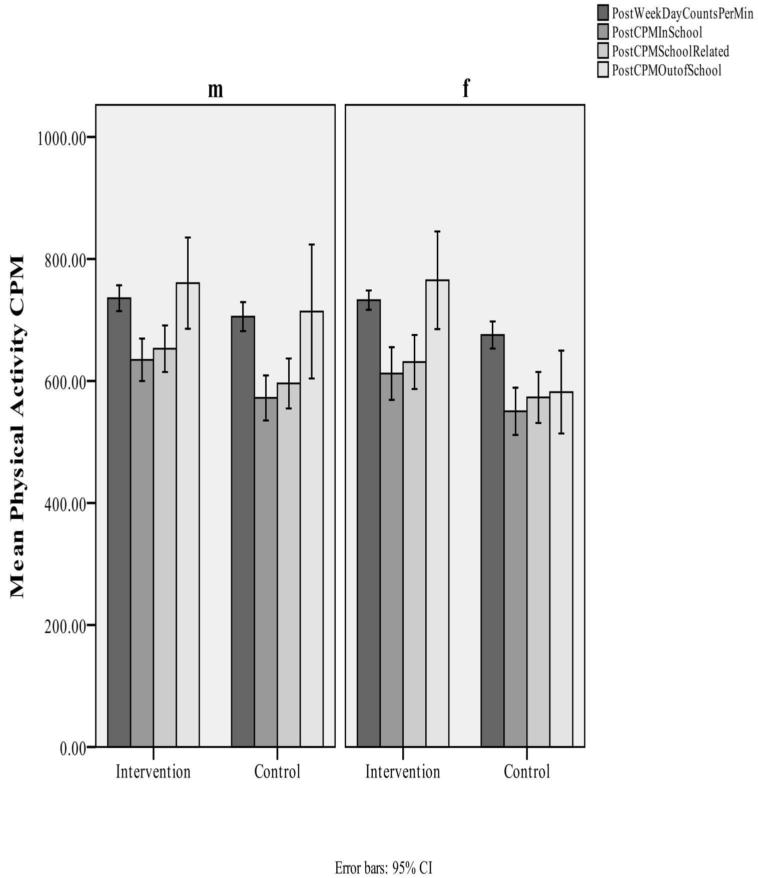

Figure 19: Post-intervention Physical Activity Differences in Control Versus Intervention Schools

Six-month Post-intervention CPM

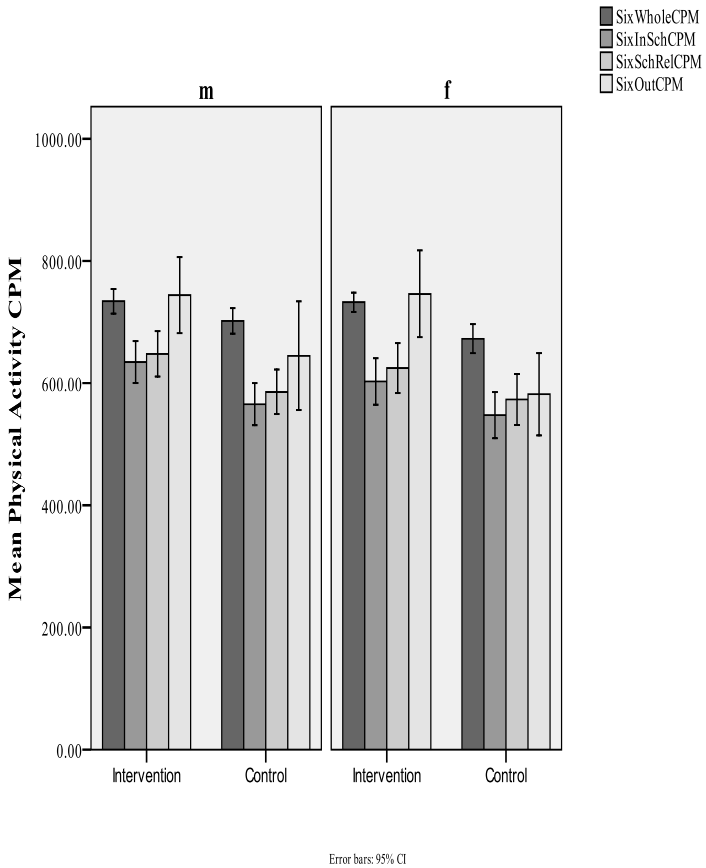

Figure 20: Six-Month Post-intervention Physical Activity Differences in Control Versus Intervention Schools

An ANCOVA was used to explore the effect of the intervention between overall measures of pre and six-months post physical activity. At six-months post-intervention Levene's was not significant (F (1,206) = 4.084, p = .055), therefore assumptions of homogeneity of variance were met. After accounting for pre-intervention variance in six-month post measures, findings were still significant (F (1,206) = 16.920, p < .001), indicating a significant difference in physical activity change between control and intervention participants, even after pre measures had been accounted for. Estimated marginal means showed intervention physical activity measures were higher (733.27, $CI_{.95}$ 717.51, 749.04) than control group measures (686.71, $CI_{.95}$ 670.95, 702.48).

An ANCOVA was also used to determine significant change in physical activity between post and six-month Post-intervention. Levene's was not significant (F (1,245) = 3.172, p = .076), therefore assumptions of homogeneity of variance were met. After accounting for variance in post-intervention measures, there were no significant changes in physical activity between post and six-month post-intervention (F (1,245) = 3.066, p = .081). Estimated marginal means showed intervention physical activity measures were slightly (but not significantly) higher (712.13, $CI_{.95}$ 708.75, 715.51) than control group measures (707.80, $CI_{.95}$ 704.41, 711.19).

Six-Month Post-intervention Physical Activity by Year Group

Similar to the post-intervention physical activity levels, the intervention schools showed significant differences between the Year Groups in school day CPM (F (6, 128) = 2.860, p = .012); and school-related CPM (F (6, 128) = 2.501, p = .026) (using a one-way ANOVA). School day physical activity was highest amongst Reception year (mean CPM = 704.37) and Yr 6 children (mean CPM = 622.56). School-related physical activity was also highest amongst Reception year (mean CPM = 741.79) and Yr 6 children (mean CPM = 640.33).

There were no differences between physical activity levels of school year groups in the male intervention sample (week day CPM (F (6, 62) = 1.423, p = .224); school day

CPM (F (6, 62) = 844, p = .542); school-related CPM (F (6, 62) = .1.518, p = .191); and out of school CPM (F (6, 57) = 1.901, p = .099) (using a one-way ANOVA).

In contrast to the post-intervention findings, there were now no differences between physical activity levels of school year groups in the female intervention sample: week day CPM (F (6, 54) = .656, p = .685); school day CPM (F (6, 65) = .926, p = .484; school-related CPM (F (6, 65) = .913, p = .493); and out of school CPM (F (6, 65) = .280, p = .944) (using a one-way ANOVA).

Six-Month Post-intervention Physical Activity by BMI

As in the post-intervention phase, a Pearson product-moment correlation coefficient was used to explore correlations between physical activity and BMI in the intervention and control samples.

In the intervention sample, there were no significant correlations found between BMI and In School CPM (r = -.033, p = .724); and School-related CPM (r = -.028, p = .765)

In the control sample, there were significant correlations found between BMI and In School CPM (r = -.355, p < .001); and School-related CPM (r = -.336, p < .001) (Figure 21).

Intervention Sample Control Sample

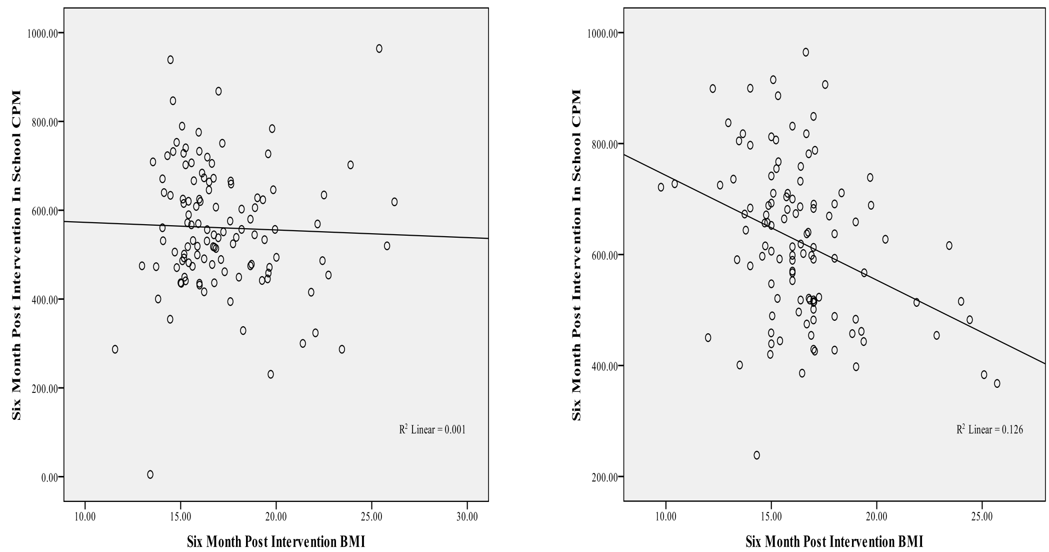

Figure 21: Six-month Post-intervention Relationship Between BMI and In School Physical Activity, by Intervention and Control Sample

7.3.3 Discussion of Six-Month Post-intervention Physical Activity

Similar to the post-intervention findings, physical activity levels across all of the sampling periods were again significantly higher in the intervention schools than the control schools. The physical activity levels across all of the sampling periods had not significantly changed in the six-month post-intervention sample. Whilst physical activity levels had not increased in the six-month post-intervention period, they had not decreased. This finding suggests that the effects of the intervention were sustained across this time period. Conversely, physical activity levels amongst the control sample had changed in the six-month post-intervention period. Levels of physical activity out of school had significantly decreased since the post-intervention measurements were taken.

The pattern of male and female physical activity was similar in the six-month post-intervention period, when compared to the post-intervention measures, whereas physical activity levels were higher in males than females before the intervention, consistent with literature (Broderson, et al., 2007). There were no differences in post-intervention or six-month post-intervention indicating sustained benefits. Physical activity levels amongst both males and females were significantly higher in the six-month post-intervention phase when compared to the baseline levels of physical activity.

Where pre-intervention physical activity levels showed a decrease with age (across the School Year Groups), post-intervention findings revealed the physical activity levels of Years 1, 3, 4, 5, and 6 were significantly higher than Reception and Year 2. In the six-month post-intervention physical activity, there were no differences in physical activity levels across the year groups. This finding suggested that the physical activity levels of the older children could not be sustained across the six-month post-intervention phase, but did not decrease to the pre-intervention levels. The finding is in contrast to an abundance of previous research which has found physical activity levels to decrease with age (Brevata, et al., 2007; Sherar, et al., 2007; Shiroma & Min Lee, 2010).

The purpose of the intervention was to increase the opportunities for children to be physically active across the whole school, rather than targeting specific population groups within school. In the post-intervention physical activity measures, the findings showed that decreased levels of physical activity were significantly correlated with an increase in BMI in the control sample. This finding echoed previous research which purports that physical activity decreases as BMI increases (Cherkas, et al., 2008). The intervention schools showed no significant correlations between physical activity and BMI in the post-intervention measurement, which was sustained Six-months post-intervention; i.e., physical activity levels were sustained across the whole school sample, regardless of BMI. As the intervention aimed to provide opportunities for physical activity that were accessible and tailored to the needs of all of the children, data indicated that the delivery of activities was maintained to a similar level, demonstrating a degree of intervention sustainability.

The six-month findings showed that post-intervention increases in physical activity were sustained. This finding supported the use of an ecological approach to increase levels of physical activity amongst primary school children, and adds to our existing knowledge.

Chapter 8

Key Research Question 4

How has the intervention changed the relationships between pupil perceptions, the school environment, and physical activity?

8.1 Changes to the School Environment: Audit Tool

8.1.1 Rationale

The rationale for developing and implementing an environmental audit tool is discussed in detail in Chapter 4.1.1. The post-intervention audit phase was used to determine whether the intervention had changed school environmental characteristics captured by the environmental audit. It was also implemented to examine whether any correlations between physical activity and the elements of the school environment had emerged.

The audit did not change at all in design since the pre-intervention phase. Learning from previous research and the theories behind the Social Ecology Model (Stokols, 1992, 2000) and the ANGELO Framework (Swinburn, et al., 1999) provided a robust theoretical rationale on which to base develop this audit tool (see Chapter 4.1.2 for an in-depth account of how the audit tool was developed and Appendix 5 for an example of the audit tool).

Despite the researcher having a greater knowledge of the school environments than at the pre-intervention phase, all elements of the audit tool were approached without any pre-empting of answers. This was particularly true for the intervention schools, where the researcher had spent a large amount of time on site delivering the intervention. The researcher enquired about all elements, even if the answers were thought to be known.

8.1.2 Method

All of the control and intervention schools (a total of eight) were audited at post-intervention, to determine any changes in scores since the pre-intervention phase. The method and scoring remained exactly the same as at pre-intervention (see Chapter 4.1.3). Analysis of the post-intervention scores remained the same as the pre-intervention scores where Spearman's Rank Correlation was used to identify significant correlations between the various aspects of the school environment and average physical activity counts per minute. This analysis was used to determine any changes to the elements of the school environment that were significantly correlated with physical activity. In addition, paired t-tests were performed to determine any significant changes between the pre- and post- audit scores (see Appendix 20 for raw data).

8.1.3 Post-intervention Results

The average normalised audit scores for the intervention and control sample are presented for each section of the school environmental audit (Table 20). Pre-intervention scores are also presented for comparison. It is important to note the small sample size for audit comparisons, with only 8 schools audited. Although some significant differences were found in the pre and post audit scores, the power may be low.

Table 20: Pre- and Post-intervention Scores for each Audit Section, by Intervention and Control Sample

	Pre-Intervention		Post-Intervention	
	Intervention	Control	Intervention	Control
Total Score	77.58	79.18	83.20***	76.15
PA score	74.58	76.43	81.64***	73.50
Healthy Eating score	76.88	80.63	83.78***	74.50
Emotional Health and Wellbeing score	91.25	88.75	97.00***	88.75
PSHE score	96.40	96.40	97.68***	96.28

*** Denotes significant difference between pre- and post-intervention audit scores at $p < .001$ level

In the intervention schools, the pre intervention audit scores were significantly lower before the intervention than after (using a paired samples *t*-test):

- Total Score: $t(103) = -31.434$, $p < .001$
- Physical Activity $t(103) = -28.565$, $p < .001$
- Healthy Eating $t(103) = -18.954$, $p < .001$
- Emotional Health and Wellbeing $t(103) = -17.139$, $p < .001$
- PSHE $t(103) = -8.840$, $p < .001$

The relationship between the post-intervention audit scores and the post-intervention physical activity levels were compared. All comparisons with physical activity refers to post-intervention physical activity levels for the remainder of this audit tool analysis.

In the intervention schools there were no significant correlations found between whole day CPM and any of the sections of the audit tool. Analysis revealed significant correlations between:

- In School CPM and Total Audit Score (Spearman's Correlation = .500, p <.001)
- Physical Activity section of the audit (Spearman's Correlation = .516, p <.001)
- Healthy Eating section of the audit (Spearman's Correlation = .342 p <.001)
- Emotional Health section (Spearman's Correlation = .486, p <.001)
- PSHE section (Spearman's Correlation = .486, p <.001)

School-related CPM was significantly positively correlated with:

- Total Audit Score (Spearman's Correlation = .501, p <.001)
- Physical Activity section of the audit (Spearman's Correlation = .511, p <.001)
- Healthy Eating section of the audit (Spearman's Correlation = .362 p <.001)
- Emotional Health section (Spearman's Correlation = .475, p <.001)
- PSHE section (Spearman's Correlation = .474, p <.001).

In the control schools, the audit scores were significantly higher for some of the sections:

- Total Score: $t(103) = 6.973$, $p < .001$
- Physical Activity $t(103) = 24.575$, $p < .001$
- Healthy Eating $t(103) = 8.614$, $p < .001$
- Emotional Health and Wellbeing $t(103) = .282$, $p = .779$
- PSHE $t(103) = 8.188$, $p < .001$

In the control schools significant positive correlations were only found between school-related CPM and the PSHE section of the audit score (Spearman's Correlation = .182 p = .044).

Similar to the pre-intervention phase, the physical activity section of the audit tool was broken down into those questions relating to PE and school sport policies, facilities, activity and curriculum, and quality of PE and school sport.

The average normalised audit scores for the intervention and control sample are presented for each of the physical activity sections of the audit (Table 21). Pre-intervention scores are also presented here for comparison.

Table 21: Post-intervention Physical Activity Audit Scores

	Pre-Intervention		Post-Intervention	
	Intervention	Control	Intervention	Control
Physical Activity score	77.28	74.58	81.64***	73.50
Policy score	73.50	78.73	88.80***	85.17
Facilities score	82.43	78.98	84.92***	74.50
Activities score	74.05	67.00	86.00***	80.00
Quality score	72.25	68.50	80.90***	72.00

*** Denotes significant difference between pre- and post-intervention audit scores at $p < .001$ level

In the intervention schools, these audit scores were significantly lower before the intervention than afterwards (using a paired samples t-test):

- Physical Activity $t(103) = -28.565$, $p < .001$
- Policy $t(103) = -17.050$, $p < .001$
- Activities $t(103) = -8.269$, $p < .001$
- Quality $t(103) = -6.010$, $p < .001$
- Facilities $t(103) = -39.951$, $p < .001$

In the intervention schools there were no significant correlations found between whole day CPM and any of the physical activity sections of the audit tool. Analysis revealed significant positive correlations between:

- In School CPM and the Physical Activity score (Spearman's Correlation = .516, p <.001)
- Policy (Spearman's Correlation = .433, p <.001)
- Activities (Spearman's Correlation = .518, p <.001)
- Quality (Spearman's Correlation = -.462, p <.001)
- Facilities (Spearman's Correlation = .291, p <.001)

School-related Physical Activity was significantly correlated with:

- Physical Activity score (Spearman's Correlation = .511, p <.001)
- Policy (Spearman's Correlation = -402, p <.001)
- Activities (Spearman's Correlation = .501, p <.001)
- Quality (Spearman's Correlation = .444, p <.001)
- Facilities (Spearman's Correlation = .314, p <.001)

In the control schools the only significant correlations were found between In School CPM and Facilities (Spearman's Correlation = .245, p <.001) and School-related CPM and Facilities (Spearman's Correlation = .295, p <.001).

8.1.4 Discussion

The audit was extremely valuable in identifying issues within the school micro-environment which required attention. Audit scores were significantly higher post-intervention in the intervention schools sample. There were no significant differences between the control schools, indicating some success in addressing low scoring elements of the environmental audit in the intervention schools. All elements of the environmental audit were addressed in the intervention schools. This included improving areas where schools had scored low, and examining the areas significantly correlated with physical activity.

At follow-up the intervention schools showed significant correlations between in-school and school-related physical activity and all the sections of the audit tool (Physical Activity; Healthy Eating; Emotional Health and Wellbeing; and Personal and Social Health Education). Separating these layers of the environment and addressing them through the intervention was found to have a significant impact on physical activity in and around school, but not out of school physical activity. These findings suggest it is not possible to address a change in out of school physical activity levels by addressing specific aspects of the school environment alone. Without the collaborative integrated approach, including focus groups and extensive meetings with staff and relevant stakeholders, this intervention may not have been as effective.

The physical activity elements of the audit tool (activities, policy, quality and facilities) were significantly related post-intervention in the intervention schools. The control schools showed no increase. Again, as the intervention addressed all elements of the audit in the intervention schools, this finding was anticipated.

In school and school-related CPM were significantly correlated with policy, activities, quality and facilities. These findings showed that by changing elements such as the type of activity delivered, when, where and with what equipment, school physical activity can increase.

8.2 Changes to the School Environment: Focus Groups

8.2.1 Method

The methods for the post-intervention focus groups followed the same procedures as the pre-intervention qualitative investigation (Chapter 5.1.2).

Participants

Seven focus groups of mixed gender were undertaken across the five intervention schools. A total of 32 pupils participated, selected using the same approach as at baseline (see Chapter 5.1.2). Each focus group comprised:

Focus group 1: 3 girls, 2 boys (aged 7 / 8);
Focus group 2: 2 boys, 2 girls (aged 10 / 11);
Focus group 3: 2 boys, 2 girls (aged 6 / 7);
Focus group 4: 3 boys, 2 girls (10 / 11);
Focus group 5: 3 boys, 2 girls (aged 6 / 7);
Focus group 6: 3 girls, 2 boys (aged 9 / 10);
Focus group 7: 2 boys, 2 girls (aged 6 / 7).

Materials

The topic areas discussed were similar to those asked during the pre-intervention phase (see Appendix 21 for post-intervention discussion guide). Changes to the focus groups that were specific to the post-intervention phase included discussion regarding activities they had participated in and suggestions for change.

8.2.2 Analysis

Focus groups were transcribed verbatim, and coded to maintain the confidentiality and anonymity of the participants and their schools. Similar to baseline, data were analysed using a Grounded Theory approach, following the systematic procedures recommended by Strauss and Corbin (1990) (see Chapter 5.1.3).

8.2.3 Open Coding of Data

Several concepts emerged from the post-intervention focus group data that were classified into five main themes. These five themes related to various areas of the whole school environment and the physical activity and health behaviour choices of the school pupils: PE and school sport policy; role models; weather; facilities and resources; and promotion of health and healthy behaviours.

PE and School Sport Policy

The focus group findings indicated that children clearly enjoyed their PE lessons. All of the focus groups elicited positive views about PE, but it was clear that a number of different factors contributed. Some children attributed their enjoyment of PE to feeling confident and proficient in the skills required during PE, whereas they did not feel this way about many of their classroom based activities.

D: I don't like reading and I don't like writing and I'm not very good at it and then I like doing PE cos I can do it alright and I'm good at kicking the balls and catching and jumping

GL Yr 3

Other children attributed their enjoyment of PE to being out of the classroom, and taking part in a different activity to those which dominate the majority of their curriculum time.

I: Fab. Any other things you like about PE?
R: Erm just cos we not doing numbers or reading

GL Yr 6

Children spoke about the large number of options they have during their PE lessons and the types of activities that they participated in. Choice was important, with children suggesting that although they liked to have a choice of activities, often this was difficult as people liked doing different things. There was a general consensus that there were enough activities to please people.

S: PE's just nice to do but there's loads of stuff to do and we don't really get to choose only sometimes
C: But when we get asked what we want to do it ends up everyone wanting to do different stuff so at least when Mr Frost decides it's more fair. And we always have loads of different PE stuff to play so it's not like it's always the same.
I: So you get to choose what you do every now and again?
S: Yeah which is good but we don't always do what we want cos everyone wants to do something different.
E: It's okay though.

SH Yr 5

Many of the children discussed participating in activities that were appropriate to their age. These conversations were predominantly with older children, who discussed looking forward to participating in more 'grown-up' activities that were not currently available to them at primary school, but would be available to them following their imminent move to Secondary School.

> O: Maybe we'll get to do more PE when we go up (to the High School)
> F: They have trampolines there oh my God I've always wanted to do trampolines i can't wait they're just so
> O: I've done trampolining
> C: They just look so big –
>
> GL Yr 6

Some of the children talked about the specific activities and equipment that they disliked using at primary school.

> "We have to do like the baby things, like the foam javelin and I want the proper ones!"
>
> GL Yr 6

Role Models

All of the focus groups included discussion of the role of various school staff in supporting and promoting health and healthy behaviour choices. These included teachers, dinner ladies, sports club leaders and Kids Club leaders. Children felt these people were very important in influencing their health behaviours, teaching them about health, providing healthy food and activities, and acting as positive role models. This was particularly evident in the focus groups with younger children. The children considered the role of the teacher in educating pupils about health to be important. Children also perceived the image of the school staff to be a particularly important aspect of this.

D: Well all our teachers here look healthy and they are healthy I think, they look healthy anyway

E: I think they are healthy and they help us to be healthy too because we're only young we're children and it's important that we know what it's like to be healthy and stay healthy

J: And we need to know what it is about to be healthy so we learn about it from our teachers and they tell us about healthy bodies and how to make food that will be healthy for us....

S: ....Yeah well it's what they're meant to do they meant to teach us about things and make it so we know stuff but also like not just reading and writing it's about us as well and keeping us healthy

GLYr 3

The younger children also expressed interesting views about the role of the school staff in determining the food available to school pupils. Some of these children clearly thought that the school teachers and other staff chose the food that was on offer at lunch times. Children thought that the school staff chose healthy foods for the children in an effort to ensure they eat healthily.

H: It's the teachers who buy the food so they pick what they think we should have

A: Not what we want to have!

R: And the dinner ladies choose what to make us and we ask for chips and Jamie says why can't we have chips again today cos he's always asking and the dinner ladies say well this is much nicer and if you eat this cos its vegetable then you grow up strong

A: And we know how to grow our own. We get told.

I: So you think the teachers and dinner ladies choose what you eat for you?

A: Yeah they do it so we grow proper

H: If we eat what we're sposed to then its better we know that we did it in learning

SH Yr 2

The older children also discussed the role of the school staff, and the influence they had upon their health and health behaviour choices. These children linked the role of the school staff with the PE and school sporting activities available at the school. Some of the children clearly associated these with health, and spoke about the types of extra-curricular activities that teachers offered, and discussed the various clubs that were led by certain teachers.

> O: Yeah Mr Rushton like tells us to be in the clubs after school and the teams
> F: And we do the netball clubs with Miss Deaville, she (encourages) us to join and then we do the matches and have training clubs after school
> I: Great, so they're the teachers?
> O: Yeah they teach the other classes but they're in charge of running the after school clubs, Mr Rushton does loads of football and cross country
>
> GL Yr 6

Some of the other focus groups with older children also discussed the role of the teachers in educating pupils about the health-related benefits of physical activity and healthy eating. Here, children discussed their teachers being good role models by ensuring pupils participate in PE, and eat healthily during the school day.

> C: Well yeah cos the teachers tell us all about being healthy and staying healthy and then they show us PE....
> E: ....well you know we said before we learn about healthy food like our fruit and vegetables well that's what we have when we have our dinner at school
> Ja: Yeah but the teachers don't make the dinners though
> E: No but they make sure we have healthy food, they wouldn't let them cook us chips and pizza every single day now
> Ja: Oh yeah
>
> HC Yr 6

Weather

Many of the children discussed how the weather impacted upon their PE and playground activities. This theme largely focused around the wet and cold weather, and the effects that this had on both their PE activities, and playtime activities. The children often perceived that playing indoors limited the types of activities that they could participate in due to the lack of available space.

> B: I like when we can outside and play outside but I don't really like playing inside much
> I: Why's that?
> B: Just cos its small and everyone gets in the way
>
> TW Yr 2

> E: I like it best when we're outside and not in the hall cos there's not as much space there
>
> SH Yr 5

Some of the children mentioned specific activities that they participated in indoors and outdoors, and the disadvantages of playing certain activities indoors.

> J: If it's raining outside we play inside
> S: Well but ...in the cold we do it inside anyway we go outside when it's nicer
> J: Sometimes though we should go outside cos if we're doing the games then it's okay cos we can stay in the hall and for the -
> E: We do mini- golf too and we play that inside!
> J: Yeah no but when we do things like with the big balls or the tennis we do it inside when it's cold but I wish we could go outside cos, cos you can hit the ball harder and you don't need to be told off for hitting the roof or the windows
>
> GL Yr 3

The children also discussed the impact of weather on PE lessons. Views about participating indoors varied. Children discussed enjoying the space of the outdoor activities but also expressed their dislike at being outdoors when it was cold. This was particularly evident amongst the younger children.

B: We do some things outside but mostly we do it inside
I: So do you (rest of group) like it inside or outside?
N: I like both, cos if we inside least we not get cold
A: We only have our shorts!
N: Yeah sometimes it's really cold

TW Yr 2

Some of the children gave examples of indoor activities and discussed that these were often prohibited by being in a small enclosed space. Despite this, some children thought it preferable to being outside in the cold.

I: Do you like doing PE in your hall?
H: Well it's a bit small but it's okay
K: When we do tennis we have to be careful cos the balls go all in that cupboard!
I: Ah right okay. So do you prefer doing games inside or outside?
R: It's really cold outside sometimes so maybe inside

HC Yr 2

Facilities and Resources

All of the focus groups saw the children discussing the equipment available to them, particularly during playtime. Although it was evident that there were numerous types of equipment available, there were both positive and negative views expressed here. The parachute was a piece of equipment that was regularly discussed positively, and it was clear that this was an activity enjoyed by many of the children.

H: I like the parachute and we have that and the balls and we float them on top when we do it. We do it in the hall and we all play together and run underneath it and play with it
J: Yeah I like the parachute

SH Yr 2

J: Well sometimes we all play together but it's not all the time sometimes we play running and races and then sometimes we play with the football.
I: So you have equipment that you can play with at play time then do you?
J: Yeah we have games and things that the leaders give to us and then sometimes we can choose what we have but sometimes there isn't everything left that we want sometimes if we're allowed the parachute we all have to play together
S: Yeah everyone loves the parachute but sometimes we can't all play with it
E: If you get there last you can't pick what you want and sometimes not everybody shares.

