The physical activity and health status of British young people: a school year case study

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By

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Abstract

Introduction: Children's physical activity (PA) behaviours differ according to their surrounding environment. There is a need for continued exploration into children's PA across the school year using a mixed-method design. The significance of this thesis provides a deeper understanding of children's PA behaviours and health status, and this thesis implements a PA intervention informed by children's voice. **Aim:** The aim was to design a moderate-vigorous physical activity (MVPA) promoting intervention that was informed by children's PA behaviours, which consequently informed the time of year, and time of day for when a PA intervention should be offered. **Methods:** Implementing a mixed-methods design, two exploratory studies investigated children's heart rate (HR) and health status (Study 1), and children's PA behaviours using HR and global positioning systems (GPS) – (Study 2). Studies 1 and 2 explored the PA behaviours of 119 children (aged 9-13 years, boys *n* = 57, girls *n* = 62) from a Middle school using HR monitors, GPS, PA diaries and focus groups. Anthropometric and cardiovascular fitness data were also collected. Study 3 applied a case study approach including a PA intervention underpinned by the Social-Ecological Model within the same school (aged 9-13 years, boys *n* = 31, girls *n* = 29). **Results:** The Spring term (winter months) showed children engaged in least amounts of MVPA, and also revealed the greatest number of children as overweight and 'at risk' of an obesity related disease according to BMI and waist -to-height ratio (WHtR) data. The child-informed PA intervention in Study 3 positively affected children's MVPA, showing a 2.4% increase (8.2 minutes) in MVPA on intervention days compared with non-intervention days. **Conclusion:** The Social-Ecological Model underpinned the multi-staged mixed-methods design, and this approach effectively supports child-centred school-based PA programmes. Future research may wish to adopt a mixed-method approach when designing children's PA interventions.

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This research project is dedicated to my Nano, Fazal Hussain Khawaja whom I miss and love dearly.

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Chapter 1 – Introduction to the thesis

1.1 Background and context

1.1.1 The physical activity of children and the current situation

Physical activity (PA) guidelines for children and young people (5-18 years) advise participation in moderate to vigorous (MVPA) intensity PA for an average of at least 60 minutes per day (Chief Medical Officers, 2019). However, only 24% of males and 27% of females in the UK are meeting daily PA recommendations (British Heart Foundation, 2017). More specifically, only one third of children globally are estimated as being sufficiently active (Ekelund et al., 2012; Evenson et al., 2015), and the West Midlands area is reported as having the highest amounts of sedentary behaviour (SB) in England (British Heart Foundation, 2012). Literature indicates there is a strong relationship between PA and risk for developing chronic diseases, including coronary heart disease (CHD), diabetes and colon cancer (Warburton and Bredin, 2016; Haddad et al., 2018; Pearce et al., 2018; Ridgers et al., 2018a). Specifically in England, physical inactivity directly contributes to one in six deaths (Lee et al., 2012), and cardiovascular disease (CVD) is the number one killer in the UK (Townsend et al., 2012). The health benefits of PA in children have been associated with lower BMI, and improved health status (Hamer et al., 2013; Fernández-Aranda et al., 2014; Gu et al., 2016), and it is understood that PA behaviours in childhood tracks through to adult life (Telama, 2009). Understanding the causes of PA behaviour in childhood is essential for the development and improvement of public health interventions, as aetiological studies of disease provide information about treatments (Bauman et al., 2012).

Participating in adequate amounts of PA is also beneficial for children's social development, obesity prevention and bone health (Specker et al., 2004; Hartmann et al., 2010). The health risks of a sedentary and inactive lifestyle are also undeniably clear, with physical inactivity accounting for approximately 6 percent of deaths globally, making it the fourth leading risk factor for global mortality (World Health Organisation, 2011).

Physical inactivity is found to have detrimental effects on young people's cognitive function and academic achievement, with increased levels of obesity (Hillman et al., 2008; Burkhalter and Hillman, 2011; Singh et al., 2012). Therefore, PA promotes cognitive abilities and mental health, with the greatest effects having been found in relation to self-confidence, depression (Sterdt et al., 2013), and also in developing new social skills (Department of Health, 2011).

Transition between childhood and adolescence has been identified as a key area of interest when monitoring PA. Research suggests that MVPA drops by on average seven percent per year between the ages of 9 to 15 years, so that by the age of 15 years the majority of young people no longer meet the recommended daily amount of activity (Nader et al., 2008; Dumith et al., 2011). In addition to this, the PA decline is steeper among young people from disadvantaged or low income communities (Borraccino et al., 2009). The 9 to 15 years age group is critical in promoting positive PA behaviours, as PA instilled within a younger generation can track into adulthood, which may help prevent the onset of non-communicable diseases (Nader et al., 2008; Dumith et al., 2011).

Children's habitual PA such as playing outdoors, and walking and cycling for transport provide many opportunities for PA throughout the day (Loprinzi et al., 2012). Current literature indicates that a decrease in children's independent mobility may be accountable for declining amounts of children's PA (Schoeppe et al., 2014a). Independent mobility describes the freedom to play outdoors and travel to places without adult supervision (Schoeppe et al., 2014a). In addition to this, greater complexities in families' daily schedules, and longer travel distances to schools, shops and recreational facilities have also been associated with reduced rates of children's independent PA (Bringolf-Isler et al., 2008; McDonald et al., 2010). As a result of poorer levels of children's independent mobility, a growing number of PA interventions targeting children have been implemented (Singh et al., 2009; Lubans et al., 2011).

1.1.2 School-based physical activity and the role of the school

In England, schools have a national policy indicating schools have a statutory requirement to deliver a high-quality Physical Education (PE) curriculum which inspires all pupils to succeed and excel in competitive sport and other physically demanding activities (Department for Education, 2013). Furthermore, this policy requirement aims to ensure that through PE, children develop competence to excel in a broad range of PA, are physically active for sustained periods of time, engage in competitive sports and activities, and lead healthy, active lives (Department for Education, 2013). However, with the growing concern and pressures schools are faced with relating to improving students' attainment and progress in other subjects such as numeracy and literacy, PE is often a subject which is marginalised (Ní Chróinín et al., 2018; O'Sullivan and Parker, 2018; Domville et al., 2019). It is therefore suggested that with schools prioritising certain subjects over PE, there is a need for a more global approach to ensuring how children can meet the aims from the National Curriculum for PE (Department for Education, 2013), and also meet the 60 minute daily MVPA guidelines (Chief Medical Officers, 2019). It is also recommended that 30 minutes of MVPA should be accumulated at school (HM Government, 2016).

Despite challenges discussed around PE, schools are still highlighted as being a key setting for the promotion of PA as they have a compulsory curricula, infrastructure, policies and resources to promote inclusive PA (Ferreira et al., 2006; Centers for Disease Control and Prevention, 2011). The effectiveness of multi-component school-based PA interventions, particularly those that include links to families and communities, have consistently been demonstrated in reviews (Marcus et al., 2006; Salmon et al., 2007; van Sluijs et al., 2007b; De Meester et al., 2009; Dobbins et al., 2009; Kriemler et al., 2011; Cleland et al., 2012).

School-based PA interventions targeting break times and/or other extra-curricular periods facilitate a range of PA and fitness opportunities (Fairclough et al., 2016).

Additionally, interventions focusing on promoting PA during taught curricular lessons have also been effective (Fairclough et al., 2016). Evidence indicates that school-based interventions are effective in enhancing PA, cardiorespiratory and muscular fitness, psychosocial outcomes such as enjoyment, and other markers of children's health status (Dishman et al., 2005; Smith et al., 2014).

The school provides a safe and supportive environment with policies and practices supporting healthy behaviours (Centers for Disease Control and Prevention, 2011), and also provide opportunities for children to learn and practice healthy eating, and PA behaviours (Ferreira et al., 2006; Centers for Disease Control and Prevention, 2011). The school's PA policy is identified as being a key factor in encouraging children's PA (Ferreira et al., 2006), and is often informed by government policies which guide schools on their 'PE and sport premium' funding. This funding is a 'protected' budget that schools allocate for PE and sporting opportunities (Department for Education, 2014a).

While the school environment has been highlighted as a key setting for the promotion of positive health related behaviours, there has been differences in designing and applying the most effective intervention (Kriemler et al., 2011). Family based interventions have shown limited effect (van Sluijs et al., 2007a). Therefore, it is advised that the school should be used as a platform to stage PA interventions, which consider children's weekday behaviour (during term time), particularly in school daylight hours (Salmon et al., 2007). Additionally, these interventions have a positive impact on the duration of PA (González-Cutre et al., 2018; Lau et al., 2018; Smith et al., 2018), further recommending ongoing school PA promotion (Dobbins et al., 2009). These findings suggest that effectively designed and applied school-based PA interventions are useful strategies in PA promotion.

The children's voice should be considered when designing and shaping school-based PA interventions (Noonan et al., 2016a). Previous literature indicates that data collected from focus groups (Hesketh et al., 2012; Eyre et al., 2014) and interviews (O'Connor and Brown, 2013; Zahra et al., 2015) have been used as measures of children's feedback. This has resulted in children's intervention studies being informed by parents recall and subjective input, rather than a humanistic child-led approach (Bentley et al., 2012; Jago et al., 2012b; Lepeleere et al., 2013). Literature indicates there is no one size fits all approach when designing school-based PA interventions, and these interventions should be child informed (Noonan et al., 2016a).

1.1.3 Models for health promotion

Influencing factors for PA are multifactorial, with contributions from a variety of dimensions including PA type, intensity and stages of PA behaviour (Sallis and Hovell, 1990; Marcus et al., 1992; Dishman and Sallis, 1994). There is a lack of PA research which has considered theoretical frameworks to guide practitioners on strategies and theories of behaviour change (Calfas et al., 1996; Bully et al., 2015). A more in-depth understanding of theoretical principles supports an effective intervention (Bully et al., 2015). The models of PA behaviour change have only explained 35 percent of PA variance, due to difficulties in measuring PA, and the complexities of PA behaviour (Dishman, 1994).

Many conceptual models have been used exploring influential factors on PA behaviour, however, with limited designs for children (Welk, 1999a). Studies have found that using the Youth Physical Activity Promotion Model for PA promotion is a valid approach, resulting in increased PA behaviour (Rowe et al., 2007; Ahn et al., 2015). This is explained by a Social-Ecological framework acknowledging personal, social, and environmental influences on children's PA (Welk, 1999a). However, more information regarding the context of PA is required. The Human Capital Model proposes the outcomes of PA, and considers the holistic physical, emotional, individual, social, intellectual and financial factors associated with PA behaviour change (Bailey et al., 2012).

The Social-Ecological Model (McLeroy et al., 1988) focuses on a number of environmental influences including the individual, social, and physical environments, and policy components that have been used to promote PA behaviours within childcare and school (Glanz et al., 2008; Mehtala et al., 2014). The Social-Ecological Model, is essential for examining the multiple level factors that might be determinants of PA (Welk, 1999a). This inclusive model identifies opportunities to promote PA considering the individuals (e.g. gender, beliefs and attitudes), behavioural (sedentary and active time), social (family, teachers and peers) and physical environment (e.g. availability of PA equipment and facilities) that influence the ability to engage in PA (McLeroy et al., 1988; Richard et al., 1996).

1.1.4 Factors associated with physical activity

The different factors influencing children's PA are of importance and literature highlights the role that seasons play on children's PA, as temperature and weather patterns influence PA levels (Beighle et al., 2008; Carson and Spence, 2010). Current literature investigating seasonal impact on PA has found that children are more active when the weather is warmer as it allows for outdoor activity (Rowlands and Hughes, 2006; Beighle et al., 2008; Kristensen et al., 2008; Belanger et al., 2009). Seasonality in PA and sedentary behaviour (SB) is affected by different factors, including climate, the school education system and the evaluation methodology of PA and SB (Tanaka et al., 2016). Furthermore, additional research has found children's PA to be greater during months showing milder weather (Brusseau, 2015). Seasonal differences have been characterised by higher PA levels in the spring/summer and lower PA levels in the autumn/winter (Loucaides et al., 2004). Similar findings have been reported when investigating mean daily step counts, where participants were more active in summer than winter (McCrorie et al., 2015). In non-UK studies including other European countries, USA and New Zealand, significant seasonal variation in PA was not found (Rich et al., 2012), therefore, a more in depth understanding of seasonal differences is required to support children's intervention programmes in the UK (Beighle et al., 2012).

PA may be partly determined by the natural and built environment (McCormack and Shiell, 2011) such as greenspace availability (Cauwenberg et al., 2011). Several studies have found a link between access to greenspace and better physical and mental health (Cauwenberg et al., 2011; Lee and Maheswaran, 2011). Greenspace as a location is a functional venue for PA (Lachowycz and Jones, 2011), and research also indicates that PA is also a potential mediator of the relationship between exposure to greenspace and diabetes incidence (Lachowycz and Jones, 2013).

A strong disparity still exists between interests and participation in PA, with boys significantly outnumbering girls as participants (Deaner et al., 2012). Further studies confirm that boys are more physically active than girls at all intensities (Collings et al., 2014). It is critical to understand why, even at earlier ages and with seemingly equal opportunities available, boys and girls diverge in their motivation to engage in PA (Rosenfeld, 2017) with boys more likely to remain motivated to take part in PA because of the competitive aspects, whereas girls are attracted by the social opportunities that PA provides (Sirard et al., 2006).

PA levels decrease with increased chronological age in childhood in both genders (Sherar et al., 2007). Similarly, when aligned with biological age, PA declines with maturity (Sherar et al., 2007). In addition to this, SB increases as children mature, and age-associated interventions focusing on SB are required (Harding et al., 2015). It is also suggested that as the demands of school increase with age, there may be a decline in PA (Harding et al., 2015). The increased amounts of time children spend in SB, reduces MVPA (Carson and Janssen, 2011; Martinez-Gomez et al., 2012).

1.2 Significance of the thesis

The current literature indicates a multitude of factors which affect PA levels. The school environment is an ideal location to gather information of children's PA levels, and health status, which consequently can assist in planning and informing a PA intervention (Demetriou et al., 2017; Ha et al., 2017; González-Cutre et al., 2018; Pearce et al., 2018; Ridgers et al., 2018a). Additionally, the school environment allows both qualitative and quantitative PA data to be collected (Powell et al., 2016a). Applying a mixed-methods approach to measuring children's PA behaviours can explore reasons behind participation (Gibson, 2007). This information can be gathered across the school year. To the author's knowledge, there are no mixed-methods school-based PA interventions which have been informed by previous repeated measures data. Furthermore, limited research exists which considers the children's voice in outlining barriers to and facilitators of PA. Therefore, the novelty of this thesis lies within the depth of this multi-staged, mixed-methods, child-centred, case study approach within one school.

Data collected from this thesis aims to gather information on children's PA and health status throughout the academic school year. Therefore, this would identify the time of year young people display increased/decreased levels of PA, which would inform the most appropriate time to apply a PA intervention. PA differences according to gender and age will also be explored. There will be an emphasis on consulting the children through focus groups to explore their PA behaviours. These consultations will further help plan and inform a PA intervention.

1.3 Research aims and objectives

Overall aims of the thesis

1. To conduct a case study exploring the PA patterns and health status of 9-13-year-old children in a Middle school.
2. To design, implement and evaluate an intervention increasing children's MVPA, at a time of year when children's MVPA levels are lowest.

The specific primary and secondary research objectives for each study are outlined below:

Study 1: Chapter 4 - Physical activity and health status of children: a case study exploring gender and age differences

Primary objective

- To explore PA and health status of children aged 9-13 years.

Secondary objectives

- To measure children's PA and investigate reasons behind children's engagement in PA
- To assess the health status of children, and explore associations between PA, health status and cardiovascular fitness.
- Gender and age differences will be analysed for each objective.

Study 2: Chapter 5 – Children's physical activity, location and reasons behind physical activity participation: a school year study

Primary objective

- To explore 9-13-year-old children's PA, location, and reasons behind PA behaviours over the academic school year.

Secondary objectives

- To explore where and why children go to take part in PA implementing a mixed-methods approach, using GPS and heart rate (HR) monitors, PA diaries and focus groups.
- To explore any changes in PA behaviour across the school year investigating frequency, intensity, time, location and type of PA.
- To explore changes in weight status and cardiovascular fitness across the school year.
- As with Study 1, gender and age differences will be explored for each objective.

Study 3: Chapter 6 – An intervention to promote levels of MVPA of a school-based sample.

Primary objective

- To design, implement and evaluate an eight-week intervention to increase 9-13-year-old children's PA.

Secondary objectives

- To assess PA behaviours according to intervention days, and non-intervention days, and to assess differences in PA between different types of structured activities offered as part of the intervention.

- To evaluate the effectiveness of the PA intervention through exploring children's perceptions of the intervention activities.

1.4 Publications and Conference Proceedings

The following peer reviewed journal articles and conference presentations originate from the data presented in the thesis.

1.4.1 Peer reviewed journal articles

Khawaja, I., Woodfield, L., Collins, P., Benkwitz, A., and Nevill, A (2020) Tracking Children's Physical Activity Patterns across the School Year: A Mixed-Methods Longitudinal Case Study. *Journal of Children,* Vol 7: 178. Article retrievable here: https://www.mdpi.com/2227-9067/7/10/178

Khawaja, I., Woodfield, L., Collins, P., Benkwitz, A., and Nevill, A (2019) Exploring Children's Physical Activity Behaviours According to Location: A Mixed-Methods Case Study. *Journal of Sports,* Vol 7: 240. Article retrievable here: https://www.mdpi.com/2075-4663/7/11/240

1.4.2 Conference papers

Khawaja, I., Woodfield, L., Collins, P., Nevill, A. and Safi, A (2016) 'Gender differences in physical activity behaviour according to location'. Paper presented at the British Heart Foundation Physical Activity and Cardiovascular Health across the Lifespan conference. Coventry University, Coventry, UK. 6 October 2016.

Khawaja, I., Woodfield, L., Collins, P., Nevill, A. and Safi, A (2016) 'The use of technology in measuring children's physical activity'. Paper presented at Newman University's Festival of Doctoral Research. Newman University, Birmingham, UK. 7 July 2016.

Khawaja, I., Woodfield, L., Collins, P., Nevill, A. and Safi, A (2016) 'Physical activity location and intensity across the school year: a mixed methods study'. Paper presented at the International Society of Behavioural Nutrition and Physical Activity Annual Conference, Cape Town International Convention Centre. Cape Town, South Africa. 8-11 June 2016.

Khawaja, I., Safi, A., Collins, P., Nevill, A. and Woodfield, L (2015) 'The measurement of physical activity behaviours of young people'. Paper presented at the International Society of Behavioural Nutrition and Physical Activity Annual Conference, Edinburgh International Conference Centre. Edinburgh, Scotland, UK. 3-6 June 2015.

Khawaja, I. and Woodfield, L (2014) 'An Investigation to measure physical activity in a large comprehensive school – A pilot study'. Paper presented at Newman University's Festival of Doctoral Research. Newman University, Birmingham, UK. 26 June 2014.

1.4.3 Upcoming conference paper:

Khawaja, I., Woodfield, L., Collins, P., Nevill, A. and Benkwitz, A (2020) 'A child-centred school lunchtime physical activity intervention: Consulting and implementing the children's voice'. Paper to be presented at the International Society of Behavioural Nutrition and Physical Activity Annual Conference, The Aotea Centre. Auckland, New Zealand. 17-20 June 2020. Postponed to 2022 due to Covid-19.

1.5 Definition of Key Terms

A range of terms relating to the research conducted will be referred to throughout the thesis. A defined list of these terms is presented below:

Aerobic Fitness – The body's increased ability to take in and use oxygen to produce energy (ACSM, 2003).

Body Mass Index (BMI) – A value used to measure/monitor the prevalence of overweight and obesity, produced by dividing the mass of a person by the square of their height (National Health Service, 2009).

Cardiorespiratory fitness - The overall capacity of the cardiovascular and pulmonary systems to supply oxygen during sustained exercise, as well as the ability to perform such exercise (Taylor et al., 1955; Santos et al., 2014).

Children - Individuals up to the age of 19 years (World Health Organisation, 2011).

Exercise - A subset of physical activity that is planned, structured, and repetitive and has a final or an intermediate objective the improvement or maintenance of physical fitness (Caspersen et al., 1985).

Extra-curricular School Sport –Sporting activity involving physical activity which takes place during school hours, within the school environment, but outside of curriculum time (Lubans and Morgan, 2008).

Geographical Information Systems (GIS) – A system designed to store, manipulate, analyse, manage and present spatial or geographic data (Duncan and Mummery, 2007).

Global Positioning System (GPS) – A trilateration method used combining location, elevation and speed (Maddison and Ni Mhurchu, 2009).

Inverted Body Mass Index (iBMI) – A value which is better approximated by normal distribution and is used to monitor the percentage of body fatness. The value is produced by dividing a BMI value by 1000 (Nevill et al., 2011).

Light Physical Activity (LPA) - Intensities between 30-49% of a person's maximum heart rate (Kenney et al., 2012). Light intensity activities include walking, maybe walking home or to school/work (Kim et al., 2013), domestic or occupational tasks such as washing dishes, hanging washing, ironing or performing other office duties (Norton et al., 2010).

Moderate Physical Activity (MPA) - Intensities between 50-75% of a person's maximum heart rate (Kenney et al., 2012). Moderate intensity activity is described as either walking (for a duration of 10 minutes or greater) or 'other activities' such as 'for example, gentle swimming, social tennis, golf' (AIHW, 2003).

Moderate to Vigorous Physical Activity (MVPA) – Moderate and vigorous intensities combined when taking part in physical activity (Kenney et al., 2012).

Peak height Velocity (PHV) - The maximum rate of growth in stature during the growth spurt. The age of maximum velocity of growth is called the age at Peak Height Velocity (Balyi, 2009).