GL Yr 3

O: Well, we have special things that we play with, loads of things like the Velcro balls and pads, and basketballs and hoops, and we play with things every day

GL Yr 6

Some of the children discussed their negative perceptions of playtime activities. These issues related to differences in gender and age, whereby some pupils disliked the playtime pursuits of children of different age (older or younger) or gender.

R: We get given the balls and we play together but
E: All the boys run around and chase each other and play chase and if we – if we sitting down and they come and run by us then they can be really

annoying and it annoys me and Alisha and we sit and play games like if we do shops and then the boys all come and run

GL Yr 3

Other negative views expressed about the older children also included the equipment available to them during playtime.

S: We can't all play together though like my brother is older and he goes on a different playground and I don't want to go on their playground everyone is big and they throw the balls at people and –
E: No they don't!
S: Yeah –
E: Who does that!
S: They all do *[name]* said they do and when we go up they'll throw the balls and kick the balls at everyone

GL Yr 3

Promotion of Health and Healthy Behaviours

All of the focus group discussions involved the role of the school in promoting healthy behaviours. Children discussed what they learnt about health during lesson times, and how this impacted upon their health behaviours. It was evident that the children of all ages knew the meaning of health, and had an understanding of why they learnt about health in school. All of the children could associate what they had learnt during lessons with what they did during the school day, with regard to health. When discussing what they learnt about health, children associated this with their school dinners, playtime activities, and PE lessons. Many of the children immediately associated health with food and nutrition, and related it to what they had been taught at school.

I: Do you know what it means to be healthy?
A: Is it if you're not poorly and when you grow up if you do all the things that make you healthy then you be big and strong.

I: Yes excellent so what kinds of things might make you big and strong?

A: Erm if you eat all your vegetables and drink lots of milk...?

B: ....We learned it with Mrs Roberts

TW Yr 2

Other children discussed the role of PE, in addition to healthy eating. Even children of a younger age displayed knowledge of the importance of food in relation to health, and of the role of PE. The children perceived PE as a lesson which was important to health, as opposed to being important for the development of physical skills and abilities.

E: Yeah we do it in school (health) and we learn about not getting sick and about eating nice things that don't make you like not healthy like not crisps and not chocolate

J: Yeah we learn about that and food we should eat but we can still eat it if we want to though like we could still eat them crisps

E: And we do PE and we learn why we do PE to make us be strong and not so we can just always play with the bean bags cos we like it and its fun but we're doing it to help us grow more not cos its fun

J: Yeah and we have to do that we have to do PE like with food and that we can pick round the bits we don't like like the peas and that but we have to do PE but it's okay cos it's not that bad

GL Yr 3

The older children particularly observed the association between being taught about the importance of health and wellbeing during lessons, and the practical application of this throughout the school day. For example, recognition of healthy food and water being provided throughout the day, PE lessons, playtime activities and extra-curricular activities.

M: Well yeah I mean they teach us stuff at school like about health and science and that, and then they always have food and that what we eat at tuck and dinner time so it’s kind of everything we do is always the school thinking bout making us healthy. Really.

E: Yeah I think definitely we get learnt about everything we should know about eating healthier and about taking care of our bodies

M: Especially as we are growing and going to big school. We need to be healthy to

SH Yr 5

8.2.4 Development of Theory

As with the pre-intervention focus groups, key themes identified post-intervention related to either whole school environmental facilitators (enjoyment, positive role models, equipment, resources, weather and health promotion) or barriers to physical activity (age limits, weather and lack of indoor facilities and resources). These data also provided clear links to the political, social, physical and economic aspects of the whole school environment. The pre-intervention focus groups findings provided clear links to key environmental research undertaken by Stokols (1990, 2000), and the Social Ecology Model (see Chapter 2.3) was modified to explain how the whole school environmental components interact with one another, and act as either facilitators or barriers to physical activity.

The conceptual models developed to explain the pre-intervention relationships between the whole school environmental facilitators and barriers to physical activity were modified to explain how these issues have changed following the intervention. Themes relating to whole school environmental facilitators that could be categorised as relating to PE and School Sport Policies were enjoyment of PE, school sport and playtime activities; choice of activities; age appropriate activities; and promotion of physical activity during lessons and around the school day. Themes relating to social aspects of the environment were support from peers and school staff, including teachers, dinner ladies, school club leaders and Kids Club leaders. The theme relating to physical aspects of the environment was weather, where outdoor activities were seen to be more conducive to physical activity. Finally, those that could be classified as both physical and economic aspects of the whole school environment were PE and playground facilities and resources, and the type and availability of equipment. The pre-intervention explanatory model comprising the whole school environmental facilitators to physical activity was modified, to explain the changes in the obesogenicity of the environment following the intervention (Figure 22).

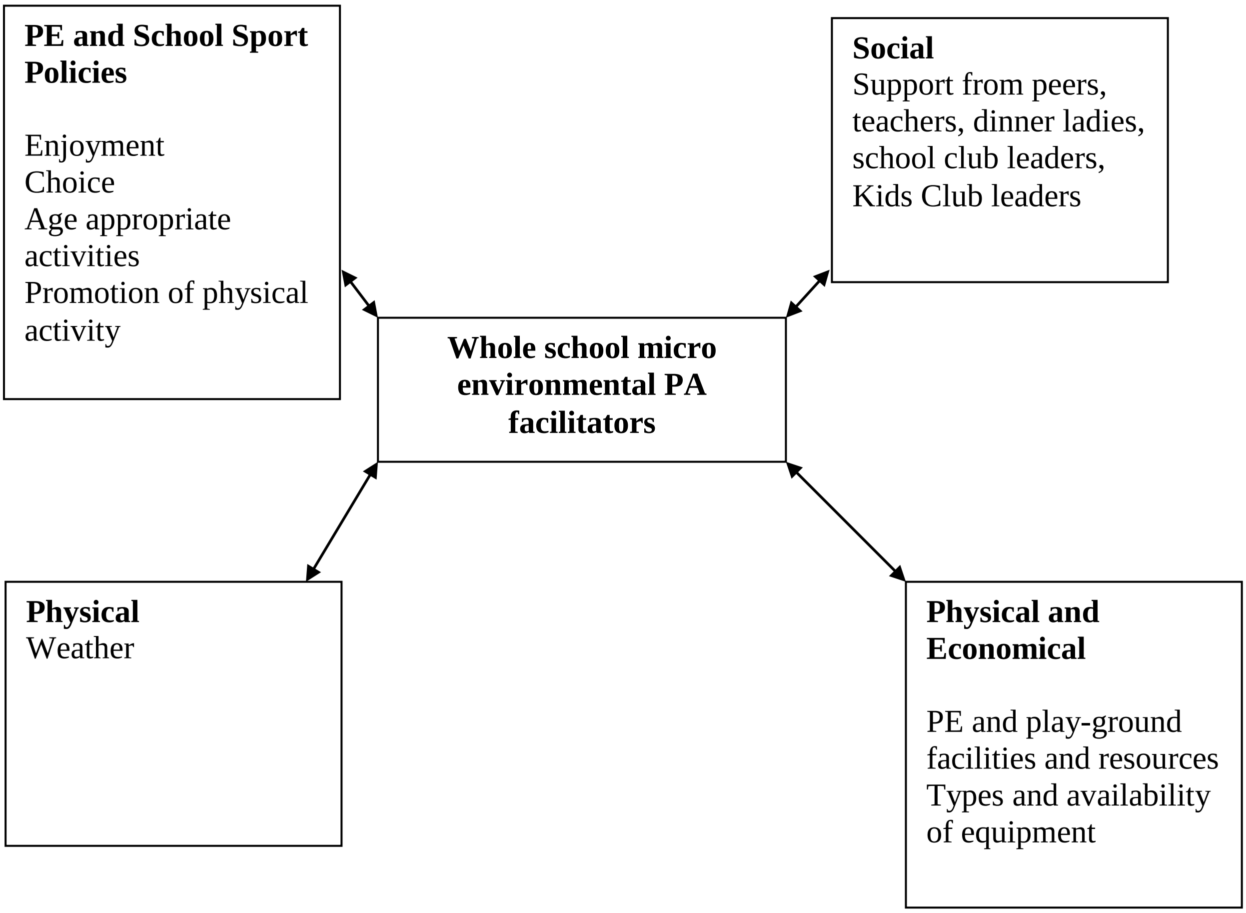

Figure 22: Post-intervention Conceptual Model of Environmental Facilitators to Physical Activity

The theme relating to whole school environmental barriers to physical activity, that could be classified as relating to PE and School Sport Policy, was age limit. Age was particularly an issue where some of the older children wanted to participate in more ‘grown-up’ activities, and some of the equipment was seen as ‘baby things’. This was most evident in children at the end of their primary school years, who were looking forward to taking part in the activities provided for them at secondary school.

The theme relating to the physical aspect of the whole school environment was weather. Weather was found to limit the type of physical activity provided during PE and wet-play. Themes relating to physical and economical aspects of the whole school environment were negative experiences of the school environment during wet-play and indoor PE, a lack of indoor sports facilities and equipment. No themes emerged relating to social barriers to physical activity. The pre-intervention explanatory model comprising the whole school environmental barriers to physical activity was modified, to explain the changes in the obesogenicity of the environment following the intervention (Figure 23).

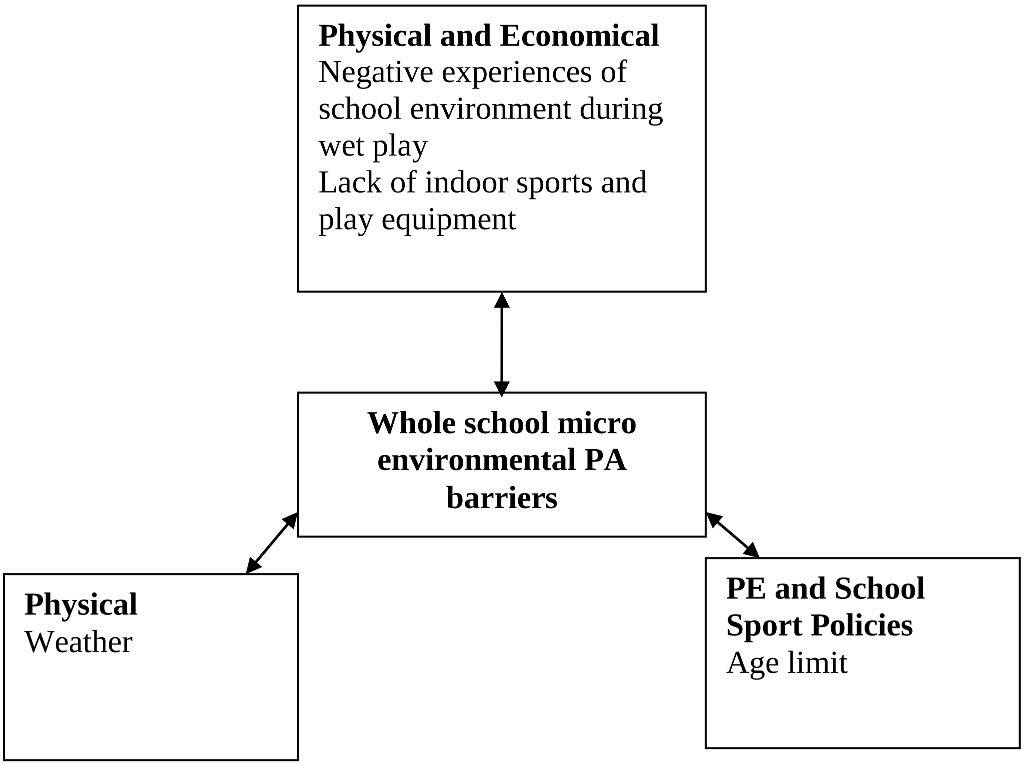

Figure 23: Post-intervention Conceptual Model of Environmental Barriers to Physical Activity

8.2.5 Discussion

Data from the post-intervention focus groups were incorporated into the modified Social Ecology Model (Stokols, 1992, 2000). The post-intervention focus groups provided an understanding of the political, economic, physical and social resources within the school micro-environment, and how these influenced and acted as facilitators and barriers to physical activity. This qualitative model illustrates how perceived aspects of the environment changed following the intervention, providing further evidence of the impact. This added depth to qualitative findings as part of a comprehensive analysis of the efficacy of the intervention.

Changes to micro-environmental facilitators to physical activity

Enjoyment was found to be an important facilitator to physical activity, and was largely determined by children having the opportunity to choose what activities they could participate in and participating in activities that were appropriate to their age. Enjoyment has long been regarded as one of the most important factors influencing the uptake and maintenance of physical activity behaviour (Sherwood, et al., 2008). These findings are similar to those in the pre-intervention focus groups, where enjoyment, choice and age appropriate activities emerged as influences on physical activity. Similar to the pre-intervention focus group findings, enjoyment, choice and age appropriate activities were classified as relating to the political aspects of the environment. There is an abundance of evidence which has suggested that allowing children to choose what activities they participate in, and ensuring they are age appropriate, will increase enjoyment in physical activity (Sherwood, et al., 2008). Pre-intervention focus groups highlighted the need for school physical activity policies that provide a choice of such age appropriate activities. As a result, the intervention worked to provide a wider range of activities for both PE and other physical activities, and encouraged teachers to allow children to choose activities. This included providing additional types of activities undertaken during PE, or options for the ways in which specific games or skills were practiced.

The promotion of health in and around the school day emerged as important during post-intervention focus groups. The initial conceptual model of whole school micro-environmental facilitators to physical activity was modified to include health promotion as a political factor. Many of the children discussed the role of their teacher in promoting healthy lifestyles to them, and all of the focus group discussions conveyed an understanding of the concept of health. The children had excellent ideas of how they classroom based learning was reflected throughout the whole of their school day. Children discussed the importance of nutrition and activity for health, and related this to the PE and food that was provided for them at school. There was recognition that the school environment reinforced what they were learning about health and healthy behaviours. Evidence suggested that the role of the teacher is paramount in the promotion of health, yet many teachers are unaware of the important role they play (Jourdan, Samdal, Diagne, & Carvalho, 2008). Eaton, Marx and Bowie (2007) further highlight the importance of school staff health knowledge and behaviours in influencing the health behaviours of school children.

Similar to pre-intervention focus groups, weather was once again identified as a physical factor of the whole school environment that could facilitate physical activity. The children felt that dry weather allowed outdoor PE and playtime, which was more conducive to physical activities. The evidence which surrounds the impact of weather on physical activity has been conflicting. Many researchers hypothesised that dry weather was significantly associated with elevated levels of activity and some researchers have confirmed this (Broderson, et al., 2005). However, other researchers have found that hot and sunny weather was related to a decrease in physical activity levels (Baranowski, et al., 2001). The pre-intervention focus groups discussed their dislike at having to undertake classroom based activities such as arts and crafts during wet play. As a result, the intervention aimed to promote active indoor play during wet play and PE, by providing more equipment for pupils to play with. However, the issue of indoor facilities could not be addressed within the scope of the intervention. The post-intervention focus groups saw children express their dissatisfaction with the lack of space during indoor activities, for example “When we do tennis (indoors) we have to be careful cos the balls go all in that cupboard!” and “you don’t need to be told off (outside) for hitting the roof or the windows”.

Social support was once again identified as a facilitative social aspect of the school environment. Peer support was still identified as an important influence on physical activity, consistent with the literature (McNeil, et. al., 2006). Despite the importance of peer support it was difficult to influence this through intervention. It was anticipated that using a whole school approach to promote health and physical activity will embed these behaviours into habitual lifestyles, and thus be supported and promoted by peers. The other types of social support had changed since the intervention. Previously, children discussed the role of the parents and siblings in facilitating and supporting physical activity behaviours. The post-intervention focus groups did not discuss the role of the parents or their siblings, but rather the role of a wide range of school staff, including teachers, dinner ladies, school club leaders and Kids Club leaders. Children discussed the role of teachers in promoting health through their personal health behaviour. Some of the groups also discussed the role of the teachers in promoting health by being healthy and demonstrating healthy behaviour choices themselves. Children also discussed the role of the teachers in leading PE lessons, therefore promoting physical activity to them. The children felt that PE was a reflection of what they had been taught about PE and physical activity for health in the classroom. Interestingly, many children discussed the role of teachers and dinner ladies in providing healthy food for them. Some children discussed how teachers and dinners ladies chose what food they would eat for their lunch, hence further ‘helping’ them to be healthy. These findings suggested that teachers and other school staff were very aware of the important influence they had on children’s health and health behaviour choices. This factor has been identified in previous literature as crucial to the success of health promotion (Jourdan, et al., 2008).

Physical activity and playground resources were again identified as facilitators of physical activity, and were again classified as both physical (physical contexts of the environment) and economic (dependent on financially ability to provide such resources) aspects of the school micro-environment. Issues such as the availability and quality of equipment were identified as facilitating physical activity in the pre-intervention focus groups. Previous research highlighted the impact of widely available and functional equipment on physical activity behaviours (Fein, et al., 2004; Sallis, et al., 2001). As a result, the intervention worked to ensure that all pupils had access to a wide variety of good quality equipment. This included providing more equipment for the schools, and providing ideas and games to undertake with already existing equipment (see Case Study outlined in Chapter 6.2).

Changes to micro-environmental barriers to physical activity

Following the intervention, perceived barriers to physical activity had reduced considerably. The post-intervention conceptual model contained fewer issues than previous than the pre-intervention. Age limit remained a political barrier to physical activity. Prior to the intervention, it was evident that children required activities which were appropriate for their age, particularly evident amongst younger children who disliked competitive and technical activities. The intervention worked to ensure that the activities amongst the younger children placed a large emphasis on fun, and provided opportunities for them to choose whether they incorporated competition within their PE lessons and other physical activities. The post-intervention focus groups saw older children discussing their excitement of being able to participate in activities that they viewed as being for ‘older’ children. These were predominantly those children who were in their last year at primary school, and were looking forward to participating in activities that could not be delivered within a primary school environment (such as trampolining, and playing with ‘real’ athletics equipment rather than the ‘foam javelins’).

Poor weather was a physical aspect of the school environment that was a barrier to physical activity. As mentioned previously, the weather was found to limit the types of activities that children could participate in. Weather was also found to relate to the physical and economic aspects of the whole school environment, as it related to negative experiences of the school environment. The children discussed the lack of equipment and sports facilities for indoor PE and play, and that limited physical activity participation. This was particularly evident during wet play, where the children were resigned to their classrooms due to space limitations. Although activity DVD's and classroom based activities were promoted, children preferred activities that were more physically active, such as bench ball. Indoor sports facilities for PE were better than for wet play, as children could use their school hall. Some children preferred the warmth of the indoor environment, but felt that the space was too small to be very physically active.

In contrast to the pre-intervention focus groups there were no micro-environmental barriers to physical activity which were classified as relating to the social aspects of the environment. At baseline, gender stereotyping was perceived as both a social and political barrier to physical activity. Here, many of the female pupils expressed an interest in participating in a wider range of activities during PE, playtime and during other school sports activities. Socially, the beliefs of their male peers prevented the girls from participating in traditionally male dominated activities. However, changes to the political factors provided all children with a wider and more varied choice of activities, whereby the girls could choose to participate in activities such as football and cricket.

CHAPTER 9

Discussion

9.1 Research Rationale and Overview

An abundance of evidence suggests that children need to be physically active to improve and maintain their health (Pedersen, 2007; Rukavina & Li, 2007). Furthermore, it is evident that children who are active at a younger age would be more likely to carry this on throughout their older years (Tobias, et al., 2007). Despite this, research in the UK has shown that children's levels of activity are insufficient for optimum health (Riddoch, et al., 2007; The Information Centre, 2008). The premise for this current research was based on a dearth of any evidence informing us how to tackle this issue.

Specific environmental models and theories from existing literature provided the focus for this pilot intervention framework. The use of such theories and learning from previous research was cemented in the innovative methods for developing and measuring the effectiveness of this pilot intervention. The Social Ecology Model (Stokols, 1992, 2000) and the ANGELO Framework (Swinburn, et al., 1999) were adapted for the purposes of this research, and provided the theoretical foundations for the development and implementation of the pilot intervention.

Previous evidence provided insight into the types and settings of interventions that could be effective. Prior research had focused on increasing physical activity in children in older primary school years, or secondary school. This, along with the evidence that children should be encouraged to be physically active from a very young age, provided the rationale for implementing this pilot intervention in primary school aged children. There was agreement in the literature that the school would provide the optimum environment for increasing physical activity in young children. It was important that the intervention was developed in collaboration with the school pupils, to ensure that the intervention activities matched their needs, and with school staff, staff other than teachers, and other relevant stakeholders, to maximise the sustainability and longer-term maintenance of the intervention.

A collaborative and mixed-methods approach to both the development and implementation of the pilot-intervention was determined on the basis of previous evidence. Qualitative data collection was the most appropriate method for exploring the school micro-environment, and barriers and positive facilitators to physical activity. A key aspect of this research was to focus on creating a shift away from targeting individual behaviour; therefore focus groups were preferred to interviews (Wilkinson, 2008). Qualitative findings corresponded to the theory represented in the Social Ecology Model (Stokols, 1992, 2000), and this provided a framework that enabled exploration of barriers and facilitators to physical activity. This adaptation of environmental theories was an innovative approach, and the findings add to the current body of research. This method revealed an in-depth understanding of the levels of the environment, and the ways in which they influence physical activity.

9.2 Methodological Approach

Measuring the effect of physical activity interventions is challenging given the difficulties and lack of consensus surrounding measurement of children's physical activity (Wareham, et al., 2005). Accelerometry has been identified as the most reliable and valid field-based tool for objectively measuring physical activity when compared with other methods, such as heart rate monitoring and pedometry (Brage, et al., 2004; Halsey, et al., 2008). Conflicting recommendations regarding the most effective method of processing the data, especially in relation to intensity thresholds, remain a problem in children's physical activity research (see Chapter 2.1.2). Indeed, the findings from the current study showed very different results when the accelerometry data were analysed using two intensity thresholds employed widely in previous research (Puyau, et al., 2002; Trost, et al., 2002). Applying the thresholds developed by Puyau, et al. (2002) showed that a very small proportion of the study sample achieved the recommended levels of moderate and vigorous physical activity, whilst the thresholds developed by Trost, et al. (2002) showed that the whole study sample achieved the recommended levels of moderate and physical activity. This was unsurprising given previous research findings, but vindicated use of accelerometry counts per minute as the primary physical activity outcome. A large number of researchers had used this method as an alternative (Gidlow, et al., 2008; Riddoch, et al., 2004; Schmitz, et al., 2005; Simmons, et al., 2008; Treuth, et al., 2008). Additionally, this had been validated against doubly labelled water (Ekelund, et al., 2001). This provided enough justification for the use of accelerometry to objectively capture physical activity, with counts per minute as the main outcome. Although accelerometry was the most robust method of measuring physical activity in this study, additional qualitative methods were implemented to provide a holistic measure of impact.

9.3 Key Research Question 1: *What are the relationships between the social, economic, physical and political elements of the school environment and physical activity?*

The ecological approach to this research required a clear understanding of the impact of the school micro-environment on physical activity, necessitating the development and use of the environmental audit tool. Most existing audit tools had been developed for the purpose of examining the walkability and bikeability of neighbourhood physical and built environments (Hoehner, et al., 2006). The development of this audit tool for exploring the school micro-environment was innovative, and both the design and the findings add to the existing body of literature. The environmental audit was designed to consider physical activity, healthy eating, emotional health and wellbeing and personal and social health education, with the physical activity element further explored by activities, policy, quality and facilities. The environmental audit was effective in providing a simple method of identifying the complex multi-levelled characteristics of the school environment. The audit scoring system was simple, and provided an easy method of identifying low scoring elements of the environment which could be easily addressed. The audit tool scores formed an important part of the development of the pilot intervention.

Findings revealed that PE and school sports policy, and quality and provision of facilities, had a key impact on physical activity (see Chapter 4.1.4). Children participated in more physical activity if they attended a school which scored highly for physical activity policies and for the facilities element of the audit. Previous research suggested that focusing policies towards supporting and promoting physical activity can have a positive impact (Hang, et al., 2010; Lee, et al., 2007), and that availability and provision of facilities are strong predictors of physical activity (Scott, et al., 2007; van der Horst, et al., 2007). The audit tool findings demonstrated the need to strengthen the availability and provision of physical activity facilities and the policy aspects in the intervention schools. The specific elements of this were further informed by focus group findings.

9.4 Key Research Question 2: *What are the views, perceptions and experiences of physical activity and the school environment amongst a sample of primary school children?*

Focus groups explored the school micro-environment and its impact on physical activity behaviours, and provided understandings of the gaps, barriers and facilitators of physical activity embedded within the school micro-environment (see Chapter 5.1.6). Findings revealed that the environmental determinants of physical activity are strongly influenced by political, economic, social and physical elements of the school environment, and provided key areas for the intervention to address. Issues such as enjoyment, age appropriate activities, and peer support were identified as facilitators to physical activity, whilst issues such as lack of equipment and provisions for indoor physical activity were identified as barriers. The findings from the focus groups were crucial to the development of the intervention, where facilitators to physical activity were further supported in all the intervention schools, whilst barriers were addressed.

Intervention Development

Evidence suggested that an intervention would only work if tailored towards the specific ‘micro-environment’ of each school. This notion for pilot intervention development was echoed and cemented in the findings from both the focus groups and audit tool. The pilot intervention was developed in consultation with school staff, pupils, parent/guardians, and other relevant stakeholders, especially members of the Stoke-on-Trent School Sports Partnership. This was another fundamental aspect of the research. Previous evidence suggested that an intervention developed with input from the target population could be tailored to meet their specific and individual wants and needs (Carter & Swinburn, 2004). The notion of changing the environment to support change, rather than trying to change the individual, was central to the ecological approach.

The pilot intervention was developed with reference to previous research and learned experiences. It was crucial to extract from literature what had worked previously, what did not, and to understand why. A fundamental process was to take successful elements from previous learning and tailor it to enable to current research to be effective. Baseline levels and patterns of physical activity were similar to previous research, and provided a foundation on which to design the pilot intervention. Three main issues occurred that needed to be addressed: 1) levels of physical activity needed to be increased amongst the female sample to reduce the gender imbalance of physical activity, whilst ensuring that physical activity levels increased across the whole intervention sample; 2) levels of activity amongst older children needed to be increased to reduce the age imbalance of physical activity, whilst again ensuring that physical activity levels increased across the whole sample; 3) physical activity opportunities needed to be appropriate and suitable to the whole population. Children who were overweight or obese needed to be as physically active as the whole sample, whilst not specifically targeting this group of children. Hence, designing an intervention to address the above issues, and ensure sustainability and effectiveness in the longer-term was challenging.

The School Sport Partnership facilitated discussions with the school staff about the intervention. Once the initial staff meetings had been attended, subsequent discussions were more straightforward. On the whole, school staff members were happy to be involved with the intervention and provided many ideas and offers to help tailor the intervention towards their needs. Combining this information with previous literature, baseline physical activity levels, focus group and audit tool data created a unique and innovative intervention. The generic principles of the intervention were applied to each school to tailor initiatives specifically to each micro-environment. Intervention delivery was also a challenge; it was imperative to ensure that key people in the various schools were happy with the types and timings of the activities, while ensuring that volunteers delivering sessions were happy. It was important to ensure that all of these aspects of the delivery were covered, whilst not losing the essence of the pilot intervention.

9.5 Key Research Question 3: *Will an ecological physical activity intervention developed using a range of quantitative and qualitative methods be effective in increasing the physical activity levels in primary school children in the immediate and longer term (six-months)?*

Baseline measures indicated that levels of physical activity amongst children were low, and would benefit from an intervention. Physical activity out of school was lower than in school. The contribution of school day activities on overall levels of weekly physical activity echoed similar research in the area (Cooper, et al., 2005; Cooper, et al., 2003). In addition, patterns of activity were clustered around certain periods of the school day, such as between eight and nine in the morning, when children would be travelling to school; at lunch time; and in the hour following the school day, when children would be participating in extra-curricular activities or travelling home from school. This highlighted the need to maximise these existing physical activity opportunities, and was included in the development of the intervention. Findings from baseline physical activity measurements, qualitative work and existing literature informed three main intervention aims:

Intervention aim 1) Increase physical activity levels amongst girls to reduce the gender discrepancy (whilst increasing physical activity levels in boys also)

Levels and patterns of physical activity amongst the study participants were consistent with literature: lower amongst girls and decreasing with age (Wang & Beydoun, 2007;

Wyatt, et al., 2006). It was therefore important to not only increase physical activity levels across the whole sample, but to pay particular attention to increasing physical activity levels amongst the girls, and this formed one of the key aims of the intervention:

Post-intervention physical activity measurements showed that the targeting of the intervention towards girls and older children, whilst still promoting and supporting physical activity for all, had been successful. The focus group and audit tool data provided information on how best to target the physical activity of this population. The types of activities were tailored in the intervention to ensure that the views of the girls were taken into consideration; for example, the playground initiative 'The Golden Mile' was chosen to ensure that girls' physical activity preferences could be catered for.

Post-intervention and six-month post-intervention physical activity levels were significantly higher in the intervention schools than the control schools at both follow-up all time points. Perhaps of most importance were the findings relating to gender and age. The disappearance of gender differences in physical activity in intervention (not control) schools indicated that one of the key project aims had been achieved.

Intervention Aim 2) Increase physical activity levels of older children to reduce the age-related decline in physical activity levels of the younger children (whilst increasing physical activity levels in younger children also)

Baseline physical activity showed that participant physical activity levels reduced as age increased. Therefore, the intervention physical activities offered to the older children were different to those offered to the younger children. Again, pre-intervention focus group and audit tool data revealed stark differences in the positive facilitators, barriers and preferences of physical activity between the older and younger children. The younger children enjoyed finding their physical activity in their spontaneous play. Conversely, the older children wanted to participate in activities, sports and games where they could learn new technical moves, and spend more of their time in competitive activities. The element of competition was particularly strong amongst the boys. This understanding enabled the design of the intervention to be tailored towards these age groups. The post-intervention physical activity measurements showed that, in the intervention schools, the physical activity levels of the older children had increased. Physical activity levels were significantly higher in Year Groups One, Three, Four, Five and Six, compared with Reception and Year Two, a finding not replicated in control schools. The findings show that the intervention successfully addressed the age-related decline in children's physical activity, another key project aim. However, delivery of future interventions must ensure that physical activity is fully supported amongst younger children (particularly Reception and Year 2).

Intervention Aim 3) Ensure that physical activity opportunities are accessible to all children, with no differences in the physical activity levels of children with higher and lower BMI scores

Rather than targeting overweight or obese children, the intervention aimed to make physical activity accessible to all. A fundamental aspect of this ecological approach to increasing physical activity was to ensure that physical activity opportunities were provided to all children. Physical activity has the potential to both reduce and prevent overweight and obesity amongst children (BHF, 2008; Mota, et al., 2003; Riddoch, 1998; Ward, et al., 2006), and this was reflected in the current research. Baseline physical activity measures revealed an inverse relationship between BMI and physical activity, therefore the intervention aimed to provide a range of opportunities for all school children to be physically active. The post-intervention data revealed no significant correlations between BMI and physical activity, which suggests children were participating in physical activity, regardless of BMI. This finding can be attributed to the effect of the intervention, as conversely, the control schools sample showed that physical activity decreased with increased BMI.

9.6 Key Research Question 4: *How has the intervention changed the relationships between pupil perceptions, the school environment, and physical activity?*

The environmental audit and focus groups were repeated post-intervention to further measure the impact of the intervention. The audits revealed significantly higher post-intervention scores in the intervention schools, whilst the control schools showed no significant differences between pre- and post-intervention results. This indicated that the intervention was successful in addressing the low scoring baseline audit elements in intervention schools. In-school and school-related physical activity levels were significantly correlated with the four main audit tool elements, however there were no significant correlations between out of school physical activity and the audit tool elements. It is suggested that it may not be possible to change out of school physical activity levels by addressing only the school environment. The intervention changes to the policy, activities, quality and facilities within schools had a significant correlation to the in school and school-related physical activity, which again suggests that physical activity can be increased by addressing the types of activity, the location and the equipment.

The impact of the intervention was further revealed through focus groups, in which enjoyment, choice and age appropriate activities were identified as key facilitators to physical activity; aspects that were all important elements in the development of the intervention. The number of separate facilitators to physical activity had increased post-intervention, where there were more elements within the political, physical, social and economic categories of the environment. The number of different perceived barriers to physical activity had decreased post-intervention, and comprised many issues which could not feasibly be addressed within an intervention, such as weather and negative experiences of the school environment during wet play. Exploration of the relationships between pupil perceptions, the school environment and physical activity further highlighted the impact of this intervention, and helped to identify the elements within a school environment that could be changed to create a positive impact on physical activity.

9.7 Implications for Practice

The findings of this research give insight into the complexity of the determinants of physical activity and health behaviours in schools, and allowed the development of an intervention which supported the identified facilitators, and addressed the identified barriers to physical activity. Although political initiatives exist to increase physical activity amongst children and young people within schools, the findings from the baseline focus groups indicated that they were unlikely to work if the environment did not facilitate physical activity behaviours. Criticisms of political initiatives such as the PESSCL scheme, introduced to improve fitness and tackle rising obesity, and improve talent identification and pathways to elite sport for young people (Learning Through PE and Sport, 2003), included the wide variations in regional delivery of strategies. Ofsted (2005) identified that many School Sport clusters are misinterpreting guidelines, failing to identify pupils' needs and progression, failing to integrate political initiative programmes into core PE, whole school and the wider curriculum, and failing to improve teachers' knowledge and quality of teaching and assessment. Many schools were found to still have limited physical and economical resources, including poor playground provision and space, insufficient physical activity facilities, accommodation and equipment (Ofsted, 2005). Concerns were also raised that initiatives may only be undertaken by a small minority of gifted and talented pupils, and would not provide support for children who do not like team sports (Boyle, et al., 2008). The activities undertaken in the development of this intervention supported this evidence, and justified the need for a school-based physical activity intervention to address these issues.

Auditing the availability of school equipment such as physical activity packs was a quick and easy way to determine school provision. The environmental audit tool was simple yet robust and could be implemented by schools to identify provisions for physical activity. This research highlighted that if schools focus on improving the quality and provision of their school facilities, and the quality of their PE and school sport, this can significantly increase physical activity levels of school pupils during the school day, and increase school-related physical activity.

Similarly, the baseline focus groups highlighted the key impact that elements of the school micro-environment can have in supporting or hindering physical activity. These findings could be applied within other schools, to ensure that activities are age appropriate, are supported by policies, and that facilities and provisions for physical activity are adequate. Enjoyment has been highlighted as a key factor, and it would be feasible for schools to consult with their pupils to explore the types of in school and extra-curricular activities they would like to participate in, and to provide 'taster' sessions to encourage participation in new activities.

A collaborative and facilitative approach was employed in the development and delivery of this intervention, where Head Teachers, school teachers, staff other than teachers, health educators, community agencies, and other related school staff to worked collectively to increase the opportunities for primary school children to be physically active in and around the school day. The development and delivery of the physical activity intervention aimed to evaluate and address the issues concerned with the role of the School Sport Partnerships and related agencies, and their potential role in the delivery of physical activity. Such issues included those raised in the evaluation of the School Sport Partnership Programme (Ofsted, 2005, 2006), involving the availability and provision of physical and economical resources, integration of PE, school sport and health into the wider curriculum, playground provision, and equipment.

One of the fundamental aspects of this research was the ease with which the principles could be transferred into other schools. The most simple adaptation of this intervention is to examine current school resources and ensure even distribution of these across the school. Other straightforward tasks include completing an environmental audit, addressing those areas with low scores, and liaising with school children (via classroom activities or a school council for example) to discuss how they feel about provisions for physical activity within their school. This approach to increasing physical activity would not be resource intensive, but would use existing resources more effectively. This has been one of the most crucial elements of this research, whereby effective utilisation of equipment, facilities, school staff, and voluntary coaches provided an important and previously under-used resource.

It is the effective use of existing resource which has meant that this intervention could be easily transferred to other school settings. Interventions in other schools could also implement a playground initiative such as The Golden Mile, and draw upon existing activities, facilities and resources to ensure that these are used to give pupils every opportunity to be physically active during the school day, including PE lessons and break-times. The Primary Link Teachers in each school could use the environmental audit tool to determine available resources and issues for change. The practical implications of this intervention are wide ranging, and will support schools to successfully deliver a wide range of curricular and extra-curricular PE and school sport activities.

9.8 What This Research Adds

This research demonstrated a number of novel elements which represented a unique contribution to the existing body of literature. The development and design of this ecological approach to increasing physical activity amongst primary school children appeared to be successful, at post-intervention, and at six-months. Adapting the Social Ecology Model (Stokols, 1992, 2000) and the ANGELO Framework (Swinburn, et al., 1999) as a theoretical framework on which to base the environmental audit and focus group design ensured that all layers of the environment were considered, and allowed a robust understanding on which to base the intervention. The baseline research and previous evidence provided the foundation for the general intervention principles. The development of the intervention in collaboration with school pupils, staff, and other relevant stakeholders then ensured that the initiatives were tailored towards the specific micro-environments of each school.

The environmental determinants of physical activity are complex and multi-faceted. The environmental audit alone provided an innovative tool for examining environmental determinants of physical activity behaviours within school micro-environments. The development and delivery of this tool also represented an important contribution to the existing body of literature. However, the environmental audit and focus group interviews contributed towards an in-depth and more complete understanding of how the school environment can impact upon physical activity behaviours. The intervention was developed to support those aspects of the school environment identified as being facilitators to physical activity during the pre-intervention focus group phase, whilst addressing micro-environmental factors identified as barriers. The focus groups allowed the children to voice their personal perceptions and experiences of how the school environment impacted on their physical activity choices and behaviours. Further, meetings with school staff and stakeholders ensured their involvement in the design and delivery of this pilot intervention. It was anticipated that this collaborative approach, based on robust previous evidence, would make this pilot intervention as sustainable and effective as possible, which was somewhat supported by the six-month changes in physical activity levels in the intervention schools.

This research provides an innovative approach to increasing physical activity in primary school children. The finding that the collaborative involvement of school pupils, Head Teachers, school teachers, staff other than teachers, the School Sport Partnership, health educators, community agencies, and other related school staff, can work collectively to increase the opportunities for primary school children to be physically active in and around the school day, adds new insight to the existing body of literature.

Future research could see this intervention implemented in a wider range of schools, in the ways suggested above, and monitored over a longer-term. The long-term effects of school-based physical activity interventions are largely unknown. Indeed, a Cochrane review of 26 studies of school-based programmes for increasing physical activity found that all but one had immediate or six-month follow up timescales (Dobbins, DeCorby, Robeson, Husson, & Tirilis, 2009). It would be beneficial for the intervention to be monitored over a longer time scale. Pate, et al., (2007) followed up a physical activity intervention which involved making changes to the school environment over four years. The authors of this study purported that four years was an appropriate time scale to establish maintenance of intervention success over the longer-term (Pate, et al., 2007). It would therefore be beneficial to monitor the impact of this intervention over a minimum of a four-year period.

9.9 Limitations

One of the main limitations of this research was the limited timescale for the follow-up measurements. Although a follow-up of six-months was appropriate and sufficient for this pilot intervention, monitoring the impact over a longer-term would provide more insight into the sustainability of the intervention.

Although the most valid and reliable measure of physical activity for the purposes of this study, the use of accelerometry does not provide a truly accurate account of the physical activity levels of the sample. The uniaxial monitors used do not allow for the measurement of all physical activities, particularly water based activities such as swimming (as the accelerometers are not waterproof), or those involving little vertical movement (such as static lifting, cycling, rowing).

Although a large and robust sample size was calculated, not all participants produced usable findings due to them not wearing their accelerometers for the minimum required time. However, this was identified as a potential problem during the planning stages of this research and it was anticipated that any issues regarding the true reflection of objective measures of physical activity would be overcome by implementing the focus group and environmental audit tool measures.

Limitations of focus groups are that the findings may not necessarily be representative of the views of the wider population under study. It was hoped that undertaking a number of focus groups with children of different age ranges would ensure that views would be representative. It was also crucial to ensure that focus groups continued until the data reached saturation, and no new themes were emerging.

The nature of focus group research meant that the interaction between participants can lead discussions in different directions (Morgan, 1998). This approach worked well for the purposes of this research, but the lack of control over the produced data could be a limitation for other research. One limitation which could not be controlled was that each participant may not have expressed their own thoughts and experiences, but may have responded so as to conform to the rest of the group. Again, the aim of this approach was to understand the views, perceptions and experiences of the participants. Transcripts were checked as each focus group was undertaken. If the focus groups were not producing the information required for the research, a different approach would have been implemented, such as one-to-one interviews.

Each of the data collection methods employed in this research had recognised limitations. However, the use of these methods in triangulation ensured that sufficient data were collected to appropriately develop and measure the impact of this pilot intervention.

9.10[1] Reflexive Analysis

I found that reflecting on my PhD experiences could not be done in isolation from the experiences and decisions I had made which led me to my PhD. My interest in physical activity and children's health research was fuelled by a Pedagogy, Exercise and Children's Health module I undertook during my MSc Sports Science. I found the delivery of PE and school sport, and the related public health implications of this, particularly fascinating.

This module led me to want to explore this topic further, and I chose to research children's enjoyment of PE for my MSc thesis. During this experience, I found that not only was I extremely interested in children's school-related physical activity, exercise and sport in relation to health, but I really enjoyed working with children and young people as participants in research. For me, the logical next step after completing my MSc was to explore a career in research. My experience that followed was working as a Research Assistant, and involved undertaking health-related research with children and young people in schools. This experience affirmed my passion for researching children's health, and after almost 18 months Research Assistant experience, I knew that I was ready both in my experience as a researcher, and in my career aspirations, to

[1] This section has been written in the first person

undertake a PhD. I was also certain that I wanted to research the area of physical activity and children's health.

When the opportunity arose to undertake a PhD in this field at Staffordshire University it was the perfect opportunity. Having undertaken my Undergraduate degree at Staffordshire, I knew that I would feel comfortable there, I knew staff were friendly and approachable, and I knew that just having knowledge of the University and surrounding areas, and the staff, would ensure that I would settle in and feel confident and comfortable right from the off. I was also confident in the knowledge and experience and of my supervisors.

My previous research experiences taught me the value of triangulation, of implementing various data collection and analysis methods. Not just the value but also the enjoyment. I enjoyed examining the quantitative data with reference to the qualitative data, to find some context or narrative that would help understand and interpret the reasons behind the data. It was, in my mind, a vital way forward for me to take my research. I approached my PhD with a clear vision that this was an important element of my research. I knew that I wanted to collect both qualitative and quantitative data that would intertwine to allow the best opportunity for a complete picture or story to be told. I was aware that this would also have an impact on ensuring my interpretations of the data were not one-sided, and that through gathering different types of evidence, my interpretations would be based on the truest picture possible.

My previous experience of undertaking research in schools was research would be very difficult without the cooperation of the schools, and that communication was probably the one key factor to remember throughout. Whilst I always very much enjoyed going out and collecting the data, I had experienced that organising this, particularly in schools, could be very challenging.

I was excited at the prospect of having the opportunity to deliver an intervention, in primary schools, for a whole academic year. I was determined that this intervention would learn from the existing literature, and I was really interested in the concept of a whole school approach before I think I really realised this was a very viable way forward.

The support and assistance of the North and South Stoke-on-Trent School Sports Partnership Development Managers was invaluable in approaching the selected schools, and helping make school staff aware of the project. They were also a great help in providing contact names and details of those staff who would be best placed to speak about the research. I was very aware that, whilst I would do everything possible to reduce any burden of this research on school staff, I needed school staff to be enthusiastic about the research. It was clear to me that if the school staff believed in the need and the reasons for this research then it would make it much easier for me to organise and undertake the data collection.

The organisation of the physical activity data collection was potentially challenging. The collection of physical activity measurements were done with the schools in pairs, and it was vital that each school was available to allow us to come and collect the data when we required. Challenges faced here included school year groups out on school trips on the day of fitting the accelerometers.

I was excited at the prospect of using objective methods to measure the levels of physical activity in children. Having previously used a lot of self-report questionnaires to measure behaviours, including physical activity, I was very aware of the limitations that came along with subjective measures. I was, however, slightly daunted by the prospect of learning about the accelerometers. After learning how to use the software, and having a trial few days of experiencing what it was like to wear the accelerometers I was pleased to have succeeded in downloading the information about my physical activity. I also particularly liked the visual nature of the output information, in the form of a graph which charted activity levels over the days worn.

Although I practiced with the accelerometers, the practicalities concerned me. I was still worried about the thought that any errors in charging, initialising and then downloading the data from the accelerometers would affect the data collected. A whole week of a participant wearing an accelerometer could result in no data. Ultimately, it all went fine.

One of the most time consuming activities, which I hadn't factored in as being so time consuming, was chasing up the accelerometers which hadn't been returned. I had no idea that so many children would lose or not return their accelerometers. Some parents sent in notes apologising that the accelerometers had been lost, but there were a large number that weren't returned, and without explanation. School staff would ring parents to ask if they had seen the accelerometers, and I would visit schools on a regular basis to collect newly returned accelerometers. Not only were these small machines so expensive, but the sample size had been determined on the basis of having 90 accelerometers available (45 per school). Any lost accelerometers would then impact on the number of participants able to take part in future waves of this data collection, and in other research studies.

I knew that I wanted the qualitative element of the research to not just measure the impact of the intervention, but to help inform the intervention. Evidence had shown that involving the intervention population in the development increased the likelihood that it would work. I also wanted to ensure that all school pupils, staff and staff other than teachers were given the opportunity to share their views, and to understand that I wasn't just there to do research on them, but that I was there to do research with them. This was especially true with the children, I wanted them to be as involved as possible in every element of the intervention development.

When it came to undertake the focus groups I had already been into the school to undertake the baseline physical activity measurements. This meant I was already familiar with the school, many of the school staff, and some of the school pupils. I think that this really helped me to approach the focus groups feeling relaxed, as I had some idea of what to expect, in terms of the people, the school environment, and the location. I made it clear to the pupils that I was there to chat to them, and find out their views. I did not want pupils to think I was an authority figure. This was true throughout all of the research, but particularly so for the focus groups. I made sure that I wore casual clothes, such as jeans or trainers. I wanted the children to feel comfortable talking to me about what they did and did not like about issues related to physical activity. I knew that if I was to wear a tracksuit that children might perceive me as very pro-physical activity or exercise, and be afraid to share their views that were perhaps more negative towards physical activity. In light of my prior experience in the schools, I felt very comfortable undertaking the focus groups, and I very much enjoyed this element of the research.

When the time came to discuss the intervention with school staff and stakeholders it was great to share with them the many ideas and concepts that had been borne out of the focus group discussions with the children. I felt very satisfied to know that the intervention was being developed with reference to what children and school staff actually wanted. I really enjoyed organising how the intervention would work in each school, and embraced the logistical and organisational challenges.

It is my reflections on the intervention that make me very grateful that I had the opportunity to undertake this research in the way that I did. It was a hugely satisfying experience to know that all elements of the intervention were addressing issues that I knew lay in each school. The baseline physical activity measures, the audit, and the focus groups had all provided challenges that I knew that could be overcome in this intervention. I also really enjoyed working with the school staff, it was fantastic to provide them with opportunities they may not have had before, but which they found invaluable. A great example of this was having them participate in the PE lessons, to give them ideas how to use equipment differently or innovatively. At the beginning of the intervention, a few of the school staff thought that my presence in facilitating the PE lesson would mean they could sit in the room and read, or disappear into the staff room. I knew I wanted them to be part of this aspect of the intervention, and really made an effort to encourage them to be part of these lessons. Most importantly this gave them a flavour of how PE could be and the pupils loved having their teacher join in the PE lessons.

I had been so involved with each of the intervention schools, and had grown fond of the pupils and the school staff that I had worked with. It was strange to come to the end of academic year, I had mixed emotions. I had found the intervention to be enjoyable and challenging, but found that the coordination and delivery of the intervention was tiring. After a year of delivery, I was looking forward to seeing the results. However, when it came to the end of the academic year and I was measuring the post-intervention physical activity levels I realised that I would miss the relationships that I had built with the staff and pupils in the schools. I imagined that I would be really excited to have completed the intervention delivery, which I was, but did not realise that I would also feel a little sad that it was over. Although I kept in regular contact with the schools after the official intervention delivery period had ended, I was very hands off in terms of continued intervention delivery.

Reflecting on all of the intervention elements, my most poignant memories are from the Family Fun and Fitness Zones that were held. These sessions were for families and involved a mixture of information delivery, and practical sessions on physical activity and health-related activities. A very wide range of families attended the sessions, yet everyone got such a great deal out of them. It really made me appreciate just how valuable physical activity and health activities can be, and about just how strong the impact of this is on mental, as well as physical health. I got such a lot out of working with the families that attended the sessions, and the wide range of people that came. From babies to grandparents, everyone became immersed in all of the activities, from learning to grow vegetables, to make smoothies, to make pizza, to economic shopping. The activities at the end of the session, where everyone got together to dance to a TOP DVD, provided a fantastic culmination to each session. It was real proof that activity can bring people of all ages together, and can be brilliant fun.

The dissemination of my research was vitally important to me. Throughout my research, I was lucky to have the support of the School Sport Partnership Development Managers, who helped me disseminate my research to a wide range of people. For me, the process of the intervention had been equally as important as the outcome. I wanted to share the ways in which I had developed the intervention, and the direction this had taken, with others. I was very grateful to have had the opportunity to share the process, as well as the outcome, with various audiences. I was able to attend many Primary Link Teacher and School Sport Co-ordinator meetings and events where I could present my research. Towards the beginning I would share with them my ideas, and my actions so far. During the intervention phase I would share with them the process of delivering my intervention. And of course, it was great for me to have the opportunity to share with them the findings of my intervention, and the implications for how it could be delivered in their school. I was also extremely lucky that the School Sport Partnership Development Managers took many elements of my intervention and applied them more widely across the region.

Much of my research depended on me building strong relationships with a wide range of people. I found that I really enjoyed this element of the research, and thrived on meeting and working with lots of different people. I also knew that I really valued undertaking research that could make a difference, and where the findings could be applied to practice, rather than sit as a report on a shelf in someone's office. Since completing my PhD I have pursued a career working as a Health and Wellbeing Researcher in the NHS.

I was very aware that I had acquired knowledge about how public health is delivered in the NHS, but that I did not know the everyday practicalities of this. As a provider of many different types of healthcare to the wider population I have always been interested in how the NHS determines which interventions to deliver, and how to evaluate these. I was very driven by the fact that this role required that recommendations from research and evaluation to have a direct impact on service delivery.

In my role as Health and Wellbeing Researcher I am still very much involved in physical activity, and have learned a vast amount about how this is delivered in the NHS. I have undertaken research and evaluation at all spectrums, from weight management programmes with very young children and their families, to Bariatric care pathways. I have also had the opportunity to broaden my research horizons, and have been involved in projects around CVD, alcohol, smoking cessation, and health inequalities. Most recently, I have evaluated the effectiveness of a Marie Curie night nursing service for end of life care, which was a very new but very interesting experience for me.

My PhD has definitely provided me with the foundations to apply my research across many elements of public health. I feel the support and encouragement I have received from everyone I have encountered on this journey has helped give me the confidence to pursue something that I truly enjoy. For that I will be always grateful.

CHAPTER 10

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APPENDICES

Appendix 1 Pre-intervention baseline physical activity measurement: participant information sheet

SCHOOL SPORT PARTNERSHIP AND
CENTRE FOR SPORT AND EXERCISE RESEARCH, FACULTY OF HEALTH, STAFFORDSHIRE UNIVERSITY

STUDY INFORMATION SHEET

Physical activity of school children

Purpose of the study

There is concern that physical activity levels of school children have been dropping and that this may have longer term health implications. The purpose of this study is to measure the physical activity levels of a representative sample of Stoke on Trent school children.

What is involved if I agree to take part in the study?

We propose to record physical activity from a sample of children (in 10 schools – 8 Primary and 2 Secondary) each of whom will be asked to wear an accelerometer recording physical activity over 7 consecutive days. The accelerometer is similar to a step-counter, is completely non-invasive and is worn using an elasticated belt around the waist. This records the amount of physical activity undertaken each minute throughout the day. A researcher will fit the devices in the school on the recording day and will collect them again at the end of the sampling period (a week later). We will also record height, weight, age, gender, ethnicity and post-code so that we will be able to test for differences or trends within sub-groups in the whole sample.

Where and when will the study take place

We would like to carry out the study at your school on **Friday 23rd March 2007**.
You will be notified of what the room to meet in on this day.

Will the information in the study be confidential?

The information obtained from this study will be treated with total confidentiality. Individual identities are not required and will not be stored with any of the data. Your school identity will not be divulged to anyone outside of the researchers involved in the study and will not be used in any published material without first receiving your school's permission to do so.

Can I ask further questions about the study?

The information contained in this form is intended to provide you with all the necessary information on the study and your commitments to it, should you choose to participate. If you have any unanswered questions or you need to have something clarified, please do not hesitate to contact the researchers (see below).

Can I withdraw from the study?

Yes. You may withdraw from the study at any time during its course, or choose not to provide certain details.

What if I wish to complain about the way in which the study has been conducted?

If you have any cause to complain about any aspect of the way in which you have been approached or treated during the course of this study, the normal University complaints mechanisms are available to you and are not compromised in any way because you have taken part in a research study.

If you have any complaints or concerns please contact the project co-ordinators below in the first instance:

Dr Chris Gidlow	Ph.: 01782 294038 E-mail: c.gidlow@staffs.ac.uk
Professor Rachel Davey	Ph.: 01782 295986 E-mail: r.davey@staffs.ac.uk

Frequently Asked Questions:

Why did you choose me?

We chose you at random as one of several pupils to represent your school in this study.

What will happen to my information?

The information collected is used for research purposes only and the results of the study will never include any names. All the information will be treated in strict confidence in accordance with the Data Protection Act.

When should I take the monitor off?

When you have a ***shower, a bath*** or if you go ***swimming*** (they are ***not waterproof***)
Apart from this you can wear your monitor from when you get up in the morning until you go to bed at night.

What happens if I forget to return my monitor?

If you forget to take the monitor to school when it is due to be collected, please take it to school the following day or as soon as possible.

What if I lose my monitor?

If you think that you have lost your monitor, ***please*** let your teacher know or contact Chris Gidlow as soon as possible (01782 294038).

Who is carrying out the study?

The study is being carried out by *Staffordshire University,* and is supported by the *Schools Sport Co-ordinators Network*. A teacher from your school will be present when we give out the accelerometers and measure height and weight. All members of the research team have CRB checks.

What do I get for taking part?

Each child will receive a certificate for taking part and a summary of their personal physical activity levels.

Contact number and contact names

If you would like to talk to someone about the study, please contact one of the study co-ordinators (Chris Gidlow 01782 294038).

Appendix 2 Pre-intervention baseline physical activity measurement: parental consent forms

Stoke on Trent Schools Physical Activity Study

Dear Parent,

Measuring physical activity of school children

We have been approached by researchers in the Centre for Sport and Exercise Research, in the Faculty of Health, Staffordshire University, to participate in a project to measure the physical activity of Stoke on Trent school children. In principle, our school would like to support this study.

What is involved?

All that is involved is that the children will be asked to wear a simple device called an accelerometer (it is a bit like a pedometer, which you may have heard of) for seven days. The device is completely non-invasive, is worn using an elastic belt around the waist and records the amount of physical activity undertaken each minute throughout the day. A researcher will fit the devices at a pre-arranged time and will collect them one week later. Height, weight, age, gender, ethnicity and post-code will also be recorded so that we will be able to test for differences or trends with different sub-groups in the whole sample (the complete sample will include ~600 local school children). It is hoped that participation in this study will be incorporated by the school as a learning activity.

Will the information in the study be confidential?

The information obtained from this study will be treated with **total confidentiality**. Individual identities are not required and will not be stored with any of the data. Your child's identity or the school identity will not be divulged to anyone outside of the researchers involved in the study.

Please return the reply slip below in the envelope provided.

✂…………………………………………………………………………………….