Physically active – Children who reach a minimum of 60 minutes per day of physical activity performed at least at moderate-vigorous intensity (World Health Organisation, 2011).

Physical Activity (PA) - Any physical movement created by the body which is produced by skeletal muscles resulting in energy expenditure (Caspersen et al., 1985).

Physical Education - An educational course related to the physique of the human body, taken during primary and secondary education (Siddiqui et al., 2010). Physical Education is the planned, progressive learning that takes place in school curriculum timetabled time and which is delivered to all pupils (afPE, 2016).

Physical Fitness - A set of attributes that are either health or skill related (Caspersen et al., 1985).

Physically inactive – Children who do not reach 60 minutes per day of physical activity performed at moderate-vigorous intensity (World Health Organisation, 2011).

SB – Any waking behaviour characterised by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture (Tremblay et al., 2017).

Sitting height – The distance from the top of the head to the buttocks when in a sitting position (Hall et al., 2006).

Sport - All forms of competitive/non-competitive physical activity which, through casual or organised participation, aim to use, maintain or improve physical ability and skills whilst providing entertainment to participants, and in some cases, spectators (Siddiqui et al., 2010).

Standing height – The total height measured in the standing position from the top of the head to the soles of the feet (Hall et al., 2006).

Vigorous Physical Activity (VPA) - Intensities above 75% of a person's maximum heart rate (Kenney et al., 2012). Vigorous intensity activity is defined as physical activity which 'made you breathe harder or puff and pant – for example, jogging, cycling, aerobics, competitive tennis' (AIHW, 2003).

Waist circumference (WC) – The measurement taken at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest (World Health Organisation, 2008).

Waist-to-height ratio (WHtR) - A measure that indicates the level of risk of obesity-related diseases, as it is correlated with abdominal obesity (Ashwell et al., 2012).

Chapter 2
Literature Review

Chapter 2 - Literature Review

2.1 The benefits of physical activity during childhood

Research has shown that children can make many positive health gains by engaging in moderate-vigorous physical activity (MVPA) (Biddle and Asare, 2011; Jansen et al., 2016; Jago et al., 2017). For example, data indicates that participation in MVPA during adolescence leads to improvements in high-density lipoprotein cholesterol (Andersen et al., 2011), cardiorespiratory fitness (Santos et al., 2014), psychological health (Seabra et al., 2013b), and musculoskeletal development and body composition (Hills et al., 2011). Additionally, regular leisure time physical activity (PA) is inversely associated with the prevalence of cardiovascular risk factors for boys and girls (Fransonn et al., 2003). Ward et al (2010) discuss the wider impact of PA in children. It is proposed that regular PA not only helps young children achieve energy balance but it also contributes to a variety of physical, social, and psychological developments (Van Dyck et al., 2010; Ward et al., 2010). This is supported by Aburto et al (2011, p1898): 'Physical activity in childhood improves cardiovascular health and physical fitness, increases bone mass and density, is associated with better mental health, improves body composition, reduces the risk of obesity, and may promote the development of a physically active lifestyle for lifelong health benefits' (Aburto et al., 2011). The Human Capital Model as discussed in Chapter 1.1.4 considers the wider benefits of PA, and the different factors associated with implemented PA behaviour change (Bailey et al., 2012).

When focusing specifically on bone health, engaging in regular and well-designed targeted PA in childhood is crucial to maintaining a healthy skeleton in adulthood (Gunter et al., 2012). It has also been identified that 60% of the risk of developing osteoporosis can be explained by the amount of bone mass accrued by early adulthood (Baxter-Jones et al., 2011). Therefore, PA undertaken during or prior to puberty may have greater, positive effects on bone mass than many pharmacological interventions undertaken by adults with osteoporosis (Gunter et al., 2012). In addition to this, weight bearing activities such as jumping convey the greatest benefits to bone mineralisation and structure in children and adolescents

(Gunter et al., 2012). Weight-bearing activities during childhood have a positive effect on variables related to bone strength (Khan, 2001; Sundberg et al., 2002) and low bone strength in childhood is associated with a higher fracture risk in later life (Weaver et al., 2016a). A school-based context for when children would engage in such bone strength activities, may be within invasion games, striking and fielding activities and individual performance activities, such as gymnastic activities, which are taught within Physical Education lessons. Gymnastics, for example, is a weight-bearing activity providing opportunities for children to jump, land and bear body weight on hands and arms as well as legs. It is suggested that childhood PA that includes a range of different PA, leads to residual benefits in bone density and strength in adulthood (Bass et al., 1998; Karlsson et al., 2008).

When researching the relationship between musculoskeletal health, muscular fitness and PA, it has been confirmed that in childhood, the skeleton adapts to the physiological changes induced by physical training (Larsen et al., 2016). Furthermore, following a school-based study exploring physical training for 8-10-year-old children, high intensity interval training (HIIT) and odd-impact training, involving 40-minute small sided game/circuit strength training activities, was established as a more favoured intervention for achieving musculoskeletal changes, when compared with other physiological training modalities (Larsen et al., 2016). However, it could be argued that such types of activities do not follow the 60 minute guidelines set for UK based children (Chief Medical Officers, 2019). For example, HIIT may provide opportunities for children and young people to engage in a variety of types and intensities of PA across the week to develop movement skills, muscular fitness, and bone strength, however, HIIT does not always fit in with the contexts in which children are active such as Physical Education (PE), active travel, after-school activities, play and sports which all can establish a moderate (MPA) and vigorous (VPA) levels of PA (Chief Medical Officers, 2019). Additionally, it is important to consider reasons for PA participation between younger and older children. The enjoyment and fun element of PA is associated with children’s engagement (Atkin et al., 2016; Noonan et al., 2016a), whereas PE has a greater focus on developing knowledge and skills (Ní Chróinín et al., 2018; O'Sullivan and Parker, 2018; Domville et al., 2019). Therefore, HITT training may be better suited with older children who are already aware of the health benefits associated with PA.

Cardiorespiratory fitness has also been investigated in relation to PA, with research indicating that better levels of cardiorespiratory fitness delays human mortality primarily because of decreased rates of CVD (Blair et al., 1989). Longitudinal studies indicate that higher cardiorespiratory fitness during childhood and adolescence is associated with a healthier cardiovascular profile (Ruiz et al., 2009) and a healthier body composition later in life (Ornelas et al., 2011). However, more recently, children's cardiovascular studies have found different results (Füssenich et al., 2016). When exploring cardiovascular differences between an active sample who would meet the current 60 minute daily MVPA guidelines (Chief Medical Officers, 2019), and an inactive sample who would not meet these guidelines, it was found that there were no cardiovascular differences between the two samples (Füssenich et al., 2016). It is therefore argued that current MVPA guidelines may underestimate the amount of MVPA needed to reduce CVD, and there should be a greater emphasis placed on applying greater VPA recommendations for cardiovascular improvements (Füssenich et al., 2016). Following these recommendations, it is worthwhile noting children's PA is sporadic and therefore, children are more likely to accumulate shorter bouts of MVPA (Cohen et al., 2014).

Current literature highlights trends in BMI and obesity, and its associated health conditions. In 2008, an estimated 1.46 billion adults globally were overweight, and 502 million adults were obese. Furthermore, an estimated 170 million children (aged <18 years) globally were classified as overweight or obese (Swinburn et al., 2011). In England, 30% of boys and 29% percent of girls have been classified as overweight or obese, with 16% of boys and 15% of girls specifically being measured as obese (Health and Social Care Information Centre, 2019). Year 6 (ages 10-11 years) data from the 2018-19 UK National Health Service (NHS) National Child

Measurement Programme (NCMP) in England, showed 1.4% of children as underweight, 64.3% healthy weight, 14.1% overweight, 20.2% as obese, and 4.4% as severely obese (National Health Service, 2019). The school's local regional data for year 6 children in 2018-19 showed a greater percentage of year 6 children as underweight (1.5%) and healthy weight (65.7%), but fewer children classed as overweight (14%), obese (18.8%), and severely obese (3.5%) (National Health Service, 2019). However, despite less year 6 children in the local school area being classed as overweight or obese, this is considerably greater than the percentage of overweight and obese reception aged children (aged 4-5 years) reported from 2018-19 NCMP data, both nationally (overweight = 12.9%, obese = 9.7% severely obese = 2.4%), and locally (overweight = 11.3%, obese = 8.3%, severely obese = 2.2%) (National Health Service, 2019). Therefore, this rise in obesity during primary school years demonstrates a need for greater understanding on the behaviours of this age range.

The global rise of obesity has serious health effects. The increase in BMI is an established risk factor for diseases such as type 2 diabetes, CVD, and many cancers (Swinburn et al., 2011). This signifies the urgency and importance for PA and health related interventions to be in place to reduce the risk of obesity escalating. A greater understanding of the health benefits of PA and leading a balanced, healthy and active lifestyle could make a considerable difference to levels of obesity, and schools are ideally placed to help promote such benefits (Lai et al., 2012).

It is hoped that with the 60-minute daily MVPA guidelines for children (Chief Medical Officers, 2019), current research can focus on increased school interventions and improved pedagogical practices promoting a more physically active learning environment (Fairclough and Stratton, 2005b; Cohen et al., 2014; Chief Medical Officers, 2019). The desired effect is to instil a physically active lifestyle within children so that it tracks through to adulthood, which in turn will help reduce the prevalence of non-communicable diseases (NCDs). It is argued that there is evidence of the health-related benefits of PA, and also sufficient evidence of the harms of inactivity, however, the PA benefits message needs to be emphasised further (Lai et al., 2012). This indicates that a stronger message on the positive health benefits of leading a healthy and active lifestyle needs to be enforced in schools.

2.2 Children's physical activity levels

Evidence suggests that children have become less physically active than previous years (Jago et al., 2017; Chalkley et al., 2018; Howe et al., 2018; Saint-Maurice et al., 2018). With the current generation of children reporting lower levels of PA, concerns are being raised on the impact this will have on their growth, lifestyle, and physical and mental development (Ward et al., 2010). Research amongst children is particularly warranted because of the low levels of children who are meeting the daily recommended MVPA levels (Chief Medical Officers, 2019). In England specifically, it is reported that 21% of boys, and 16% of girls (aged 5-15 years) meet the MVPA guidelines (Health and Social Care Information Centre, 2019).

2.2.1 Critical windows for school day physical activity

The school offers critical windows to promote children's PA, and these are in the form of break times, lunchtimes, curricular lessons, particularly PE lessons, and a wider extra-curricular programme (Brooke et al., 2014). Research indicates significant differences in the total amount of PA which includes light physical activity (LPA) and MVPA during the school day; total PA was lower in school compared with out of school whereas MVPA was higher in school compared with out of school (Brooke et al., 2014). It is suggested that although schools have the opportunity to engage in higher intensity PA, such as during PE lessons, there is also a pattern of SB for a large proportion of school time (Brooke et al., 2014).

PE lessons have been identified as the formal opportunity in schools for the direct delivery of health-related PA and fitness (Fairclough et al., 2016). PE is therefore viewed as the primary vehicle for promoting these outcomes in schools (Sallis et al., 2012). However, the recent findings on PE identifies that children are insufficiently active during PE lessons and therefore current practice is not providing sufficient MVPA (Department for Education, 2018). It has been highlighted that current PE teaching practices may contribute towards the low levels of MVPA within PE lessons (Powell et al., 2016b). Research indicates that PE-based interventions, relating to improving teacher confidence, practice and/or knowledge, results in children spending 30% more lesson time in MVPA compared to regular PE lessons, which consequently may have a significant contribution to daily PA levels (Powell et al., 2016b). In addition to this, there is evidence to suggest that these types of interventions can positively impact on health-related fitness (Sallis et al., 1997; Erfle and Gamble, 2015) and motivational constructs, such as enjoyment (Fairclough and Stratton, 2005a).

The after school time period has been identified as being a key time window for the accumulation of children's PA and SBs (Olds et al., 2009), and for PA intervention (Arundell et al., 2015). While behaviours performed after-school can make a significant contribution to daily activities, with up to half of children's daily steps performed after school (Flohr et al., 2006), the after school period also provides children with opportunities to be sedentary, with up to 72% of daily TV viewing occurring between 3pm-9pm (Hager, 2006; Arundell et al., 2015). It is suggested that schools with the best PE provision enabled pupils to achieve well by providing a range of extra-curricular activities (Ofsted, 2013). An understanding of how the after-school period contributes to daily PA and SB levels, and impacts the possibility of achieving the PA guidelines (Chief Medical Officers, 2019), would provide further rationale for interventions to target this time window (Arundell et al., 2015). Additionally, evidence shows that the after school period becomes more important for the accumulation of PA as children progress through primary and into secondary school (Arundell et al., 2013), based on research showing age-related declines in PA (Brooke et al., 2016; Corder et al., 2016; Farooq et al., 2016).

Despite this, other research has made use of school break times and lunchtimes to apply PA interventions. In a study researching how the school environment can support and facilitate a physically active lifestyle, Eather et al (2013) planned for children to participate in PA during both break and lunchtimes on a daily basis (Eather et al., 2013). In order to encourage children to become physically active during these time periods, schools were provided with activity task cards outlining the rules and organisation of a range of fun and vigorous games (e.g. small-sided invasion games, skipping challenges) and a variety of equipment (e.g. balls, markers, skipping ropes) (Eather et al., 2013). This particular intervention study was child-directed and children were asked to support their friends throughout the programme by encouraging them to join in the activities and by working together to organise games; consequently, there was a significant increase in children's PA (Eather et al., 2013). It could be argued that interventions integrated into break/lunchtime periods would enhance children's uptake compared with after school interventions, as it may not be possible for all children to remain at school. This may be due to differences in children's independent mobility, and transportation issues for children to get home. Data produced in England shows that 86% of primary school children were allowed to independently travel home in 1971, which reduced to 35% in 1990, and further declined to 25% in 2010 (Shaw et al., 2013; Schoeppe et al., 2014a). Parental concerns about road safety and stranger danger have been highlighted as some of the reasons behind this decline in children's independent mobility, and therefore children are increasingly being taken to and picked up from school by car (Bringolf-Isler et al., 2008; McDonald et al., 2010; Shaw et al., 2013). Parents are more likely to allow children to walk to and from school when there are other adults within the local area (Bringolf-Isler et al., 2008; McDonald et al., 2010). These factors may have a direct influence on numbers of children who are able to attend after-school PA clubs. Therefore, school break and lunchtime interventions may be best placed for optimum uptake of children's participation as this does not involve travel to other locations, and there would always be adult supervision, which reduces parental safety concerns.

2.2.2 Gender differences in physical activity

Trost et al (2002) suggest that descriptive epidemiological studies of youth physical activity have consistently reported that boys are more active than girls, and this has been supported by further literature (Collings et al., 2014; Magoc et al., 2016). Differences in participation rates have been described as "modest" with boys reporting 11% more PA time when compared to girls (Trost et al., 2002b). More specifically, girls report smaller amounts of time spent in light, moderate and vigorous activity (Owen et al., 2009; Ridgers et al., 2012a; Health and Social Care Information Centre, 2019). Research indicate that boys complete an average of 13,000-15,000 steps/day, and girls 11,000-12,000 steps/day (Tudor-Locke et al., 2011). Further UK research concludes that boys were more likely to be physically active and of normal weight than girls (Van Sluijs et al., 2008). In a study involving 1,163 students, girls were found to engage in lower levels of PA than boys (Butt et al., 2011) and Barrett et al (2007, p128) stated that 'boys participate in more leisure time physical activity than girls'. This could potentially lead on to another avenue exploring equality in opportunities for both genders to take part in PA. It is further proposed that girls participate in fewer PE classes, lower levels of total PA, and lower levels of VPA, and a greater number of hours of television viewing (Wu et al., 2006). However, additional research exploring gender differences according to screen-based behaviours show boys to engage in greater amounts of screen time than girls (57% and 44.7% respectively) (Klitsie et al., 2013). This supports the UK gender patterns associated with PA, and indicates how screen time differs according to gender.

In school children, the amount of time boys engaged in PA is associated with enjoyment and perceived physical competence, whereas girls' PA levels are positively associated with perceived acceptance by peers in games, sports, and parental encouragement (Seabra et al., 2013b). Research has consistently found these trends (Carlin et al., 2015; Magoc et al., 2016; Rosenfeld, 2017). Physical exertion, body image, and increased muscle mass were reported by boys as primary attractants to PA (Butt et al., 2011). In a study involving 812 participants, boys were found to report greater levels of PA than girls, and levels of PA in boys are associated with self-determination and task-orientation (Rosenfeld, 2017). This shows boys to engage in PA for physical competences, improving body image, muscle mass and task orientation. However, in contrast to this, girls reported time as being a major barrier to engaging in PA, which was not seen as a barrier by boys (Barrett et al., 2007). This infers that girls may prioritise other things over taking part in leisure time physical activity and consequently PA may hold a low status on the hierarchy of importance. However, girls may have less freedom and opportunity to be active, and also may have less confidence (Bentley et al., 2012). A 'lack of motivation and enjoyment' have also been highlighted as significant barriers to regular PA for girls (Barrett et al., 2007). However, despite this, reasons for non-participation have been found to be due to other factors (Barrett et al., 2007). Girls were more likely than boys to report that they lacked knowledge and skills in certain areas, specifically regarding appropriate types of activities, balancing aspects of self-care, and strength/resistance training (Barrett et al., 2007).

While previous literature identifies gender differences in PA behaviour, with boys more active than girls, these findings tend to be based upon one source of PA measurement i.e. self-report or accelerometry. Studies that are reliant on one source of PA measurement, may be subject to limitations such as the loss of data and/or corrupting of files associated with GPS, accelerometry and HR monitors (Chaix et al., 2014; Collins et al., 2015; Pearce et al., 2018), and also the over/under estimation of PA in self-report measures (Pearce et al., 2014; Cooper et al., 2015). There appears to be little evidence using a combination of approaches in a mixed-methods design when measuring PA, and literature indicates that a mixed-methods approach provides a more reflective and accurate measure of PA behaviours exploring why we find these gender differences (Greene et al., 1989; Powell et al., 2016a), which most single method approaches do not explore.

As much of the literature indicates, descriptive epidemiological studies assessing objectively measured PA among children suggest that boys are more active than girls and that PA declines in both genders with age, while SB is higher in girls and increases in both genders with age (Taylor et al., 2009; Whitt-Glover et al., 2009). These differences have been reported consistently in multiple countries (Beets et al., 2010), even though PA habits differ by culture and lifestyle (McManus, 2007).

When exploring independent mobility differences between boys and girls, it is reported that while parents are more likely to allow both genders to travel locally, wider area travel is reported as greater amongst boys than girls, where parents allow boys more access to unsupervised travel than girls (Page et al., 2009b). This is found to be consistent with other studies reporting parents allowing boys greater unsupervised access to a range of PA opportunities compared to girls (Reilly et al., 2008). Girls' independent mobility is significantly related to weekend PA (Page et al., 2009b), indicating that girls are given more freedom to be independently mobile at weekends compared with weekdays (Page et al., 2009b). This suggests that independent mobility makes a valuable contribution towards children's PA, and weekend independent mobility is associated with higher levels of girls' PA.

The breakdown of PA into its light, moderate and vigorous categories also reveals differences between genders (Collings et al., 2014). Gender differences in LPA were modest at approximately 20 minutes/day, where girls engaged in 508 min/day in LPA compared with 528 min/day of LPA reported by boys (Collings et al., 2014). As the health benefits acquired from LPA are at present largely unknown, the high prevalence of this exposure in both boys and girls implies that additional research surrounding this intensity is needed (Collings et al., 2014). In comparison to the light intensity domain, levels of MPA and VPA for both genders are low with boys engaging in 50 min/day and girls engaging in 30 min/day of MPA, and boys engaging in 8 min/day, and girls engaging in 2 min/day of VPA (Collings et al., 2014). This gender pattern in data is similar to findings from the Health Survey for England 2008, where boys engaged in greater objectively measured MPA and VPA than girls (Health Survey for England., 2008). This indicates that there is a need to promote VPA, particularly in girls (Collings et al., 2014).

When exploring PA behaviours between weekdays and weekends in the UK, it has been reported that both girls and boys are less active at the weekend with Sunday being the least active day of the week, potentially due to societal structure where Sunday is seen as a day of rest (Collings et al., 2014). Further research has also reported reduced levels of PA at weekends compared to weekdays (Treuth et al., 2007; Nilsson et al., 2009). Additionally, boys engage in greater SB across both days of a weekend when compared with school days, whereas girls engage in less SB on a Saturday than school days, and greater SB on Sunday than school days (Collings et al., 2014). This may be due to weekend locations encouraging more SB (i.e. home environment), and possibly reduced opportunities for PA.

To summarise, girls have consistently reported higher levels of inactivity than boys with one third of boys being inactive compared to over two thirds of girls (Magoc et al., 2016; Dudley et al., 2018; Meier et al., 2018). Boys are also found to be more inactive at weekends, whereas girls are likely to display greater inactivity on a Sunday compared to weekdays (Collings et al., 2014). This identifies the need for further research to explore differences between PA at weekends and weekdays, and between Saturday and Sunday PA for both boys and girls.

2.2.3 Age differences in physical activity

The age-related decline in boys' and girls' PA is of interest when targeting public health goals (Trost et al., 2002b; Sherar et al., 2007; Sutherland et al., 2013; Corder et al., 2016; Farooq et al., 2016) because the age-related decline in PA is one of the 'most consistent' findings in PA epidemiology (Sallis, 2000). Research using accelerometry and self-reported questionnaires has found that older girls participate in less VPA in comparison to younger girls (Labbrozzi et al., 2012). However, there is also evidence to suggest otherwise, as further research has found no significant differences in accelerometer assessed PA between age groups (Boddy et al., 2015). Similarly, further accelerometer-based research has shown few differences in PA between age groups with PA levels generally remaining consistent with age (Downs et al., 2016). From the range of findings from recent literature, it can be suggested that there are conflicting findings when exploring age-related PA.