Measuring physical activity of school children

I **do/do not*** wish my child to participate in the above named project

Name: Child's Name:

* delete as appropriate

Appendix 3 Example physical activity measurement data collection sheet

UPN	Height	Weight	Monitor Number
A861205902064			
A861205903065			
A861205904008			
A861205905067			
A861205906012			
A861206200064			
A861206202010			
A861300900001			
A861330003019			
A926241001090			
B860311200012			
B861205902026			
B861205904028			
B861205905002			
B861206200055			
C861205905051			
C861205906023			
C861205906052			
C861206200046			
C861206201047			
C861206202048			
D861205902010			
D861205905013			
D861206200010			
D861206201011			
D861206201040			
D861206201067			
D861700499002			
E860215804007			
E860349103021			
E861201899057			
E861205903002			
E861205903058			
E861205904032			
E861205905004			
E861205905033			
E861205906063			
E861206201002			
E861206202032			
F861205902048			
F861205903049			
F861205905053			
F861206200048			
F861206201022			
G861205902012			
G861206202043			

Appendix 4 Healthy Schools Criteria the Support Obesity Prevention (Department of Health, 2007)

HEALTHY EATING

Healthy Schools Criteria	Minimum evidence for Healthy Schools Status
2.1 **Has an identified member of the senior management team to oversee all aspects of food in schools** Ofsted self evaluation 6a	o There is named member of the Senior Leadership/*Management* Team o The person's role (re healthy eating) is known to staff
2.2 **Ensures provision of training in practical food education for staff, including diet, nutrition, food safety and hygiene** Ofsted self evaluation 6a	o This criterion should directly support 2.9 o The school's CPD file evidences how staff needs regarding practical food education are identified o Staff (such as Food Technology and PSHE teachers) can discuss their experience of appropriate CPD – examples might include the local training by community dietitians, DfES Food Partnerships Programme, food safety and hygiene courses etc.
2.3 **Has a whole school food policy – developed through wide consultation, implemented, monitored and evaluated for impact** Ofsted self evaluation 2a, 2b, 6a	o Parents/carers, governors, caterers and pupils are/have been involved in policy development and can describe their involvement o A policy is available covering all aspects of food and drink at school, including appropriate curriculum links, reference to policy regarding packed lunches/food bought into school and pupils going off-site to purchase foods o The policy is referred to in the school prospectus/profile o The policy is regularly communicated to the entire school community o The policy is reviewed on an ongoing basis (at least yearly)
2.4 **Involves pupils and parents in guiding food policy and practice within the school, enables them to contribute to healthy eating and acts on their feedback** Ofsted self evaluation 2a, 2b, 6a	o Pupils and parents are/have been involved in guiding the school's food policy and can describe their involvement o Pupil and parents agree that their feedback has been appropriately considered
2.5 **Has a welcoming eating environment that encourages the positive social interaction of pupils (see Food in Schools guidance)** Ofsted self evaluation 6a	o The school has developed healthy/welcoming aspects of the dining room environment - including display and labelling of food, promoting healthy eating, availability of water, appropriate queuing arrangements, adequate time available, non-stigmatisation of FSM pupils, social dining and cleanliness o Pupils and staff feel that the dining area makes a positive contribution to the dining experience – including adequate time available to eat meal and avoiding stigmatisation of FSM pupils

2.6 **Ensures that breakfast club, tuck shop, vending machine and after school food service (where available in school) meets or exceeds DfES school food standards** Ofsted self evaluation 6a	Where service is provided: o Breakfast club meets or exceeds the DfES standards o Tuck shop meets or exceeds the DfES standards o Vending machine meets or exceeds the DfES standards o After school food service meets or exceeds the DfES standards o The governing body, the named member of the SLT (and head caterer where involved in service provision) agree that the standards are being met and review this regularly
2.7 **Has a school meal service that meets or exceeds current DfES School Meals standards** Ofsted self evaluation 6a	o The school meal meets or exceeds the current DfES School Meal Standards o The governing body, the named member of the SLT and head caterer agrees that the standards are being met and review this (at least termly) o Healthy options are promoted e.g. tasting sessions, menu boards, sampling o The caterer can say how minority ethnic and medical/allergy needs have been considered/incorporated in menu planning o There is appropriate guidance (promoting healthier options) given to pupils/parents who have packed lunches

2.8 **Monitors pupils' menus and food choices to inform policy development and provision** Ofsted self evaluation 2a, 2b, 6a	o The school has developed a system for monitoring menus and choices o The governing body, the identified member of the SLT and the school caterer can demonstrate that they use data and how it influences developments
2.9 **Ensures that pupils have opportunities to learn about different types of food in the context of a balanced diet (using the Balance of Good Health), and how to plan, budget, prepare and cook meals, understanding the need to limit the consumption of foods high in salt, sugar and fat and increase the consumption of fruit and vegetables** Ofsted self evaluation 5b	o This curriculum *can* be found in *Schemes of Work for* Food Technology, PSHE and other subject areas. o The Schemes of Work and/or out of hours activity incorporates age and ability appropriate lessons on a balanced diet, planning, budgeting, preparing, and cooking skills, for ideas and support o The curriculum considers the emotional aspects of food, the nature of eating disorders, the role of the media and is appropriately connected to aspects of Emotional Health and Well-Being. o A curriculum map is being developed or is in place
2.10 **Has easy access to free, clean and palatable drinking water, using the Food in Schools guidance** Ofsted self evaluation 4a, 6a	o Children/young people and staff say they have access to free, clean and palatable drinking water at lunch time and throughout the day, and have been consulted about where it is located

	o The school is monitoring the availability of water and ensures it is being used by children/young people o Water consumption is encouraged and promoted
2.11 **Consults pupils about food choices throughout the school day using school councils, Healthy School task groups or other representative pupil bodies** Ofsted self evaluation 2a, 4d	o Children/young people say that they are regularly (at least termly) and appropriately consulted about food choices – including school meals and food and drink other than lunch

PHYSICAL ACTIVITY

Healthy Schools Criteria	Minimum evidence for Healthy Schools Status
3.1 **Provides clear leadership and management to develop and monitor its physical activity policy** Ofsted self evaluation 6a	o There is a named person in the school who leads policy and practice development on physical activity within the school and is known to all staff in that role
3.2 **Has a whole school physical activity policy – developed through wide consultation, implemented, monitored and evaluated for impact** Ofsted self evaluation 2a, 2b, 4d, 6a	o A physical activity policy is in place o Clear monitoring procedures are in place to review and amend the policy o Parents/carers, children/young people were/are actively involved in the development and review of the policy and can describe their involvement o The policy supports the curriculum for PE and wider programme for Physical Activity and School sports
3.3 **Ensures a minimum 2 hours of structured physical activity each week to all of its pupils in or outside the school curriculum** Ofsted self evaluation 4a, 4f, 5b	o The curriculum for PE includes health related fitness o Children and young people can access a range of activities that add up to a minimum of 2 hours structured physical activity each week o The school's Inclusion Policy refers to how it is addressing the needs of all its children/young people with reference to physical activity
3.4 **Provides opportunities for all pupils to participate in a broad range of extra curricular activities that promote physical activity** Ofted self evaluation 5b	o Children/young people and staff are aware of the extra-curricular physical activity opportunities that are available to them o The school has a range of activities for individuals and groups

3.5 **Consults with children/young people about the physical activity opportunities offered by the school, identifies barriers to participation and seeks to remove them** Ofsted self evaluation 2a, 2b	o Children/young people say they are consulted about what types of physical activities they would like to be offered to them. o The school can specify the activities that have been introduced, influenced and adapted as a result of consultation o The school has a system in place to monitor the increase in participation of pupils in physical activity
3.6 **Involves Schools Sport Coordinators (where available) and other community resources in provision of activities** Ofsted self evaluation 5b, 6a	o The school attends SSC network meetings. o The school uses PESS/CL materials
3.7 **Encourages children/young people, parents/ carers and staff to walk or cycle to school under safe conditions, utilising the school travel plan** Ofsted self evaluation 4a, 5b, 6a	o The school is engaged with representatives from the Safe Routes to School programme and School Travel Plan (STP) Scheme o The school has a School Travel Plan in place or is working towards one being in place o Parents/carers have received information regarding the School Travel Plan via newsletter articles/letters etc. o The school has used STP surveys to develop the broader physical activity agenda o Throughout the school year there is a planned promotion of walking and cycling to school o Pedestrian and cycle skills training are available for children/young people and staff
3.8 **Gives parents/carers the opportunity to be involved in the planning and delivery of physical activity opportunities and helps them to understand the benefits of physical activity for themselves and their children** Ofsted self evaluation 2a	o Parents/carers are aware of the opportunities to learn about the benefits of physical activity o Parents/carers say they are actively encouraged to take part in the planning and delivery of physical activity o Most parents/carers report that they know why physical activity is good for them and their children
3.9 **Ensures that there is appropriate training provided for those involved in providing physical activities** Ofsted self evaluation 6a	o There is a planned annual programme of CPD for appropriate staff o Staff involved in providing physical activity for pupils can evidence that they have received appropriate training/CPD. (These may be teachers, lunchtime, breakfast or after school supervisors and coaches and others from the community) o The school operates an appropriate visitors' policy, which addresses risk management and relevant training/qualification
3.10 **Encourages all staff to undertake physical activity** Ofsted self evaluation 6a	o Staff are aware of the opportunities they have to increase their levels of physical activity o Staff have been involved in informing and developing opportunities for them to increase their levels of

	physical activity

Two of the four healthy schools themes highlighted above – healthy eating and physical activity - are widely recognised as being key to contributing to the Obesity PSA. The remaining two themes - emotional health and wellbeing and PSHE - are arguably as important in ensuring the activity is both beneficial and appropriate. The themes, criteria and minimum evidence below help to form an environment that promotes positive social and emotional health, and therefore supports healthy lifestyle choices.

EMOTIONAL HEALTH AND WELLBEING

Healthy Schools Criteria	**Minimum evidence for Healthy Schools Status**
4.1 **Identifies vulnerable individuals and groups and establishes appropriate strategies to support them and their families** Ofsted self evaluation 4b, 4f, 5b, 5c	o Drawing on relevant DfES guidance, schools are able to identify children/young people experiencing or at risk of experiencing behavioural, emotional and social difficulties o Vulnerable children/young people have individual support plans o The school has examples of planned and structured intervention work to address the issues of identified children/young people o The school has plans and protocols in place for working with other agencies to support individuals and their families o Vulnerable children/young people report feeling supported o Children/young people with specific behavioural, emotional or social difficulties have planned and structured interventions matched to their needs
4.2 **Provides clear leadership to create and manage a positive environment which enhances emotional health and well-being in school – including the management of the behaviour and rewards policies** Ofsted self evaluation 4b, 4f, 5b, 5c	o The school has a behaviour policy that strikes a healthy balance between rewards and sanctions and clearly explains how positive behaviour is promoted o The Vision/Mission Statement, Aims and Prospectus refer to the emotional health and well-being of the children/young people o The Senior Management Team demonstrate an effective leadership role emotional health and well-being
4.3 **Has clear, planned curriculum opportunities for children/young people to understand and explore feelings using appropriate learning and teaching styles** Ofsted self evaluation 4a, 4b, 4c, 4f, 5a, 5b	o The school can demonstrate that teaching social and emotional skills is an integral part of its curriculum for PSHE o The school ensures that there is a planned and comprehensive programme for teaching social and emotional skills and either uses, is planning to use or has considered using the DfES recommended SEAL programme o The school has a Teaching and Learning

	policy which considers the effect of teaching on emotional well being and the promotion of social and emotional skills o Children/young people can describe how they learn to explore, express and manage their feelings and are able to empathise with others
4.4 **Has a confidential pastoral support system in place for children/young people and staff to access advice – especially at times of bereavement and other major life changes – and that this system actively works to combat stigma and discrimination** Ofsted self evaluation 4b, 4f, 5c	o Children/young people say they understand the pastoral system and are able to easily access it o The school has identified routes of referral for children/young people and staff o Children/young people and staff report they know how to seek help if they are upset or troubled o Children/young people and staff are aware of and can identify how the school is actively combating stigma and discrimination
4.5 **Has explicit values underpinning positive emotional health which are reflected in practice and work to combat stigma and discrimination** Ofsted self evaluation 5b, 6a	o The school has clear values in its prospectus or in another appropriate public place that can clearly be linked to the promotion of positive emotional health and the development of social and emotional skills o Children/young people and staff can identify practice and activities, which actively combat stigma and discrimination o The school has clear policies setting out its position on stigma and discrimination
4.6 **Has a clear policy on bullying, which is owned, understood and implemented by the whole school community** Ofsted self evaluation 2a, 2b,	o The school signs the Anti-Bullying Charter and uses it to draw up an effective Anti-Bullying Policy o Staff know and understand the policy on bullying including their role within it o Staff feel supported and are able to identify and manage bullying o Children/young people and parents/carers know and understand the policy on

Appendix 5 Environmental Audit Tool

Date: ________ Start Time: _____ Stop Time: _______

School ID: _______________ Auditor ID: __________

1. SCHOOL CHARACTERISTICS	
Age of school	
Number of pupils in school	
School IMD score	
Attendance (average % attendance rates for each school year)	
Does the school have National Healthy School Status	

2. PHYSICAL ACTIVITY	**Very Poor/ Not present**	**Poor**	**Satisfactory**	**Good**	**Excellent**
	1	**2**	**3**	**4**	**5**
a. Does the school have a whole school physical activity policy?	☐	☐	☐	☐	☐
b. Was this developed in consultation with: Pupils ………………………………………………………… Parents/guardians? …………………………………………					
c. Is the policy continually monitored and evaluated? If so how? ………………………………………………………….. …………………………………………………………………….. ……………………………………………………………………..	☐	☐	☐	☐	☐
d. Does the policy support the PE curriculum and wider programmes for PE and school sport? Examples …………………………………………………………… …………………………………………………………………….. ……………………………………………………………………..	☐	☐	☐	☐	☐
e. Is there clear leadership and management in place to develop and monitor the physical activity policy? Examples …………………………………………………………… ……………………………………………………………………..	☐	☐	☐	☐	☐
(i) Is there a named person in the school?	☐	☐	☐	☐	☐
(ii) Does this person lead all practice and policy development on physical activity?	☐	☐	☐	☐	☐
(iii) Is this person known to all staff in this role?	☐	☐	☐	☐	☐
f. Does the school have at least 2 hours of structured PA every week, in or outside the curriculum, available to all pupils? Examples of activities available …………………………………… ……………………………………………………………………… ………………………………………………………………………	☐	☐	☐	☐	☐
g. Does the PE curriculum include health related fitness?	☐	☐	☐	☐	☐
h. Does the school have a range of activities available for all individuals and groups? Examples ……………………………………………………………… ……………………………………………………………………….. ………………………………………………………………………..	☐	☐	☐	☐	☐
i. Are pupils aware of the available activities?	☐	☐	☐	☐	☐

2. PHYSICAL ACTIVITY CONT'D	Very Poor/ Not Present	Poor	Satisfactory	Good	Excellent
	1	2	3	4	5
j. Are pupils consulted about the types of PA they would like to participate in? How? .... …………………………………………………………………	☐	☐	☐	☐	☐
k. Can the school specify activities that have been introduced, monitored and evaluated by consultation? Examples …………………………………………………………… …………………………………………………………………… ……………………………………………………………………	☐	☐	☐	☐	☐
l. Does the school have a system in place to monitor pupil's participation in PA? Examples…………………………………………………………….. …………………………………………………………………… ……………………………………………………………………	☐	☐	☐	☐	☐
m. Does a representative from the school attend School Sport Co-ordinator network meetings?	☐	☐	☐	☐	☐
n. Does the school use PESSCLE materials?	☐	☐	☐	☐	☐
o. Does the school have a School Travel Plan?	☐	☐	☐	☐	☐
If no is the school working towards one?	☐	☐	☐	☐	☐
p. Is there promotion of walking/cycling to school?	☐	☐	☐	☐	☐
q. Are parents/carers given the opportunity to be involved in the planning and delivery of PA? Examples... …………………………………………………………………… ……………………………………………………………………	☐	☐	☐	☐	☐
r. Are parents/carers actively encouraged to participate in the planning and delivery of PA? Examples …………………………………………………………….. …………………………………………………………………… ……………………………………………………………………	☐	☐	☐	☐	☐
s. Is there appropriate training provided/ available for all involved in delivering PA? Examples ………………………………………………………… …………………………………………………………………..	☐	☐	☐	☐	☐
t. Are all staff encouraged to undertake PA? Examples ………………………………………………………… …………………………………………………………………	☐	☐	☐	☐	☐
u. Are staff involved in developing opportunities to increase PA and to inform others about PA? Examples ………………………………………………………… ………………………………………………………………… …………………………………………………………………	☐	☐	☐	☐	☐
v. Quality of sport and PE provision:					
Is the school committed to making PE and sport a central part of pupils lives?	☐	☐	☐	☐	☐
Do school staff and pupils know and understand what they are trying to achieve and how to do this?	☐	☐	☐	☐	☐

2. PHYSICAL ACTIVITY CONT'D	Very Poor/ Not Present	Poor	Satisfactory	Good	Excellent
v. Cont'd	1	2	3	4	5
Do staff and pupils understand the importance of PE and sport as part of a healthy, active lifestyle?	☐	☐	☐	☐	☐
Do pupils have confidence to get involved in PE and sport?	☐	☐	☐	☐	☐
Do pupils have the skills they need to take part in PE and sport?	☐	☐	☐	☐	☐
Do pupils willingly participate in a range of individual and team activities?	☐	☐	☐	☐	☐
Do pupils show a desire to improve?	☐	☐	☐	☐	☐
Do pupils enjoy PE and school sport?	☐	☐	☐	☐	☐
Does the school provide adequate indoor facilities for PE, physical activity and sport?	☐	☐	☐	☐	☐
Does the school provide adequate outdoor facilities for PE, physical activity and sport?	☐	☐	☐	☐	☐
w. Is the indoor PE teaching space suitable for teaching 30+ children?	☐	☐	☐	☐	☐
Is the indoor PE teaching space of adequate size and dimension?(minimum recommended size is 2 badminton courts)	☐	☐	☐	☐	☐
Does the indoor PE teaching space have a purpose designed floor?	☐	☐	☐	☐	☐
Does the indoor PE teaching space have adequate:					
Lighting	☐	☐	☐	☐	☐
Ventilation	☐	☐	☐	☐	☐
Heating	☐	☐	☐	☐	☐
Is the colour of the indoor PE teaching space lively and stimulating?	☐	☐	☐	☐	☐
Is the indoor PE teaching space a welcoming and pleasant environment?	☐	☐	☐	☐	☐
Is the PE equipment height adjustable?	☐	☐	☐	☐	☐
Is the PE equipment in a suitable condition?	☐	☐	☐	☐	☐
Is adequate storage provided for the PE equipment?	☐	☐	☐	☐	☐
Are there separate changing facilities for boys/girls?	☐	☐	☐	☐	☐
Are the changing facilities pleasant and welcoming?	☐	☐	☐	☐	☐
Does the school have a grass playing field?	☐	☐	☐	☐	☐
Is this a single flexible area where a wide range of activities can take place?	☐	☐	☐	☐	☐

2. PHYSICAL ACTIVITY CONT'D	Very Poor/ Not Present 1	Poor 2	Satisfactory 3	Good 4	Excellent 5
x. Quality of play provision:					
Does the school have adequately sized outdoor play facilities?	☐	☐	☐	☐	☐
Are the outdoor play facilities of a suitable condition?	☐	☐	☐	☐	☐
Does the school have suitable facilities for pupils to play during wet playtimes?	☐	☐	☐	☐	☐
Does the playground have zone markings to organise the playground?	☐	☐	☐	☐	☐
Does the playground have activity markings on the floor or walls?	☐	☐	☐	☐	☐
Does the playground have any fixed activity equipment? e.g. sports posts/goals, adventure playground	☐	☐	☐	☐	☐
Does the playground have any signage? e.g. to indicate zones or suggesting activity ideas	☐	☐	☐	☐	☐
Are there any areas that are fenced off for ball games?	☐	☐	☐	☐	☐
Does the school playground have adequate drainage?	☐	☐	☐	☐	☐
Is the playground level or at a gradient?	☐	☐	☐	☐	☐
Are there any organised play time activities? Examples ……………………………………………………… ……………………………………………………………… ………………………………………………………………	☐	☐	☐	☐	☐

Score for this section ______________/300

3. HEALTHY EATING	Very Poor/ Not Present 1	Poor 2	Satisfactory 3	Good 4	Excellent 5
a. Does the school have a whole school food policy?	☐	☐	☐	☐	☐
b. Was this policy developed through consultation with staff, pupils and parents/carers?	☐	☐	☐	☐	☐
c. Is this continually monitored and evaluated?	☐	☐	☐	☐	☐
d. Does the school have an eating environment that promotes positive interaction between pupils?	☐	☐	☐	☐	☐
e. Does the school environment promote healthy eating? e.g. promoting 5-a-day campaigns, providing fruit and vegetables, providing high quality school meals	☐	☐	☐	☐	☐

f. Do pupils have opportunities to learn about different types of food in the context of a balanced diet?	☐	☐	☐	☐	☐
g. Does the curriculum cover the emotional aspects of food?	☐	☐	☐	☐	☐
h. Does the school consult pupils about their food and drink choices - including school lunches and other – via school councils, task groups or other representative bodies?	☐	☐	☐	☐	☐

Score for this section
___________/40

4. EMOTIONAL HEALTH AND WELL-BEING

a. Are social and emotional skills part of the curriculum for personal, social and health education?	☐	☐	☐	☐	☐
b. Does the school have a confidential support system in place for children and staff to access advice? Examples ………………………………………………………………. ……………………………………………………………………... ……………………………………………………………………...	☐	☐	☐	☐	☐
c. Does the school provide opportunities for children to participate in school activities to help build their confidence and self-esteem? Examples ……………………………………………………… ………………………………………………………………….. …………………………………………………………………..	☐	☐	☐	☐	☐
d. Does the school regularly celebrate activities and display achievements?	☐	☐	☐	☐	☐

Score for this section
_____________/20

5. PERSONAL AND SOCIAL HEALTH EDUCATION	**Very Poor/ Not Present**	**Poor**	**Satisfactory**	**Good**	**Excellent**
	1	**2**	**3**	**4**	**5**
a. Are there arrangements in place to refer children to specialist services who can advise on professional matters?	☐	☐	☐	☐	☐
b. Does the school have clear protocols for referring children to specialist services that are understood by staff?	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

c. Are pupils aware of how to access these services?					
d. Does the school use local initiatives to inform activities and support important national priorities? e.g. 5-a-day healthy eating campaign, Take 10 physical activity campaign	☐	☐	☐	☐	☐
e. Are there any mechanisms in place to ensure all pupils views are reflected in curriculum planning and the whole school environment? Examples …………………………………………………………….. …………………………………………………………………………. ………………………………………………………………………….	☐	☐	☐	☐	☐
f. Do school/year/class councils exist?	☐	☐	☐	☐	☐
g. Can the school demonstrate any changes to the curriculum/ whole school environment as a result of pupils views? Examples …………………………………………………………….. …………………………………………………………………………. ………………………………………………………………………….	☐	☐	☐	☐	☐

Score for this section
__________/35

6. ADDITIONAL ACTIVITIES	Very Poor/ Not Present	Poor	Satisfactory	Good	Excellent
	1	2	3	4	5
National initiatives: a. Youth Sport Trusts TOP Activity (provides fun alternative activities for 7-11 years olds such as salsa and martial arts)	☐	☐	☐	☐	☐
b. Elevating Athletics (a movement literacy package aimed at developing core physical skills for 5-11 year olds)	☐	☐	☐	☐	☐
c. Take 10 – Fit to Succeed (a package providing a selection of 10 minute activity ideas to encourage learning about physical activity)	☐	☐	☐	☐	☐
d. Multi-skills FUNdamentals (physical activity training and toolkits for children in Key Stage 1 and 2)	☐	☐	☐	☐	☐
Local initiatives: e. Community Swimming and After School Swimming	☐	☐	☐	☐	☐
f. Walking Bus	☐	☐	☐	☐	☐
g. Safer Routes to School	☐	☐	☐	☐	☐
Individual school initiatives: h. Primary Play Leaders	☐	☐	☐	☐	☐
i. Junior and Community Sports Leaders	☐	☐	☐	☐	☐

Any other:
……
……
……

………

Score for this section

____________/45

TOTAL SCORE _______________/440

Appendix 6 Baseline audit tool raw data

Descriptives

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
PreCountsPerMin	CC	607.3137	130.08616	26.55373	552.3831	662.2443	322.68	856.01
	GI	651.3235	100.51299	33.50433	574.0624	728.5847	500.68	774.80
	GJ	543.2091	155.28763	32.37971	476.0577	610.3606	244.53	909.87
	HC	564.5740	135.38776	26.05539	511.0164	618.1316	355.21	834.89
	HP	508.8745	164.91668	32.34282	442.2632	575.4857	274.34	883.97
	PR	594.5801	143.73367	26.24206	540.9091	648.2511	343.89	950.97
	SG	632.8366	144.34532	29.46436	571.8849	693.7883	455.57	1037.17
	SH	564.2761	128.71600	24.77140	513.3577	615.1944	331.79	782.77
	TW	557.0398	141.07958	24.93958	506.1752	607.9044	325.80	827.03
	Total	574.2869	144.36047	9.68884	555.1926	593.3813	244.53	1037.17
CPMInSchool	CC	702.7046	149.85438	30.58890	639.4266	765.9825	473.55	971.65
	GI	635.8522	93.97285	31.32428	563.6183	708.0862	496.73	815.99
	GJ	601.0757	150.20167	31.31921	536.1236	666.0277	335.58	956.71
	HC	614.9833	171.96252	33.09420	546.9572	683.0094	400.05	1033.36

	HP	531.9523	184.61683	36.20634	457.3840	606.5207	283.53	886.55
	PR	623.3717	166.00816	30.30880	561.3832	685.3601	353.13	1006.85
	SG	535.4204	123.89262	25.28948	483.1051	587.7356	376.33	805.94
	SH	574.9522	156.82231	30.18047	512.9154	636.9890	316.40	896.71
	TW	580.1001	160.58598	28.38786	522.2027	637.9975	318.40	846.08
	Total	596.7828	162.42638	10.90134	575.2989	618.2667	283.53	1033.36
CPMSchRelated	CC	679.9287	144.26306	29.44757	619.0118	740.8457	449.40	936.77
	GI	673.2867	103.30673	34.43558	593.8781	752.6952	516.12	842.93
	GJ	595.2965	157.70754	32.88430	527.0987	663.4944	339.55	973.12
	HC	618.1470	173.21028	33.33433	549.6273	686.6667	419.41	1053.78
	HP	544.6142	190.55997	37.37188	467.6454	621.5831	267.26	917.94
	PR	622.3380	161.03882	29.40153	562.2051	682.4709	345.05	964.48
	SG	581.0671	167.73315	34.23839	510.2396	651.8946	373.76	1050.20
	SH	572.5751	144.67074	27.84190	515.3453	629.8050	327.23	872.16
	TW	581.0709	160.99879	28.46083	523.0247	639.1172	321.32	858.29
	Total	601.7531	163.27335	10.95819	580.1571	623.3490	267.26	1053.78
CPMOutofSchool	CC	497.4521	169.79525	34.65931	425.7538	569.1503	201.51	826.37
	GI	653.0589	156.39510	52.13170	532.8430	773.2748	423.17	869.20
	GJ	487.2487	216.19889	45.08058	393.7573	580.7401	157.83	1055.67
	HC	500.9448	170.26539	32.76759	433.5901	568.2996	262.72	1061.14
	HP	504.0727	183.33676	35.95530	430.0214	578.1240	215.92	901.87

	PR	528.8263	191.37031	34.93928	457.3675	600.2852	277.70	1224.46
	SG	671.2179	375.49035	76.64665	512.6622	829.7736	248.57	2160.07
	SH	557.7689	148.38151	28.55604	499.0711	616.4667	317.97	884.48
	TW	526.1291	159.23138	28.14840	468.7200	583.5381	255.76	934.53
	Total	538.3982	211.36075	14.18560	510.4419	566.3546	157.83	2160.07

Correlations

			PreCountsPer Min	CPMInSchool	CPMSch Related	CPMOutof School	TotalAudit Norm	PANorm	PolicyNorm	ActivitiesNorm	QualityNorm	Facilities Norm	HealthEat Norm	EmoHealth Norm	PSHENorm
Spearman's rho	PreCountsPerMin	Correlation Coefficient	1.000	.795**	.830**	.671**	.074	.085	.161*	.048	.090	-.035	.047	.022	-.007
		Sig. (2-tailed)	.	.000	.000	.000	.274	.207	.017	.476	.182	.607	.484	.747	.918
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	CPMInSchool	Correlation Coefficient	.795**	1.000	.977**	.370**	-.011	.026	-.021	-.074	.019	.033	-.103	-.040	-.130
		Sig. (2-tailed)	.000	.	.000	.000	.874	.697	.753	.274	.777	.630	.125	.558	.062
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	CPMSchRelated	Correlation Coefficient	.830**	.977**	1.000	.443**	-.010	.024	.010	-.056	.016	-.003	-.073	-.045	-.118
		Sig. (2-tailed)	.000	.000	.	.000	.886	.727	.879	.403	.812	.966	.277	.501	.090
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	CPMOutofSchool	Correlation Coefficient	.671**	.370**	.443**	1.000	.085	.086	.152*	.091	.087	-.024	.065	.060	.105
		Sig. (2-tailed)	.000	.000	.000	.	.208	.202	.024	.175	.195	.722	.337	.370	.131
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	TotalAuditNorm	Correlation Coefficient	.074	-.011	-.010	.085	1.000	.976**	.772**	.917**	.909**	.704**	.809**	.792**	.847**
		Sig. (2-tailed)	.274	.874	.886	.208	.	.000	.000	.000	.000	.000	.000	.000	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	PANorm	Correlation Coefficient	.085	.026	.024	.086	.976**	1.000	.719**	.910**	.915**	.706**	.737**	.811**	.803**
		Sig. (2-tailed)	.207	.697	.727	.202	.000	.	.000	.000	.000	.000	.000	.000	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	PolicyNorm	Correlation Coefficient	.161*	-.021	.010	.152*	.772**	.719**	1.000	.784**	.852**	.133*	.679**	.566**	.659**
		Sig. (2-tailed)	.017	.753	.879	.024	.000	.000	.	.000	.000	.048	.000	.000	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	ActivitiesNorm	Correlation Coefficient	.048	-.074	-.056	.091	.917**	.910**	.784**	1.000	.911**	.486**	.832**	.845**	.883**
		Sig. (2-tailed)	.476	.274	.403	.175	.000	.000	.000	.	.000	.000	.000	.000	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	QualityNorm	Correlation Coefficient	.090	.019	.016	.087	.909**	.915**	.852**	.911**	1.000	.451**	.644**	.776**	.811**
		Sig. (2-tailed)	.182	.777	.812	.195	.000	.000	.000	.000	.	.000	.000	.000	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	FacilitiesNorm	Correlation Coefficient	-.035	.033	-.003	-.024	.704**	.706**	.133*	.486**	.451**	1.000	.435**	.463**	.484**
		Sig. (2-tailed)	.607	.630	.966	.722	.000	.000	.048	.000	.000	.	.000	.000	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	HealthEatNorm	Correlation Coefficient	.047	-.103	-.073	.065	.809**	.737**	.679**	.832**	.644**	.435**	1.000	.690**	.627**
		Sig. (2-tailed)	.484	.125	.277	.337	.000	.000	.000	.000	.000	.000	.	.000	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	EmoHealthNorm	Correlation Coefficient	.022	-.040	-.045	.060	.792**	.811**	.566**	.845**	.776**	.463**	.690**	1.000	.831**
		Sig. (2-tailed)	.747	.558	.501	.370	.000	.000	.000	.000	.000	.000	.000	.	.000
		N	222	222	222	222	222	222	222	222	222	222	222	222	208
	PSHENorm	Correlation Coefficient	-.007	-.130	-.118	.105	.847**	.803**	.659**	.883**	.811**	.484**	.627**	.831**	1.000
		Sig. (2-tailed)	.918	.062	.090	.131	.000	.000	.000	.000	.000	.000	.000	.000	.
		N	208	208	208	208	208	208	208	208	208	208	208	208	208

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 7 Baseline focus group discussion guide

1. Do you think your school promotes a healthy lifestyle?
Do you think this is important? Why? Do you think your school should promote a healthy lifestyle? How does/could your school promote healthy living? Talk about physical activity, PE, healthy eating Do you feel you have any control over these situations?
2. What do you think of your school playgrounds, play spaces and facilities?
How do you spend your break and lunch times? What do you like about your school's play spaces? Is there anything you would like to change? Why? What would encourage you to be more active at break times? Do you want to be more active at break times? Do you feel you have any control over these situations?
3. Do you enjoy your PE lessons?
How often do you have PE lessons? Do you think children at your school should do more/less PE Would you like to do it more/less? What are your favourite PE activities? Why? Would you like to change anything about your PE lessons? Why? Do you take part in any after school physical activities? Do you feel you have any control over these situations?
4. Do the staff at your school encourage you to be healthy?
How and why? Do you think this is important? Why? Do you know of any initiatives within the school that encourage/promote physical activity? Do the staff influence your physical activity behaviour? Who do you think influences your physical activity and health behaviours?
5. Do you like the food provided by the school?