Emerging longitudinal evidence indicates that time spent in MVPA in childhood tracks into adolescence, particularly for girls (Francis et al., 2013), and that daily MVPA and MVPA performed during school breaks (i.e. break/lunchtimes) declines with age (Ridgers et al., 2012b). A five year longitudinal study combining the use of pedometers and accelerometry in 8 to 12 year olds, showed MVPA data and step count data both decreased (meeting MVPA guidelines: boys =33% reduced to 30%, girls = 18% reducing to 14%; percent meeting step recommendations: boys = 42% reducing to 38%, girls = 37% reducing to 33%), and SB increased from age 11-12 years (Telford et al., 2013). These findings support previous longitudinal research showing a decline in PA with age in children (Basterfield et al., 2011; Ridgers et al., 2012b). Furthermore, this particular study identified a 'day of the week' pattern across all year groups, where students were persistently less active on one particular day (Telford et al., 2013). This trend would support the need for PA interventions focusing on enhancing specific days/periods within the week to promote PA behaviours.

In a two year longitudinal study using accelerometry to measure the PA of 405 participants aged 7 years at baseline (Basterfield et al., 2011), mean daily volume of PA declined over the two years and the percentage of daily time in SB (which was already high at baseline) increased from 78% to 81.1%, furthermore, these increases were statistically significant for girls. Additionally, the decline in MVPA and increase in SB were significantly greater in those with higher BMI scores at baseline (Basterfield et al., 2011). It is therefore concluded that children's PA declines, and SB increases prior to adolescence (Basterfield et al., 2011). Another longitudinal study investigating PA differences according to location also found that the total number of minutes spent in MVPA decreased across all locations over two years (Perry et al., 2016). These locations included home, school, neighbourhood, others' homes, alternative school visit, public, outdoor parks and recreational facilities, indoor recreational facilities, private recreational facilities, service locations, shopping, food eateries, and non-descript geographic locations (Perry et al., 2016). Over the two year period, the home environment was where most time was spent, however, this environment also showed children to accumulate the least amount of MVPA when compared with other locations (Perry et al., 2016). This suggests that irrespective of age, research shows that the home environment is a location which does not support MVPA during childhood and adolescence, and other environments are more conducive to MVPA.

Additional school-based research supports these findings. In a study using accelerometry to measure PA over 5 years, it was found that PA levels during break and lunchtimes decreased over time (Ridgers et al., 2012b). It is therefore suggested that interventions are required in schools to promote PA levels and counter the age-related PA decline during break and lunchtime, particularly during the early years of secondary school (Ridgers et al., 2012b). Middle-schools in the UK (years 5-8, ages 9-13 years) would also be of interest as these schools encompass the age range identified by Ridgers and colleagues (2012b), with children from both primary (key stage 2, school years 5 and 6, ages 9-11 years) and secondary (key stage 3, school years 7 and 8, ages 11-13 years) stages of learning. Therefore, PA behaviours could be compared without a change to the school environment which is typically experienced by children in the UK when they move from primary to secondary schools.

2.3 Seasonal Variation in physical activity

Previous literature has indicated that seasonality and weather conditions have been relatively overlooked as determinants of PA (Tucker and Gilliland, 2007), that said, research has reported that children participate in increased amounts of SB in spring compared to summer (Collings et al., 2014), with further studies stating that SB was higher and PA (including number of children fulfilling PA recommendations) was lower during winter compared to summer (Hjorth et al., 2013). Research indicates that children are found to be more active in the summer, when activity levels are higher after school than in school (Silva et al., 2011). Furthermore, summer months are suggested to provide relevant conditions that promote PA, such as warmer temperatures and climates, increased number of daylight hours, whereas the winter season has been highlighted as a significant barrier to preferred PA (Silva et al., 2011). When using accelerometry to study UK based seasonal variation in PA, Rich et al (2012) reported that within all UK studies, PA was highest in summer and at its lowest during the winter months (Rich et al., 2012). These findings support those of Rowlands et al (2009) who completed a longitudinal study of sixty-four nine to eleven-year-old UK children. PA levels in this study were also found to be greatest in summer and lowest in winter (Rowlands et al., 2009). This research highlights the impact the varying seasons has on children's PA levels in the UK.

Further research also indicates that the specific amount of daylight, extreme temperatures and precipitation levels might influence PA behaviours, especially walking outdoors, which is the most common PA undertaken by all populations (Dannenberg et al., 1989; Yusuf et al., 1996; Atkin et al., 2016; Katapally et al., 2016). Weather conditions have been identified as a factor that can strongly promote or deter outdoor PA (Merrill et al., 2005). A wide range of literature indicates that being outdoors has been identified as a significant predictor of PA levels (Klesges et al., 1990; Baranowski et al., 1993; Oja and Jurimae, 2002; Burdette et al., 2004). However, despite outdoor recreation time fluctuating according to season, the seasonality is found to vary with geographic location (Tucker and Gilliland, 2007), and weather has been reported as being a barrier to PA (Gordon-Larsen et al., 2000; Tu et al., 2004; Merrill et al., 2005; Harrison et al., 2015; McCrorie et al., 2015; Atkin et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). This information is particularly valuable for determining how PA interventions must be modified during different seasons of the year, and for identifying the critical need for studies of PA prevalence among children with respect to time of year (Tucker and Gilliland, 2007).

It is suggested that in regions where sustained periods of colder, wetter, darker months in the UK, it is necessary to offer indoor PA facilities so that participation can continue to take place (Tu et al., 2004; Atkin et al., 2016; Tanaka et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). Temperature and humidity in particular show month-by-month PA differences in the UK (Baranowski et al., 1993). In contrast to this, precipitation, cold weather and wind may specifically be the deterring factor to PA (Tucker and Gilliland, 2007; Schuttoff and Pawlowski, 2017). The levels of PA in the UK during winter may be lower than those in summer because winter activities, such as skiing, ice skating, snowboarding etc., may be less convenient and accessible (physically and financially) than summer activities (Merrill et al., 2005). It is further suggested that although it rains during all seasons of the year in the UK, it is the continuous poor weather that acts as an ongoing deterrent to participation in PA in the winter (Tucker and Gilliland, 2007; Atkin et al., 2016; Schuttoff and Pawlowski, 2017). One day of rain may prevent individuals from engaging in activity on that day, however, ongoing precipitation may decrease levels of PA for extended periods of time e.g. months (Tucker and Gilliland, 2007; Schuttoff and Pawlowski, 2017). Therefore, it is advised for population-based interventions to provide information regarding choices for PA that are tailored by season and climate conditions and that address concerns related to convenience, safety, accessibility and aesthetics (Merrill et al., 2005).

Children's PA behaviours have been highly correlated with outdoor playtime (Baranowski et al., 1993), and seasonal differences have an intermediate effect on children's PA (Sallis et al., 2000; McCrorie et al., 2015; Atkin et al., 2016; Tanaka et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). Research suggests that in order to promote children's PA levels, children should spend more time outdoors, however, younger children may need supervision and parents have identified that they are not interested in spending time outside in the cold (Irwin et al., 2005). Parents suggest that the warmer seasons are more conducive to PA for their children, and the colder seasons posed greater challenges (Irwin et al., 2005). Therefore, parents identified the need for indoor facilities to provide the opportunity for year-round participation in PA (Tucker et al., 2006).

As much of the literature indicates, winter seasons result in the lowest levels of PA in children, particularly in areas which experience cold and long winters (Stephens et al., 1986; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). Therefore, it is imperative for additional innovative efforts to be made to increase inclusive children's PA during colder winter weather (Tucker and Gilliland, 2007; Atkin et al., 2016; Schuttoff and Pawlowski, 2017). These proposals have been suggested over the course of two decades where a review of environmental and policy interventions to increase PA reported weather as a barrier to PA participation (Sallis et al., 1998). Historically, it has been suggested that people residing in areas with repeated harsh rain or cold should be supplied with supplementary resources for indoor activity e.g. swimming pools (Sallis et al., 1998). In addition to this, it has also been proposed that providing resources for cold weather activities to take place outdoors e.g. waterproof/warmer clothing etc. will enhance PA during colder winter periods (Sallis et al., 1998). A potential strategy to increase PA in winter is for local governments and organisations to provide facilities that support participation in the broad range of winter sports (Tucker and Gilliland, 2007; Atkin et al., 2016; Schuttoff and Pawlowski, 2017).

Seasonal differences have also been related to differences in obesity levels (Kobayashi, 2006; Tanaka et al., 2016). Children's obesity levels have been demonstrated to be the highest when measured in autumn and winter (December-March), while a lower prevalence of obesity is present in summer (May-September) (Dietz and Gortmaker, 1984; Atkin et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). This reduced prevalence of obesity in summer may result from higher levels of activity due to the increased availability of outdoor recreational facilities (i.e. parks), and weather that supports activity behaviours (Dietz and Gortmaker, 1984; Atkin et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). As obesity has reached epidemic proportions worldwide (World Health Organisation, 2011), it seems imperative to acknowledge the effect of season and weather on PA (Tucker and Gilliland, 2007). In order to combat obesity in children, it is necessary for PA interventions to be provided in a way that supports activity during all months of the year (Tucker and Gilliland, 2007).

Despite individual, social and environmental factors (i.e. access to facilities, parks and lack of leisure time) being important when designing effective intervention programs (Dowda et al., 2012; Fox et al., 2012), the influence of seasonality is less understood (Gracia-Marco et al., 2013). Developing a greater understanding of seasonal variation can contribute to public health interventions aimed at reducing SB and increasing PA levels, which can be targeted at specific times of the year, as appropriate to the geographical location (Gracia-Marco et al., 2013). Further research confirms this and has revealed lower levels of MVPA and increased SB during winter months (Gracia-Marco et al., 2013).

Literature has shown that boys are more likely to exercise outdoors than girls, which can be explained by boys perceiving more opportunities for activity when they are outdoors, having more access to outdoor PA environments (because of parental safety concerns for girls) and/or prefer to exercise outdoors (whereas girls could prefer home-based exercise) (Dunton et al., 2010). Despite this, UK based research has found higher levels of PA (total, MPA and VPA) during the summer than winter in both genders (Rowlands et al., 2009). Additionally, the average PA (counts per minute) was higher in the summer than winter (adjusting per month) but did not vary with gender (Owen et al., 2009). There is sufficient evidence to support public health interventions aimed at increasing PA during winter in UK children (Rich et al., 2012), however the current thesis aims to explore whether seasonality trends from current literature are reflected within this particular school-based sample, or whether other differences exist. In addition to this, findings related to PA location according to season may be of interest, as PA locations may change based on seasonality, which consequently would have an effect on PA behaviours and time spent in different PA intensities.

2.4 Social factors influencing physical activity

The different social factors surrounding children, may have a direct impact on their PA behaviours. Family and peer support, the surrounding environment, finance, location and access to facilities have been reported to influence children's PA (Martin Ginis et al., 2016). This indicates that the immediate environment children experience, on a daily basis and at a personal level, is likely to affect their PA behaviours. The school environment may consist of peer and staff support for PA, allowing for greater social interaction, and time periods of the school day which may allow for social/recreational PA alongside performance and competitive PA opportunities (Fairclough et al., 2016).

Social environmental factors (e.g. social support for PA, neighbourhood social cohesion), as well as neighbourhood physical environment factors (e.g. walkability, safety, aesthetics, proximity to recreation facilities) are related to PA (Gebel et al., 2007; Wendel-Vos et al., 2007). Furthermore, literature suggests that an improved quality of life is associated with increased social support for PA from family/friends (Van Dyck et al., 2010). Additionally, the Social Interaction Theory (Ransford, 1982) suggests that social relationships can improve mental health through PA. The social environment a child is exposed to can encourage greater mental health, and PA environments often provide increased opportunities for children to develop their social skills and social relationships, which in turn reduces chances of future mental health-related issues (Sugiyama et al., 2008). This highlights how the social environment encourages greater PA, and enhances children's mental health.

Research suggests that the socio-economic status of individuals has an effect on health related behaviour and PA (Macdonald et al., 2004; Green et al., 2005; Cohen et al., 2014; McPherson et al., 2018). Within the UK, high socioeconomic status children are reported to be more active than low socioeconomic status children (Duncan et al., 2004a; Cohen et al., 2014; McPherson et al., 2018). Additionally, children from the highest income group participate in more leisure time PA than low or middle-income groups (Barrett et al., 2007). Social class is one factor that may affect adolescents' PA levels (Macdonald et al., 2004; Cohen et al., 2014; McPherson et al., 2018) and is an important consideration as it is an environmental and social factor which may have a positive or negative influence on participation in PA (Green et al., 2005; Cohen et al., 2014; McPherson et al., 2018).

Greater childhood PA levels are associated with well-educated parents and families of higher socioeconomic status (Trang et al., 2009). While literature indicates that children from higher socio-economic backgrounds are most active, parents in higher socio-economic status groups see their children's participation in PA as a 'task' impacting on a family's everyday routines and transport arrangements (Macdonald et al., 2004). However, Bourdieu (1984) argues that the dominant classes are likely to invest a considerable amount of time and money in elite activities for their children designed to maximize the potential production and conversion of physical capital.

It is reported that children of high socio-economic status spent more time in MVPA than young people from a low socio-economic background (Duncan et al., 2004b). Additionally, children from lower economic strata experience greater barriers (e.g. financial, location, proximity of facilities) to activity than children from higher economic status. This is further reinforced as adolescents from lower socio-economic groups participate less in sport, and also suffer poor health and have a lower life expectancy (Kirk, 2005; Cohen et al., 2014; Lonsdale et al., 2016), and children living in households with below median income or of low social class are at increased risk of obesity (Jebb et al., 2003; Cohen et al., 2014; Lonsdale et al., 2016). From the published research it can be put forward that over the last thirty years, significant social class differences have been revealed for inactivity, poor health and increased levels of obesity. This information would therefore warrant further research amongst a sample of children from a range of socio-economic backgrounds.

Dagkas and Stathi (2007) explored school children's social and environmental factors affecting PA levels. It was found that school children from a higher socio-economic status had not only higher reported levels of PA participation compared to children from a lower socio-economic status, but also opportunities for participation in a wider range of activities (Dagkas and Stathi, 2007). The opportunities available to participate in activities were considerably different, with both groups of children attending different types of activities within and outside the school environment. More specifically children from School A (high socio-economic status) were given a diversity of activities from football, basketball, netball, athletics and cricket within the school and rowing, sailing and skateboarding during the weekends; whereas in School B (low socio-economic status) football or netball were the only options offered by the school. This limited provision in School B was also evidenced during the weekends, with very few children involved in football only (Dagkas and Stathi, 2007). However, a limitation of this study may be that only one school from each socio-economic status category participated, and each school may prioritise school sport and PA in different ways i.e. School A prioritising school sport and PA more when compared with School B. Despite this, the findings support trends showing that students from higher socio-economic status groups have generally greater participation levels than those from a lower socio-economic status group (Duncan et al., 2004a; Cohen et al., 2014; McPherson et al., 2018). These findings create an argument for further attempts to broaden school-based options for organised PA in schools with a high proportion of children from low socio-economic status homes, or in areas of low socio-economic status.

Ahn et al (2008) proposed that children of low socioeconomic status are disproportionately negatively affected by the lack of PA support their local surrounding environment provides e.g., lack of PA facilities and poor neighbourhood safety (Ahn et al., 2008). PA facilities and neighbourhood safety could be significant in determining how physically active a community is i.e. if a leisure centre or park with different facilities was built within a safe area, then it may encourage PA behaviours within that community. Community-based policies that emphasise PA changes are likely to be successful, as a community surrounded by a supportive PA environment can encourage PA behaviours (Wang and Beydoun, 2007). Socioeconomic status and contextual influences must be considered when investigating PA levels, so PA interventions can be effectively informed and underpinned promoting an inclusive PA strategy (Gordon-Larsen et al., 2003).

Bourdieu’s (1984) framework of social stratification explains how middle and upper-class people tend to be attracted to costlier PA, whereas certain ‘working class sports’ are attractive to the lower classes due to them being relatively inexpensive (Bourdieu, 1984). Duncan et al. (2004) propose that those ‘rich’ in cultural and physical capital are more likely to be involved in an activity due to ‘taste’, past experience or life-long involvement through family encouragement. Those ‘rich’ in economic capital are more likely to be involved in an activity primarily because of taste and the symbolic values accorded to particular bodily forms but also because they can afford it, in terms of both money and time. These findings indicate the need for PA interventions, potentially school-based, targeting those from lower socio-economic backgrounds in order to promote PA behaviours (Fairclough et al., 2016).

2.4.1 Interpersonal relationships and their influences on physical activity

Family and parental characteristics are factors associated with physical inactivity in children (Trang et al., 2009). The next section will discuss how PA from a social perspective is influenced by family members and peers. Pugliese and Tinsley (2007) indicate that parents, who are key influential figures within the family unit, can affect the socialisation process of their children's behaviour, including PA (Pugliese and Tinsley, 2007).

The influence of parents on children's PA can be achieved through a variety of mechanisms (Trost and Loprinzi, 2011). These mechanisms include direct modelling of PA, as outlined in the social cognitive theory (Bandura et al., 1977), and learning theory (Skinner, 1953), which provides resources to perform PA, establishing or eliminating barriers to PA, and rewarding children for participation in PA (Trost and Loprinzi, 2011). Parental support and family cohesion facilitate children's PA, and a supportive environment encourages positive health behaviours (Trost and Loprinzi, 2011).

Longitudinal research has found that parental PA when a child is young is associated with the PA of the child in their preadolescent years (Mattocks et al., 2008a). Furthermore, research suggests that physically active fathers positively influence their sons' participation in sports and inactive mothers negatively influence their daughters' sport participation (Martin et al., 2005). This describes the influence parents have on their children's PA. However, PA is also seen to have a positive effect on parenting practices such as having greater confidence in child rearing abilities and helping cope with the challenges of being a parent (Hamilton and White, 2010). The literature therefore suggests that there is a need for both parents to be physically active when their children are young, in order to help promote a physically active lifestyle to younger generations (Hamilton and White, 2012).

Parental support comes in a variety of forms, including informational, emotional, appraisal, and instrumental support. The instrumental support of this model not only includes participating in physical activity with the child, but also facilitating access to PA opportunities by signing the child up for PA programmes and providing transportation to recreational facilities such as parks and recreational PA areas (Trost and Loprinzi, 2011). This social support from parents facilitates PA behaviours (Hamilton et al., 2012). For example, social support for PA can be instrumental (e.g. providing childcare), emotional (e.g. giving companionship), informational (e.g. giving advice), or appraisal (e.g. giving encouragement) (Hamilton et al., 2012).

Family support for PA in the form of social persuasion from parents and siblings, for example, encouragement, has been shown repeatedly to be positively associated with PA levels of children (Sallis et al., 1999; Sallis, 2000; Spink et al., 2005). Further, parents’ involvement in PA has also been shown to be positively associated with PA participation in this population (Trost and Loprinzi, 2011). Parents’ PA participation provides children with a model through which they may gain vicarious experience (Shields et al., 2008).

In addition to the influences parents have on PA promotion, peer friendship groups have also been identified as having significant effects on PA participation. Alderman et al (2012) conducted research on parental and peer influence on Middle school children’s PA and identified that a significant relation was found between the best friend's MVPA and the child's PA involvement (Alderman et al., 2012). Further research indicates that children are more physically active in the presence of friends and peers when compared with being in the presence of family members or when alone (Barkley et al., 2009; Alderman et al., 2012). There has been increased interest in both positive (e.g. friendships) and negative peer experiences (e.g. peer rejection, peer victimisation) as contributing factors that either encourage or deter children from engaging in PA. Evidence indicates that positive experiences with peers can provide opportunities for children to be physically active but overweight/obese children often are lacking such social networks (Salvy et al., 2012).

In a study researching the effect of peers on physical activity participation, Rittenhouse and Barkley (2009) found that at-risk-of and overweight boys were less active than boys of healthy weight when alone but as active when a peer was present (Rittenhouse and Barkley, 2009). Furthermore, the presence of a healthy weight peer significantly increased students' rating for activity sessions (Rittenhouse and Barkley, 2009). Therefore, individuals who are of healthy weight have a positive effect on developing PA for overweight children. These findings are further supported by a study conducted by Barkley et al (2009) which proposes that the presence of a friend had a 'robust positive effect' on PA in young children. However, only non-overweight children reduced the time they allocated for sedentary activity when in the presence of their friend (Barkley et al., 2009). This indicates that the presence of a friend enhances children's PA, and reduces sedentary time in non-overweight children. Those who were classified as being overweight were more likely to develop more sedentary habits amongst peers as opposed to being more physically active (Barkley et al., 2009).

From reviewing the literature, both families and peers have significant effects on physical activity participation in young people. Family influences can be broken down further in identifying different methods of parenting, modelling and how cohesive a family is. Peers seem to also play a significant role in PA participation. Numerous studies have highlighted that individuals are more likely to take part in PA if peers are present, compared to when family members are present (Salvy et al., 2012). This would suggest that the power of peer influence appears to outweigh the power of family influence, however, literature indicates this to be age-related, as it suggested that as children mature, there is a shift in primary social influence from parents to peers (Carlin et al., 2015).

2.4.2 The physical environmental and physical activity

Ferreira et al (2006) argue that the surrounding environment plays a significant part in determining whether a community is leading a physically active lifestyle, and this has been confirmed by further literature (Sallis et al., 2000; Humpel et al., 2002; Haddad et al., 2018; Pearce et al., 2018). The importance of having access to recreational facilities is discussed to help combat health problems. Studies have demonstrated associations between childhood obesity and environmental features, namely at the home and neighbourhood level (Mitchell et al., 2016; Perry et al., 2016; Haddad et al., 2018). Consequently, it is important to understand, measure and alter environments that promote or hinder obesity-inducing behaviours, such as low physical activity (Ferreira et al., 2006). This proposes that PA behaviour can be influenced by the surrounding environment and adapting this environment could result in improved health related behaviours.