Do you have a school dinner or bring in a packed lunch? Why? Does the school have a tuck shop/vending machines? What do you think of the food and drinks that are on offer? Would you like anything to change? Why? Do you feel you have any control over these situations?
6. How do you travel to and from school?
Would you like to use a different method? Why? Is there anything you would change to make this easier for you? Why? Do you know of any schemes within the school that promote active travel to school? Do you feel you have any control over these situations?
What do you think would encourage you to be more physically active?

Appendix 8 Focus group letter to Head Teachers

An Ecological Approach to Increasing Physical Activity in Primary School Children in Stoke-on-Trent

Centre for Sport and Exercise Research, in the Faculty of Health, Staffordshire University

Hannah Smith
PhD Student
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Staffordshire University
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Dear ……

I am writing to you in connection with the research that your school has been involved with. As you will be aware, physical activity levels have already been collected from a sample of children from your school. We are most grateful for your co-operation with this, and your support is much appreciated. Physical activity is an important aspect of health, and this research will examine the role of the whole school environment in promoting and increasing levels of physical activity at school, with the aim of encouraging and supporting a more physically active school lifestyle.

I would like to request permission to visit the school to undertake an audit of the school environment, relating to the Healthy Schools Framework, to make observations about the school environment. This will help us to understand what factors of the school environment can impact on the physical activity levels of children.

In addition to this we would like to carry out seven focus group interviews; three with school pupils, two with members of school staff and two with parents. Each focus group will comprise of six people, and will take place on school premises. The children's focus groups will take place during school time, and the staff and parent focus groups will take place within school time or immediately before or after, depending on your convenience. I have extended Criminal Records Bureau clearance (Disclosure Number 001127706160).

Participation in the study is voluntary. I have included a parental consent form and participant information sheet, which provides further details about the focus group interviews. All participants can withdraw from the study at any time.

The focus group discussions will take place at your school, at a time that is convenient for you, in a room such as the school library or classroom, at a time that is convenient for you.

The information obtained from the environmental audit and focus group interviews will be treated with total confidentiality. The identities of any individuals and your school will be kept completely anonymous.

I hope that we will be able to minimise any difficulty in arranging and carrying out the visit. If you have any further questions about this study please do not hesitate to contact me. Hopefully we will be able to arrange a mutually convenient appointment.

Once again, I would like to thank the school for agreeing to participate in this research.

Hannah Smith
PhD Student
Faculty of Health
Staffordshire University
Leek Road
Stoke-on-Trent
ST4 2DF
t: 01782 294024 / 0777 592 7931 e: H.E.Smith@staffs.ac.uk

Appendix 9 Focus group consent letter for parents

An Ecological Approach to Increasing Physical Activity in Primary School Children in Stoke-on-Trent

Focus Group Interviews

Centre for Sport and Exercise Research, in the Faculty of Health, Staffordshire University

Dear Parent,

I am conducting a research project that will examine the role of the whole school environment on physical activity levels of children at school. Your child's school has already agreed to take part in this project, and has already been recruited as part of a wider project to assess the physical activity levels of school children in Stoke-on-Trent.

What is involved?

Children will be involved in a small focus group discussion with five other children from their school who are of a similar age group. These children will be selected at random from the class. Each focus group will take place at school, during lesson time and will take between 30-45 minutes.

During the discussion we will have an informal chat about the children's views, understandings and experiences of physical activity and health within their school. The children can withdraw from the study at any time. Each focus group discussion will be audio-taped and transcribed, and the information stored securely and anonymously.

I will also be conducting focus group interviews with parents of school children. Again, this will be an informal chat, in a group of six people, about your views of physical activity and health within your child's school. Please could you indicate on the reply slip whether you would be interested in taking part.

Will the information in the study be confidential?

All information obtained from this research will be treated with **total confidentiality**. Individual identities of the children or their school are not required, and will not be stored with any of the data.

If you have any further questions about this study please do not hesitate to contact me.

Yours Sincerely

Hannah Smith - PhD Student
Centre for Sport and Exercise Research
Faculty of Health
Staffordshire University
Tel: 01782 294024 / 0777 592 7931
Email: H.E.Smith@staffs.ac.uk

I would be most grateful if you could return the reply slip in the envelope provided.

✂………………………………………………………………………………………….

Focus group interviews

I **do/do not*** wish my child to participate in the above named project

I **would/would not*** be interested in taking part in the above named project

Name: Child's Name:

* Please delete as appropriate

Appendix 10 Focus group information sheet for participants

An Ecological Approach to Increasing Physical Activity in Primary School Children in Stoke-on-Trent

Centre for Sport and Exercise Research, in the Faculty of Health, Staffordshire University

Purpose of the study

Physical activity is an important aspect of health, and schools are encouraged to offer quality P.E and physical activity during the school day. This research will examine the role of the whole school environment in promoting and increasing levels of physical activity at school.

What is involved if I agree to take part?

If you agree to take part in this research you may be involved in a small class discussion group. There will be about five other children, of a similar age to you, who are from your school. The children in the groups will be selected at random from your class. Each discussion will take between 30-45 minutes, and will take place during your normal lesson time with your teacher present. We will talk about your views, understandings and experiences of physical activity and health within your school.

You can withdraw from the study at any time.

Where and when will this take place?

The focus group discussions will take place at your school, during the school day, in a room such as the school library or classroom. Your teacher will tell you when this will take place.

Will the information in the study be confidential?

The information obtained from the focus group interviews will be treated with total confidentiality. The identities of any individuals and your school will be kept completely anonymous.

If you have any further questions about this study please do not hesitate to contact me.

Yours Sincerely

Hannah Smith – PhD Student
Centre for Sport and Exercise Research
Faculty of Health
Staffordshire University
Tel: 01782 294024 / 0777 592 7931

Email: H.E.Smith@staffs.ac.uk
Appendix 11 Example of baseline qualitative analysis: coding

GJ Yr 6

1. Do you think your school promotes a healthy lifestyle?
Okay, do you think your school promotes a healthy lifestyle?
B: Yep
I: And why do you think that?
B: Because we have healthy school dinners and we're allowed to eat fruit at break times.
I: What do you mean by healthy school dinners?
K: Like vegetables, and y'have milk at dinnertime and meat.
I: And why do you think that's healthy?
K: Cos it's good for you and
B: Makes you be healthy
H: What you need for growing up.
S: Yeah
I: And do you think that's important, having healthy food in the school?
C: Yeah
B: Yeah cos you won't eat chips every day and be unfit and that
I: And what about physical activity in the school?
C: We do that a lot, like rounders and stuff like that in PE.
I: And what do you think about the physical activity and PE in school?
B: Yeah we enjoy it
I: So why do you think it's important that you are healthy? Don't worry about putting your hand up.
B: So you can keep fit and erm help you have a better lifestyle.
I: Can you think of any other reasons?
C: Not sure
[All quiet, B shakes head]
I: Have any of you heard of the Golden Mile
B: Yeah
(General agreement)
I: Have any of you taken part in it?
B: Yeah we go round the course and we have a planner and a certificate if we get a bronze mile
I: Good, anyone else?
C: Yeah we do it too.
I: Have you all had a go?
(General agreement)
I: So do you enjoy it?
C: We do it when we have PE and in the morning
H: And in PE we do it at the start
S: And you count how many times you go round and then you put it on the planner and that!
I: Great, is there anything about it that you would change?
H: No

S: Sometimes if you do more than a mile you can only tick off each mile not how many laps
I: So do you sometimes lose track of where you off
S: Well no I remember but then I start from where I finished
I: Can you write it on the chart?
S: There's a bit of room yeah
I: Okay, anything else you would change
T: We could have to do it every day at every lesson!
I: Really you like it that much!
T: Yeah
H: Yeah!
I: As part of the work we are doing with the school we're planning a healthy week in the summer, with lots of different activities and healthy stuff to do. What do you think?
T: Yeah!
K: We could do dancing!
I: Well that would be my next question – what sorts of things would you like to try if you got the chance?
H: Yeah dancing
C: And football
S: More football
C: And rounders
H: And trampoline
C: Yeah and space hoppers! More space hoppers!
I: Okay what I'll do is make a note of all of this, and try and get all the pupils involved in the planning, as much as possible okay?
All: Yeah

CODE #1 p.1 SCHOOL DINNERS, FRUIT, VEGETABLES, MILK, MEAT
CODE #2 pp.1-2 ENJOY PE
CODE #3 p.1 HEALTH, KEEP FIT, BETTER LIFESTYLE

2. What do you think of your school playgrounds, play spaces and facilities?
I: So what do you think about the playgrounds and play spaces in your school? Do you think they help you to be active?
H: Yeah
B: Yeah
S: Yeah
H: I like the climbing frame yard
I: You've got a climbing frame yard – what's that like?
H: Erm it's got lots of like monkey bars and erm
K: There's a climbing wall
I: Is that inside or outside?
H: That's outside
B: In the hall there's like erm apparatus and outside there's a football yard and a long jump pit and stuff.
I: So at playtimes when you go outside - what sorts of things do you play?
H: Yeah – we're outside
C: Yeah

I: What sorts of things do you do at playtime?
C: Handstands
B: On Tuesdays and Thursdays year 5 and 3 are on football yard
I: That's at breaktime?
B: Yeah
I: Is there anything that you would like to change at all – specifically where you go at break, where you play at break times and lunch times?
[quiet – no response]
I: Do you think there might be anything you'd like to change?
S: The climbing frame, make it a bit bigger
C: Yeah
B: On the top yard like cos there's a long jump pit and like we could like more things like long jump and stuff.
I: Do you have any Playground Leaders at all?
B: Yeah
K: Yeah
S: Yeah:
I: And what do they do at playtime?
B: They – at dinnertimes – they go on the top yard and they've got like toys and stuff to play with
I: What sort of toys do they have for you to play with?
B: Erm space hoppers
H: Skipping ropes
B: Sometimes bowling
I: Brilliant. And do you think that the Playground Leaders – are they there every day?
H: Not every day
I: Not every day. Do you think they make a difference at playtimes?
S: Yeah
K: Yeah
I: Would you like them to be there everyday?
Collectively: Yeah
I: Would you like to have more Playground Leaders?
H: Yeah
I: Do you think that would make a difference to the sorts of games that you played?
H: Yeah
B: It'd make you more active and keep fitter
I: So you think it would have a difference
B & H: Yeah

CODE #4 pp.2-3 PLAYGROUND APPARATUS, ACTIVITIES,
CODE #5 PLAYGROUND LEADERS, ACTIVE, FITTER

3. Do you enjoy your PE lessons?
I: How often do you have PE lessons? Do you know?
B: Tuesdays and Thursdays
I: Yeah?
Collective: Yes
I: And what sorts of things do you do in PE?

H: Mini-tennis!
C: And the multi-skills games too
B: Erm we have games lessons and PE and on games lessons we do rounders and like hockey and stuff and in PE we do gymnastics and go on the apparatus and that.
I: Is that the same for all of you?
All: Yeah
I: And do you have any after school clubs?
B: There's golf club and football club and got football team as well.
I: [Directed to others] And do you have golf and football club as well? Do you have any other after school clubs?
H: I do golf
[Others quiet]
I: Do you think there are enough after school clubs?
All: [Quite quiet] Yeah
I: Is there anything you'd like to change about them?
All: No
I: And what do you think about your PE lessons?
[quiet]
I: Do you think you'd like to do more or less or?
B: To do a bit of football as well
H: Not do gymnastics cos I'm scared of heights
S: Think its okay really now
C: Wouldn't really change it

CODE #6 PP. 3-4 PE DAYS, ACTIVITIES, GENERAL POSITIVE

4. Do you think the staff at the school encourage you to be healthy?
I: Okay. Do you think there is any one thing that really influences your health or physical activity?
[quiet]
I: – do you think it's your parents, your school, your teachers or do you think it's your friends?
B: Erm I think its me brother cos he makes me chase after him
H: And school at PE time
I: [Directed to others] And what about you – what do you think about it?
K: Think it's a big mixture of people
S & C: Yeah
I: Do you think the staff at your school influence you to be healthy?
B: Yeah cos they make you do PE and games and help you with it
C: Yeah and at play times and stuff
S: And cos of the school dinners and that
I: And do you think it's important that the staff encourage or influence you to be healthy?
C: Well yeah. Yeah.
I: Why?
K: Cos then you'll grow up healthy and that like.
S: Yeah and be fit and healthy.

CODE #7 p.4 SIBLINGS, STAFF, PE, FOOD

5. Do you like the food provided by the school?
I: And do you think – you said earlier that you think the school promotes you to be healthy – like with healthy school dinners - do you think there is anything about the school that you would change if you could do?
B: I don't know I have sandwiches
H: I've got sandwiches
I: Why do you have sandwiches instead of school dinners?
B: Just what me Mum makes
H: Just what we have
I: Would you like to have school dinners instead?
B: Don't know, no.
I: Any reason why?
B: No, don't know.
K: I like school dinners.
I: Would you like to change anything about them?
K: Erm, no
I: So, those of you who have sandwiches - how do you know about the healthy school dinners?
B: Cos we get told about it and
H: What other people say
B:Yeah
I: Okay. And do you have a tuck shop or anything like that?
S: Yeah think so
I: Does any of you go to the tuck shop?
B: You can buy like sweets and that
H: Yeah
I: What sorts of things does it sell?
B: Just like sweets and that, not sure. Erm….
H: Yeah

CODE #8 pp.4-5 SANDWICHES, SCHOOL DINNERS,

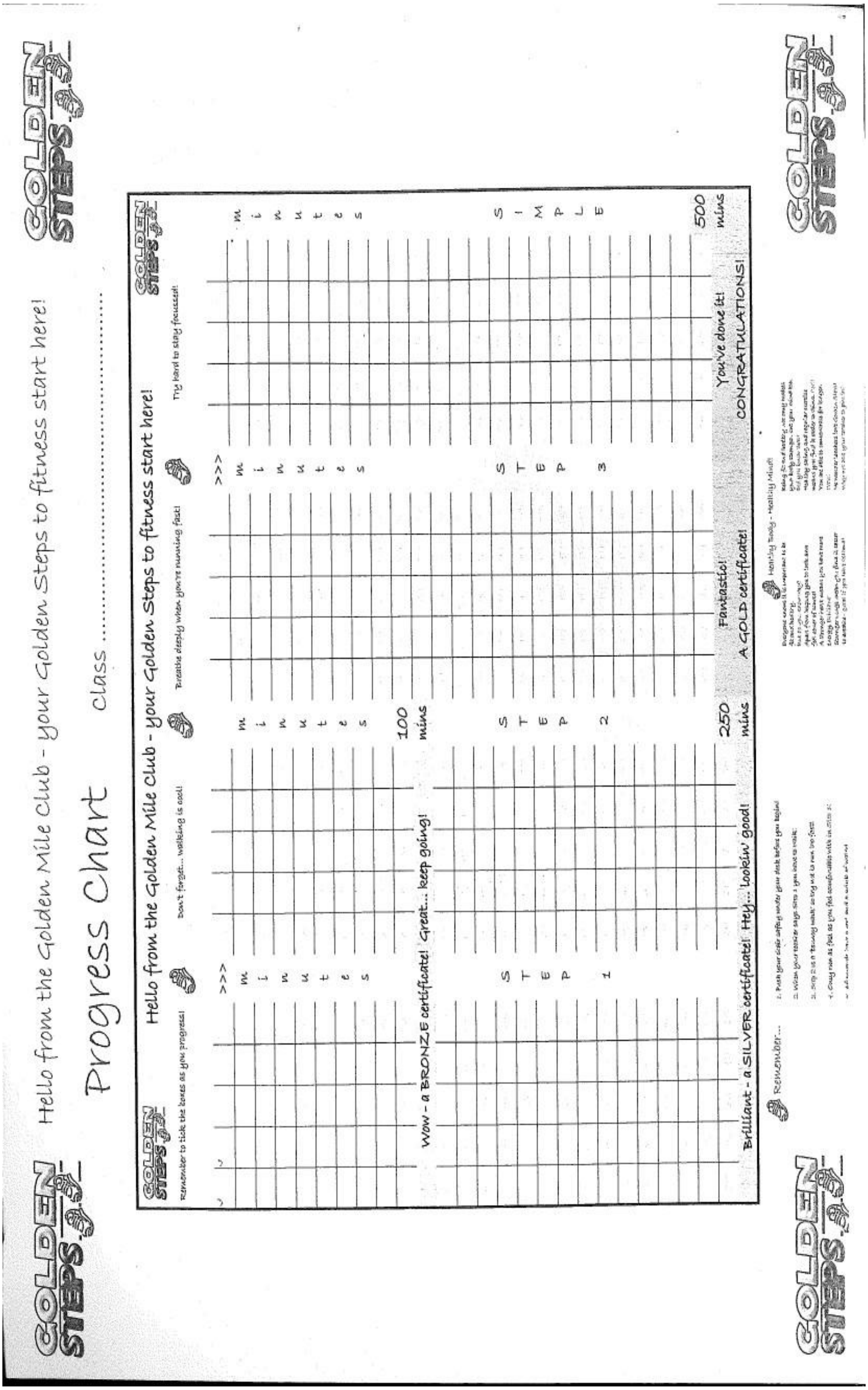
6. How do you travel to and from school?
I: Okay, so you're not too sure? No. Okay then. How do you travel to school.
S: I have go in the car cos I have go to like a day care and I have to get up at 6am
K: Walking and the car
C: Car
B: In the car
H: Come in the car
I: And does the school have anything that promotes you to walk to school?
B: Yeah we have Walk to School Week
I: And what is that?
S: Erm it's a record of how active people are
B: Yeah to get them to walk to school more
I: Okay. Is that often?

B: Erm don't know, like once every year or term or erm
C: Yeah
I: And do you think it works?
All: Yeah [general agreement]
I: Okay. Is there anything else you would like to add just before we finish?
H: Erm, no
I: Do you think I've covered everything to do with health and physical activity and your school – nothing else you'd like to add?
All: No
I: Okay well that's brilliant then, thank you. You all had some really interesting things to say, I've got some thank you notes for you all, just to thank you for taking part so I'll give those out now.

CODE #9 p.5 CAR, WALK TO SCHOOL, WALK TO SCHOOL WEEK,

PROMOTION OF WALKING TO SCHOOL,

Appendix 12 Golden Mile activity materials



Appendix 13 Pre-intervention data collection timetable and Ethical Approval

Nov	Fr	24		
	Sat	25		
	Sun	26		
	Mon	27	Site 1	Site 2
	Tue	28		
	Wed	29		
	Th	30		
	Fr	1		
	Sat	2		
	Sun	3		
	Mon	4	collect/charge	
	Tue	5		
	Wed	6	Site 3	Site 4
	Th	7		
	Fr	8		
	Sat	9		
	Sun	10		
	Mon	11		
Dec	Tue	12		
	Wed	13	collect/charge	
	Th	14		
	Fr	15		
	Sat	16		
	Sun	17		
	Mon	18		
	Tue	19		**CHRISTMAS**
	Wed	3		
	Th	4		
	Fr	5		
	Sat	6		
	Sun	7		
	Mon	8	Site 5	Site 6
	Tue	9		
	Wed	10		
	Th	11		
	Fr	12		
	Sat	13		
Jan	Sun	14		
	Mon	15	collect/charge	
	Tue	16		
	Wed	17	Site 7	Site 8
	Th	18		
	Fr	19		
	Sat	20		
	Sun	21		
	Mon	22		
	Tue	23		
	Wed	24	collect/charge	
	Thur	25		

Fri	26		
Sat	27		
Sun	28		
Mon	29		
Tue	30		
Wed	31		
Th	1		
Fr	2	Site 9	Site 10
Sat	3		
Sun	4		
Mon	5		
Tue	6		
Wed	7	collect/charge	
Thur	8		

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Proposed Research Project:

An Ecological Approach to Increasing Physical Activity in Primary School Children

Hannah Smith

1. Aim of the investigation

To contribute to improving the lives and future health prospects of children at school by increasing opportunities for physical activity in and around the school day.

2. Objectives of the project

a) Measure baseline physical activity levels of a representative sample of primary school children in Stoke-on-Trent.
b) Develop a physical activity related environmental audit tool for use with primary schools, using observations, assessments and focus group interviews with pupils, staff and parents/guardians to assess the environment of the school and how this might be changed to increase opportunities for children to be physically active.
c) Develop and evaluate a primary school based multi-component intervention based on the findings from the environmental audit, targeting those specific areas which were found to impact on physical activity behaviours.
d) Measure post-intervention physical activity levels using a randomised controlled trial design.

This research project will be carried out in collaboration with the North and South Stoke-on-Trent School Sport Partnerships, who will facilitate access to the schools and help with the implementation of the physical activity intervention.

Signatures:

Hannah Smith – Researcher | Date: 16/5/2007

Hannah S

Nigel Edwards - Stoke-on-Trent School Sport Partnership Development Manager

N A Edwards .... Date: 16/5/2007

STAFFORDSHIRE UNIVERSITY

Faculty of Health/Faculty of Sciences

ETHICAL APPROVAL FEEDBACK

Student name:	**Hannah Smith**
Title of Study:	**The development of a physical activity related environmental audit tool for use with Primary Schools**
Award Pathway:	**MPhil/PhD**
Status of approval:	**Approved**

Action now needed:

Your project proposal has now been approved by the Faculty's Ethics Panel and you may now commence the implementation phase of your study. You do not need to approach the Local Research Ethics Committee. You should note that any divergence from the approved procedures and research method will invalidate any insurance and liability cover from the University. You should, therefore, notify the Panel of any significant divergence from this approved proposal.

You should arrange to meet with your supervisor for support during the process of completing your study and writing your dissertation.

Comments for your consideration:

Thank you for forwarding the amendments requested by the Panel

Signed: David Clark-Carter
Chair of the Faculty of Health/Faculty of Sciences Ethics Panel

Date: 11th April 2007

Appendix 14 Accelerometry information sheet and instructions for participants

STAFFORDSHIRE UNIVERSITY

Children's Health & Activity Monitoring Progamme for Schools (*CHAMPS*)

This project aims to measure the physical activity of Stoke on Trent school children during the school week. Remember to wear your accelerometer all the time, except when you are in water (for example swimming or in the shower or bath).

Do not wear the accelerometer in water or in situations where you think it may get damaged or may be likely to injure you or someone else.

Take the accelerometer off when you go to bed but remember to put it on again in the morning!

We will collect the accelerometers on Friday 25th May. Please remember to return them.

ActiGraph worn on the waist with an Elastic Belt

ActiGraph worn on the waist with the Belt Clip

Appendix 15 Example Summary Physical Activity Sheet

Children's Activity Monitoring Programme for Schools (CHAMPS)

Aim Of This Project

There is concern that physical activity levels of school children have been dropping and that this may have longer term health implications. The purpose of this study is to measure the physical activity levels of a representative sample of Stoke on Trent school children.

How Active Are You?

According to the activity monitor, during the whole week you spent 1682 minutes in activity of moderate-to-vigorous intensity:

- **1493** minutes in **moderate** physical activity (e.g. brisk walk)
- **189** minutes in **vigorous** physical activity (e.g. running)

It is recommended that all children should do at least 60 minutes of moderate or vigorous physical activity every day. This is the same as doing 420 minutes per week. How does your total amount compare with this?

Work Out Your Own Daily Activity Levels

You can work out your own daily activity levels. You could ask your teacher or whoever looks after you to help.

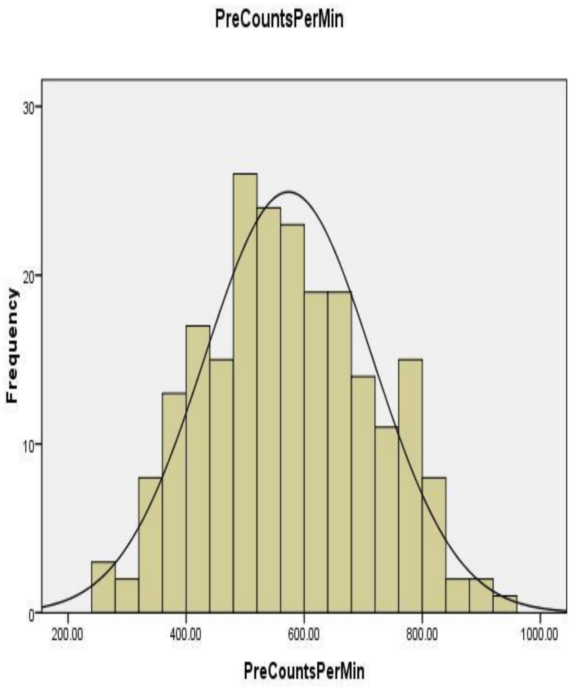
Total minutes of moderate and vigorous activity in the week	÷	Number of days you wore the monitor for (in case you forgot to wear it on any days)

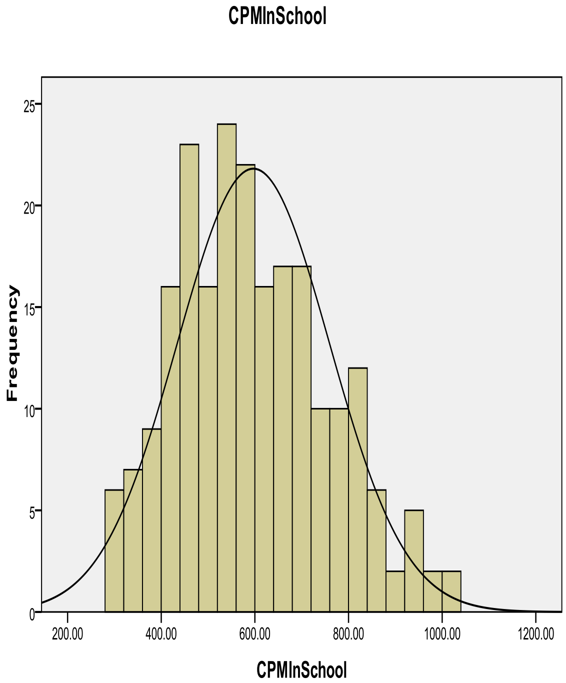
= _____ minutes per day

Are you getting your recommended 60 minutes per day?

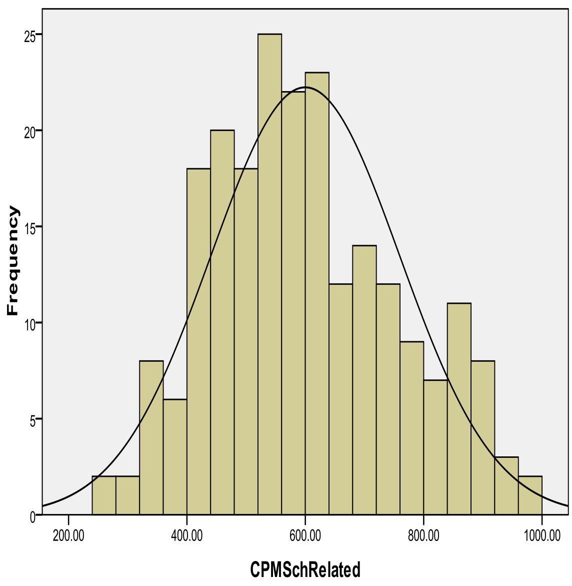
Thank you very much for taking part!