Certain attributes of the built environment around homes such as parks and open green spaces have been identified as being destinations for PA (Troped et al., 2010; Chaix et al., 2013; Thierry et al., 2013; Chaix et al., 2014), however, studies show that these locations have been underused (Dunton et al., 2013; Evenson et al., 2013). Greenspace may encourage people to engage in PA by, for example, providing increased opportunities for walking and cycling (Humpel et al., 2002; Kaczynski and Henderson, 2007). However, additional research has identified poor walkability, increased density of cul-de-sacs, which includes building upon green space and parks as being associated with reduced levels of PA (Laxer and Janssen, 2013).

As previously outlined in Chapter 2.2.1, time spent outdoors is consistently associated with higher daily PA in children, and parents often limit children’s levels of outdoor play in response to concerns about safety (McMinn et al., 2013; Gray et al., 2015), even when children report positive perceptions of the local neighbourhood (Timperio et al., 2004). Kumanyika and Grier (2006) identify a number of factors within surrounding environments which has detrimental effects on children's levels of PA. Obstacles to PA are unsafe streets, meaning children are less likely to have parental permission to use this area as a platform for PA; dilapidated parks, which would have potential health and safety issues associated with PA related equipment; and lack of facilities, which immediately reduces the opportunities for children to engage in PA behaviours (Kumanyika and Grier, 2006). Combining these three factors may contribute to a less physically active community, consequently leading to increased future health problems. This literature suggests that the surrounding environment contributes significantly to a child's lifestyle and this can often affect decisions related to the amount of PA undertaken (Pearce et al., 2018). Therefore, establishing a surrounding neighbourhood environment that promotes PA behaviours encourages a physically active lifestyle and will help combat health risks (Ferreira et al., 2006).

Perceptions of the suitability of the surrounding environment for children to be active may result in children being restricted to the home which has been linked with lower levels of active transport and MVPA, and greater levels of SB in children (Atkin et al., 2013). It is suggested that associations have been identified between childhood obesity and environmental features, particularly related to the home environment (Ferreira et al., 2006). Research shows the home environment to expose children to greater screen time and media equipment, which consequently promotes SB, and reduces PA (Noonan et al., 2016b). Therefore, it is proposed that modifying and providing PA support for the home environment is required to bring about greater home-related PA behaviour, and other locations children visit, such as the school environment, should provide opportunities for PA and encourage participation (Haddad et al., 2018).

The proximity of the home environment to school has also been explored. Children who live close to schools are more likely to actively commute to school on a regular basis, which consequently increases levels of PA (Krahnstoever Davison and Lawson, 2006). The commute to and from school is a productive, cost-effective and relatively simple method of engaging in PA (McMinn et al., 2014; Chillon et al., 2015). However, the independent mobility of children could be a factor which contributes to the number of children, who actively commute to and from school (Page et al., 2009b; Shaw et al., 2013). Independent mobility is discussed in detail in Chapter 2.2.2.

The school environment has been evidenced to encourage children's PA behaviours (Engelen et al., 2018; González-Cutre et al., 2018; Pearce et al., 2018; Saint-Maurice et al., 2018). More specifically, children are more active during play periods when characteristics of school play areas (i.e., access to equipment, permanent play structures, and marked courts) facilitate PA (Krahnstoever Davison and Lawson, 2006; Collins et al., 2012). This supports the hypothesis that greater access to PA equipment and PA facilities will encourage greater levels of PA behaviour (Lee et al., 2016). Access to PA equipment and facilities at school has been established as an effective strategy for increasing PA and preventing overweight and obese children (Cleland et al., 2008). The integration of PE-related equipment into school lesson time can help combat the SB associated with school lessons, which reduce children's daily PA, and literature suggests lesson time should be targeted when encouraging children's PA (Fairclough et al., 2016; Lonsdale et al., 2016; Pate et al., 2016).

Research has supported the implementation of interventions to promote PA, particularly in children, and suggests that environmental influences can be especially relevant to children because they have less autonomy in their behavioural choices (Ferreira et al., 2006). As PA interventions often provide children with limited choice, interventions should be underpinned by examination of children's PA at different levels (e.g. home, neighbourhood, school) to increase PA behaviour, and it is important to alter environments that are obesity-inducing, such as low PA (Ferreira et al., 2006; Rahman et al., 2011). However, there is a need to consult children's voice regarding choice of PA locations prior to interventions being put in place to facilitate an accessible environment, leading to a healthier, more active lifestyle (Kumanyika and Grier, 2006).

PA within the built environment has been investigated with the use of GPS and GIS (Chaix et al., 2014; Dessing et al., 2014; Harrison et al., 2014; Moore et al., 2014; Collins et al., 2015; Pearce et al., 2018), but it is equally important to understand children's perceived environment (Kumanyika and Grier, 2006). GPS studies exploring children's commuting patterns and transport show that every additional hour spent in a car per day is associated with a 6% increase in the likelihood of obesity, whereas any additional kilometre walked per day is associated with a 4.8% decrease (Rahman et al., 2011). This shows the influence of motorised transport and the commuting journey on potential impact to children's health. However, Biddle et al (2004) indicate that there are additional factors that should be considered when exploring PA location and environment. Future research and policy needs to look at the many environments that operate in shaping sedentary and PA behaviours, such as intra-personal (psychological), inter-personal (social), physical, and policy environments (Biddle et al., 2004). The social and physical aspects are likely to affect the likelihood of individuals participating in PA. If an environment does not support change, then it will prove difficult to achieve a change in human behaviour (Biddle et al., 2004), implying that if the environment which a child is exposed to promotes PA, then the result will be an increase in PA behaviour.

The literature generally supports the hypothesis that communities which have greater opportunities for PA including safe environments and recreational facilities, will bring about a more physically active lifestyle. However, there appears to be a lack of literature exploring children's reasons behind their interactions with their local environments, which could be used to inform and further improve PA interventions specifically targeting children's PA, whilst also providing an insight into reasons behind their PA behaviours.

2.5 Physical activity interventions for children and adolescents

Different approaches to PA interventions are previously discussed in Chapter 1.1.3, which indicate there is no 'one size fits all' approach to designing and implementing a successful PA intervention.

PA interventions for children with family, school and community involvement have shown small to moderate effects (van Sluijs et al., 2011; Biddle et al., 2014) or no effects (Metcalf et al., 2012) on objectively measured PA levels. Despite the majority of studies employing multicomponent models including schools and families, there is a need for greater research into children's PA interventions (O'Connor et al., 2009; Mehtala et al., 2014).

A multitude of PA intervention types have been tested making it difficult to conclude which strategies are most effective for improving children's PA (Gilliland et al., 2015). A recent review suggests the importance of conducting community-based interventions that provide additional opportunities for PA (Perry et al., 2012), and some studies have used this approach to promote PA in children (Wilson et al., 2005). In the majority of these studies, the local community promoted greater PA behaviours which consequently encouraged participation (Webber et al., 2008; Lytle et al., 2009). Community based interventions targeting PA are attractive for their potential to influence entire populations (Sallis et al., 1998), including those most at risk for inactivity (Lavizzo-Mourey and McGinnis, 2003; Sallis et al., 2006). Research has shown that such interventions are most effective and sustainable when involving collaboration among multiple sectors of the community, such as policy-makers, schools, service providers, practitioners and academics (Gilliland et al., 2015).

Quantitative approaches investigating PA provide limited contextual understanding or explanation as to why some children are more active than others, and offer little insight into intervention design (Noonan et al., 2016a). A successfully designed intervention incorporates the intended user groups i.e. children and parents within the design, eliciting their perspectives on PA (Craig et al., 2008; Davison et al., 2013). However, there appears to be a lack of literature which features 'children's voice', with qualitative research exploring children's PA largely based upon data from parent led focus groups (Hesketh et al., 2012; Eyre et al., 2014), and interviews (O'Connor and Brown, 2013). Furthermore, children's PA intervention studies generally proceed with the informed view of what parents consider children need rather than adopting a humanistic child-led approach (Bentley et al., 2012; Jago et al., 2012c). Therefore, there is a need for PA interventions to be more child-centred and interventions based purely on quantitative measures limit potential explanations for children's PA behaviours. As a result of this, an intervention combining quantitative qualitative measures may encourage greater PA behaviours than interventions adopting one approach.

2.5.1 The role of the school in promoting physical activity

Schools have been an area of interest in the promotion of PA, and increased PA during school hours is associated with better physical, psychological and social health and well-being (Smedegaard et al., 2016). Furthermore, the school environment has been identified as being a key setting for PA promotion, which provides an ideal platform for children to meet PA guidelines (Fairclough et al., 2016). The physical, social and pedagogical environments that children interact with at school influence activity-related behaviours (Alderman et al., 2012), and it has been suggested that some children may be stimulated to accumulate more PA when presented with active opportunities during school (Morgan et al., 2007; Alderman et al., 2012).

Intervention approaches set in and delivered through school environments hold promise (Kriemler et al., 2011), as they can facilitate a range of PA and fitness opportunities, including discretionary periods between lessons and at break times, and through more structured and formal periods such as PE lessons (Fairclough et al., 2016). In addition to this, school-based PA interventions have been effective in increasing the number of children engaged in MVPA, as well as how long they spend in these activities (Dobbins et al., 2013b; Powell et al., 2016b). Further evidence indicates that school-based interventions can be effective in enhancing PA, cardiorespiratory and muscular fitness, psychosocial outcomes associated with PA such as enjoyment, and other markers of health status in children (Dishman et al., 2005; Kriemler et al., 2011; Smith et al., 2014). This would indicate that UK school-based PA interventions lead to improved health outcomes and increased PA levels in children.

Children's motivation towards PE lessons is positively associated with extra-curricular MVPA motivation and self-reported PA outside school hours (Lonsdale et al., 2016), and high quality PE is central to achieving PA goals in the school setting (Eather et al., 2013). PE lessons have been highlighted as being the formal opportunity in schools for direct delivery of health-related PA and fitness (Fairclough et al., 2016), and therefore, PE is often viewed as the primary vehicle for promoting these outcomes in schools (Sallis et al., 2012; Cohen et al., 2014; Erfle and Gamble, 2015). However, PA during PE classes has decreased since the early 1990s (Hallal et al., 2012b), and despite 90% of pupils in English schools participating in at least two hours of PE and out of hours school sport each week, only 56% of these children meet recommended daily PA levels (British Heart Foundation, 2012). Additionally, PE lessons specifically show that children are not meeting the 50% MVPA time guidelines (Ofsted, 2013), thus reinforcing the need to explore alternative school-based opportunities to promote children's MVPA (Curtner-Smith et al., 2007). Therefore, as PE is not a daily feature of the school day and the direct contribution of PE to current PA guidelines is limited to the days on which PE is timetabled, other parts of the school day have greater potential to positively contribute to children's daily MVPA.

Alongside the advice to increase children's MVPA, PA is also important to develop movement skill competency, as this may affect the degree to which skills are effectively performed, consequently influencing the level of PA partaken (Fairclough and Stratton, 2005b). Children's competency of motor skills is integral to successful physical and motor development (Chen et al., 2016), and fundamental motor skills are described as the building blocks of life for successful participation in sports and various children's PA (Okely et al., 2001; Barnett et al., 2009; Bandhauer, 2016). Fundamental motor skills are commonly used in a range of PA, and children should be provided with opportunities to both increase MVPA and practice movement skills at other times of the school day (Chen et al., 2016). Opportunities to offer children PA can apply Harter's competence motivation theory and self-determination theory (Deci and Ryan, 1985), whereby successful attempts to master a skill can increase perceived confidence, leading to increases in motivation (Cairney et al., 2012). Therefore, with improved learning of motor skills, and increased perceived confidence, will encourage children's motivation to engage in PA outside of school (Fairclough et al., 2016).

School-based interventions can positively impact health-related fitness (Sallis et al., 1997; Erfle and Gamble, 2015), and have resulted in children spending significantly more MVPA time (Lonsdale et al., 2013; Powell et al., 2016b). This consequently enhances contributions towards the 60 minute MVPA recommended guidelines (Chief Medical Officers, 2019), and outlines how the school can be used as a platform for targeted intervention to improve children's PA behaviours.

Schools provide all children with the same environmental stimuli to be physically active, but PA engagement is highly variable between individuals across whole school days and specific segments (Tudor-Locke et al., 2006; Fairclough et al., 2007). Furthermore, it is unclear as to what extent children's PA differs during the segments of the day, and which segments offer most potential for PA engagement (Fairclough et al., 2012). The provision of non-curricular PA opportunities during break times in the school day (break time and lunchtime), has shown to relate to the amount and intensity of children's PA during these times (Parrish et al., 2009; Rashad Kelly et al., 2010; Dobbins et al., 2013a; Eather et al., 2013; Fairclough et al., 2016; Powell et al., 2016a). Literature suggests there are positive associations between children's PA and time spent during extra-curricular periods, and pre-school activities such as wake-up, shake-up PA breakfast clubs have revealed significantly greater levels of children's PA (Fairclough et al., 2007; Lee et al., 2008; Cooper et al., 2010a; Ridgers et al., 2010).

During short school break times, boys spend significantly more time in MVPA than girls, as boys see it as an opportunity to engage in competitive games, and girls spend this time socialising with friends (Ridgers et al., 2006; Powell et al., 2016a). The lunchtime segment of the school day has been found to make a meaningful contribution to daily PA levels in both less active and more active groups of children (Fairclough et al., 2012). Therefore, lunchtime activities that explicitly promote PA, fitness and health whilst allowing for recreational participation may be better suited than more traditional PE activities (Fairclough et al., 2016). In addition to this, evidence suggests that lunchtime and break time periods are opportunities to provide children with fun and enjoyable PA experiences, which can enhance children's intrinsic motivation and increase the likelihood of continued participation (Fairclough et al., 2016). Furthermore, effectively designed children's break/lunchtime PA interventions have resulted in a 13 percent increase in MVPA (van Sluijs et al., 2007b).

Participation in after-school PA programmes can also make a valuable contribution to children's PA levels (Trost et al., 2008), fitness status, body composition and lipid profiles (Beets et al., 2009). The hours from 3:30-6:30pm have been described as 'critical' for PA participation on school days because during this time children can do a variety of activities, from technology-based sedentary activities and homework to PA including sport (Tudor-Locke et al., 2006; Atkin et al., 2008). This would therefore highlight the opportunity schools have in promoting children's PA behaviours in this time period via after-school PA clubs. However, as discussed in Chapter 2.2.2, the difference in children's independent mobility may affect the level of participation.

Further research highlights that MVPA occurs away from the school environment, and that PA may be partly influenced by parental rules relating to safety (Nichol et al., 2010), parental support for PA (Hohepa et al., 2007), children's own activity preferences (Atkin et al., 2008), and recreational PA during non-school hours (Steele et al., 2010; Brusseau et al., 2011). However, when categorising children into either more active and less active groups, the more active children were found to be more active outside of school, and the least active were found to be more active in school (Cox et al., 2006). This highlights the value of using schools to promote PA to those for whom the need is greatest (Cox et al., 2006). School-based PA is also of great importance as within the UK, after 5pm daylight hours may be limited, which most likely restricts outdoor play, which would suggest that outside of school MVPA, particularly outdoors, could be significantly hindered (Fairclough et al., 2012).

From the discussed literature, the importance of PE, access to PA facilities/equipment, the school environment and the quality of pedagogical practice, are all highlighted as important factors to promote and encourage PA behaviours (Heath et al., 2012). There is a great importance for schools to deliver high quality PE and PA, reinforcing the health benefits of leading a physically active and healthy lifestyle, and the school lunchtime period could offer the most benefits to children's PA, due to its accessibility for all, not being affected by daylight hours (i.e. consistently light), no financial implication for children, and often offering the greatest time period in comparison to other extra-curricular windows (Ridgers et al., 2018b).

When implementing school-based interventions to promote PA, support from key stakeholders such as teachers is essential for their success (Eather et al., 2013). The Diffusion of Innovations model identifies stakeholders such as teachers as essential in promoting PA participation (Owen et al., 2006). Teachers also help to provide access to the target participants, and their continuing support is important for the institutionalisation of interventions and increased likelihood of sustainability (Owen et al., 2006). In addition to this, interventions where PE teachers enhance students' motivation towards PE, also produce increases in extra-curricular PA behaviours and enjoyment (Cheon et al., 2012), which consequently increases extra-curricular MVPA (Neumark-Sztainer et al., 2003; Cleland et al., 2005; Chatzisarantis and Hagger, 2009), for example, teachers prompting and encouraging children to join in break-time PA as they exit the classroom (Eather et al., 2013).

The school's physical environment is also an area that has received much attention in promoting PA in the school setting (Bergh et al., 2012). Visual aids such as posters pinned on the classroom doors, school newsletter articles, student work booklets, and a reward system have all been associated with providing support for PA intervention programmes to encourage participation (Eather et al., 2013). Carefully planned school-based interventions are feasible to deliver in English schools, which children enjoy, teachers' value and ultimately provide favourable results indicating their potential to positively impact on PA behaviour (Fairclough et al., 2016).

2.6 Models of behaviour change to promote physical activity

As mentioned previously in Chapter 1.1.4, there are a range of models which could be used to underpin physical activity interventions. The Health Belief Model (Rosenstock et al, 1950) is one of the first models designed which takes a holistic approach to modifying human behaviour (Glanz et al., 2008). It suggests that a person's belief in a likelihood of developing an illness or disease alongside a person's belief in the effectiveness of the recommended action will predict the likelihood that person will adopt/change their behaviour (Glanz et al., 2008). By considering individual perceptions, modifying factors and a likelihood of action, this model considers the individual at the core of the process, whereby personal thoughts and behaviours are taken into account before acknowledging any potential factors within an individual's lifestyle which could be altered (Glanz et al., 2008). As a consequence of this, an informed action based intervention can be implemented which has been tailored personally to an individual's needs (Glanz et al., 2008).

When applying this to child populations, the children would be educated about the health benefits associated with PA, and this would support positive behaviour change and encourage an active lifestyle, however, there may be difficulties in applying this within the school environment. Schools have a large population, and therefore, the personal approach of the model would be diluted to accommodate a more generalised intervention. Furthermore, it would be difficult to accommodate each child's lifestyle when designing large-scale sample interventions.

The Transtheoretical Model of behaviour change, as developed by Prochaska and Di Clemente in 1977, is a model used to underpin PA interventions which focuses on behaviour change, including stages of change, processes of change, levels of change, self-efficacy, and decisional balance (Dishman et al., 2010; Abdi et al., 2015). This model of behaviour change has been developed from different psychological theories including social cognitive theory (Bandura et al., 1977) and learning theory (Skinner, 1953) (Pekmezi et al., 2010). This model includes six stages whereby three stages are focused on preparation before an intervention is implemented, known as precontemplation, contemplation and preparation. Following stage four which is the action stage, there is a maintenance and relapse stage where an intervention and human behaviour is monitored to identify any modifications (Abdi et al., 2015). The Transtheoretical Model theorizes that people use experimental and behavioural processes to alter their experiences and environment in ways to prompt or support their attempts to move between progressive stages of change from building intention to subsequent adoption and maintenance of regular PA (Dishman et al., 2010).

This model has been used to promote PA behaviours, and recommends early and ongoing assessments of individuals being ready for change, exercise goals and target setting (Pekmezi et al., 2010). However, similarly to the Health Belief Model (Rosenstock et al, 1950), this model may be better suited working on a more personal, individual basis (Pekmezi et al., 2010), and it would be difficult to implement the personal approach in a school-based environment due to the large children population.

A theory which has been used to promote PA behaviours and also includes a holistic approach for intervention planning is Social Cognitive Theory (Bandura, 1986). This theory utilises a multifaceted casual structure in which self-efficacy beliefs operate together with goals, outcome expectations, and perceived environmental impediments and facilitators in the regulation of human motivation, behaviour and well-being (Bandura, 2004). This theory suggests that the greater self-efficacy an individual has in health-related behaviours (such as PA), the more likely they will continue such behaviours, and the lower self-efficacy an individual has in health-related behaviours will result in a reduced chance of observing these behaviours (Bandura, 2004). Furthermore, this core belief affects each of the basic processes of personal change – whether people even consider changing their health habits, whether they mobilise the motivation and perseverance needed to succeed should they do so, their ability to recover from setbacks and relapses, and how well they maintain the habit changes they have achieved (Bandura, 2004). In addition to this, this model outlines that human health is a social matter, not just an individual one, and therefore a comprehensive approach to health promotion also requires changing the practices of social systems that have widespread effects on human health (Bandura, 2004).

The Social Cognitive Theory is a useful framework for the design of PA interventions as it considers behaviours and voices of participants (Rogers et al., 2004). This theory has been applied to previous studies in children focusing on PA intentions and exercise promotion (Rogers et al., 2004; Roberts et al., 2010), where the purpose has been to explore PA knowledge, attitudes and behaviours, and utilising this theory is effective for larger, survey studies and for future intervention research (Rogers et al., 2004). Previous studies (Bully et al., 2015; Magoc et al., 2016) have conducted focus groups with questions based on the Social Cognitive Theory constructs of self-efficacy, environment, behavioural capability, expectations, expectancies, self-control and performance, observational learning, and reinforcement (Rogers et al., 2004). This approach would be particularly useful when exploring children's PA behaviours.

Social cognitive theory may be a useful framework for future studies of PA behaviours as it considers individual attitudes and behaviours, and measurement constructs related to this theory should be explored (Rogers et al., 2004). This would indicate that studying PA behaviours through methods such as focus groups and interviews could help shape and inform PA interventions. Future PA intervention studies should explore barriers to and facilitators of PA, whilst focusing on self-efficacy, outcome expectations/expectancies, observational learning and reinforcements, which contribute towards a well-planned, personalised and successful PA intervention (Rogers et al., 2004). A school-based PA intervention underpinned by the Social Cognitive Theory would be effective in exploring children's PA through consultation with the children. This would allow the researcher to gain a deeper insight into reasons behind children's PA behaviours.

The Precede-Proceed health promotion planning model is a tool for designing, implementing, and evaluating health behaviour change programmes (Green and Kreuter, 1991). This model comprises of eight phases and four assessments on social aspects and situation analysis, epidemiological assessment, educational assessment and finally ecological assessment (Green and Kreuter, 1991). Following implementation, this model then evaluates the process, impact and outcome of the intervention (Green and Kreuter, 1991). The Precede-Proceed model is used to provide a structure for applying theories and concepts systematically for planning and evaluating health behaviour change programmes (Porter, 2016).

The appropriateness of applying this model when exploring children's reasons for PA behaviours could be questioned as the Precede-Proceed model does not explain the relationship among factors thought to be associated with an outcome of interest (Porter, 2016). Therefore, this may not be appropriate to implement as one of the main objectives within this thesis is to search for explanations regarding children's PA behaviours and reasons how and why they interact within locations. Within a school environment, the relationship between children and their PA behaviours is integral to informing an effective PA intervention, and this can be established by consulting children's voice. Therefore, as the Precede-Proceed model is not associated with exploring or explaining these relationships, other models may be better suited.

Ecological models postulate that health behaviours are shaped by the setting in which they occur (Welk, 1999a; Glanz et al., 2008). As previously outlined, neighbourhood environmental factors such as PA provision (Grow et al., 2008), proximity to PA locations (D'Haese et al., 2011; Chillon et al., 2015), traffic volume, and neighbourhood safety (Carver et al., 2008), are considered to be important influences on children's PA (Noonan et al., 2016a).

Researchers have shown interest in even broader social-ecological approaches to understanding PA behaviour (Stokols, 1992), and the difference in children's motivation for PA compared with adults, must be considered to better understand their behaviour (Welk, 1999a). Social-ecological frameworks which are designed specifically for children, suggests that multiple levels of environmental influence (e.g., social, cultural, physical, institutional) can directly and indirectly influence behaviour (Welk, 1999a). This is useful as social-ecological frameworks acknowledge self-regulation is difficult to establish without broader social and institutional support (Welk, 1999a). This indicates that behaviour change in children may be influenced by the social environment, including peers, and school environment which provide opportunities to engage in PA.

In accordance with the social-ecological framework, the Youth Physical Activity Promotion Model provides a broad perspective on the factors that influence PA behaviour in children, and is underpinned by the Social Cognitive Theory (Welk, 1999a). This model utilises aspects of the Precede-Proceed health promotion planning model (Green and Kreuter, 1991) as an organisational framework (Welk, 1999a). This model was developed to provide guidelines for establishing health education programmes for a variety of different behaviours, but the main advantage of this model is that it advocates a 'bottom up' approach to programme planning rather than a 'top down' perspective (Welk, 1999a). This means that a population's specific characteristics and needs are considered to help underpin and inform a PA programme (Welk, 1999a). In addition to this, further adaptation of this model have also been implemented (Seabra et al., 2013a). The adapted version of the Youth Physical Activity Promotion Model has been used in research to explain PA participation in schoolchildren (Seabra et al., 2013a). This demonstrates the appropriateness of using this model when exploring PA behaviours in school children, and could potentially be useful when designing future PA interventions in order to create a PA intervention which is child-centred.

Research suggests that the social, physical and policy environments impact on the ability or likelihood of individuals participating in PA (McLeroy et al., 1988). Human behaviour is difficult to change, especially in an environment that does not support change (Victorian Curriculum Education, 2014). In order to increase PA, efforts need to focus not only on the behaviour choices of each individual but also on factors that influence those choices (Stokols, 1992). The Social-Ecological Model helps to identify opportunities to promote participation in PA by recognising the multiple factors that influence an individual's behaviour (Giles-Corti et al., 2005). Efforts to change behaviour are more likely to be successful when the multiple levels of influence are addressed at the same time (Sallis et al., 2008).
An individual's social environment of family, friends and workplace are embedded within the physical environment of geography and community facilities, which is in turn embedded within the policy environment of different levels of government or governing bodies (Victorian Curriculum Education, 2014). All levels of the Social-Ecological Model impact on the behaviour of the individual (Stokols, 1996). The Social-Ecological Model represents this concept as a series of overlapping circles, with each circle representing a different layer or component of the model which include factors that affect the individual (Victorian Curriculum Education, 2014). The model represents a comprehensive approach to designing, implementing and evaluating interventions which target the multiple influences on behaviour including PA behaviour (Sallis et al., 2008). More details on the Social-Ecological Model are provided in Chapter 3.1.

2.7 Measuring physical activity in young people

Given the general tendency for young people to over-report their MVPA (Rzewnicki et al., 2003) and the evidence showing a poor association between self-reported and objectively-measured MVPA among children (Chinapaw et al., 2010), there is a need to use more objective MVPA measures (Lonsdale et al., 2016). Furthermore, due to the lack of gold standards, numerous methods are used, often simultaneously, therefore, the strengths and limitations of each method should be acknowledged (Loprinzi and Cardinal, 2011).

The imbalance of traditional PA measurements being restrictive and low in accuracy is called the 'feasibility versus validity trade off' (Corder et al., 2008). This refers to valid measures of PA being least practical for field testing, and vice versa (Corder et al., 2008). In this context of this thesis, the sporadic nature of children's PA means that accurate measurement can be a difficult task (Rowlands and Eston, 2007). PA types, duration and intensity are likely to differ daily, and consequently, researchers have identified the importance of measuring 3-4 days of PA, using any method, to gain a reflective representation of habitual PA behaviour including weekdays and weekends (Hart et al., 2011). With the advancement of technology, the number of affordable activity monitors available to measure PA is growing, which are a more objective, accurate and reflective measure of children's PA than self-report measures (van Remoortel et al., 2012). The following subsections will provide an evaluation of a range of methods used for measuring children's PA.

2.7.1 Heart Rate and Global Positioning Systems

Objective methods for the assessment of PA are now more common and more feasible, largely because both the cost and complexity have been addressed (Biddle et al., 2011). Heart rate (HR) monitors are objective tools and have been used within previous PA research (Fjortoft et al., 2010; Collins et al., 2012). Measuring HR is a well-known metric to determine the intensity of PA (Åstrand, 2003), and HR monitors are compact, light and very simple to operate, cost effective and accurate tools. The storage of HR data is kept internally within each unit which can be downloaded at a later period and analysed accordingly (Åstrand, 2003; Fjørtoft et al., 2009), making them suitable for use with children to explore PA behaviours. However, previous research outlines how HR equipment failed to report HR data due to HR monitors moving whilst being worn (Moore et al., 2014), consequently meaning the HR sensors did not detect children's heartbeat. Additionally, HR monitors may need to be removed for water based activities (as not all HR monitors are waterproof) or for health and safety reasons (Moore et al., 2014). Therefore, MVPA behaviours may not be recorded by HR equipment. HR monitors are discussed further in Chapter 3.4.3.

The use of GPS is increasingly popular in health research and many studies tend to collaborate their use with other measures to explore levels of PA according to location (Maddison and Ni Mhurchu, 2009; Cooper et al., 2010b; Collins et al., 2012; Oreskovic et al., 2012; Moore et al., 2014). GPS monitoring shows promise as a method to improve understanding of how the physical environment influences PA behaviours by allowing activity to be quantified in a range of physical contexts (Troped et al., 2010). More specifically, GPS provides precise location data and can be used to identify when an individual is outdoors (Cooper et al., 2010b). GPS is also used to explore how individuals interact with the environment (Cooper et al., 2010b). The associations of location and PA behaviour could be researched using GPS monitoring systems which enables researchers to gain a greater insight into how young people utilise their surrounding environment for PA, and identify the environmental facilitators and barriers that different geographical environments present to young people (Collins et al., 2012).

The development of lightweight personal GPS receivers allows the outdoor location of an individual to be recorded with high frequency and accuracy, and combining GPS data with objectively measured PA has the potential to enable both the location and use of PA promoting or inhibiting environments to be described (Cooper et al., 2010b). Personal GPS receivers have been used to map travel routes to school (Duncan and Mummery, 2007; Duncan et al., 2007), and combined accelerometer and GPS data have been used to describe associations between children's PA and independent movement (Cooper et al., 2010b; Pearce et al., 2018) and the location of bouts of moderate intensity PA (Jones et al., 2009). While GPS tracking produces a data set that is detailed, data are highly complex to interpret, and most studies have been limited to a small number of participants or to specific behaviours (e.g. the journey to school) occurring within a prescribed period of time (Pearce et al., 2018). Furthermore, GPS receivers record data predominantly when outdoors due to a loss of signal when indoors, and studies have specifically used GPS to explore PA behaviours in the outdoor environment (Pearce et al., 2018). GPS measured time outdoors may be a useful tool to provide an objective reflection of environmental influences on children's PA (Pearce et al., 2018).

School-based studies using GPS have found that children's time spent in the outdoor environment is likely to promote PA behaviours, particularly in school environments that support and promote PA such as playgrounds/school fields with PA related equipment (Oreskovic et al., 2012). Further studies using GPS support this, as measurement over a seven-day period found that the school environment is where students reported the greatest amounts of MVPA (Moore et al., 2014). Additional research using GPS with school children, has been used to monitor commuting patterns to and from school, and active transport (Dessing et al., 2014; McMinn et al., 2014).

Technological advancement in GPS receivers has made them easy to carry, and these devices have already been used for measuring free-living activities in children without interfering with their day-to-day activities (Jones et al., 2009; Quigg et al., 2010). The use of GPS offers great potential for progress in the field of health research (Kerr et al., 2011) due to the objective method to monitor the actual distance travelled and mode of transport of children which may replace subjective self-report measures used previously (Kerr et al., 2011). Researchers have integrated GPS technology into PA related studies (Maddison and Ni Mhurchu, 2009; Chaix et al., 2014; Collins et al., 2015; Pearce et al., 2018).

There are a number of limitations associated with the use of GPS. When using GPS to explore PA, research has indicated the poor satellite signal affects the volume of data recorded, and this is dependent on location, specific GPS model and weather influences (Fjørtoft et al., 2009; Jones et al., 2009; Pearce et al., 2018). Signal accuracy has been known to be influenced by being indoors, or surrounded by tall buildings and/or trees (Stopher et al., 2008; Pearce et al., 2018). The location on the body has been known to impact GPS accuracy, with research indicating that GPS devices worn on lanyards or around the waist reporting least accurate results, compared with when GPS devices are worn on the wrist (Duncan et al., 2007).

Further limitations of GPS relate to an 'initialisation period' (usually less than 1 minute) where satellite signal is located (Duncan et al., 2009c; Pearce et al., 2018). Data within this initialisation period can be erroneous, and therefore studies using GPS ask participants to remain stationary until this period is complete (Duncan et al., 2007; Pearce et al., 2018). GPS monitors generally have a short battery life and limited data storage capacity which can pose potential limiting factors to data collection when gathering data over several days (Duncan et al., 2009c). Subsequently, researchers have either encouraged participants to switch GPS devices on only when necessary or to recharge devices, and researchers download data during the measuring period (Duncan et al., 2009b). The invasive nature of GPS is identified as a limitation, as participants may not be willing to provide consent to studies tracking personal location (Matthews et al., 2009). Therefore, studies have stressed greater emphasis on the health-related nature of the study, and reported post codes rather than specific address details to protect participants' privacy (Brownstein et al., 2006). Finally, as with the use of HR monitors and any other tool used for data collection, participant compliance can be a limitation. Encouragement from the researcher to engage in the study will assist in maintaining greater compliance levels (Oliver et al., 2010).

2.7.2 Surveys to measure physical activity

Until the development of movement sensors, such as pedometers and accelerometers, the assessment method of choice for PA has been self-report (Biddle et al., 2011). Consequently, there are a large number of instruments aimed at assessment in young people (Biddle et al., 2011). Self-report methods are often preferred over accelerometers, HR monitors and GPS, as they are cheap to administer, take little time to complete, require limited technical expertise in analysis, can offer information on the context of activities and record more than just ambulatory activities (Westerterp, 2009). When used exclusively, the use of self-report measures remains problematic as the measurement of error related to issues of recall is of concern, i.e. likely to only pick up types of PA that can easily be recalled, which may miss some of the short and sporadic bursts of activity common for younger children (Biddle et al., 2011). However, assessment of some aspects of PA (e.g. type) will require self-report assessment, alongside objective methods (Biddle et al., 2011). This has resulted in trials of using questionnaires alongside other measures when assessing large samples of young people (Riddoch et al., 2007; Mattocks et al., 2008b). Nonetheless it is likely that self-report instruments will be required for some time yet, if mainly for reasons of cost (Biddle et al., 2011). Self-report instruments will continue to be required as information on both the type and context of PA is also important, moreover, the design of effective interventions requires an understanding of what PA people do alongside how much they do (Biddle et al., 2011).

The use of self-report measures have been questioned in literature (Sallis and Saelens, 2000), and with technological improvements and reductions in cost, population surveillance may, in future, routinely use more objective instruments, such as accelerometers (Biddle et al., 2011). Previous research has demonstrated differences in the amount of activity individuals report doing, compared to their level of PA when measured with an accelerometer (Tully et al., 2014), with studies reporting PA as being ranked higher by self-report measures than by accelerometer, due to the lack of accuracy of recalled PA in self-reported measures (Walsh et al., 2004; Tully et al., 2014). Therefore, it is advisable that children’s PA should not be measured with the sole use of self-report measures. Combining objective tools alongside self-reported measures will assist in providing a more accurate and reflective dataset.

In school-based studies, self-report measures have been used to help inform and evaluate PA intervention programmes, particularly when exploring reasons behind PA, perceived exertion and enjoyment factors (Goudas and Biddle, 1994; Fairclough et al., 2016). However, these measures have not been used in isolation, as they have been combined with objectively measured PA methods (Fairclough et al., 2016). This would further support the ongoing need for self-report measures to be used as part of a wider PA measurement process.

2.7.3 Focus groups to explore physical activity behaviour

Greater understanding of the nature of PA (or inactivity) is essential to develop and implement effective interventions (Maddison and Ni Mhurchu, 2009). Identifying barriers to and facilitators of PA is key in order to understand the nature of children's PA, but it is also important to identify the components to be utilised in future interventions aiming to increase PA in this group (Vu et al., 2006).

A focus group is commonly defined as a method of collecting research data through moderated group discussion based on the participants' perceptions and experience of a topic decided by the researcher (Bender and Ewbank, 1994). The use of focus groups has been used when combining measures of PA (Moore et al., 2014) and a thematic approach to analysing the data has been modelled (Derrett and Colhoun, 2011).

Focus groups differ from group interviews in that the emphasis is on the interaction between the participants rather than between the moderator or researcher and the participants (Carlsen and Glenton, 2011). Focus groups are recommended as a pre- or post-study to prepare or interpret data from surveys or trial studies (Carlsen and Glenton, 2011). Focus groups specifically involving children offer a valuable, versatile, interactive and fun method of gathering information on a specific topic

(Gibson, 2007; Gibson, 2012), and this allows the researcher to explore the depth and complexity of phenomena (Carlsen and Glenton, 2011). When exploring children's PA, focus groups have been particularly useful as it allows children to interact with peers in a less formal environment, whereby topics can be discussed openly, allowing the researcher to gain an insight into children's thoughts and reasons behind PA behaviours (Gilliland et al., 2015; Lassetter et al., 2015; Ha et al., 2017).

Despite the popularity of focus groups, current literature indicates that advice on how to decide on the number of groups to conduct is often meagre compared to advice on other aspects of the method, with some books claiming there are no existing guidelines for deciding the number of groups (Carlsen and Glenton, 2011). Furthermore, guidance on group size is common and seldom goes beyond a minimum of 4 and a maximum of 12 participants per group (Bender and Ewbank, 1994; Kitzinger, 1995). Research also indicates that greater attention needs to be directed towards the interpretation of results from focus groups, ensuring focus groups are reflective of the wider diverse sample, whilst considering the challenges when exploring personal or sensitive topics (Gibson, 2007; Gibson, 2012). Literature emphasises that both too few and too many focus groups can lower the quality of focus group studies (Sandelowski, 1995), thus suggesting quantity must be balanced against quality, and the more hours of taped interviews or pages of transcribed material, the less depth and richness the authors will be able to extract from the material (Carlsen and Glenton, 2011).

The focus group method requires that data collection, i.e. recruiting, interviewing and analysis, is conducted as an iterative process for each interview, thus representing a different approach from the traditional quantitative design of successfully calculating sample size beforehand and analysing all data collected (Kennedy and Lingard, 2006). The use of focus groups to date have been largely homogeneous with respect to gender, most commonly featuring females, and therefore there is a greater emphasis required on ensuring focus groups are equally representative of both genders, particularly when exploring PA behaviours (Carlin et al., 2015). Understanding the interactions between males and females and how this can influence PA participation will provide useful insight to inform the development of future interventions which may be targeted at mixed or single gender groups (Carlin et al., 2015).

As focus groups are widely employed in qualitative research and can be used within many areas of health research to provide detailed information on the range of feelings and ideas individuals experience in relation to a particular issue or behaviour (Rabiee, 2004), this open-ended approach provides a useful method for exploring, in depth, factors associated with PA (Carlin et al., 2015), and is therefore applicable to research aiming to explore children’s PA experiences.

Chapter 3
Methodology

Chapter 3 - Methodology and Research Methods

This chapter will provide details of the methodological decisions and rationale for the different studies conducted within the thesis. Firstly, the paradigm including concepts, thoughts and theories will be discussed (3.1), followed by information on research framework (3.1.1). Further information on research design (3.2), research settings and participants (3.3) are then provided, which is followed by details of research measures and procedures (3.4). The research procedure (3.5) is then explained specifically in relation to Studies 1 and 2 (3.5.1). The ethical considerations for the thesis are discussed (3.6), followed by a conclusion (3.7). More specific details on data analysis are provided within each study chapter (Chapters 4-6).

3.1 Paradigm

The focus of this investigation is to explore the reality of school children's physical activity (PA) behaviours. Research from a social constructionist perspective is concerned with identifying the various ways of constructing social reality that are available in a culture, to explore the conditions of their use and trace their implications for human experience and social practice (Willig, 2013). Reality is socially constructed by and between the persons who experience it (Gergen, 1999), therefore the reality of school children's PA is personal to them, and, as such researchers may find it difficult to gain an accurate insight into a reality that they are not actually a part of. In addition to this, reality can be a different experience for everyone, based on unique understandings and experiences of the world (Berger and Luckmann, 1966). Therefore, the researcher within this investigation would need to explore a wide range of differing perspectives or life-worlds (Jones, 2012; Smith and Caddick, 2012; Sparkes and Smith, 2013) in order to attempt to develop meaningful interpretations and conclusions. Within the current thesis, this involves the researcher exploring the perspectives of children from different ages, gender, and backgrounds. Although the investigation explores one school, each child brings their own different and personal perspective and experience, which can be explored within the thesis. However, this may be more complicated than it seems, as the realities of human experience (including perception), are mediated historically, culturally and linguistically (Willig, 2013). From a research perspective, this could be interpreted as the researcher never obtaining a direct reflection of the environmental conditions, but obtains a specific reading of these conditions (Willig, 2013). Therefore, in the context of this thesis, when exploring PA behaviours of children, the researcher is unlikely to obtain a first-hand experience, but more likely to gain information of PA behaviours according to the children's perspective.

The empiricist stance argues differently as it suggests the only source of knowledge is experience (Godfrey-Smith, 2009), which in the context of this thesis would be the children's lived experience and engagement in PA. The classic outlook of empiricism focuses on the mind and how it works in relation to colour and sound, which is known as 'sensationalist' (Godfrey-Smith, 2009). However, this 'experience-based' empiricist approach would not be applicable to exploring children's PA, as the experience is personal to the children. Therefore, constructing school children experience may be better suited, rather than reflecting school children experience (Willig, 2013). On the other hand, this investigation lends itself more towards a rationalist approach, whereby knowledge of the world is gained by pure reason alone, prior to experience (Nelson, 2012). Within the context of this thesis, the researcher will gain knowledge of the children's world, specifically exploring PA behaviours and, the focus groups in particular, will provide an opportunity for children to articulate this.

In order to ensure the current research is child-centred, the Social-Ecological Model (McLeroy et al., 1988) will underpin the thesis studies, and gather information on children, and their social and physical surrounding communities. Therefore, the researcher can explore contributing factors towards children's PA. The Social-Ecological Model is made up of the individual, social and physical environment and policy components and is presented in Figure 3.1 and discussed further in section 2.6 of this chapter.