Appendix 16 Baseline physical activity measurement raw data

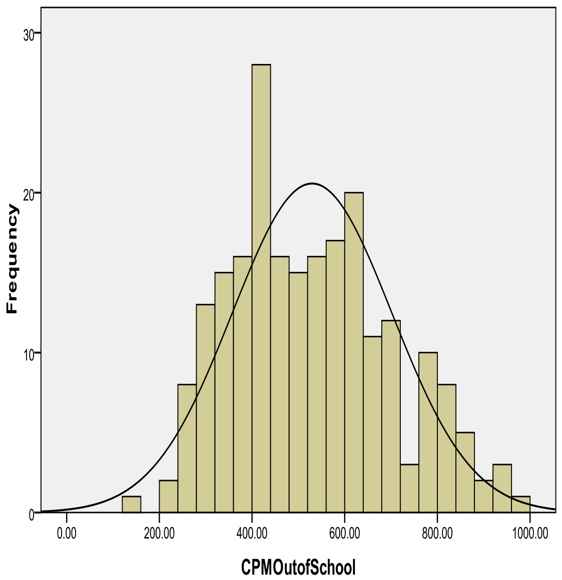




CPMSchRelated



CPMOutofSchool



Oneway ANOVA

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PreCountsPerMin	CC	24	607.3137	130.08616	26.55373	552.3831	662.2443	322.68	856.01
	GI	9	651.3235	100.51299	33.50433	574.0624	728.5847	500.68	774.80
	GJ	23	543.2091	155.28763	32.37971	476.0577	610.3606	244.53	909.87
	HC	27	564.5740	135.38776	26.05539	511.0164	618.1316	355.21	834.89
	HP	26	508.8745	164.91668	32.34282	442.2632	575.4857	274.34	883.97
	PR	30	594.5801	143.73367	26.24206	540.9091	648.2511	343.89	950.97
	SG	24	632.8366	144.34532	29.46436	571.8849	693.7883	455.57	1037.17
	SH	27	564.2761	128.71600	24.77140	513.3577	615.1944	331.79	782.77
	TW	32	557.0398	141.07958	24.93958	506.1752	607.9044	325.80	827.03
	Total	222	574.2869	144.36047	9.68884	555.1926	593.3813	244.53	1037.17
CPMInSchool	CC	24	702.7046	149.85438	30.58890	639.4266	765.9825	473.55	971.65
	GI	9	635.8522	93.97285	31.32428	563.6183	708.0862	496.73	815.99
	GJ	23	601.0757	150.20167	31.31921	536.1236	666.0277	335.58	956.71
	HC	27	614.9833	171.96252	33.09420	546.9572	683.0094	400.05	1033.36
	HP	26	531.9523	184.61683	36.20634	457.3840	606.5207	283.53	886.55
	PR	30	623.3717	166.00816	30.30880	561.3832	685.3601	353.13	1006.85
	SG	24	535.4204	123.89262	25.28948	483.1051	587.7356	376.33	805.94

	SH	27	574.9522	156.82231	30.18047	512.9154	636.9890	316.40	896.71
	TW	32	580.1001	160.58598	28.38786	522.2027	637.9975	318.40	846.08
	Total	222	596.7828	162.42638	10.90134	575.2989	618.2667	283.53	1033.36
CPMSchRelated	CC	24	679.9287	144.26306	29.44757	619.0118	740.8457	449.40	936.77
	GI	9	673.2867	103.30673	34.43558	593.8781	752.6952	516.12	842.93
	GJ	23	595.2965	157.70754	32.88430	527.0987	663.4944	339.55	973.12
	HC	27	618.1470	173.21028	33.33433	549.6273	686.6667	419.41	1053.78
	HP	26	544.6142	190.55997	37.37188	467.6454	621.5831	267.26	917.94
	PR	30	622.3380	161.03882	29.40153	562.2051	682.4709	345.05	964.48
	SG	24	581.0671	167.73315	34.23839	510.2396	651.8946	373.76	1050.20
	SH	27	572.5751	144.67074	27.84190	515.3453	629.8050	327.23	872.16
	TW	32	581.0709	160.99879	28.46083	523.0247	639.1172	321.32	858.29
	Total	222	601.7531	163.27335	10.95819	580.1571	623.3490	267.26	1053.78

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
PreCountsPerMin	.442	8	213	.895
CPMInSchool	1.328	8	213	.231
CPMSchRelated	.742	8	213	.654

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PreCountsPerMin	Between Groups	322452.697	8	40306.587	2.004	.047
	Within Groups	4283175.250	243	20108.804		
	Total	4605627.947	251			
CPMInSchool	Between Groups	535000.607	8	66875.076	2.690	.008
	Within Groups	5295494.046	243	24861.474		
	Total	5830494.653	251			
CPMSchRelated	Between Groups	345485.919	8	43185.740	1.659	.110
	Within Groups	5545973.484	243	26037.434		
	Total	5891459.402	251			

Robust Tests of Equality of Means

		Statistic[a]	df1	df2	Sig.
PreCountsPerMin	Welch	1.982	8	75.147	.060
	Brown-Forsythe	2.086	8	199.971	.039
CPMInSchool	Welch	2.896	8	76.264	.007
	Brown-Forsythe	2.877	8	205.202	.005
CPMSchRelated	Welch	1.890	8	75.740	.074
	Brown-Forsythe	1.748	8	203.254	.089

a. Asymptotically F distributed.

Whole sample gender

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PreCountsPerMin	Equal variances assumed	.066	.798	5.466	252	.000	99.62328	18.22666	63.70208	135.54449
	Equal variances not assumed			5.468	219.935	.000	99.62328	18.22040	63.71436	135.53221
CPMInSchool	Equal variances assumed	.285	.594	6.069	252	.000	122.76840	20.22779	82.90335	162.63345
	Equal variances not assumed			6.070	219.841	.000	122.76840	20.22437	82.90994	162.62686
CPMSchRelated	Equal variances assumed	.859	.355	6.146	252	.000	124.74346	20.29621	84.74357	164.74335
	Equal variances not assumed			6.151	219.984	.000	124.74346	20.27984	84.77582	164.71110
CPMOutofSchool	Equal variances assumed	.249	.618	2.075	252	.039	58.43768	28.16601	2.92795	113.94742
	Equal variances not assumed			2.069	212.080	.040	58.43768	28.24643	2.75796	114.11741

Intervention sample gender

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PreCountsPerMin	Equal variances assumed	.467	.496	3.897	127	.000	109.14463	28.00666	53.59355	164.69571
	Equal variances not assumed			3.932	100.920	.000	109.14463	27.75955	54.07662	164.21264
CPMInSchool	Equal variances assumed	2.142	.146	5.016	127	.000	152.07121	30.31665	91.93828	212.20413
	Equal variances not assumed			5.071	101.304	.000	152.07121	29.99018	92.58092	211.56150
CPMSchRelated	Equal variances assumed	2.675	.105	5.141	127	.000	155.79226	30.30130	95.68978	215.89473
	Equal variances not assumed			5.210	101.659	.000	155.79226	29.90382	96.47578	215.10873
CPMOutofSchool	Equal variances assumed	.338	.563	1.135	127	.259	55.19661	48.64194	-41.28445	151.67767
	Equal variances not assumed			1.096	78.917	.276	55.19661	50.36987	-45.06375	155.45697

Control sample gender

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PreCountsPerMin	Equal variances assumed	.467	.496	3.897	124	.000	109.14463	28.00666	53.59355	164.69571
	Equal variances not assumed			3.932	100.920	.000	109.14463	27.75955	54.07662	164.21264
CPMInSchool	Equal variances assumed	2.142	.146	5.016	124	.000	152.07121	30.31665	91.93828	212.20413
	Equal variances not assumed			5.071	101.304	.000	152.07121	29.99018	92.58092	211.56150
CPMSchRelated	Equal variances assumed	2.675	.105	5.141	124	.000	155.79226	30.30130	95.68978	215.89473
	Equal variances not assumed			5.210	101.659	.000	155.79226	29.90382	96.47578	215.10873
CPMOutofSchool	Equal variances assumed	.338	.563	1.135	124	.259	55.19661	48.64194	-41.28445	151.67767
	Equal variances not assumed			1.096	78.917	.276	55.19661	50.36987	-45.06375	155.45697

Whole sample

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
PreCountsPerMin	m	131	623.2010	137.02164	12.88991
	f	122	523.5778	134.44633	12.87762
CPMInSchool	m	131	657.0610	151.35931	14.23869
	f	122	534.2926	149.95017	14.36262
CPMSchRelated	m	131	663.0010	154.44918	14.52936
	f	122	538.2575	147.71088	14.14814
CPMOutofSchool	m	131	567.0906	192.84362	18.14120
	f	122	508.6529	226.04112	21.65081

Control sample

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
PreCountsPerMin	m	64	634.2456	147.83074	19.58066
	f	61	525.1010	134.89976	19.67715
CPMInSchool	m	64	667.2525	161.34188	21.37025
	f	61	515.1812	144.24977	21.04099
CPMSchRelated	m	64	677.0793	162.83354	21.56783
	f	61	521.2870	142.00760	20.71394
CPMOutofSchool	m	64	573.2019	201.19336	26.64871
	f	61	518.0053	293.03172	42.74307

Intervention sample

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
PreCountsPerMin	m	66	611.9592	125.40422	16.75784
	f	62	522.4231	135.19209	17.16941
CPMInSchool	m	66	646.6875	141.17598	18.86543
	f	62	548.7802	153.69964	19.51987
CPMSchRelated	m	66	648.6712	145.48267	19.44094
	f	62	551.1222	151.76332	19.27396
CPMOutofSchool	m	66	560.8702	185.57151	24.79804

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
PreCountsPerMin	m	66	611.9592	125.40422	16.75784
	f	62	522.4231	135.19209	17.16941
CPMInSchool	m	66	646.6875	141.17598	18.86543
	f	62	548.7802	153.69964	19.51987
CPMSchRelated	m	66	648.6712	145.48267	19.44094
	f	62	551.1222	151.76332	19.27396
CPMOutofSchool	m	66	560.8702	185.57151	24.79804
	f	62	501.5632	159.97332	20.31663

Physical activity across sampling periods: whole sample

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CPMInSchool	596.7828	253	162.42638	10.90134
	CPMSchRelated	601.7531	253	163.27335	10.95819
Pair 2	CPMSchRelated	601.7531	253	163.27335	10.95819
	AfterSchCPM	538.3982	253	211.36075	14.18560
Pair 3	CPMInSchool	596.7828	253	162.42638	10.90134
	AfterSchCPM	538.3982	253	211.36075	14.18560

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	CPMInSchool & CPMSchRelated	253	.970	.000
Pair 2	CPMSchRelated & AfterSchCPM	253	.339	.000
Pair 3	CPMInSchool & AfterSchCPM	253	.271	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	CPMInSchool - CPMSchRelated	-4.97026	39.58601	2.65684	-10.20625	.26572	-1.871	252	.063
Pair 2	CPMSchRelated - AfterSchCPM	63.35482	218.98570	14.69736	34.38991	92.31973	4.311	252	.000
Pair 3	CPMInSchool - AfterSchCPM	58.38455	229.07037	15.37420	28.08576	88.68335	3.798	252	.000

Physical activity across sampling periods: male sample

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CPMInSchool	657.0610	130	151.35931	14.23869
	CPMSchRelated	663.0010	130	154.44918	14.52936
Pair 2	CPMInSchool	657.0610	130	151.35931	14.23869
	CPMOutofSchool	567.0906	130	192.84362	18.14120
Pair 3	CPMSchRelated	663.0010	130	154.44918	14.52936
	CPMOutofSchool	567.0906	130	192.84362	18.14120

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	CPMInSchool & CPMSchRelated	130	.950	.000
Pair 2	CPMInSchool & CPMOutofSchool	130	.233	.013
Pair 3	CPMSchRelated & CPMOutofSchool	130	.343	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	CPMInSchool - CPMSchRelated	-5.94000	48.36794	4.55007	-14.95539	3.07539	-1.305	129	.194
Pair 2	CPMInSchool - CPMOutofSchool	89.97035	215.62508	20.28430	49.77961	130.16110	4.435	129	.000
Pair 3	CPMSchRelated - CPMOutofSchool	95.91035	201.50338	18.95584	58.35178	133.46893	5.060	129	.000

Physical activity across sampling periods: female sample

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CPMInSchool	534.2926	123	149.95017	14.36262
	CPMSchRelated	538.2575	123	147.71088	14.14814
Pair 2	CPMInSchool	534.2926	123	149.95017	14.36262
	CPMOutofSchool	508.6529	123	226.04112	21.65081
Pair 3	CPMSchRelated	538.2575	123	147.71088	14.14814
	CPMOutofSchool	508.6529	123	226.04112	21.65081

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	CPMInSchool & CPMSchRelated	123	.983	.000
Pair 2	CPMInSchool & CPMOutofSchool	123	.244	.011
Pair 3	CPMSchRelated & CPMOutofSchool	123	.287	.003

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	CPMInSchool - CPMSchRelated	-3.96494	27.90241	2.67257	-9.26243	1.33255	-1.484	122	.141
Pair 2	CPMInSchool - CPMOutofSchool	25.63964	238.81708	22.87453	-19.70165	70.98092	1.121	122	.265
Pair 3	CPMSchRelated - CPMOutofSchool	29.60458	231.86978	22.20910	-14.41770	73.62686	1.333	122	.185

Year group differences: whole sample

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CPMOutofSchool	Between Groups	346774.061	8	57795.677	1.304	.256
	Within Groups	9526040.337	251	44307.164		
	Total	9872814.398	259			
CPMSchRelated	Between Groups	141932.938	8	23655.490	.885	.507
	Within Groups	5749526.464	251	26741.984		
	Total	5891459.402	259			

Year group differences – male sample

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PreCountsPerMin	Between Groups	130340.065	6	21723.344	1.167	.329
	Within Groups	1972452.141	125	18608.039		
	Total	2102792.206	131			
CPMInSchool	Between Groups	97058.004	6	16176.334	.695	.655
	Within Groups	2468821.919	125	23290.773		
	Total	2565879.924	131			
CPMSchRelated	Between Groups	104572.701	6	17428.784	.720	.635
	Within Groups	2567136.844	125	24218.272		
	Total	2671709.546	131			
CPMOutofSchool	Between Groups	146763.083	6	24460.514	.645	.694
	Within Groups	4018366.833	125	37909.121		
	Total	4165129.916	131			

Year group differences: female sample

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PreCountsPerMin	Between Groups	213696.388	6	35616.065	2.090	.061
	Within Groups	1738491.842	116	17044.038		
	Total	1952188.230	122			
CPMInSchool	Between Groups	112832.224	6	18805.371	.828	.551
	Within Groups	2315553.604	116	22701.506		
	Total	2428385.828	122			
CPMSchRelated	Between Groups	160999.359	6	26833.227	1.247	.289
	Within Groups	2195399.231	116	21523.522		
	Total	2356398.590	122			
CPMOutofSchool	Between Groups	399520.290	6	66586.715	1.327	.252
	Within Groups	5118695.283	116	50183.287		
	Total	5518215.573	122			

BMI data

Correlations

		PreBMI	PreCountsPerMin	CPMInSchool	CPMSchRelated	CPMOutofSchool
PreBMI	Pearson Correlation	1	-.163*	-.138*	-.143*	-.088
	Sig. (2-tailed)		.015	.040	.034	.194
	N	253	253	253	253	253
PreCountsPerMin	Pearson Correlation	-.163*	1	.785**	.829**	.567**
	Sig. (2-tailed)	.015		.000	.000	.000
	N	253	253	253	253	253
CPMInSchool	Pearson Correlation	-.138*	.785**	1	.970**	.271**
	Sig. (2-tailed)	.040	.000		.000	.000
	N	253	253	253	253	253
CPMSchRelated	Pearson Correlation	-.143*	.829**	.970**	1	.339**
	Sig. (2-tailed)	.034	.000	.000		.000
	N	253	253	253	253	253
CPMOutofSchool	Pearson Correlation	-.088	.567**	.271**	.339**	1
	Sig. (2-tailed)	.194	.000	.000	.000	
	N	253	253	253	253	253

*. Correlation is significant at the 0.05 level (2-tailed).

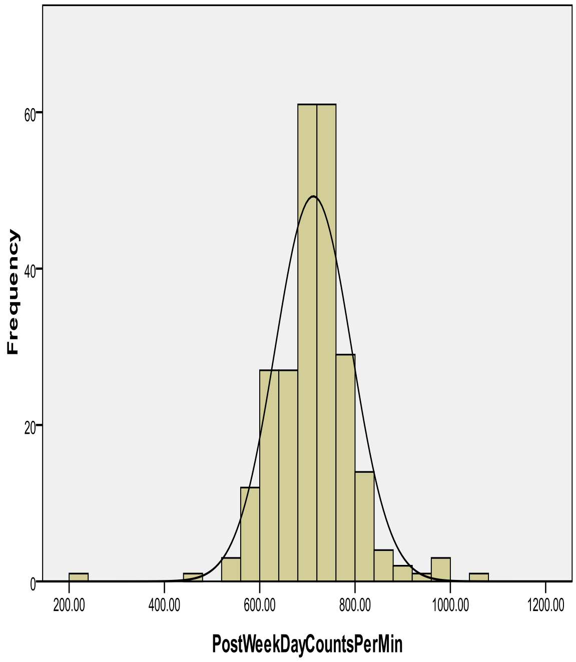
Appendix 17 Copy of post intervention data collection timetable

	Mon	26	HALF-TERM		
	Tue	27			
	Wed	28			
	Th	29			
	Fr	30			
	Sat	31			
June	Sun	1			
	Mon	2			
	Tue	3			
	Wed	4			
	Th	5			
	Fr	6			
	Sat	7			
	Sun	8			
	Mon	9	Site 1	Site 2	Fit 9am
	Tue	10			
	Wed	11			
	Th	12			Collect 3pm/4pm dependent on after school activities
	Fr	13			
	Sat	14			Download/Charging
	Sun	15			
	Mon	16	Site 3	Site 4	Fit 9am
	Tue	17			
	Wed	18			
	Th	19			Collect 3pm/4pm dependent on after school activities
	Fr	20			
	Sat	21			Download/Charging
	Sun	22			
	Mon	23	Site 5	Site 6	Fit 9am
	Tue	24			
	Wed	25			
	Th	26			Collect 3pm/4pm dependent on after school activities
	Fr	27			
	Sat	28			Download/Charging
	Sun	29			
	Mon	30	Site 7	Site 8	Fit 9am
July	Tue	1			
	Wed	2			
	Th	3			Collect 3pm/4pm dependent on after school activities
	Fr	4			
	Sat	5			Download/Charging
	Sun	6			
	Mon	7	Site 9	Site 10	Fit 9am
	Tue	8			
	Wed	9			
	Th	10			
	Fr	11			Collect 3pm/4pm dependent on after school

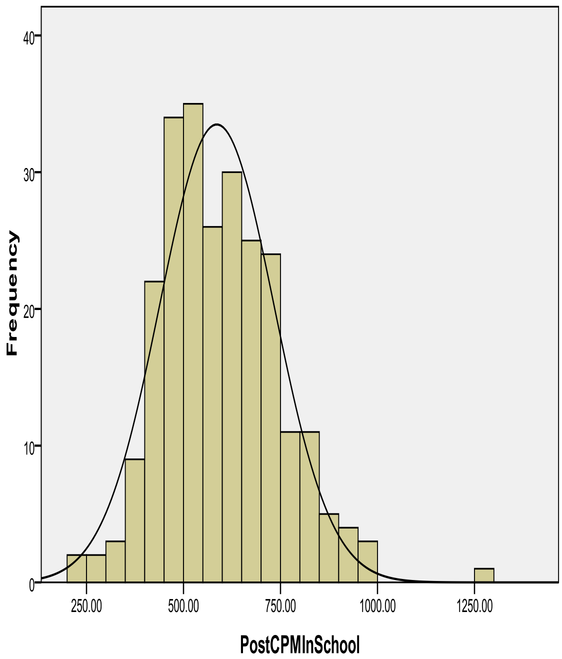
			activities
Sat	12		Download/Charging
Sun	13		
Mon	14	Reserve dates	
Tue	15		
Wed	16		
Th	17		
Fr	18		
Sat			

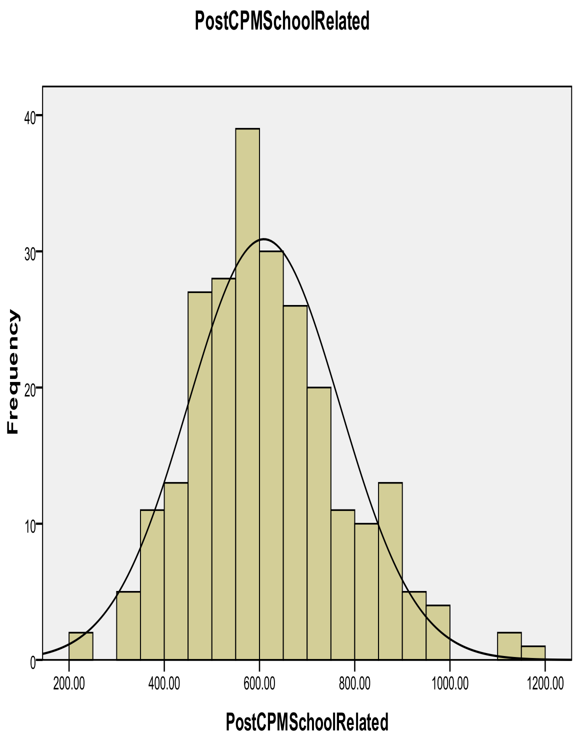
Appendix 18 Post-intervention physical activity measurement raw data

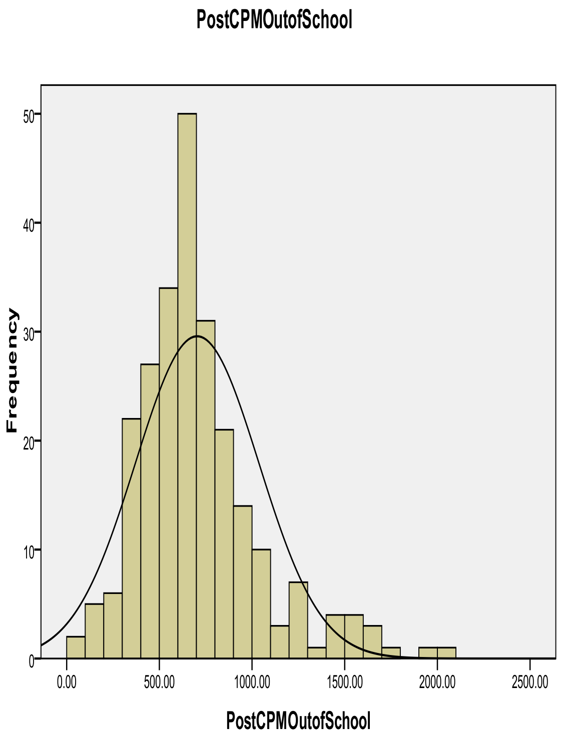
PostWeekDayCountsPerMin



PostCPMInSchool




PostCPMSchoolRelated
Frequency
0
10
20
30
40
200.00
400.00
600.00
800.00
1000.00
1200.00
PostCPMSchoolRelated


PostCPMOutofSchool
Frequency
0
10
20
30
40
50
0.00
500.00
1000.00
1500.00
2000.00
2500.00
PostCPMOutofSchool

Post-intervention physical activity: intervention sample

Group Statistics

	PostGender	N	Mean	Std. Deviation
PostWeekDayCountsPerMin	m	57	735.6686	82.81109
	f	59	732.4743	62.42953
PostCPMInSchool	m	57	634.5743	135.87290
	f	59	612.2097	171.14769
PostCPMSchoolRelated	m	57	652.8921	149.41044
	f	59	631.0167	175.94708
PostCPMOutofSchool	m	57	760.3756	291.98627
	f	59	765.0824	318.19380

Control sample

Group Statistics

	PostGender	N	Mean	Std. Deviation
PostWeekDayCountsPerMin	m	62	705.4252	90.24537
	f	67	675.3961	90.14860
PostCPMInSchool	m	62	572.3173	140.32491
	f	67	550.3189	155.85415
PostCPMSchoolRelated	m	62	596.0297	155.74306
	f	67	573.0887	168.68823
PostCPMOutofSchool	m	62	713.7848	417.68474
	f	67	581.7200	274.27262

Physical activity sampling periods

Group Statistics

	PostType	N	Mean	Std. Deviation	Std. Error Mean
PostWeekDayCountsPerMin	1.00	116	734.0457	72.88584	6.54534
	2.00	129	689.5561	91.07614	8.21206
PostCPMInSchool	1.00	116	623.2116	154.58476	13.88212
	2.00	129	560.6922	148.53981	13.39338

PostCPMSchoolRelated	1.00	116	641.7780	163.13984	14.65039
	2.00	129	583.9064	162.45765	14.64831
PostCPMOutofSchool	1.00	116	762.7670	304.35027	27.33146
	2.00	129	643.9945	354.05449	31.92402

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PostWeekDayCountsPer Min	Equal variances assumed	2.344	.127	4.240	245	.000	44.48958	10.49205	23.82346	65.15570
	Equal variances not assumed			4.237	232.982	.000	44.48958	10.50140	23.79974	65.17942
PostCPMInSchool	Equal variances assumed	.262	.609	3.241	245	.001	62.51948	19.29292	24.51834	100.52062
	Equal variances not assumed			3.241	244.753	.001	62.51948	19.28979	24.52431	100.51466
PostCPMSchoolRelated	Equal variances assumed	.156	.693	2.793	245	.006	57.87158	20.71766	17.06412	98.67904
	Equal variances not assumed			2.793	244.996	.006	57.87158	20.71731	17.06481	98.67835
PostCPMOutofSchool	Equal variances assumed	1.248	.265	2.828	245	.005	118.77248	41.99997	36.04540	201.49956
	Equal variances not assumed			2.826	239.021	.005	118.77248	42.02561	35.98462	201.56034

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
PreType	.00	Control	129
	1.00	Intervention	116

Descriptive Statistics

Dependent Variable:PostWeekDayCountsPerMin

PreType	Mean	Std. Deviation	N
Control	690.2797	94.27354	129
Intervention	734.2612	70.49684	116
Total	712.2704	85.91340	245

Levene's Test of Equality of Error Variances[a]

Dependent Variable:PostWeekDayCountsPerMin

F	df1	df2	Sig.
3.197	1	206	.075

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + PreCountsPerMin + PreType

Tests of Between-Subjects Effects

Dependent Variable:PostWeekDayCountsPerMin

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	100712.448[a]	2	50356.224	7.233	.001	.066	14.466	.932
Intercept	6229051.967	1	6229051.967	894.742	.000	.814	894.742	1.000
PreCountsPerMin	124.890	1	124.890	.018	.894	.000	.018	.052
PreType	99712.331	1	99712.331	14.323	.000	.065	14.323	.965
Error	1427177.643	243	6961.842					
Total	1.071E8	245						
Corrected Total	1527890.091	244						

a. R Squared = .066 (Adjusted R Squared = .057)

b. Computed using alpha = .05

Estimated Marginal Means

PreType

Dependent Variable:PostWeekDayCountsPerMin

PreType	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	690.330[a]	8.190	674.182	706.478
Intervention	734.211[a]	8.190	718.063	750.359

a. Covariates appearing in the model are evaluated at the following values: PreCountsPerMin = 575.6375.

Pre versus post intervention: intervention sample

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreCountsPerMin	566.3545	115	136.39181	13.37432
	PostWeekDayCountsPerMin	734.2612	115	70.49684	6.91278
Pair 2	CPMInSchool	592.2592	115	154.98320	15.19735
	PostCPMInSchool	626.4212	115	157.71084	15.46482
Pair 3	CPMSchRelated	594.9387	115	155.15461	15.21416
	PostCPMSchoolRelated	647.3043	115	167.18788	16.39412
Pair 4	CPMOutofSchool	532.7428	115	170.07744	16.67746
	PostCPMOutofSchool	773.4248	115	319.76378	31.35542

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PreCountsPerMin & PostWeekDayCountsPerMin	115	-.053	.590
Pair 2	CPMInSchool & PostCPMInSchool	115	-.097	.326
Pair 3	CPMSchRelated & PostCPMSchoolRelated	115	-.064	.518
Pair 4	CPMOutofSchool & PostCPMOutofSchool	115	-.046	.646

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	PreCountsPerMin - PostWeekDayCountsPerMin	-167.90676	156.84181	15.37961	-198.40858	-137.40494	-10.917	103	.000
Pair 2	CPMInSchool - PostCPMInSchool	-34.16196	231.62793	22.71299	-79.20781	10.88390	-1.504	103	.136
Pair 3	CPMSchRelated - PostCPMSchoolRelated	-52.36559	235.26245	23.06938	-98.11826	-6.61291	-2.270	103	.025
Pair 4	CPMOutofSchool - PostCPMOutofSchool	-240.68200	368.95818	36.17933	-312.43516	-168.92884	-6.652	103	.000

Pre versus post intervention: control sample

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreCountsPerMin	584.9206	129	151.61871	14.86744
	PostWeekDayCountsPerMin	690.2797	129	94.27354	9.24428
Pair 2	CPMInSchool	598.5280	129	170.96593	16.76459
	PostCPMInSchool	566.6801	129	153.08765	15.01148
Pair 3	CPMSchRelated	606.6732	129	171.73268	16.83977
	PostCPMSchoolRelated	591.9277	129	169.70568	16.64101
Pair 4	CPMOutofSchool	548.2573	129	247.22147	24.24206
	PostCPMOutofSchool	644.3033	129	354.16084	34.72833

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PreCountsPerMin & PostWeekDayCountsPerMin	129	.020	.839
Pair 2	CPMInSchool & PostCPMInSchool	129	.073	.464
Pair 3	CPMSchRelated & PostCPMSchoolRelated	129	.093	.350
Pair 4	CPMOutofSchool & PostCPMOutofSchool	129	-.148	.133

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	PreCountsPerMin - PostWeekDayCountsPerMin	-105.35904	176.91253	17.34770	-139.76411	-70.95396	-6.073	128	.000
Pair 2	CPMInSchool - PostCPMInSchool	31.84788	221.05548	21.67627	-11.14190	74.83765	1.469	128	.145
Pair 3	CPMSchRelated - PostCPMSchoolRelated	14.74552	229.98212	22.55160	-29.98027	59.47130	.654	128	.515
Pair 4	CPMOutofSchool - PostCPMOutofSchool	-96.04595	460.97444	45.20226	-185.69398	-6.39793	-2.125	128	.036

BMI correlations: intervention sample

Correlations

		PostBMI	PostWeekDayCountsPerMin	PostCPMInSchool	PostCPMSchoolRelated	PostCPMOutofSchool
PostBMI	Pearson Correlation	1	.003	.045	.037	.006
	Sig. (2-tailed)		.977	.629	.691	.952
	N	116	116	116	116	116
PostWeekDayCountsPerMin	Pearson Correlation	.003	1	.046	.005	.210*
	Sig. (2-tailed)	.977		.614	.959	.020
	N	116	123	123	123	123
PostCPMInSchool	Pearson Correlation	.045	.046	1	.912**	.219*
	Sig. (2-tailed)	.629	.614		.000	.015
	N	116	123	123	123	123
PostCPMSchoolRelated	Pearson Correlation	.037	.005	.912**	1	.454**
	Sig. (2-tailed)	.691	.959	.000		.000
	N	116	123	123	123	123
PostCPMOutofSchool	Pearson Correlation	.006	.210*	.219*	.454**	1
	Sig. (2-tailed)	.952	.020	.015	.000	
	N	116	123	123	123	123

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		PostBMI	PostWeekDayCountsPerMin	PostCPMInSchool	PostCPMSchoolRelated	PostCPMOutofSchool
PostBMI	Pearson Correlation	1	.003	.045	.037	.006
	Sig. (2-tailed)		.977	.629	.691	.952
	N	116	116	116	116	116
PostWeekDayCountsPerMin	Pearson Correlation	.003	1	.046	.005	.210*
	Sig. (2-tailed)	.977		.614	.959	.020
	N	116	123	123	123	123
PostCPMInSchool	Pearson Correlation	.045	.046	1	.912**	.219*
	Sig. (2-tailed)	.629	.614		.000	.015
	N	116	123	123	123	123
PostCPMSchoolRelated	Pearson Correlation	.037	.005	.912**	1	.454**
	Sig. (2-tailed)	.691	.959	.000		.000
	N	116	123	123	123	123
PostCPMOutofSchool	Pearson Correlation	.006	.210*	.219*	.454**	1
	Sig. (2-tailed)	.952	.020	.015	.000	
	N	116	123	123	123	123

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

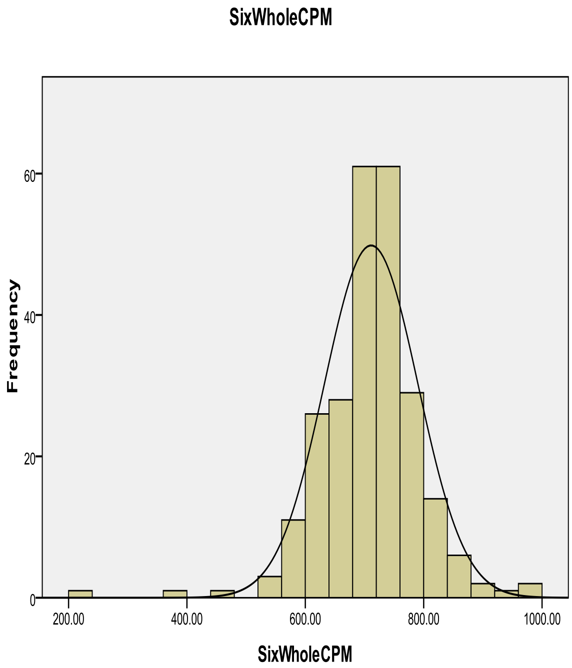
BMI correlations: control sample

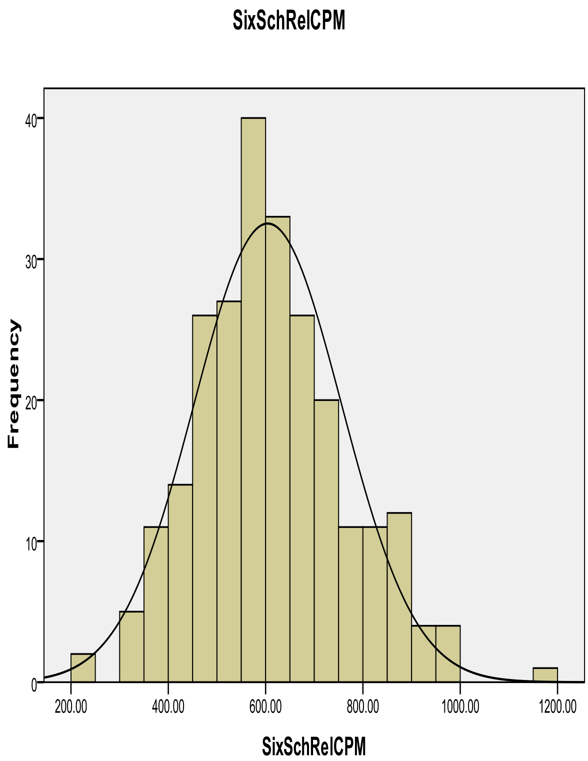
Correlations

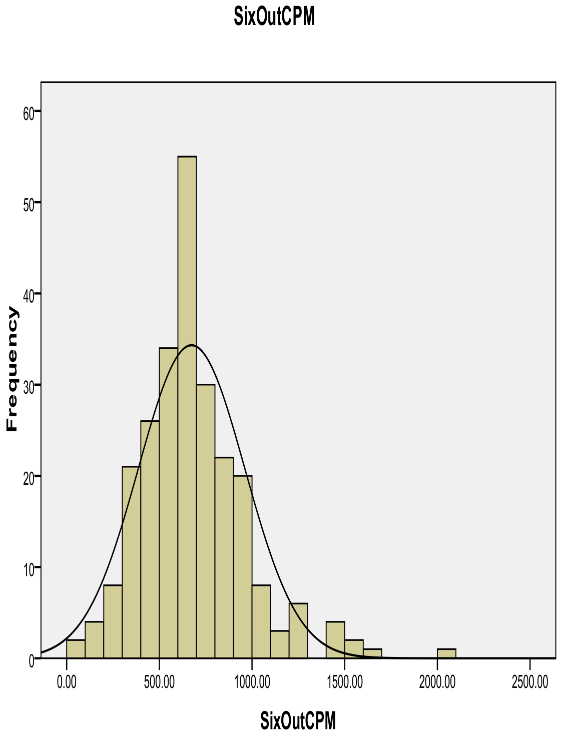
		PostBMI	PostWeekDayCountsPerMin	PostCPMInSchool	PostCPMSchoolRelated	PostCPMOutofSchool
PostBMI	Pearson Correlation	1	.042	.339**	.330**	.135
	Sig. (2-tailed)		.658	.000	.000	.153
	N	113	113	113	113	113
PostWeekDayCountsPerMin	Pearson Correlation	.042	1	.024	.041	.150
	Sig. (2-tailed)	.658		.792	.647	.097
	N	113	124	124	124	124
PostCPMInSchool	Pearson Correlation	.339**	.024	1	.913**	.324**
	Sig. (2-tailed)	.000	.792		.000	.000
	N	113	124	124	124	124
PostCPMSchoolRelated	Pearson Correlation	.330**	.041	.913**	1	.504**
	Sig. (2-tailed)	.000	.647	.000		.000
	N	113	124	124	124	124
PostCPMOutofSchool	Pearson Correlation	.135	.150	.324**	.504**	1
	Sig. (2-tailed)	.153	.097	.000	.000	
	N	113	124	124	124	124

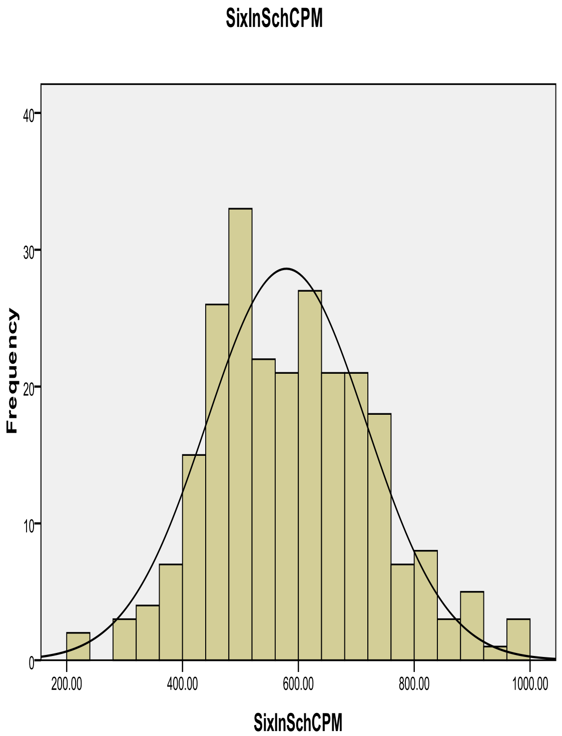
**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 19 Six-month post intervention physical activity measurement raw data






SixOutCPM
Frequency
0
10
20
30
40
50
60
0.00
500.00
1000.00
1500.00
2000.00
2500.00
SixOutCPM


SixInSchCPM
Frequency
0
10
20
30
40
200.00
400.00
600.00
800.00
1000.00
SixInSchCPM

Male physical activity: control group

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SixWholeCPM	63	526.00	965.00	701.9769	79.39479
SixInSchCPM	63	230.60	938.96	565.2483	130.94270
SixSchRelCPM	63	230.19	900.42	585.6849	139.08467
SixOutCPM	63	19.40	2029.43	644.8193	337.89464
Valid N (listwise)	63				

Female physical activity: control group

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SixWholeCPM	67	225.60	853.00	672.7221	96.62322
SixInSchCPM	67	5.00	964.17	547.3959	152.71780
SixSchRelCPM	67	5.00	970.50	573.2425	168.72822
SixOutCPM	67	5.00	1611.66	581.7200	271.92557
Valid N (listwise)	67				

Male physical activity: intervention group

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SixWholeCPM	63	563.00	965.00	728.0292	78.86597
SixInSchCPM	63	367.63	981.48	622.5743	133.82431
SixSchRelCPM	63	369.00	984.46	647.9741	145.13239
SixOutCPM	63	299.69	1539.75	743.9821	243.69772
Valid N (listwise)	63				

Female physical activity: intervention group

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SixWholeCPM	66	582.50	917.25	722.4743	62.42953
SixInSchCPM	66	238.37	964.68	602.6859	150.03313
SixSchRelCPM	66	236.80	1166.80	624.6675	162.45004
SixOutCPM	66	356.48	1564.29	746.0348	282.32128
Valid N (listwise)	66				

Intervention sample post-intervention versus six-month post –intervention

Group Statistics

	PostGender	N	Mean	Std. Deviation	Std. Error Mean
SixWholeCPM	m	63	734.0292	78.86597	10.09775
	f	66	732.4743	62.42953	7.86538
SixInSchCPM	m	63	634.5743	133.82431	17.13445
	f	66	602.6859	150.03313	18.90240
SixSchRelCPM	m	63	647.9741	145.13239	18.58230
	f	66	624.6675	162.45004	20.46678
SixOutCPM	m	63	743.9821	243.69772	31.20230
	f	66	746.0348	282.32128	35.56914

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SixWholeCPM	Equal variances assumed	2.287	.133	.122	122	.903	1.55490	12.75187	-23.68871	26.79850
	Equal variances not assumed			.121	114.208	.904	1.55490	12.79956	-23.80045	26.91024
SixInSchCPM	Equal variances assumed	.798	.373	1.248	122	.215	31.88841	25.55981	-18.70980	82.48661
	Equal variances not assumed			1.250	121.195	.214	31.88841	25.51254	-18.61958	82.39640
SixSchRelCPM	Equal variances assumed	.167	.684	.842	122	.402	23.30665	27.69451	-31.51740	78.13069
	Equal variances not assumed			.843	121.226	.401	23.30665	27.64400	-31.42092	78.03422
SixOutCPM	Equal variances assumed	.891	.347	-.043	122	.966	-2.05269	47.42791	-95.94098	91.83560
	Equal variances not assumed			-.043	120.438	.965	-2.05269	47.31540	-95.73041	91.62503

Univariate Analysis of Variance pre versus six-month post-intervention

Between-Subjects Factors

		Value Label	N
PreType	.00	Control	104
	1.00	Intervention	104

Descriptive Statistics

Dependent Variable:SixWholeCPM

PreType	Mean	Std. Deviation	N
Control	686.6854	92.78920	130
Intervention	733.2997	67.79510	129
Total	709.9925	84.36205	259

Levene's Test of Equality of Error Variances[a]

Dependent Variable:SixWholeCPM

F	df1	df2	Sig.
4.084	1	258	.055

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + PreCountsPerMin + PreType

Tests of Between-Subjects Effects

Dependent Variable:SixWholeCPM

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	113025.000[a]	2	56512.500	8.517	.000	.077	17.035	.965
Intercept	6163859.369	1	6163859.369	928.985	.000	.819	928.985	1.000
PreCountsPerMin	34.460	1	34.460	.005	.943	.000	.005	.051
PreType	112265.663	1	112265.663	16.920	.000	.076	16.920	.984
Error	1360184.657	256	6635.047					
Total	1.063E8	259						
Corrected Total	1473209.657	258						

a. R Squared = .077 (Adjusted R Squared = .068)

b. Computed using alpha = .05

Estimated Marginal Means

PreType

Dependent Variable:SixWholeCPM

PreType	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	686.712[a]	7.996	670.947	702.476
Intervention	733.273[a]	7.996	717.509	749.038

a. Covariates appearing in the model are evaluated at the following values: PreCountsPerMin = 575.6375.

Univariate Analysis of Variance Post versus six-month post-intervention

Between-Subjects Factors

		Value Label	N
PreType	.00	Control	130
	1.00	Intervention	129

Descriptive Statistics

Dependent Variable:SixWholeCPM

PreType	Mean	Std. Deviation	N
Control	686.5170	89.76473	130
Intervention	733.2392	70.70533	129
Total	709.9727	83.92659	259

Levene's Test of Equality of Error Variances[a]

Dependent Variable:SixWholeCPM

F	df1	df2	Sig.
3.172	1	257	.076

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + PostWeekDayCountsPerMin + PreType

Tests of Between-Subjects Effects

Dependent Variable:SixWholeCPM

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	1.647E6	2	823485.080	2342.578	.000	.950	4685.157	1.000
Intercept	3241.263	1	3241.263	9.220	.003	.036	9.220	.856
PostWeekDayCountsPerMin	1512174.206	1	1512174.206	4301.701	.000	.946	4301.701	1.000
PreType	1077.851	1	1077.851	3.066	.081	.012	3.066	.415
Error	85773.168	256	351.529					
Total	1.262E8	259						
Corrected Total	1732743.329	258						

a. R Squared = .950 (Adjusted R Squared = .950)

b. Computed using alpha = .05

Estimated Marginal Means

PreType

Dependent Variable:SixWholeCPM

PreType	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	707.800[a]	1.721	704.409	711.190
Intervention	712.128[a]	1.714	708.752	715.505

a. Covariates appearing in the model are evaluated at the following values: PostWeekDayCountsPerMin = 711.8910.

School year differences: intervention group

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SixWholeCPM	Between Groups	44224.894	6	7370.816	1.511	.180
	Within Groups	570682.165	123	4877.625		
	Total	614907.058	129			
SixInSchCPM	Between Groups	319958.621	6	53326.437	2.860	.012
	Within Groups	2181709.229	123	18647.087		
	Total	2501667.850	129			
SixSchRelCPM	Between Groups	331585.579	6	55264.263	2.501	.026
	Within Groups	2585234.828	123	22096.024		
	Total	2916820.408	129			
SixOutCPM	Between Groups	451124.796	6	75187.466	1.092	.371
	Within Groups	8054049.535	123	68838.030		
	Total	8505174.331	129			

School year differences: control group

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SixWholeCPM	Between Groups	51988.373	6	8664.729	1.080	.379
	Within Groups	931051.943	124	8026.310		
	Total	983040.315	130			
SixInSchCPM	Between Groups	135502.828	6	22583.805	1.118	.356
	Within Groups	2344241.761	124	20208.981		
	Total	2479744.589	130			
SixSchRelCPM	Between Groups	255334.919	6	42555.820	1.846	.096
	Within Groups	2674078.843	124	23052.404		
	Total	2929413.762	130			
SixOutCPM	Between Groups	1076059.196	6	179343.199	2.022	.068
	Within Groups	1.029E7	124	88674.226		
	Total	1.136E7	130			

Intervention sample BMI

Correlations

		SixWholeCPM	SixInSchCPM	SixSchRelCPM	SixOutCPM	PostBMI
SixWholeCPM	Pearson Correlation	1	-.036	.005	.247**	.017
	Sig. (2-tailed)		.690	.953	.006	.859
	N	129	129	129	129	129
SixInSchCPM	Pearson Correlation	-.036	1	.899**	.191*	-.033
	Sig. (2-tailed)	.690		.000	.034	.724
	N	129	129	129	129	129
SixSchRelCPM	Pearson Correlation	.005	.899**	1	.436**	-.028
	Sig. (2-tailed)	.953	.000		.000	.765
	N	129	129	129	129	129
SixOutCPM	Pearson Correlation	.247**	.191*	.436**	1	-.008
	Sig. (2-tailed)	.006	.034	.000		.928
	N	129	129	129	129	129
PostBMI	Pearson Correlation	.017	-.033	-.028	-.008	1
	Sig. (2-tailed)	.859	.724	.765	.928	
	N	129	129	129	129	129

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Control sample BMI

Correlations

		SixWholeCPM	SixInSchCPM	SixSchRelCPM	SixOutCPM	PostBMI
SixWholeCPM	Pearson Correlation	1	.038	-.025	-.121	.044
	Sig. (2-tailed)		.678	.782	.181	.645
	N	130	130	130	130	130
SixInSchCPM	Pearson Correlation	.038	1	.910**	.383**	-.355**
	Sig. (2-tailed)	.678		.000	.000	.000
	N	130	130	130	130	130
SixSchRelCPM	Pearson Correlation	-.025	.910**	1	.509**	-.336**
	Sig. (2-tailed)	.782	.000		.000	.000
	N	130	130	130	130	130
SixOutCPM	Pearson Correlation	-.121	.383**	.509**	1	-.151
	Sig. (2-tailed)	.181	.000	.000		.111
	N	130	130	130	130	130
PostBMI	Pearson Correlation	.044	-.355**	-.336**	-.151	1
	Sig. (2-tailed)	.645	.000	.000	.111	
	N	130	130	130	130	130

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 20 Post-intervention audit tool raw data

Pre versus post intervention audit: intervention sample

Paired Samples Test

		Paired Differences		
		Mean	Std. Deviation	Std. Error Mean
Pair 1	TotalAuditNorm - PostTotalAudit	-2.53942	.82385	.08078
Pair 2	PANorm - PostPAAudit	-3.35192	1.19668	.11734
Pair 3	PolicyNorm - PostPolicyNorm	-3.40288	2.03534	.19958
Pair 4	ActivitiesNorm - PostActivitiesNorm	-2.89904	3.57555	.35061
Pair 5	QualityNorm - PostQuality	-2.59615	4.40547	.43199
Pair 6	FacilitiesNorm - PostFacilities	-4.47981	1.14352	.11213
Pair 7	HealthEatNorm - PostHealthyEat	-6.02115	3.23961	.31767
Pair 8	EmoHealthNorm - PostEmoHealyj	-3.70192	2.20273	.21600
Pair 9	PSHENorm - PostPSHE	-.77019	.88853	.08713

Paired Samples Test

		Paired Differences			
		95% Confidence Interval of the Difference			
		Lower	Upper	t	df
Pair 1	TotalAuditNorm - PostTotalAudit	-2.69964	-2.37921	-31.434	103
Pair 2	PANorm - PostPAAudit	-3.58465	-3.11920	-28.565	103
Pair 3	PolicyNorm - PostPolicyNorm	-3.79871	-3.00706	-17.050	103
Pair 4	ActivitiesNorm - PostActivitiesNorm	-3.59439	-2.20368	-8.269	103
Pair 5	QualityNorm - PostQuality	-3.45291	-1.73940	-6.010	103
Pair 6	FacilitiesNorm - PostFacilities	-4.70219	-4.25742	-39.951	103
Pair 7	HealthEatNorm - PostHealthyEat	-6.65118	-5.39113	-18.954	103

Pair 8	EmoHealthNorm - PostEmoHealyj	-4.13030	-3.27355	-17.139	103
Pair 9	PSHENorm - PostPSHE	-.94299	-.59739	-8.840	103

Paired Samples Test

		Sig. (2-tailed)
Pair 1	TotalAuditNorm - PostTotalAudit	.000
Pair 2	PANorm - PostPAAudit	.000
Pair 3	PolicyNorm - PostPolicyNorm	.000
Pair 4	ActivitiesNorm - PostActivitiesNorm	.000
Pair 5	QualityNorm - PostQuality	.000
Pair 6	FacilitiesNorm - PostFacilities	.000
Pair 7	HealthEatNorm - PostHealthyEat	.000
Pair 8	EmoHealthNorm - PostEmoHealyj	.000
Pair 9	PSHENorm - PostPSHE	.000

Pre versus post intervention audit: control sample

Paired Samples Test

		Paired Differences		
		Mean	Std. Deviation	Std. Error Mean
Pair 1	TotalAuditNorm - PostTotalAudit	.83462	1.22068	.11970
Pair 2	PANorm - PostPAAudit	.83462	.34635	.03396
Pair 3	PolicyNorm - PostPolicyNorm	1.89808	1.12698	.11051
Pair 4	ActivitiesNorm - PostActivitiesNorm	1.37500	.93826	.09200
Pair 5	QualityNorm - PostQuality	2.40385	6.53522	.64083
Pair 6	FacilitiesNorm - PostFacilities	-.00769	2.21906	.21760
Pair 7	HealthEatNorm - PostHealthyEat	3.43269	4.06385	.39849
Pair 8	EmoHealthNorm - PostEmoHealyj	.09615	3.48232	.34147

Paired Samples Test

		Paired Differences		
		Mean	Std. Deviation	Std. Error Mean
Pair 1	TotalAuditNorm - PostTotalAudit	.83462	1.22068	.11970
Pair 2	PANorm - PostPAAudit	.83462	.34635	.03396
Pair 3	PolicyNorm - PostPolicyNorm	1.89808	1.12698	.11051
Pair 4	ActivitiesNorm - PostActivitiesNorm	1.37500	.93826	.09200
Pair 5	QualityNorm - PostQuality	2.40385	6.53522	.64083
Pair 6	FacilitiesNorm - PostFacilities	-.00769	2.21906	.21760
Pair 7	HealthEatNorm - PostHealthyEat	3.43269	4.06385	.39849
Pair 8	EmoHealthNorm - PostEmoHealyj	.09615	3.48232	.34147
Pair 9	PSHENorm - PostPSHE	-.58654	.73048	.07163

Paired Samples Test

		Paired Differences			
		95% Confidence Interval of the Difference			
		Lower	Upper	t	df
Pair 1	TotalAuditNorm - PostTotalAudit	.59722	1.07201	6.973	103
Pair 2	PANorm - PostPAAudit	.76726	.90197	24.575	103
Pair 3	PolicyNorm - PostPolicyNorm	1.67891	2.11725	17.176	103
Pair 4	ActivitiesNorm - PostActivitiesNorm	1.19253	1.55747	14.945	103
Pair 5	QualityNorm - PostQuality	1.13291	3.67478	3.751	103
Pair 6	FacilitiesNorm - PostFacilities	-.43924	.42386	-.035	103
Pair 7	HealthEatNorm - PostHealthyEat	2.64238	4.22301	8.614	103
Pair 8	EmoHealthNorm - PostEmoHealyj	-.58107	.77338	.282	103
Pair 9	PSHENorm - PostPSHE	-.72860	-.44448	-8.188	103

Paired Samples Test

		Sig. (2-tailed)
Pair 1	TotalAuditNorm - PostTotalAudit	.000
Pair 2	PANorm - PostPAAudit	.000
Pair 3	PolicyNorm - PostPolicyNorm	.000
Pair 4	ActivitiesNorm - PostActivitiesNorm	.000
Pair 5	QualityNorm - PostQuality	.000
Pair 6	FacilitiesNorm - PostFacilities	.972
Pair 7	HealthEatNorm - PostHealthyEat	.000
Pair 8	EmoHealthNorm - PostEmoHealyj	.779
Pair 9	PSHENorm - PostPSHE	.000

Appendix 21 Post intervention focus group discussion guide

1. Do you think your school promotes a healthy lifestyle?
Do you think this is important? Why? Do you think your school should promote a healthy lifestyle? How does/could your school promote healthy living? Talk about physical activity, PE, healthy eating Do you feel you have any control over these situations? Where have you learnt about the information you know? Any changes to lessons, lunch or break times? PE?
2. What do you think of your school playgrounds, play spaces and facilities?
How do you spend your break and lunch times? What do you like about your school's play spaces? Is there anything you would like to change? Why? What would encourage you to be more active at break times? Do you want to be more active at break times? Do you feel you have any control over these situations? Discuss Golden Mile, any other activities?
3. Do you enjoy your PE lessons?
How often do you have PE lessons? Do you think children at your school should do more/less PE Would you like to do it more/less? What are your favourite PE activities? Why? Would you like to change anything about your PE lessons? Why? Do you take part in any after school physical activities? Do you feel you have any control over these situations? Any changes to PE?
4. Do the staff at your school encourage you to be healthy?

How and why? Do you think this is important? Why? Do you know of any initiatives within the school that encourage/promote physical activity? Do the staff influence your physical activity behaviour? Who do you think influences your physical activity and health behaviours? Any changes?
5. Do you like the food provided by the school?
Do you have a school dinner or bring in a packed lunch? Why? Does the school have a tuck shop/vending machines? What do you think of the food and drinks that are on offer? Would you like anything to change? Why? Do you feel you have any control over these situations? Any changes?
6. How do you travel to and from school?
Would you like to use a different method? Why? Is there anything you would change to make this easier for you? Why? Do you know of any schemes within the school that promote active travel to school? Do you feel you have any control over these situations?
What do you think would encourage you to be more physically active?

Appendix 22 Postgraduate Certificate in Research Methods

STAFFORDSHIRE UNIVERSITY

Hannah Elizabeth Smith

has been awarded the

University Postgraduate Certificate

having followed an approved programme of study in

Research Methods
25th February 2009

Chancellor

Christine E King
Vice-Chancellor

CREATE THE DIFFERENCE

Appendix 23 Approved MPhil to PhD transfer

HANNAH SMITH

h.e.smith@staffs.ac.uk

3 November 2009

Dear Hannah

MPhil to PhD registration transfer application – approved 3/11/09

With reference to your research degree transfer interview which was held on 14 September 2009, I am pleased to inform you that the Chair of the University Research Degrees Sub-Committee has today ratified the following recommendation submitted by the Faculty of Health transfer panel:

Recommendation:

i) The candidate's registration is transferred from MPhil to PhD. (Recommendations as to reconsiderations of minor aspects of the project can be conveyed to the candidate and supervisor **by the transfer panel** and need not impede transfer – see summary list attached.)

Your successful transfer from MPhil to PhD registration is now formally approved and your records will be amended accordingly to show you are now registered for the degree of PhD. Please observe the minimum and maximum periods of registration as detailed in the research degree regulations.

Yours sincerely

LINDA EYRE
Administrative Officer (Research Awards)
Tel: (01782) 294366
E: l.c.eyre@staffs.ac.uk

cc: Principal Supervisor - Professor Rachel Davey
Faculty Administrator - Helen Sutton

Appendix 24 Publications and Presentations

Poster presented at 10h Annual Achieving Excellence in Public Health Conference, 10th May 2007: Telford and 16th UK Public Health Association Annual Conference, 1st Mar 2008: Liverpool

Presentation given at 2008 BASES Annual Conference,4th Sept: Brunel University, and Creating Active School Environments workshop (CEHAP strategy launch), Sept 2008: WMPHO, Birmingham

Gidlow, C., Cochrane, T., Davey, R. & Smith, H. (2008) In-school and out-of-school physical activity in primary and secondary school children. *Journal of Sports Sciences* 26(13):1411-1419.

Journal of Sports Sciences
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713721847

In-school and out-of-school physical activity in primary and secondary school children

Christopher J. Gidlow [a]; Tom Cochrane [a]; Rachel Davey [a]; Hannah Smith [a]
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First Published:November2008

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In-school and out-of-school physical activity in primary and secondary school children

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Abstract

The aim of this study was to compare in-school and out-of-school physical activity within a representative sample. Socio-demographic, physical activity, and anthropometric data were collected from a random sample of children (250 boys, 253 girls) aged 3–16 years attending nine primary and two secondary schools. Actigraph GT1M accelerometers, worn for seven days, were used to estimate physical activity levels for in-school (typically 09.00–15.00 h), out-of-school (weekday), and weekend periods. Physical activity as accelerometer counts per minute were lower in school versus out of school overall (in school: 437.2 + 172.9; out of school: 575.5 + 202.8; P 5 0.001), especially in secondary school pupils (secondary: 321.6 + 127.5; primary: 579.2 + 216.3; P 5 0.001). Minutes of moderate-to-vigorous physical activity accumulated in school accounted for 29.4 + 9.8% of total weekly moderate-to-vigorous physical activity overall but varied by sector (preschool: 37.4 + 6.2%; primary: 33.6 + 8.1%; secondary: 23.0 + 9.3%; F ¼ 114.3, P 5 0.001). Approximately half of the children with the lowest in-school activity compensated out of school during the week (47.4%) and about one-third at the weekend (30.0%). Overall, physical activity during the school day appears to be lower than that out of school, especially in secondary school children, who accumulate a lower proportion of their total weekly moderate-to-vigorous physical activity at school than younger children. As low in-school activity was compensated for beyond the school setting by less than half of children, promoting physical activity within the school day is important, especially in secondary schools.