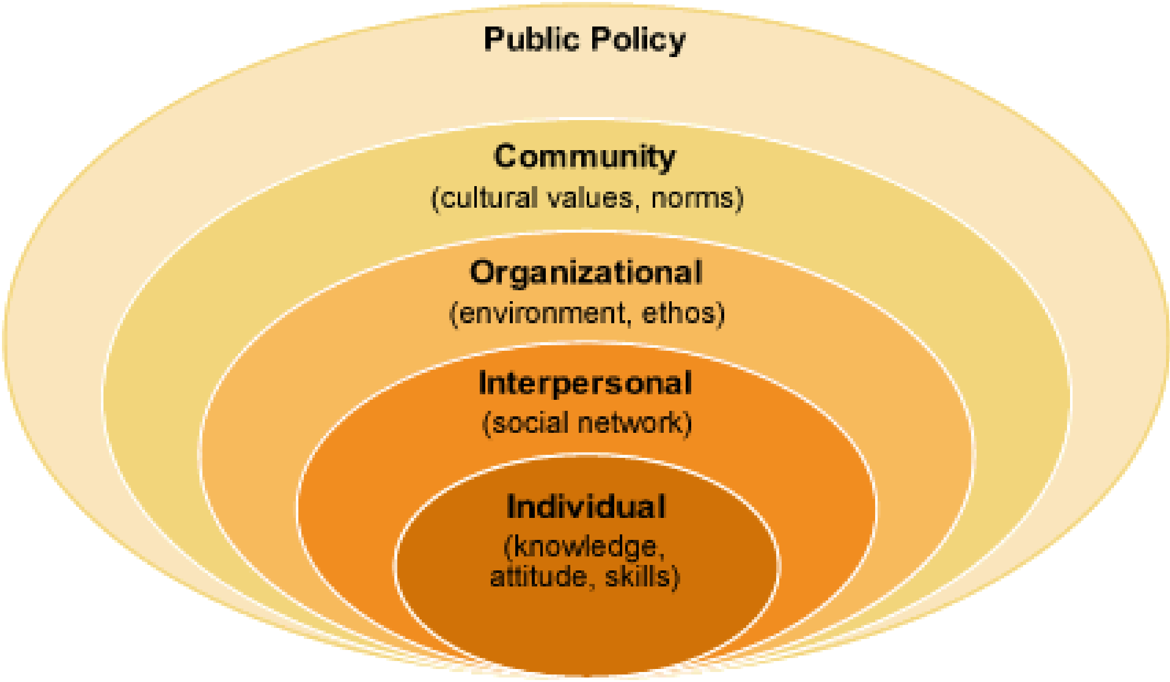


Figure 3. 1 Social-Ecological Model (McLeroy et al., 1988).

This multifaceted research study aims to gather different types of data to explore different elements, therefore different approaches are adopted at different points. Through a mixed-methods approach, it is hoped to explore and interpret valid and reliable PA-related information. A combination of methods is more enlightening and helps to understand a complex research problem, or answer a question that cannot be answered in a mono-method study (Jones, 2012). Furthermore, each of the methods adds strength to offset the other's disadvantages, as quantitative research will link commonalities, trends and generalities, while the inductive logic of qualitative methods answers 'how' and 'why' questions (Jones, 2012). The ontological assumption would be that the reality is seen as a contextual field of information whereby different school children report different results based on their own personal circumstances.

Study one aims to measure children's PA and weight status, and explore reasons behind school children's choices for PA, which are dependent on their own personal contexts and circumstances. A realist perspective is held when carrying out and reporting this study as the children's lived experiences is their actual lived reality, which the researcher can explore. Furthermore, children's explored reality will be investigated independently of the researcher's thoughts, therefore, a post-positivist critical realist epistemological stance is held. However, it is difficult to be able to establish this reality without researcher bias (Trochim, 2006). The post-positivist critical realist recognises that all observation is fallible, has error and suggests that all theory is revisable (Trochim, 2006). Consequently, as all measurement is fallible, the post-positivist emphasises the importance of multiple measures and observations, each of which may possess different types of error, and the need to use triangulation to establish a deeper understanding of the reality (Trochim, 2006). In relation to the studies within this thesis, the qualitative nature of both studies one and two have a more constructivist approach where there is a greater emphasis on gaining experience of participants' PA behaviours. Study two and study three (which includes an intervention) of this thesis support a pragmatic approach whereby a researcher will use thoughts as an instrument/tool for prediction, problem solving and action (James et al., 1978). As a result of these viewpoints, and in the context of this thesis, the intervention study (Study 3) aims to increase levels of PA at times of the year where PA levels are at their lowest (informed by Study 2).

3.1.1 Research Framework

Health promotion programmes have been criticised for their lack of clearly specified theoretical foundation or for being based upon a narrowly conceived conceptual model. For example, lifestyle modification programs typically emphasise individually focused behaviour change strategies, while neglecting the environmental underpinnings of health and illness (Stokols, 1996). Therefore, this research will be underpinned by the Social-Ecological Model (McLeroy et al., 1988), which although simplistic in nature, allows for the integration of multiple levels and contexts to establish communication with health (Oetzel et al., 2006). The child as the individual within the model will be affected by his/her social environment. The school provides a social environment as well as the home, it is envisaged that this will be heavily influenced by parents, peers, teachers/coaches, and social groups. The social environment is shaped according to the provided physical environment (D'Haese et al., 2016). The school also provides the organisational environment, and this may provide opportunities for children to engage in greater PA. The community layer is reflected within both in school and outside of school environments, such as the home, local parks, and green spaces etc. The final part of the model is outlined by the provided school or public policy. An intervention strategy within this thesis may include a new policy promoting PA, whereby children have more access to PA facilities during recreational periods. This is further supported by the Social Cognitive theory (Bandura, 2004), which relates health-related behaviours to an individual's self-efficacy. This will be discussed in relation to the first two studies, and also how it relates to supporting the Social-Ecological Model (McLeroy et al., 1988) when designing an intervention for Study 3.

The focus of Study 1 in this thesis explores the PA and health status of children in relation to gender and age differences. The Social-Ecological Model (McLeroy et al., 1988) provides a framework for which the individual's surrounding environment could be investigated in relation to gender and age, more specifically it allows gender and age to be explored in relation to the social and physical environment, and local policies affecting the individual in relation to PA. An example of which may be the school's policies relating to PA.

Study 2 adds a further dimension by tracking PA locations and different times of the years and researching reasons behind school children's PA behaviours. The Social-Ecological Model (McLeroy et al., 1988) was useful in shaping the questions and themes explored within the focus groups to explore the reasons for children's PA behaviours, for example, by exploring how the different social and physical environments (at school and outside of school) affect personal PA participation. The policy element of the model could also be embedded within focus group questions, and these included discussions around school-based opportunities and rules/regulations from parents/guardians outside of school with regards to time and location for PA.

The Social-Ecological Model (McLeroy et al., 1988) underpinned the decision to use the measures and equipment in both Studies 1 and 2. The children formed the individual sample to be measured, and the tools for data collection were based on the social and physical environment components, and the policy component of the model. An example of this is how GPS tracking devices were used to investigate location within the children's physical environment. Furthermore, focus groups were used to research how the social environment and policy components affected PA participation. Focus groups are a more versatile and fun way of gathering data with children (Gibson, 2012), and these differ from interviews in the sense that there is a greater emphasis on the interaction between the children as opposed to the researcher and children (Carlsen and Glenton, 2011). It was also felt that focus groups would allow all children regardless of levels of confidence, or shyness, to articulate their thoughts more openly amongst peers, in comparison to the use of questionnaires.

The third thesis study formed the intervention phase. As previously outlined, Studies 1 and 2 were underpinned by the Social-Ecological Model (McLeroy et al., 1988), and this was also used to underpin the intervention design. The intervention study was grounded within the Social Cognitive theory (Bandura, 2004), as there was a main objective of promoting, and creating a positive change in children's PA behaviours. Therefore, in accordance with this theory (Bandura, 2004), by staging popular physical activities, the aim was to increase children's level of moderate-vigorous physical activity (MVPA) in the school term which reported lowest levels of MVPA the previous academic year. Within the intervention context, all components from the model being explored were primarily concerned with the school environment. Therefore, heart rate (HR) monitors were used as a measure of PA intensity. Focus groups in Study 3 evaluated the effectiveness of the PA intervention from the children's perspective, and this highlighted areas of strength and areas of development of the designed PA intervention programme. The Social-Ecological Model is further discussed in Chapter 2.5 and 3.1.

3.2 Research Design

Following the discussed research paradigm, an in-depth case study approach was necessary for the thesis. Furthermore, as the thesis research is progressive, the chronological ordering of the three studies is designed so that the outcomes of each study inform the aims and methodological approach of the following study.

Reasons and outcomes relating to PA behaviours, with reference to children's voice from the cross-sectional approach to study one, and repeated measures approach of Study 2 help inform the intervention focus of Study 3. The associations between the three studies are shown in Figure 3.2. Research questions for each of the three thesis studies along with an overview of each study is presented after Figure 3.2.

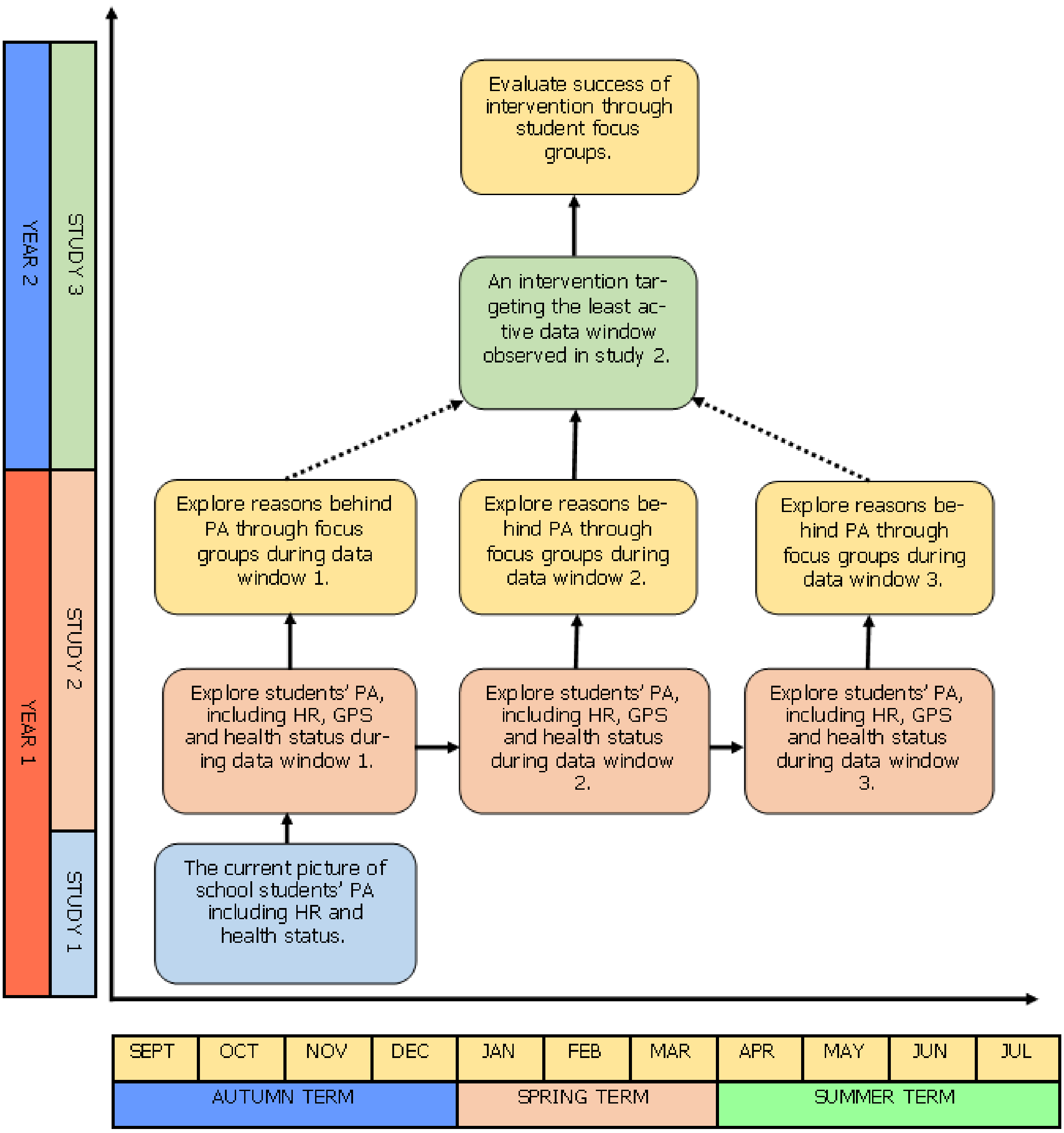


Figure 3. 2 The associations between the three thesis studies.

Study 1 – Physical activity and health status of children: a case study exploring gender and age differences

- What PA do children participate in and how much PA do they do?
- Does PA behaviour differ according to gender and age?
- Is there an association between PA and weight status?

This was an explorative, cross-sectional study where the aim was to investigate how PA and health status differed according to age and gender. Heart rate was used as a measure of PA intensity and anthropometric measurements were used to measure weight status. Peak height was also calculated to measure stages of maturation (Claessens et al., 1992), and this has been implemented in previous investigations (Malina et al., 2013). PA diaries and focus groups were used to explore PA motives.

Study 2 - Children's physical activity, location and reasons behind physical activity participation: a school year study

- Does children's physical activity location and intensity change across the school year?
- Do children's reasons to engage/not engage in PA differ according to different times of the school year?
- Do children's weight status change across the school year?

Study 2 was also explorative but repeated measures in design and aimed to investigate PA intensity and location across the academic year, as well as to establish reasons behind school children's PA participation. In addition to measuring PA intensity through the use of HR monitoring, GPS was used as a method of tracking PA location. Similarly to Study 1, weight status was measured, and PA diaries and focus groups were used to explore PA motives, and this was repeated each school term.

Study 3 - An intervention to promote levels of MVPA of a school-based sample.

This experimental study aimed to increase MVPA levels in the term which was identified as reporting lowest MVPA levels from the previous explorative studies. HR was monitored to provide indications of intensity, and focus groups were used to evaluate the intervention.

- Does a child-informed lunchtime PA intervention increase children's levels of MVPA during the school day?
- Are there PA differences between non-intervention days and intervention days?
- Are certain lunchtime activities more effective in increasing PA?
- Are there PA differences in the segmented school day according to non-intervention/intervention days?

3.3 Research Setting and participants

The focus of this investigation is to explore PA levels and health status of children, therefore, a group of school children were required as participants in the study. Schools have been used to explore children's PA (Engelen et al., 2018; Haddad et al., 2018; Pearce et al., 2018) as it is a structured environment that can provide access to a reflective childhood sample of the local area (Taylor et al., 2017b). Consent was agreed from the head teacher of an urban town Middle school in the West Midlands, United Kingdom, where the lead researcher worked as a teacher during the period of data collection. At the time of Study 1, the school had 560 total children on roll, 93 of whom were children from ethnic minority groups (17%), and with 21% of children eligible for free school meals (Department for Education, 2014b).

The school consisted of 31 teaching staff and 10 learning support assistants. This school was different to other local Middle schools within the same area, as this school benefitted from a wider range of PA facilities. The school benefitted from having two large playgrounds (one each for KS2 and KS3 children). Playgrounds were marked with coloured lines for a range of invasion games, and different activities challenging children to work on their balance and co-ordination skills. Children also had access to a 'Trim Trail' which was a designated area for children to engage in balance, agility, hopping, skipping and bounding activities. In addition to this, the school benefitted from extensive fields which were opened at lunchtime in warmer months. Children bought in a range of different pieces of equipment including footballs, skipping ropes, frisbees and cricket equipment to play with at lunchtime. The school also had a sports hall which was exclusively used for sporting activity which other Middle schools locally or nationally may not have access to. Thus, this facility provided a safe environment for indoor PA which was not impacted by the school's lunchtime dining arrangements. The range of PA opportunities offered to children was not always delivered by the PE staff and teachers of different subjects, including learning support assistants, took responsibility for leading extra-curricular PA. Therefore, children had access to a wide range of PA and the school staff promoted a healthy and active lifestyle to the children.

Literature has shown that the transition from primary to secondary school shows a reduction in children's PA (Jago et al., 2012a; D'Haese et al., 2016), however, Middle schools are of particular interest as children do not change school between key stage 2 (KS2: 9-11 years) and key stage 3 (KS3: 11-13 years). This is different to the more common two-tier school system in the UK where children attend primary school from 5-11 years, and then transition to a secondary school from 11-16 years, therefore justifying why a sample of Middle school children were recruited for this thesis. Furthermore, the declining pattern in children's PA behaviour which is evident from primary to secondary schools (Jago et al., 2012a; D'Haese et al., 2016) can be explored within this Middle school environment. Within this investigation, all children at the school were able to take part, and after promoting the investigation within the school, a convenience and purposive sample of 119 9-13 year old children (21% of the total school population, 11% from ethnic minority groups) consented to participate in the study (see Table 1.1).

Table 1.1 Number of participating children according to school year group, gender and ethnic minority group.

School Year Group (& age range)	Boys	Girls	Ethnic Minority Group	Total
5 (9-10 years)	23	20	7	43
6 (10-11 years)	19	12	1	31
7 (11-12 years)	5	14	0	19
8 (12-13 years)	10	16	5	26
Total	57	62	13	119

A stratified approach was implemented to divide children into one of six groups according to school year (ranging from years 5-8) as it ensures each subgroup within the population receives proper representation within the sample (Orcher, 2016). The groups were categorised as follows based on student uptake and availability of equipment: Group 1 (n = 15): Years 7 and 8 boys; Group 2 (n = 19): Year 6 boys; Group 3 (n = 20): Years 6 and 8 girls; Group 4 (n = 18): Years 6 and 7 girls; Group 5 (n = 24): Years 5 and 6 girls; Group 6 (n = 23): Year 5 boys. Stratified random sampling provides better coverage of the sample as there is greater control over the subgroups, and this also ensures all are represented within the sampling (Orcher, 2016).

Following the promotion of the research in school assemblies, children who consented, and whose parents/guardians provided consent, were briefed as to their involvement in the study which took place from October 2014 to June 2015. Data collection took place each school term, from October 2014 to June 2015: Autumn term (Studies 1 and 2), Spring term (Study 2), and Summer term (Study 2). Each term involved six weeks of quantitative data collection, followed by 3 weeks of qualitative data collection. The intervention (Study 3) took place in the Spring term, the following academic year (i.e., the 2015-16 academic year as shown in Figure 3.2). Participants of the intervention included those who took part the previous academic year (Studies 1 and 2), with the exception of the year 8 cohort (the last year of Middle school), who had left the school, and were replaced by a new intake of year 5 children (first year of Middle school) who had joined the school. Further details of Study 3 participants are provided in Chapter 6.2.2.

3.4 Research Measures and procedures

In order to gain a detailed reflection and deeper insight into children's PA behaviours, a mixed-methods approach was implemented. The qualitative nature of exploring children's PA behaviours was maintained in line with the constructivist approach for both studies one and two, and the pragmatic approach for studies two and three was employed exploring PA behaviours to inform an intervention. Therefore, a mixed-methods approach aligns with the ontological and epistemological approach outlined in Chapter 3.1. The following section will discuss the adopted research measures.

3.4.1 Anthropometric measurement

The following anthropometric and weight status measures were completed on the Wednesday of each data collection week, to measure health status of samples of participating children for thesis Studies 1 and 2: Standing height, seated height, waist circumference and body mass measurements (measured without shoes or excess clothing) provided peak height, waist-to-height ratio (WHtR), and BMI. Inverted Body Mass Index (iBMI) data was also calculated for Study 1. iBMI interprets leanness more accurately, and is a better proxy for percentage body fat than BMI (Nevill et al., 2011). Nevertheless, BMI as a measure of weight status have been used in research (Cloostermans et al., 2015; Kirwan et al., 2016). It is suggested that with standardisation and training procedures in place, the use of measuring height, weight (to calculate BMI and iBMI) and waist circumference are reliable measures (Miguel-Etayo et al., 2014). BMI specifically has been used in child populations as it provides a relatively non-invasive method of calculating body mass

(Freedman et al., 2013; Leatherdale and Laxer, 2013; Cohen et al., 2014). BMI was calculated using the standard equation (weight[kg]/height[m]^2). The result was then divided by 1000 to provide an iBMI score (Nevill et al., 2011).

Waist circumference has been widely used as a measure in children (Katzmarzyk and Bouchard, 2014; Schröder et al., 2014; Freedman et al., 2015) and has often been triangulated with BMI measures (Wang et al., 2013; Wohlfahrt-Veje et al., 2014; Freedman et al., 2015). Waist circumference and height measurements were used to calculate WHtR. This is a measure that indicates the level of risk of obesity-related diseases, as it is correlated with abdominal obesity (Ashwell et al., 2012). Studies 1 and 2 explored WHtR and followed guidelines and cut off points which identified children as either 'low risk' or 'at risk' (Ashwell et al., 2012). Guidelines outlined by the International Society for the Advancement of Kinanthropometry (ISAK) were followed when measuring waist circumference (see Appendix 2).

Previous research supports the use of standing and seated height measurements to establish peak height for maturational stage (Mirwald et al., 2002; Bergeron et al., 2015; Malina et al., 2015), and this has been used due to the physiological and pubertal differences, particularly amongst a children and young people sample (Muller et al., 2015). Maturational age provided from measuring peak height is the most commonly used indicator of maturity in longitudinal studies (Mirwald et al., 2002). It provides an accurate benchmark of the maximum growth during adolescence and provides a common landmark to reflect the occurrence of other body dimension velocities within and between individuals (Mirwald et al., 2002). Furthermore, research supports the use of peak height as a measure of maturation as an accurate method (Muller et al., 2015), however, it has been noted that maturational age as provided by peak height still only provides an estimate of maturity timing (Mirwald et al., 2002). Standardised peak height guidelines were adhered to (Balyi, 2009) and procedures followed are provided in Appendix 1.

Children were asked to wear P.E kit for all measurements, however, in order to improve accuracy when measuring height, weight and peak height, children were asked to remove any footwear and socks. Measures of weight status was also recorded for each participant. Boys were measured by the lead researcher, who was male. Girls were measured by female research assistants who followed the same measurement procedures. Data collection took place in an available school classroom.