Keywords: Physical activity, school children, moderate-to-vigorous physical activity

Introduction

The importance of promoting active lifestyles from a young age is widely recognized, not least to halt continuing increases in overweight and obesity in children and adolescents (Department of Health, 2005; Ebbeling, Pawlak, & Ludwig, 2002). Physical activity promotion for young people has become a public health priority and schools are the most commonly used setting (van Sluijs, McMinn, & Griffin, 2007).

School takes up approximately 40% of pupils' waking time (Fox, 2004) and, arguably, an even greater proportion of their opportunities to be physically active. This is especially true during the winter months when outdoor play is often restricted by bad weather and fewer daylight hours. Schools, therefore, provide a unique opportunity and an ideal ''micro-environment'' for multi-faceted interventions to help children and adolescents accumulate sufficient physical activity within the school day to benefit their health (Cale & Harris, 2006; Wechsler, Devereaux, Davis, & Collins, 2000).

Better targeted, more effective physical activity promotion in schools aims to instil positive health behaviours early on and maintain them into adolescence. If successful, this could have important public health consequences in terms of reducing the risks of physical inactivity and associated morbidities into adulthood (Fox, 2004). Numerous interventions have been evaluated, mostly within primary schools. The weight of evidence indicates that multi-component interventions that consider the school environment and related policy hold most promise for improving on the short-term increases in physical activity often reported (Cale & Harris, 2006; Marcus et al., 2006; van Sluijs et al., 2007).

We present analysis of baseline data from the Children's Health and Activity Monitoring Programme in Schools (CHAMPS) study and compare physical activity levels of children and adolescents in and out of school. Previous research has explored the

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contribution of physical activity within different parts of the school day (Fairclough & Stratton, 2005a, 2005b; Ridgers, Stratton, & Fairclough, 2005) and compared activity levels in and out of school (Dale, Corbin, & Dale, 2000; Mallam, Metcalf, Kirkby, Voss, & Wilkin, 2003), but has often focused on specific age or school year groups. The aim of the present analysis was to use a representative random sampling approach to improve current understanding of in- and out-of-school physical activity patterns of children across the school year groups.

CHAMPS

The Children's Health and Activity Monitoring Programme in Schools is the school-based component of a research project funded by the MRC's National Prevention Research Initiative (NPRI), exploring ecological determinants of physical activity and health in communities and schools within deprived inner-city areas of Stoke-on-Trent, UK. Ten study areas (or ''neighbourhoods'') were selected that represented the range of deprivation (Index of Multiple Deprivation) in Stoke-on-Trent. (Study areas or ''neighbourhoods'' were defined by Lower Super Output Areas, which contain 1500 residents on average.) Participating schools were linked to study areas by their location or by pupil catchment area.

The overall aim of CHAMPS is to inform the design and implementation of a multi-component ''whole-school'' approach to increasing physical activity levels, which will be evaluated using a cluster randomized controlled trial design. The protocol for baseline physical activity data collection is described. The trial design, development of the school environmental audit tool, and physical activity intervention will be reported elsewhere.

Study design and sampling approach

The study protocol was designed to obtain quality data from a representative sample of pupils from participating schools, while minimizing the burden on schools. Data collection was facilitated by the North and South Stoke School Sport Partnership (SSP), a well-established and proactive network comprising 17 secondary schools (pupil ages 11–16 years), 75 primary schools (ages 11 years), and five specialist schools. Every school has an identified link teacher funded for 12 days per year (primary schools) or two days per week (secondary schools) to undertake SSP activities, coordinated by Partnership Development Managers.

Sample size, selection, and recruitment

A representative sample of schools was selected. The nine primary schools (some of which included preschool children) were located within, or proximal to, one of the 10 study areas. The two secondary schools were chosen because of their intakes from primary ''feeder schools'' that included one or more of the nine schools selected.

We have based our sample size calculation for the schools-based intervention on the method proposed by Raudenbush (1997), in that we have assumed an effect size of 0.35 and have stipulated a within-cluster (school) population of 35 (for logistical reasons related to delivery and evaluation), intra-class correlation of 0.027 (estimated from pilot data from 10 schools), type I error rate of 0.05, and power of 0.8, which yields a requirement for a total of 16 clusters, 8 intervention and 8 control. This would enable the detection of differences in the order of 55 accelerometer counts per minute, or 19,800 counts per 6-h school day; for a 10-year-old this equates to approximately 20 min of moderate-to-vigorous physical activity based on age-specific cut-points (Trost et al., 2002). Eligible participants included any pupil registered at, and attending, one of the 11 participating schools. Given the smaller number of secondary schools and their larger student populations, four samples were taken per secondary school pupils to ensure representation across the age range. Computer randomization was used to select pupils from the register of each school; oversampling of approximately 50 pupils from each primary school and 200 from each secondary school were invited to take part.

Obtaining a representative random sample of Stoke-on-Trent school children was important, but did create some logistical issues. Using class or even year groups as the unit of sampling would have simplified recruitment and data collection because these groups are already well defined within schools. However, it was considered important to reduce the possibility of in-built grouping effects for children's physical activity, such as through shared lessons (including PE) or pupils within class groups undertaking shared play/activities. Moreover, random sampling across each school was necessary for the present analysis, which required representation across all year groups.

The study was approved by the Staffordshire University Research Ethics panel. Approval was also sought from the Director of Children's Services. Head teachers from each school were then approached by letter, follow-up phone call and, if necessary, a visit from a member of the research team. With their consent, parents of selected children were sent information sheets and written parental consent from the school. On the day of data collection, the children's assent was obtained. To facilitate random sampling, school registers comprising complete lists of pupils' unique pupil numbers (UPN) were obtained in advance through the SSP.

To protect children's identities, they were identifiable to researchers by UPN only.

Data collection

Data were collected between November 2006 and May 2007. Table I summarises data collected and outcomes of interest.

Physical activity. Objective physical activity records were obtained using accelerometery. Children were given Actigraph GT1M accelerometers. The actigraph measures physical activity with far greater precision than self-report methods and has been validated for use in children and adolescents against a range of techniques (e.g. heart rate telemetry; indirect calorimetry) (Mattocks et al., 2008). Accelerometers were programmed to record at 60-s epochs and the children were asked to wear them on their right hip during all waking hours for seven consecutive days, removing them only for water-based activities. Physical activity records for a given day were excluded if less than 10 h and 8 h of data were recorded on week and weekend days, respectively. This difference in validity criterion was chosen retrospectively because of the shorter mean duration of physical activity recordings on weekend days (Zahner et al., 2006). Apparent nocturnal activity resulting from children wearing accelerometers in bed was excluded from physical activity records. Accelerometer counts per minute were averaged for each day and for the different sampling periods of the week explored:

1. In school: determined from school start/finish times (typically 09.00–15.00 h).
2. Out of school: weekday activity before and after school.
3. School-related: activity before 16.00 h, including any physical activity before, during or immediately after school (i.e. travel to/from school, after-school extracurricular activities).
4. After school: activity after 16.00 h.
5. Weekend: activity on weekend days.

Time spent in activities of moderate-to-vigorous intensity was calculated using age-specific thresholds derived from a commonly used published algorithm (Trost et al., 2002): defined as counts per minute ! 348, 424, 504, 590, 681, 777, 880, 990, 1107, 1234, 1369, 1515, 1674, and 1845 for children aged 3–16 years, respectively. The moderate-intensity cut-point of counts per minute ! 3200 derived by Puyau and colleagues (Puyau, Adolph, Vohra, & Butte, 2002) was also applied for comparison. Minutes of moderate-to-vigorous physical activity were determined for each day and means were calculated for different periods of the week (1–5 above).

Socio-demographics. Schools were asked to provide dates of birth, gender, ethnic origin, and postcodes for selected children's UPN.

Overweight and obesity. Children's height and weight, measured in accordance with Department of Health guidelines (Department of Health, 2006b), were used to calculate body mass index (BMI). Children were classified as normal weight, overweight or obese relative to the 1990 British Growth Rate data for

Table I. Study variables.

Variable	Data collected	Data source
Age	Date of birth	School
Gender	Gender	School
Ethnic background	Ethnic code (18 categories)	School
Deprivation	Postcode: used to determine neighbourhood deprivation based on Index of Multiple Deprivation 2004 (Communities and Local Government, 2004)	School
Body mass index (kg Á m72)	Pupil height (m): portable stadiometer Pupil weight (kg): electronic scales Measured in accordance with Department of Health guidelines (Department of Health, 2006b)	Research team
Overweight/obesity	Categorized according to British Growth Rate 1990 data 85th/95th (Cole et al., 1995)	Research team
Physical activity	Accelerometers worn for 7 consecutive days: – Counts per minute (CPM): mean accelerometer counts per minute calculated for specific periods of the week – Moderate-to-vigorous physical activity: age-specific thresholds (Trost et al., 2002) used to estimate minutes of activity of low, moderate, and vigorous intensity	Research team
Physical education	Day(s) and start/finish times for PE lessons	School
Other school day physical activity opportunities	Start/finish times for: school day, recess (morning/afternoon), and lunch break	School

BMI (85th/95th percentiles) (Cole, Freedson, & Preece, 1995).

Data analysis

As a result of recognized differences in children's activity levels during the week and at the weekend (Trost, McIver, & Pate, 2005), data were processed and analysed separately. The minimum number of weekdays required to produce reliable estimates of ''typical'' weekday counts per minute was determined by calculating the intraclass correlation coefficient for a single day of monitoring and applying the Spearman-Brown prophesy formula as outlined by Trost et al. (2005). Two valid weekdays (! 10 h) was estimated to achieve the commonly accepted reliability of 0.8 (Trost et al., 2005). As there was no overall difference between mean counts per minute on Saturdays and Sundays, a valid record (! 8 h) for one weekend day was sufficient to obtain an average value. All participants who recorded two valid weekdays (n ¼ 503) were included in analysis involving only weekday physical activity. Analysis involving weekend physical activity excluded a further 99 children who did not record a valid weekend day (n ¼ 404).

We used t-tests, analyses of variance (ANOVA), and chi-squared tests to make within-individual and between-group comparisons, for physical activity and sample characteristics. Kendal's Tau correlation tests were used to explore whether children who were in the lowest in-school activity (counts per minute) tertile compensated outside school moving to moderate- and high-activity categories. Finally, the contributions of in-school and school-related moderate-to-vigorous physical activity towards total weekly activity were estimated using multiples of mean minutes of moderate-to-vigorous physical activity accumulated during these periods.

Results

Sample

Of the 913 children invited, 610 (67%) participated in the study. Reasons for non-participation included: no longer attending the school (n ¼ 26); absence on the day of data collection (n ¼ 122); and refusal of consent or unreturned consent forms (n ¼ 155). Following further exclusions for missing or incomplete physical activity records, 503 children were included in analyses of weekday data and 404 in analyses involving weekend activity data. The sample comprised approximately equal numbers of boys and girls, from preschool, primary, and secondary schools (Table II). In keeping with national trends (Department of Health, 2004), almost one-third of children were classified as overweight or obese. Most participants were classed as White British, and almost half lived in areas within the bottom 20% for national deprivation rankings. This is typical of the widespread deprivation and relatively low ethnic diversity in Stoke-on-Trent (Department of Health, 2006a). Participants and non-participants did not differ in terms of gender distribution (50.9 vs. 52.1%

Table II. Sample baseline characteristics.

	Total n (%)	Preschool n (%)	Primary n (%)	Secondary n (%)
n	503 (100%)	57 (11.3%)	233 (46.3%)	213 (42.3%)
Age				
Range (years)	3.4–16.5	3.4–5.4	5.4–11.7	11.0–16.5
Mean (years)	10.4 + 3.7	4.5 + 0.6	8.5 + 1.7	14.1 + 1.5
Gender				
Boys	250 (49.7%)	31 (54.4%)	117 (50.2%)	102 (47.9%)
Girls	253 (50.3%)	26 (45.6%)	116 (49.8%)	111 (52.1%)
Weight				
Normal weight	349 (69.4%)	48 (84.2%)	158 (67.8%)	143 (67.1%)
Overweight	65 (12.9%)	7 (12.3%)	32 (13.7%)	26 (12.2%)
Obese	89 (17.7%)	2 (3.5%)	43 (18.5%)	44 (20.7%)
Ethnicity				
White British	458 (91.1%)	55 (96.5%)	214 (91.8%)	189 (88.7%)
Pakistani	20 (4.0%)	–	6 (2.6%)	14 (6.6%)
Other	25 (4.9%)	2 (3.6%)	13 (5.6%)	10 (4.7%)
Deprivation				
(most deprived) 1	213 (45.0%)	27 (47.4%)	99 (42.5%)	106 (49.8%)
2	143 (30.2%)	20 (35.1%)	77 (33.0%)	53 (24.9%)
3	82 (17.3%)	10 (17.5%)	40 (17.2%)	37 (17.4%)
4	26 (5.5%)	–	13 (5.6%)	12 (5.6%)
(least deprived) 5	1 (0.2%)	–	1 (0.4%)	–
Unknown	8 (1.7%)	–	3 (1.3%)	5 (2.3%)

Note: Weight category defined according to British Growth Rate 1990 data 85th/95th percentiles.

boys), mean age (10.5 + 3.7 vs. 10.0 + 4.0 years) or ethnicity (90.2 vs. 88.1% White British). As reported elsewhere (Mattocks et al., 2008), within the sample of participants there were modest differences between those who did and did not provide valid physical activity records (Table III). The higher percentage of boys failing to provide valid records was the only significant difference.

In-school and school-related physical activity

Average in-school activity levels (in counts per minute) were lower than out-of-school activity levels overall (Table IV). This pattern was observed in both boys and girls, primary and secondary school pupils (not preschool), and normal and overweight/obese children (data not shown) when analysed separately. Figure 1 demonstrates a greater difference between activity levels in and out of school in secondary school pupils compared with those in pre-/primary school. Figure 2 confirms this in terms of the relative contribution of in-school activity towards total weekly moderate-to-vigorous physical activity, which differed by sector (preschool: 37.4 + 6.2%; primary: 33.6 + 8.1%; secondary: 23.0 + 9.3%; F ¼ 114.3, P 5 0.001). The mean contribution of in-school activity for the overall sample (29.4 + 9.8%) increased markedly when activity immediately before and after school (i.e. school-related activity) was included (49.1 + 11.2%). The contributions towards total weekly moderate-to-vigorous physical activity of that accumulated in school and around the school day (school-related) were similar in boys (30.2 + 9.2% and 48.3 + 11.6% respectively) and girls (28.7 + 10.3% and 49.8 + 10.8%), and in normal (29.5 + 10.3% and 48.9 + 11.5%) and overweight/obese children (29.1 + 8.6% and 49.4 + 10.5%).

There was significant agreement between children's in-school activity (counts per minute) tertile and the tertiles they were in for out-of-school (0.382, P 5 0.001) and weekend activity (0.410, P 5 0.001). Nevertheless, approximately half of children in the lowest in-school activity tertile were in the moderate- (27.0%) or high-activity (20.4%) tertiles out of school, with about one-third in the moderate- (16.8%) and high-activity (13.2%) categories for weekend activity.

Meeting physical activity recommendations

Using the moderate-intensity cut-points derived from Trost and colleagues' (2002) algorithm (MVPA$_T$), 91.6% of the sample appeared to achieve the recommended 60 min moderate-to-vigorous physical activity each day: 100% preschool, 100% primary, and 79.8% secondary. When alternative intensity thresholds were applied (Puyau et al., 2002), the proportion of primary and secondary school pupils who met the 60-min target during the week was less than 4%, most of whom were in secondary school;

Table III. Comparison of participants who provided valid physical activity records.

	Weekday physical activity		Week þ weekend physical activity	
	Valid	Invalid	Valid	Invalid
n	503	107	404	206
Age (years) (mean + s)	10.40 + 3.68	10.7 + 3.7	10.3 + 3.68	10.7 + 3.70
SDS BMI (mean + s)	0.48 + 1.17	0.48 + 1.23	0.5 + 1.14	0.44 + 1.27
% Boys	49.7	63.6*	47.5	61.2#
% White British	90.1	86.0	90.8	88.8
% Within most deprived quintile	46.1	54.2	44.3	53.9

Note: SDS BMI, standard deviation score relative to British Growth Rate curve 1990.
Significance of difference between valid vs. invalid physical activity sample characteristics: #P 5 0.01; *P 5 0.001.

Table IV. Outcomes from paired t-tests of physical activity in counts per minute (CPM; mean + s).

	1		2		3	
Pairs	In school	Out of school	School-related	After school	Weekday	Weekend day
Total	437.2 + 172.9	575.5 + 202.8*	526.3 + 158.5	502.1 + 236.1þ	516.1 + 157.2	507.6 + 250.8
Preschool	568.9 + 154.8	578.2 + 172.9	584.7 + 152.4	573.7 + 217.8	589.3 + 139.6	611.0 + 194.3
Primary	510.7 + 148.5	571.4 + 197.4*	544.1 + 143.7	535.6 + 228.6	543.1 + 146.7	568.1 + 239.6
Secondary	321.6 + 127.5	579.2 + 216.3*	491.2 + 168.1	446.4 + 237.7#	465.4 + 158.5	411.0 + 245.5*
Boys	493.3 + 161.1	616.0 + 207.0*	580.7 + 150.5	540.7 + 243.7þ	568.1 + 152.4	554.5 + 261.4
Girls	381.8 + 166.3	535.5 + 190.6*	472.6 + 147.8	464.0 + 222.3	469.1 + 146.7	465.4 + 233.66

Note: School-related, CPM before 16.00 h; After-school, CPM after 16.00 h; In school, CPM within school day; Out of school, CPM before and after school day. Pairs 1 and 2, n ¼ 503; Pair 3, n ¼ 404. Significance: þP 5 0.05; #P 5 0.01; *P 5 0.001.

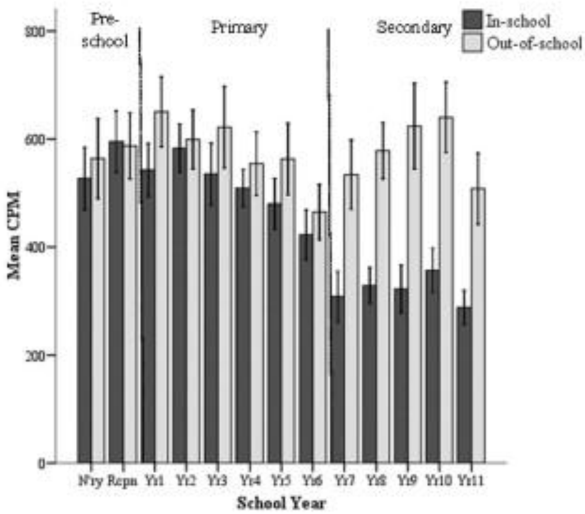

Figure 1. Mean in-school and out-of-school counts per minute (CPM) by school year group (error bars represent 95% confidence intervals).

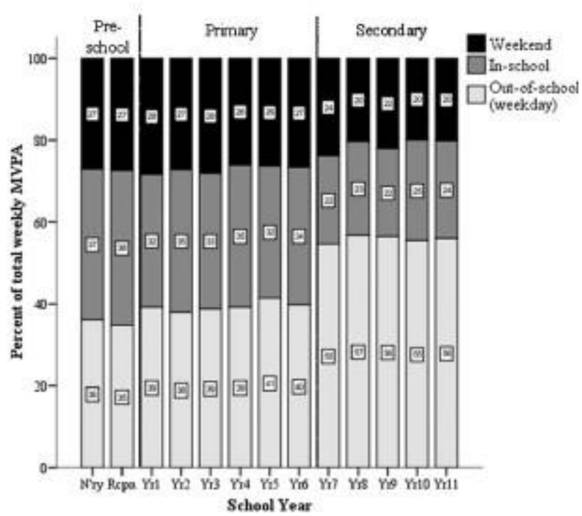

Figure 2. Relative contributions of in-school, out-of-school, and weekend moderate-to-vigorous physical activity by school year group (percentages displayed within bars).

that is, the age-related trends observed for counts per minute (Figure 1) and moderate-to-vigorous physical activity were reversed (Figure 3).

Analysis by gender and weight category highlighted that a higher percentage of boys than girls met physical activity recommendations defined by either algorithm (Trost: 94.1% vs. 88.7%; Puyau: 5.2% vs. 1.4%), with differences between normal versus overweight/obese children evident from moderate-to-vigorous activity data derived using the Puyau cut-point (Trost: 91.7% vs. 91.3%; Puyau: 5.0% vs. 0.8%).

Discussion

Analysis of data from a representative sample of Stoke-on-Trent school children confirms that in-school physical activity accounts for approximately 30% of children's total moderate-to-vigorous physical activity (Heelan et al., 2005; Sallis et al., 2003). A marked difference in this contribution when activity immediately before and after school was included (*50%) reflects the importance of activity accumulated while travelling to/from school or undertaking extracurricular activities (Cooper, Andersen, Wedderkopp, Page, & Froberg, 2005; Cooper, Page, Foster, & Qahwaji, 2003; Heelan et al., 2005; Riddoch et al., 2007). Moreover, the age-related pattern in relative contribution of in-school physical activity indicated that as children progress from primary to secondary school, the amount of total physical activity they are able to acquire at school is reduced. This would be consistent with school sport and physical activity being compromised in response to the growing academic pressures on children and teachers (Linder, 2002). This highlights the need to maximize physical activity opportunities at school, especially in secondary schools, and the important role of active commuting and extracurricular activities.

Within the present sample, approximately half of children who were least active at school made some compensation out of school. Relatively small differences in children's overall physical activity, despite marked differences in school sports facilities and PE provision, have been attributed to children compensating out of school (Mallam et al., 2003). In contrast, others have found that creating more active school days prompted higher activity levels after school, whereas restricting school-day physical activity had the opposite effect (Dale et al., 2000). Data from CHAMPS do not support the findings of either study conclusively. Rather, they suggest that although physical activity opportunities may be squeezed out of the school day as children approach adolescence, a substantial proportion of children may compensate out of school.

Similar to research in primary school-aged children that used definitions of moderate-to-vigorous physical activity derived from Trost and colleagues' algorithm (Riddoch et al., 2004; Trayers et al., 2006), 100% of preschool and primary school children in the present study achieved the 60-min moderate-to-vigorous physical activity target. As noted elsewhere, the use of alternative thresholds (Cliff & Okely, 2007; Guinhouya et al., 2006; Trayers et al., 2006) or physical activity guidelines (Pate et al., 2002) paints a very different picture. When the moderate-to-vigorous physical activity threshold published by Puyau et al. (2002) was applied to weekday activity data in the present sample, less than 4% of children appeared to meet current recommendations. Although this is similar to the relatively low compliance recently reported in a large study of

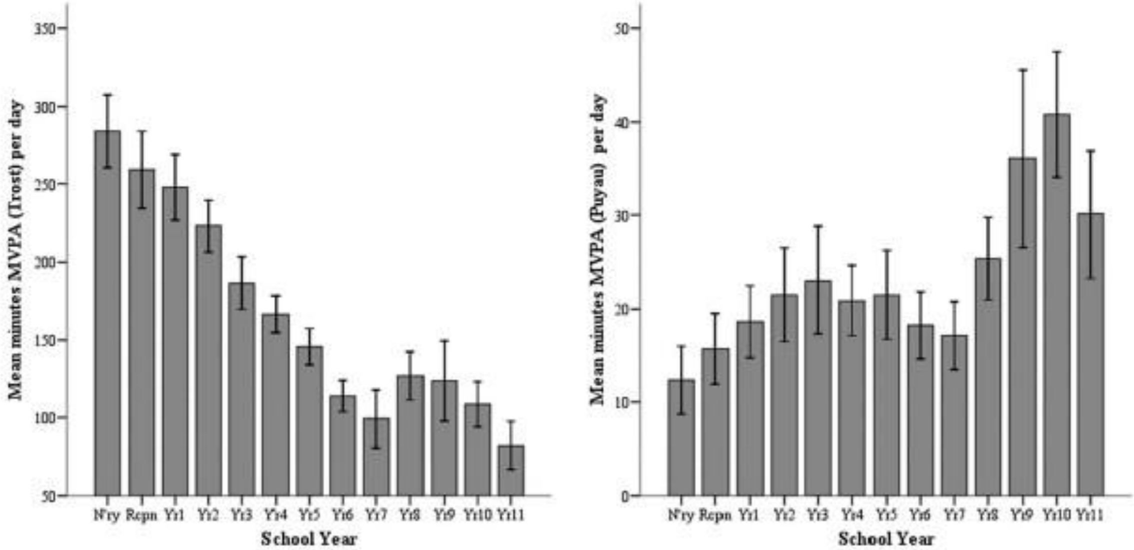

Figure 3. Mean weekday moderate-to-vigorous physical activity by school year group using different cut-points (error bars represent 95% confidence intervals).

11-year-olds (Riddoch et al., 2007), a reversing of age-related moderate-to-vigorous physical activity trends (Figure 3) highlights the uncertainty surrounding moderate-to-vigorous intensity cut-points (Baquet, Stratton, Van Praagh, & Berthoin, 2007; Boreham, Fisher, Ashworth, & Reilly, 2007; Cliff & Okely, 2007; Guinhouya et al., 2006; Riddoch et al., 2004; Sleap & Tolfrey, 2001; Trayers et al., 2006), especially in children of different ages.

By focusing on children within a narrow age range and applying a single counts per minute threshold, many studies in this field circumvent this issue. However, Figure 3 demonstrates that when applying a single moderate-to-vigorous intensity cut-point across a representative sample with a broad age range, the resultant age-related patterns contradict intuition and the age-related trend in counts per minute observed (Figure 1). Counts per minute data must also be treated with caution as they take no account of potential effects on accelerometer output of the children's height, weight, and gait patterns. The exact nature of this relationship and specific factors that mediate apparent age effects (e.g. changes in height or body composition) require further investigation (Sirard, Trost, Pfeiffer, Dowda, & Pate, 2005), ideally to reach a consensus for moderate-to-vigorous physical activity determination using easily assessed criteria, such as age, height, and weight.

Despite issues surrounding age-related patterns, there is evidence to support a reduction in physical activity levels with increasing age observed here and elsewhere (Ekelund et al., 2004; Pate et al., 2002; Riddoch et al., 2004; Stevens et al., 2005). Such a pattern is in keeping with perceived barriers to physical activity that reportedly increase as children get older (Gyurcsik, Spink, Bray, Chad, & Kwan, 2006). Moreover, especially low activity levels around the primary–secondary school transition (Years 6–7) observed here, regardless of physical activity outcome, atones with the embarrassment, self-consciousness, and perceived homework pressures linked with school transition (Biddle, Gorely, & Stensel, 2004), and issues related to the onset of puberty (Davison & Birch, 2001).

Previous research has demonstrated that specific physical activity opportunities within the school day, such as PE and recess, can make important contributions to children's overall physical activity (Fairclough & Stratton, 2005a, 2005b; Ridgers et al., 2005; Wickel & Eisenmann, 2007). The CHAMPS data add to existing knowledge regarding the contribution of school day physical activity by showing how this varies across the age range within a representative sample, indicating a need for greater physical activity promotion from the primary–secondary school transition onwards, in both boys and girls. It is worth noting that overall activity levels of children in the present sample (mean age 10.4 years) were lower than those in 11-year-olds recently reported by Riddoch et al. (2007); for example, mean weekday activity of 516 counts per minute (CHAMPS) compared with 579 counts per minute (Riddoch et al., 2007). This difference is perhaps not surprising given the widespread deprivation and associated low rates of physical activity participation by adults in Stoke-on-Trent (Sport England, 2006).

Our study has strength in objective physical activity measurement over 7 days and the random sampling approach across a broad age range. A number of potential limitations, however, must be acknowledged. From a public health perspective, the capture of moderate physical activity was the primary concern. Nevertheless, it is possible that the 60-s epoch underestimated vigorous physical activity through failing to capture shorter intermittent bouts of high-intensity activities (Baquet et al., 2007; Nilsson, Ekelund, Yngve, & Sjostrom, 2002). Second, to reduce seasonal differences in physical activity, efforts were made to adhere to a short data collection period (November–February). However, some re-sampling during spring was necessary and day-to-day weather variation was not accounted for. Third, despite asking all children to complete a simple physical activity log, poor compliance, especially in older children, meant that the contribution of extracurricular activities could not be determined. Instead, school-related activity was used to take some account of activity related to (but not during) the typical 6-h school day.

Conclusion

Physical activity levels during the school day appear to be lower than out of school, especially in secondary school children, who accumulate a lower proportion of their total weekly moderate-to-vigorous physical activity at school than younger children. Physical activity immediately before and after school appears to make a substantial contribution. Given that low in-school activity was compensated for beyond the school setting by less than half of children, it is important that physical activity opportunities within the school day are maximized, especially in secondary schools.

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