3.4.2 Measurement of cardiovascular fitness

For thesis Studies 1 and 2, the cardiovascular fitness of participants was established through participation in the multistage fitness test (Leger and Lambert, 1982) which children completed in the school gym every Tuesday of data collection weeks (see Appendix 3 for guidelines). Research indicates that the multistage fitness test has a moderate to high criterion-related validity for estimating maximum oxygen uptake and has frequently been used in children investigations (De Miguel-Etayo et al., 2014; Ferguson et al., 2014; Lang et al., 2016), however, researchers must be aware that the scores of the 20m shuttle run test is simply an estimation and not a direct measure of cardiorespiratory fitness based on the motivation of participants to provide maximum effort (Mayorga-Vega et al., 2015). When carrying out this data collection, data was recorded to the point that children could no longer keep pace with the timed bleep. Children would then be provided with the level obtained by the researcher with the number of shuttles successfully completed within this level. Due to the young age, and differences in fitness levels of the children, the levels achieved on the multistage fitness test may have been low, which produced low VO2 max scores, which could be rated as 'poor' or 'below average' and potentially demoralise children. Therefore, it was decided to use multistage fitness test scores as an indication of cardiovascular fitness. Children were provided with verbal encouragement to complete each shuttle before the bleep.

3.4.3 Measurement of PA location and intensity: Global Positioning Systems combined with heart-rate monitoring

The use of GPS is proving to be a popular and innovative tool to monitor location of different sample populations (Maddison and Ni Mhurchu, 2009; Cooper et al., 2010b; Collins et al., 2012; Oreskovic et al., 2012; Moore et al., 2014). Study 2 combined the use of GPS and HR monitoring to establish locations of each participant, but also HR intensities in the different locations. The lightweight nature of GPS monitors, and the ability to combine this tool with other methods such as HR monitors, means researchers can objectively measure PA at different locations with high frequency and accuracy (Cooper et al., 2010b). Within Study 2, the model of GPS used was a Garmin Forerunner 305 (Garmin Ltd., Olathe, KS, USA). This particular model provided an objective measurement of speed, distance travelled, elevation, pace, and if anthropometric data was inputted for each participant, the number of calories burned could also be produced. This particular model of GPS can be synchronised with a matching HR monitor which enables HR to be measured in the different visited locations. Research involving travel routes to school (Duncan and Mummery, 2007; Duncan et al., 2007; Dessing et al., 2014; Collins et al., 2015), and children's independent movement (Cooper et al., 2010a) have used GPS as a tool, however these studies have been limited to small samples, or reported small amounts of data. Further research that used GPS among children has produced meaningful findings relating to commute patterns, active transport and exploring the relationship children have with their surrounding environment (Dessing et al., 2014; Harrison et al., 2014; McMinn et al., 2014; Moore et al., 2014; Collins et al., 2015).

HR monitors have been used more frequently when exploring PA levels due to the reliability and ability to combine this method with other measures such as accelerometers e.g. GENEActiv, ActiGraph (Fjortoft et al., 2010; Collins et al., 2012). The nature of Study 2 within this thesis explores location, so combining HR and GPS monitors was a more appropriate approach as opposed to using accelerometers. Despite this method proving to be a good predictor of energy expenditure during elevated HR intervals (Fjortoft et al., 2010), limitations have been noted. HR monitors have been problematic when used with children as there is an invasive element to wearing the equipment, which are also not well adjusted to smaller bodies, meaning chest belts can lose contact with the body and the signal can be interrupted or lost (Fjørtoft et al., 2009), however, this can be overcome by adjusting HR belts to fit more securely. Additionally, it has been reported that HR monitors report elevated readings when participants display increased anxiety levels, therefore, using HR readings may not necessarily be an accurate reflection of PA intensity (Duncan et al., 2009b). Furthermore, it has been noted that HR is directly influenced by psychological/emotional and environmental factors i.e. temperature (Corder et al., 2008). Additional difficulties experienced with continuous monitoring protocols is that sedentary time and sleep can be hard to distinguish from one another, potentially leading to confounded associations for sedentariness (Collings et al., 2014). Another major limitation is PA lag which is a greater problem with children, given the sporadic nature of their play (Collins et al., 2015). While limitations of HR monitors have been noted, when participants are trained on how to apply HR monitors properly, they offer a practical, reliable and more objective reflection of children's PA when compared with self-report measures.

In order to overcome limitations associated with HR monitors, children were advised not to wear HR monitors when in bed/during sleep. Previous research has combined HR monitors alongside other measures, i.e. accelerometers and GPS, which uses trilateration (combining location, elevation and speed) and provides more accurate data with regards to HR intensities in different locations (Collins et al., 2012; van Remoortel et al., 2012; Collings et al., 2014). Additionally, fitness levels of participants affect HR (Fairclough and Stratton, 2005b), however, this limitation was overcome by calculating a heart rate reserve for each participant using the Karvonen method (Kenney et al., 2015). This allows the researcher to differentiate between the fitness levels of different children when setting the MVPA cut-points, offering a more personalised cut-point unlike other methods such as accelerometry (which applies the same generic cut-point to all). The individualised HR intensity classifications were then applied (Kenney et al., 2015), an approach applied in previous PA and free-living studies (Collings et al., 2014; Collins et al., 2015). The Karvonen method formula involves using maximum and resting recorded heart rates with the desired training intensity to establish a target HR. The formula: Target HR = [(max HR − resting HR) × %Intensity] + resting HR (Kenney et al., 2015), was utilised within each of the three studies within this thesis (see Chapters 4-6), and is discussed later in this section.

Previous literature identifies limitations of wearing PA/GPS monitor around the waist or on lanyards as this location has been identified as less accurate (Duncan and Mummery, 2007), as these locations have been relatively insensitive to upper body movement and primarily sensitive to capturing information related to walking (Webber and Porter, 2009), therefore in thesis Studies 1 and 2, GPS monitors were worn as wrist watches, as worn in previously published research (Fjortoft et al., 2010; Maddison et al., 2010; Collins et al., 2012). Participants received a tutorial on how to use and wear GPS watches and HR monitors, including written details of how to operate/charge the devices (see Appendix 5). Previous literature supports school-aged participants to take responsibility for charging their PA monitors (Maddison et al., 2010). Participants were asked to wear these devices over a four-day period, unless asleep, in water-based activities (i.e. swimming, bathing etc.), or when engaging in activities with significant risk of contact which could hurt the participant or damage the device.

The Garmin Forerunner 305 is able to record data in two settings, either at one second intervals or a 'smart' setting. It was decided to use the smart recording setting for the purpose of thesis studies as the GPS monitor would record data when there were significant changes in movements i.e. speed, direction, elevation, distance or HR intensity. The Garmin Forerunner 305 has a limited memory capacity, and using the one second interval setting would use the available memory without recording the data over the full four-day measurement period, which has been reported in previous literature (Chaix et al., 2014; Collins et al., 2015; Pearce et al., 2018). This therefore informed the use of the smart record setting.

When devices were returned after the four-day measurement period, GPS and HR data was downloaded from the Garmin training centre and Garmin Connect programs which stores each participants' data individually (Garmin Ltd., Olathe, KS, USA). To download the data, Garmin Connect and Express was utilised. Once GPS and HR data had been downloaded, a piece of software called GPS Utility was used to obtain GPS locations for each participant. These GPS location points then had to be entered manually into Google Maps to establish the location. An index of location was categorised as follows based on the most commonly visited locations in which participants spent time: 1) Home, 2) On foot, 3) Motorised transport, 4) School, 5) Outdoors, 6) Other indoor location, 7) Time outside (combining on foot and outdoors).

Data was then cleaned by analysing each participant's profile of data and removing time fields where GPS and HR data were missing. Previous research has used different amounts of GPS and HR data provided, for the data to be included in any analyses, which has varied from a minimum of 8 hours reported wear time (Van Kann et al., 2016), 3 hours reported wear time (Cooper et al., 2010b; Collins et al., 2012), to 1 hour reported wear time (Oreskovic et al., 2012). The minimum wear time of existing research differs according to the areas of investigation (Cooper et al., 2010b; Collins et al., 2012; Oreskovic et al., 2012). Within this thesis, HR data was separated from GPS data. This approach has previously been implemented when combining GPS and HR (Collins et al., 2015). In accordance with previous studies, a 1 hour minimum reported wear time was applied (Oreskovic et al., 2012), and this resulted in more participants' data being eligible for analysis. Children who had less than 1 hour of complete data per day had that particular day's data removed from the analysis.

Sedentary behaviour (SB), light physical activity (LPA), moderate physical activity (MPA) and vigorous physical activity (VPA) were used as the dependent PA variables throughout the investigation and PA intensity thresholds were established by calculating each child's HR reserve (HRR). The HRR is the difference between a participant's resting and maximum HR (Kenney et al., 2015), and within this thesis minimum and maximum HR was established from data reported from HR monitors. This was then used to inform participants' individual HR intensities. The Karvonen method of identifying percentage training intensities was applied. The PA percentage thresholds were labelled as follows: SB =0-29%, LPA = 30-49%, MPA = 50-74%, VPA = >75% (Kenney et al., 2015).

After establishing the percentage of children meeting the 60 minute daily recommended MVPA guidelines (Chief Medical Officers, 2019), further analysis of children's MVPA behaviour was categorised according to being active (≥60 minutes MVPA), minimally active (≥30<60 minutes MVPA), and inactive (<30 minutes MVPA) (Kesaniemi et al., 2010; World Health Organisation, 2011). These guidelines have been applied in previous research (Al-Nakeeb et al., 2012; Al-Nuaim et al., 2012).

For further details involving the procedure and usage of GPS and HR monitoring, please refer to Chapter 3.5.1 for studies 1 and 2, or Chapter 6 for Study 3. For information on the benefits and limitations of using GPS and heart-rate monitors, and how previous literature has utilised these tools, please see Chapter 2.7.1.

3.4.4 Self-reported physical activity: Daily physical activity diary

The daily PA diary which was used within this thesis was a modified version of an original 'PA Log' (Heyward, 2010). This method of data collection is less invasive when compared to other measures used within these studies, and participants were asked to complete these over the four-day period. An example of the current PA diary is provided in Appendix 5. The PA diary asked participants to complete four sections including; type of activity, intensity of activity, time spent on activity, and did you wear the GPS monitor? Additionally, to guide participants further, examples were provided on the 'type of activity' and 'intensity of activity' sections. Literature outlines the importance of asking participants whether GPS monitors (or any other activity tracking device) has been worn (Maddison et al., 2010). GPS and HR monitors used within this investigation were not suitable for water-based activities (i.e. swimming, bathing etc.) and some activities may request that devices are removed due to health and safety implications. Using a PA diary alongside other measures provided an opportunity for data to be cross-referenced, further supporting the validity between this subjective tool and other objective measures of PA (Bryman, 2012). Information on the strengths and limitations of using survey to measure PA, and how previous literature has utilised these, is provided in Chapter 2.7.2.

3.4.5 Qualitative data: Focus groups

The final method of data collection used was a series of focus groups. Previous literature supports the use of focus groups in exploring participants perceptions and experience (Bender and Ewbank, 1994), and allow participants to generate a discussion based upon the perceptions and experience of a specific topic (Bender and Ewbank, 1994). Focus groups are described as being 'a carefully planned discussion', designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment (Gibson, 2007). The objective of focus groups in thesis studies one and two were to explore the participants' perspectives on their motives and location for PA, and to identify the types of PA which were undertaken. Focus groups in study three aimed to evaluate the effectiveness of the PA intervention.

Within this thesis, a purposeful sample of between 5-8 children were invited to participate in each focus group. This sample size has been supported by previous literature (Bender and Ewbank, 1994; Kitzinger, 1995). These groups were formed according to school year (i.e. years 5 to 8) and gender in order to make children feel comfortable when providing responses, however, Study 3 (PA intervention) involved mixed gender focus-groups due to their evaluative nature. Focus groups took place in a school classroom during the school day based around the children's timetables, and they were recorded in MP3 format by the researcher. Focus groups were conducted at the end of quantitative data collection for Studies 1 and 3, but repeated three times, once each term for Study 2. Focus group questions were constructed in a deductive approach, as an indication of PA levels had been provided from the quantitative data which formulated a theory/hypothesis. Therefore, focus groups helped to explain the reasons behind children's PA behaviours (Study 1), their choice of PA location (Study 2), and to evaluate the effectiveness of the PA intervention from children's perspectives (Study 3). Additionally, focus groups helped to explore details of barriers and opportunities for PA and these second order themes allowed analysis for gender and age (Study 1), and PA differences across the academic school year (Study 2).

Focus group themes were formulated deductively and literature suggests deductive elements enable working propositions to be followed up and explored, allowing researchers to form broader conclusions (Jones, 2012). Therefore, there was a deductive element to this form of data collection as initial quantitative data had already been collected which provided a general insight of PA levels. Focus group data were transcribed and analysed according to a thematic approach which involves a process of data familiarisation, followed by categorising into a 'semantic/latent' code across the dataset (Smith et al., 2009). Qualitative analysis for Study 1 is provided in Chapter 4.3.4.2, Study 2 provided in Chapter 5.2.4.2, and Study 3 provided in Chapter 6.2.4.2.

The use of focus groups in research including information on strengths and limitations is provided in Chapter 2.7.3.

3.5 Research procedure

3.5.1 Studies 1 and 2

Children had an assigned week for their involvement in the research which was outlined as follows:

- Tuesday (Day 1) – Cardiovascular fitness test: Children completed a multistage fitness test in the school gym at the start of their lunch break.
- Wednesday (Day 2) – Anthropometric measurements and equipment distribution: Children had their standing and seated height, waist circumference and weight measured in a classroom. Following a tutorial of how to use and wear GPS and HR equipment, and how to complete the PA diary, children were handed their own pack (including wear and charging instructions) which was numbered for ease of monitoring and collection of equipment. Children were asked to take their packs home so the equipment could be worn on Thursday morning.

- Thursday – Sunday (Days 3-6): Children wore GPS watches and HR monitors daily over the four-day period (as soon as children woke up until going to bed). Children also completed PA diaries over this period. This four-day period enabled 2 weekdays to be compared with 2 weekend days, and has been supported by current literature (Cooper et al., 2010b; Collins et al., 2012).
- Monday – Equipment and PA diary return: Children returned GPS and HR equipment and PA diaries for equipment charging and data to be downloaded.

This process was completed for each of the six groups (the availability of HR and GPS equipment, combined with the given sample size required six groups), over the initial six-week period.

Following this, a selected sample of children took part in focus groups on a Tuesday or Wednesday lunchtime over the following three weeks, as quantitative data collection had been completed. There were six focus group sessions held in total. This procedure was repeated for each of the three data windows within studies 1 and 2. The three school terms used for Study 2 were categorised according to the relevant meteorological season, therefore term 1 was labelled as Autumn term (which included early winter), term 2 labelled as Spring term (which included late winter) and term 3 labelled as Summer term. Meteorological seasons were preferred over astronomical seasons as meteorological seasons are more consistent in season length. A more bespoke research procedure was implemented in Study 3, as outlined in Chapter 6.

3.6 Ethical Considerations

Prior to the commencement of the investigation, ethical approval from Newman University was obtained. In all cases within the investigation, participant numbers were assigned to protect anonymity within the children sample population and applied to school names (Deem et al., 1994; BERA, 2011). With regards to anthropometric measurements, and the use of GPS watches and chest straps, any potential safeguarding issues were addressed as follows: All children had anthropometric measurements taken in PE clothing, and were measured by a member of the research team who was of the same gender, and always in a room with other children and adults present. The standardised procedure for taking each anthropometric measurement was followed (see Chapter 3.4.1). A demonstration by members of the research team showed children how to wear HR chest straps and children were asked to apply/remove equipment in private. Therefore, the lead researcher and research assistants did not put HR chest straps on the children. GPS watches were checked to ensure they were functioning prior to distribution.

It is important to keep all participants briefed and up to date with the findings and progress of the research, therefore participants were fully briefed about the objectives of the research, who is conducting it and the reasons for carrying out the study. Written informed consent was obtained from participants, parents and the head teacher of the participating school (see Appendix 4). All were informed that they have the right to withdraw from the research at any time, without reason or consequence. Data was stored securely and confidentially on an encrypted USB stick belonging to the lead researcher, and this was accessed using a password protected user area of the university network. PA diaries and associated research paperwork was stored securely at the lead researcher's university institution. GPS tracking and HR data was collected retrospectively (not live), and was conducted only for times of analysis and this was kept securely and confidentially by the lead researcher. All collected data was only available to the lead researcher and the research team. The findings of the research were shared with participants, parents/guardian and the school head teacher in debriefing and feedback sessions at the school. Any breach of confidentiality was avoided by ensuring data collected was not shared verbally or visually through the data collection process, and school children and staff at the school assisting with the data collection were briefed on the importance of not sharing information and maintaining data confidentiality.

3.6.1 Insider research

As a member of staff at the school in which data was being collected, and as an insider researcher, consideration has gone into ensuring that professional relationships with children and staff are maintained throughout the period of the investigation. In addition to an insider researcher having intimate knowledge of the context of the school, both present and historical, they are also aware of the two separate lives that an organisation may have: formal and informal (Teusner, 2016). Advantages of being an insider researcher include access is more easily granted, data collection can be less time consuming with greater flexibility with regard to interview times (Mercer, 2007), and there may be no additional travel required (Robson, 2002), which were all applicable to the lead researcher within this thesis. However, it is suggested that the adoption of a reflexive approach to work are crucial aspects of work-based projects. Reflexivity is an important aspect of social research where the social scientist is to unmask social reality and its many inflections which are concealed by presumptions (Bourdieu, 1977). An important aspect to research is the ability of the researcher to identify, through reflexivity methods, the active role they play as part of the research project, which can shape the nature of the process and the knowledge produced from it (King and Horrocks, 2010). In the context of this thesis, a degree of personal knowledge of the setting and children were naturally inherited by the lead researcher, however a reflexive approach to data collection was adopted to avoid personal bias. This included consultation with the wider research team when arranging sample recruitment and grouping, and also discussing questions for focus groups amongst the research team to ensure questions were not leading, and were therefore appropriate to gather information related to specific research questions. Information collected through PA logs were shared and analysed with the research team, and a standardisation meeting with the research team took place prior to collection of anthropometric measurements.

Self-development as an insider requires a researcher to understand their professional self in relation to their personal self (Costley, 2010), and within this thesis careful planning, consideration and reflection went into ensuring the lead researcher’s teaching role did not influence their role as a researcher. These measures were applied as literature indicates that when a researcher conducts research within their place of employment, this will influence the approach and interpretation (Teusner, 2016). Throughout investigation within the thesis, it was acknowledged that a child’s participation would not have any impact on their academic performance and it was reinforced to children and parents/guardians that children were not obliged to take part in the study or provide information during the data collection process to eliminate coercion. Guidance outlined by the British Educational Research Association (BERA, 2011), were adhered to. Children, parents/guardians ('responsible others'), staff (including the head teacher) involved in the study had the right to express their views freely in all matters affecting them, and therefore were facilitated to provide full informed consent (BERA, 2011).

It was also considered that children may experience distress or discomfort in the research process and careful planning and training were in place to reduce/eliminate the sense of intrusion, or any emotional or other harm (BERA, 2011). The school in this context was the 'sponsor of research', and to reduce the danger of reciprocity, written agreements were in place to cover the purpose of the research, research methods, access to data/participants, data ownership and right to publish (BERA, 2011). Findings were shared with school staff and children following data analysis. School and participant information documents, and consent forms are provided in Appendix 4.

3.7 Conclusion

The purpose of this chapter was to outline the range of methods used for gathering data on health measures and PA behaviours, both cross-sectionally (comparing gender and age groups), and longitudinally, identifying reasons behind PA behaviours. The chapter also provides justification for the choice of measures, informed by the ontological and epistemological approach. The same procedures outlined for Study 1 are used in a repeated measures design for Study 2 involving health measures, GPS, HR monitors, PA diaries, and focus groups. However, the aims of these two studies differ accordingly. A more bespoke procedure involving HR monitors and focus groups, is outlined for the intervention (Study 3), which is provided in Chapter 6.

Chapter 4
Study 1: Physical activity and health status of children: a case study exploring gender and age differences

Chapter 4 - (Study 1) Physical activity and health status of children: a case study exploring gender and age differences

4.1 Study Overview

The primary objective of this chapter (Study 1) is to explore physical activity (PA) and health status of children in a cross-sectional case study approach, focusing specifically on the English Autumn school term (September 2014 to December 2014). The secondary objectives of this study are: 1) to explore how physically active children are, including exploring the reasons behind children's PA; 2) to assess weight status and cardiovascular fitness of children and to identify whether there are any associations between PA, weight status and cardiovascular fitness; and 3) to explore gender and age differences for each dependent variable. The study implemented a mixed-method design, and data were collected from children attending a Middle school based in the West Midlands, England, aged 9-13 years (*n*=119). The study comprised of two stages. Firstly, the quantitative stage involved children providing anthropometric and cardiovascular fitness data (*n*=109), which was followed by collecting HR data. A one-hour inclusion criteria was applied to children's HR data (meeting inclusion criteria: *n*=60). The second stage involved children engaging in focus groups (*n*=32), to share and discuss their experiences of PA. The findings are presented and discussed in this chapter. The outcomes of children's PA behaviour and fitness will then be developed further in a repeated measures design (Chapter 5, Study 2) to explore children's PA over the school year. The findings of both Studies 1 and 2 would inform the design of a PA intervention (Study 3), to increase children's moderate-vigorous physical activity (MVPA).

4.2 Introduction

As discussed in Chapter 2.1, there are numerous benefits for engaging in PA. Children and youth should accumulate at least 60 minutes of daily MVPA (Chief Medical Officers, 2019), and regular PA is associated with wide-ranging health benefits for children (Janssen and Leblanc, 2010; Biddle and Asare, 2011). Regular PA reduces the likelihood of the onset of non-communicable diseases, including obesity, type II diabetes and cardiovascular disease (Andersen et al., 2011; Hills et al., 2011). This is particularly important as children's PA behaviours and habits established in childhood track through to adolescence (Khodaverdi and Stodden, 2016). This is further supported as individuals who have a 30-year history of regular exercise are more likely to have skeletal muscle similar to young adults, rather than that of age-matched sedentary individuals (Fried, 2016). Five key benefits of engaging in 60 minutes of daily MVPA have been outlined: Improve cardiovascular health, maintain a healthy weight, improve bone health, improve self-confidence, and develop new social skills (Chief Medical Officers, 2019).

The association between physical fitness and health-related quality of life shows that cardiorespiratory fitness, muscular fitness, flexibility and body composition are positively associated with physical and mental function in school-aged children (Gu et al., 2016). This is further supported as moderate levels of PA, or high fitness levels have been associated with health benefits in children (Bermejo-Cantarero et al., 2017). When the health-related quality of life is decreased, a child is less likely to be able to develop and mature into a healthy adult (Bermejo-Cantarero et al., 2017). This would suggest that enhancing children's physical fitness can improve their health-related quality of life (Gu et al., 2016). When exploring the relationship between children's fitness, PA levels and weight status, research indicates that girls have greater cardiovascular fitness levels, but lower PA levels in comparison to boys (Gu et al., 2019). Additionally, children who demonstrated a healthy body weight had a greater cardiovascular fitness level than those with unhealthy weight (Gu et al., 2019).

Literature indicates that only 30-40% of youth are sufficiently active (Ekelund et al., 2011) and 51% of UK based children and young people complete their daily target of 60 minutes of MVPA (Griffiths et al., 2013; Fairclough et al., 2016). British children have reported spending a substantial percentage of leisure-time engaged in screen-based behaviours, with boys in more screen time than girls, (57% and 44.7% respectively) (Klitsie et al., 2013). With this common theme of reduced numbers of children and young people meeting the 60 minute MVPA recommended daily guidelines, the majority of children and young people are at risk from not experiencing the five key benefits of PA outlined by the Department of Health (2019) which are discussed earlier.

PA levels during the course of the week differ according to the time of day and gender, with boys reporting greater PA levels on the weekend, whereas girls reporting greater PA levels during the week (Brooke et al., 2016). This particular study revealed that the lunch-time period in school reported lowest levels of PA in comparison to other parts of the school day (Brooke et al., 2016). Additionally, several studies have shown that age-related changes in PA are not consistent for weekday and weekend days (Jago et al., 2017). Following the transition from primary to secondary school, previous studies report a decrease in weekend MVPA, and not in weekday MVPA (Corder et al., 2010). This supports the rationale for exploring PA differences between weekdays and weekends in a school context (Jago et al., 2017).

Children are more active than adolescents, however less than fifty percent of children and adolescents meet the recommended levels of PA (Van Hecke et al., 2016). Furthermore, literature indicates that the decline in PA begins from children at 7 years of age (Farooq et al., 2016). Within their study, there was no evidence to suggest that the decline in PA begins at adolescence, or that adolescent declines in PA were substantially greater than the declines during childhood, or greater in girls than boys (Farooq et al., 2016). This would therefore suggest that there is a need for research to explore children's patterns of PA behaviour further, particularly focusing on gender differences.

Children's stage of maturation has been discussed in relation to PA behaviours (Piola et al., 2019), with parental and social support being associated with PA for children in early stages of maturation, and positive reinforcement being associated with PA for children in later stages of maturation (Piola et al., 2019). More specifically, somatic maturation is used to evaluate biological development (Miranda et al., 2014). Further research indicates that maturational stage significantly affects physical ability and motor performance, and is dependent according to gender (Pinto et al., 2018). Additional literature suggests that children's engagement with PA remains consistent regardless of maturational stage (da Silva Oliveira et al., 2019). These findings highlight the different influential factors that affect children's PA according to stages of maturation, and justify the need for further investigation.

4.2.2 Study aims

This study aims to explore gender and age-related differences in PA levels within a school aged sample. The Middle school setting used within this study includes a sample from both key stage 2 (KS2) and key stage 3 (KS3). While the transition from primary to secondary school education (i.e., between KS2 and KS3) is as a key area of interest when monitoring PA among children in the UK (D'Haese et al., 2016), this study is of particular interest as it will explore children's PA when the children do not move from primary to secondary school, yet still enable the comparison between school Key Stages 2 and 3. The interaction between gender and age in relation to PA, and the association between PA and weight status will be explored. Research questions are as follows:

- What PA do children participate in, how much PA do they do, and why do children engage in PA?
- Does PA behaviour differ according to gender and key stage?
- Is there an association between PA, weight status and cardiovascular fitness?

4.3 Methods

4.3.1 Research design

A post-positivist critical realist epistemological stance is held within this study, where the children's reality will be investigated independently of the researcher's thoughts.

The mixed methods approach used to gather PA data, anthropometric data, and reasons behind children's PA, is an approach that is not commonly used within current research. Within the study, each of the methods adds strength, where quantitative research will link commonalities, trends and generalities, while the inductive logic of qualitative methods answers 'how' and 'why' questions (Jones, 2012). The explorative case-study approach of this study adopts a constructivist approach where there is a greater emphasis on gaining experience of children's PA behaviours. Further details of research design are provided in Chapter 3.2.

4.3.2 Participants

Consent was agreed from the head teacher of a Middle school in the West Midlands, United Kingdom (School data: 560 total children, 93 children from ethnic minority groups, 21% free school meals). One hundred and nineteen children (21% of the total school population, boys n = 57, girls n = 62) aged 9-13 years were recruited through convenience and purposive sampling and consented to participate in the study. Further information about the participant sampling procedure and breakdown according to age is provided within Chapter 3.3.

4.3.3 Measures and procedures

Following ethical approval from Newman University's Ethics Committee (see Appendix 6), the research procedure as outlined in Chapter 3.5.1, detailing information on the structure and activities involved on a weekly schedule was followed. Maturational stage was established for each of the children, using guidelines from current literature (Mirwald et al., 2002), to explore PA differences according to stage of maturation. By using the age of peak height velocity (PHV) as the maturational benchmark, each measurement occasion was described as years from PHV by subtracting the age of PHV from the chronological age at each measurement occasion. The difference in years was defined as a value of maturity offset. Details of the method and guidelines used to calculate peak height for stages of maturation are provided in Chapter 3.4.1.1. The research calendar which was planned and followed for all parts of data collection, including specific dates for each group, is provided in Appendix 7. Ethical considerations relating to the research procedure are provided in Chapter 3.6.

4.3.3.1 Cardiovascular fitness measures

The multistage fitness test (Leger and Lambert, 1982) was used as a measure of cardiovascular fitness and this has frequently been used in research to measure maximum oxygen uptake in children investigations (De Miguel-Etayo et al., 2014; Ferguson et al., 2014; Lang et al., 2016). During the multistage fitness test, data was recorded to the point that children could no longer keep pace with the timed bleep. At this point, the level achieved would be recorded. Further details of how the multistage fitness test was implemented within this thesis are provided in Chapter 3.4.2 (see Appendix 3 for guidelines).

4.3.3.2 Anthropometric measures

The details of how anthropometric measures were carried out are provided in Chapter 3.4.1.1. As previously discussed, standing height, seated height, weight measurements, and waist circumference measurements were recorded. A Seca portable height measure (Seca, Ltd., Hamburg, Germany) was used when taking standing and seated height measurements, and these recordings were to the nearest 0.5cm. When carrying out the height measurements (to calculate peak height for stage of somatic maturation, and waist-to-height ratio), the guidelines set by Williams (2009) and Simmons (2000) were followed (see Appendix 1). Seca weight scales (Seca, Ltd., Hamburg, Germany) were used to measure children’s weight, and these measurements were to the nearest 100 grams. A Seca tape measure was used to take measurements of waist circumference (to the nearest 0.5cm). The guidelines outlined by the International Society for the Advancement of Kinanthropometry (ISAK) were followed when measuring waist circumference (see Appendix 2). As mentioned in Chapter 3.4.1.1, height and weight measurements enabled BMI and iBMI scores to be calculated. Following the guidelines from the

International Obesity Task Force (IOTF), age and gender specific cut-off points were used to establish reflective BMI and iBMI scores. The cut-off points as used in previous literature were applied (Cole et al., 2000).

4.3.3.3 Heart-rate monitoring

HR was measured using a chest-worn HR monitor, which was synchronised wirelessly with a Garmin Forerunner 305 GPS device, both of which have been used in previous studies (Collins et al., 2012; Collins et al., 2015). Despite the Garmin Forerunner 305 being a GPS device, this study was only interested in using the HR data collected. These were worn from a Thursday morning until a Sunday evening (i.e. two weekdays and a full weekend's worth of data can be collected). Literature indicates that four days is an appropriate time scale to capture and measure typical levels of PA (Collings et al., 2014). Equipment was not worn in water-based activities (i.e. swimming, water polo etc). Children observed a tutorial of how the HR strap should be worn, which was demonstrated by the lead researcher and research assistant. This included details of how to moisten HR strap receptors to ensure connectivity, and how HR straps were to be worn across the chest level with the children's heart. Children were also shown how to tighten and loosen the strap accordingly. Children applied HR monitors either in the school changing room facilities, or at home prior to start of the school day. Children were shown how to check that GPS satellite signal and HR was received on worn watches. HR data was downloaded from the Garmin training centre and Garmin Connect programs which stores each participants' data individually (Garmin Ltd., Olathe, KS, USA). To download the data, Garmin Connect and Express was utilised, which allowed each participant's HR data to be analysed according to the different HR intensities. Further details of the use of HR monitors within this study are provided in Chapter 3.4.3, and children's instructions are provided in Appendix 5. Previous literature supports the feasibility of HR monitoring to measure HR in children (Cooper et al., 2010b; Maddison et al., 2010; Collins et al., 2012; Oreskovic et al., 2012; Moore et al., 2014).

4.3.3.4 Daily physical activity diary

Children also completed a PA diary which was a modified version of an original 'PA log' (Heyward, 2010) to provide a subjective record of PA (see appendix 5). This is a sheet designed to collect data hourly on the type of activity undertaken, the duration and the intensity of the activity, and whether the HR chest strap was worn (equipment was not waterproof and some activities i.e. swimming may have meant that children removed the equipment due to the nature of the water-based activity). Therefore, HR data that was not collected due to the removal of equipment, could still be captured as children completed PA diaries daily over the four-day measurement period. When HR data was provided, PA logs enabled a cross-referencing procedure to take place. Literature indicates the cross referencing process which compared this data with HR findings, ensures concurrent validity between measures of PA (Greene et al., 1989; Bryman, 2012). Further details of how the PA diary was utilised are provided in Chapter 3.4.5.

4.3.3.5 Focus groups

Focus groups were used to gain an understanding of reasons behind children's PA behaviours. As the research participants were children aged 9-13 years, it was felt that focus groups would form a less direct or intimidating approach to gathering information. It would also encourage all children, regardless of levels of confidence and shyness, to speak comfortably and openly if peers were present (Gibson, 2007; Gibson, 2012). Therefore, this took the form of a 'group activity' during which participants discussed PA behaviours with their peers according to key stage and gender (Focus group details are provided in Chapter 3.3), and the researcher facilitated this conversation, as opposed to conducting an interview. As mentioned in Chapter 3.4.6, the topics discussed during the focus groups were based upon either HR monitor data, or information provided in PA diaries. Therefore, there was a deductive insight into reasons for PA behaviours. Further information on how focus groups were implemented are provided in Chapter 3.4.6.

4.3.4 Data Analysis

4.3.4.1 Statistical Analysis

HR data was cleaned by analysing each child's profile of data, and removing time fields where HR data were missing, which may have been as a result of HR monitor straps slipping (poor connectivity), non-compliance from participants, or children not checking that HR signals were being detected. Any child who had less than one hour of complete data had their data removed from the study. This approach has been supported by previous literature (Oreskovic et al., 2012; Moore et al., 2014), and further discussion of minimum wear time is provided in Chapter 3.4.3. This one hour minimum wear time approach resulted in 60 children's (50.4% of total sample) datasets (35 boys, 25 girls) being included within the HR analysis, and 59 children's data (49.6% of total sample) being excluded. Anthropometric data were collected from one hundred and nine children (49 boys, 60 girls; KS2 = 66, KS3 = 43), which allowed for peak height, waist-to-height ratio (WHtR), BMI, and iBMI to be calculated. Descriptive statistics were provided from all analysed data. Further information about children's breakdown according to key stage and gender is provided within Chapter 4.3.1.

A Kolmogorov-Smirnov test of normality originally reported the data set not to be normally distributed (Sig. = .001), therefore a square root algorithm was used to ensure data were normally distributed (Sig. = .2). A range of statistical procedures were carried out to explore PA behaviours and weight status in relation to gender and age differences. Independent samples t-tests were used to investigate gender and age differences in relation to MVPA. Whilst conducting the analysis, the data was weighted according to the total number of valid days for which individual data was provided as, due to compliance related issues, there were differing numbers of days collected from the children, and this method has been adopted previously (Collins et al., 2012). This approach provided a dataset more reflective of children' mean daily PA levels. However, despite this, there were no differences in the number of statistically significant findings between the two datasets (weighted and unweighted), and therefore the original (unweighted) dataset was utilised for analysis.

Pearson's product moment correlations were used to establish relationships between daily MVPA and health measures (cardiovascular fitness, waist circumference, BMI, iBMI and peak height), and daily MVPA and location. A two-tailed significance value of $p < 0.05$ was considered as being significant in all statistical analysis, and this has been applied in previous research (Collins et al., 2012; Collins et al., 2015). Descriptive statistics were provided for the analyses, including mean measures of anthropometric scores, cardiovascular fitness, mean time spent in different HR intensities, and reports of meeting recommended daily PA guidelines. These could then be further analysed according to age and gender. The process of extracting raw HR data, including details of the applied heart-rate reserve, and HR intensity categories is provided in Chapter 3.4.3. All statistical analyses were conducted using SPSS version 22.

HR data was collected over a four-day period with weekdays 1 and 2 being school based days (Thursday and Friday) of each respective week. Children's HR could therefore be analysed according to each 'segment' of the school day. The school day was segmented into 3 time periods: free time including before school, after school and morning break-time; lesson time including any time spent in taught curricular lessons, assemblies and registration periods; lunch-time which included the lunch-break period in between curricular lessons.

The PA diary was used to identify the types of PA children took part in, and investigate periods where HR data was not reported. It was also used to cross reference the times of PA reported from the HR equipment as this supported the concurrent validity between these measures, which is previously supported (Greene et al., 1989; Bryman, 2012).

4.3.4.2 Qualitative Analysis

Focus group data was transcribed verbatim and a thematic analysis was undertaken to explore and develop an insight into the PA experiences of the children (Jones, 2012; Flick, 2018). The process of thematic analysis is provided in Chapter 3.4.6. This analysis allowed investigation into potential reasons/motives for physical activity which included identifying barriers and facilitators to children's physical activity (Moore et al., 2014). As discussed in Chapter 2.7.3, focus groups have been identified as being a popular method of qualitative data collection with children (Gibson, 2007).

4.4 Results

The following results section has been broken down into subsections to address the research aims outlined in Chapter 4.2.2. This will explore BMI, iBMI, waist circumference, cardiovascular fitness, PA levels between gender and key stage, and motives for PA.

4.4.1 Children meeting the inclusion criteria for heart rate (HR) analysis, and stages of maturation

From the original 119 children recruited for the study, 60 children's data met the minimum one hour HR requirements (50.4% of total study sample, 11% of the total school population), and therefore analysis was conducted on these datasets. A breakdown of children meeting this criteria according to gender and key stage is provided in Table 4.1. KS2 children comprise of children in either years 5 or 6 (aged 9-11), and KS3 children comprise of children in either years 7 or 8 (aged 11-13). From the total number of children who provided data for analysis, the average number of days that HR devices were worn was 2 days (± 1) over the four-day period, averaging 10.6 hours (± 7.2) per child.

Peak height data was used to establish stages of maturation, and these were classified as being 'early' (further developed), 'average' (average stage of maturation), and 'late' (less developed stages of maturation). Results showed that all 29 boys (100%) were classified as being in the 'average' stages of maturation. Comparatively, 18 girls (58.1%) were in the 'early' stage of maturation, and 13 girls (41.9%) were in the 'average' stage of maturation. No children were reported as being in the 'late' phase of maturation. Details of the method and guidelines used to calculate peak height for stages of maturation are provided in chapters 3.4.1.1.

Table 4. 1 Number of children reporting a minimum of 60 minutes complete HR data according to key stage and gender.

Variable	KS2	KS3	Total
Boys	20	9	29
Girls	15	16	31
Total	35	25	60

4.4.2 Children's weight status, waist circumference and cardiovascular fitness

One hundred and nine children (20% of the total school population) provided BMI and cardiovascular fitness data (49 boys, 60 girls; KS2 = 66, KS3 = 43). Current literature has advised the use of specific age and gender related BMI cut off points to provide a more reflective interpretation when calculating weight status (Cole et al., 2000), therefore, these advised cut off points were applied to this dataset. Ten children (9.3%) were classified as underweight, sixty children (55%) were classified as healthy weight, twenty five children (22.9%) classified as overweight, and fourteen children (12.8%) classified as being in the category 1 obese. No significant differences for weight status were found between genders, key stages, or stages of maturation (all $p > 0.05$).

An independent samples t-test revealed KS3 children to have significantly higher BMI scores in comparison to KS2 children ($p < 0.01$, KS2 = 17.7 ± 3.4, KS3 = 20.5 ±

4.2). However, when categorised according to weight status, findings showed no statistical significance (*p* >0.05).

There were no significant differences when exploring BMI according to, gender and maturational stage (*p* >0.05). A breakdown of children's weight status according to gender, key stage, gender within key stage, and maturational stage is provided in Table 4.2. No significant differences for iBMI were found between genders, key stages, or stages of maturation (all *p* >0.05). Details of BMI and iBMI including the formula used for each are provided in Chapter 3.4.1.

When exploring waist circumference, an independent t-test revealed that there was a significant difference between stages of maturation (F = 4.963, t = 2.579, df = 108, sig = .011). Children in the early stage of maturation showed mean measurements of 70.8cm (±10.6), and those in the average stage of maturation showed 64.8cm (±7.5). This indicates that children who were further developed according to maturational stage for their age group, had larger waist circumference measurements. Significant findings were revealed when investigating key stage differences (F = 4.857, t = -3.472, df =108, sig = .001). KS2 children had a mean waist circumference of 66.9cm (±8.7), and KS3 children had a circumference of 73.6cm (±11.3), which is explained by the larger size of KS3 children in comparison to KS2. Finally, a significant difference was according to gender (F = 2.475, t = 2.486, df =108, sig = .014), with boys having a greater mean waist circumference (72.2cm ±8.7), than girls (67.4cm ±11). As outlined in Chapter 3.4.1, WHtR was calculated to provide an indication of children's risk of obesity-related disease (Ashwell et al., 2012). No statistically significant findings were revealed (*p* > 0.05), however sixty-five children (59.6%) were classified as being 'low risk', and forty-four children (40.4%) were classified as being 'at risk' of an obesity-related disease.

A significant relationship was revealed between WHtR and BMI ($p<0.00$). Descriptives show the number of children identified as overweight/obese (combined) according BMI, to be similar to the number of children 'at risk' according to WHtR (BMI: Overweight/obese = 34.8%, WHtR: 'at risk' = 39.3%).

When exploring cardiovascular fitness, no significant results were found according to gender, key stage or maturational stage. However, a Pearson correlation revealed a positive relationship between cardiovascular fitness and iBMI, indicating that those reporting higher multi-stage fitness test scores had a higher iBMI ($r = .307$, $p = .027$).

Table 4. 2 BMI classifications according to age and gender specific cut-off points (Cole et al., 2000).

Variable	BMI Classification							
	Underweight		Healthy		Overweight		Obese Class 1	
	N	%	N	%	N	%	N	%
	KS2 (9-11 years)							
Boys	3	8.3%	21	58.3%	6	16.7%	6	16.7%
Girls	4	13.3%	19	63.3%	5	16.7%	2	6.7%
Total	7	10.6%	40	60.6%	11	16.7%	8	12.1%
	KS3 (11-13 years)							
Boys	1	7.7%	7	53.8%	3	23.1%	2	15.4%
Girls	2	6.7%	13	43.3%	11	36.7%	4	13.3%
Total	3	7%	20	46.4%	14	32.6%	6	14%
	Gender							
Boys	4	3.7%	28	25.7%	9	8.3%	8	7.3%
Girls	6	5.5%	32	29.4%	16	14.7%	6	5.5%
	Maturational Stage							
Early	6	6.9%	50	57.5%	17	19.5%	14	16.1%

Average	4	18.2%	10	45.4%	8	36.4%	0	
Overall	10	9.3%	60	55%	25	22.9%	14	12.8%

4.4.3 Device wear time and moderate-vigorous physical activity
Investigation into any potential impact device wear time had on MVPA was carried out. Results revealed positive relationships when exploring weekday 1 and 2 (Thursday and Friday), and weekend day 1 and 2 (Saturday and Sunday) total device wear time with MVPA (weekday 1: $r = .354$, $p = .007$; weekday 2: $r = .439$, $p = .001$; weekend day 1: $r = .550$, $p = .000$; weekend day 2: $r = .848$, $p = .000$). This suggests that there was an association between device wear time and MVPA, indicating that children who wore HR monitors for a greater duration engaged in greater MVPA. However, weekend day 2 (Sunday) revealed a lower number of children engaging in MVPA ($n = 4$) for this specific day, and shows fewer children within this school engaged in MVPA on Sunday. To further support this, a positive correlation ($r = 0.322$, $p = .016$) was found between mean wear time (over the four-day period) and MVPA time reported. This further supports that children who wore devices for greater durations, engaged in statistically greater amounts of MVPA. Additionally, similar findings were reported when exploring wear time and maximum HR ($r = .356$, $p = .007$). This suggests that a higher maximum HR was also associated with greater device wear time.

A significant difference was revealed when exploring device wear time and children meeting daily 60 minute MVPA guidelines (Chief Medical Officers, 2019), and this revealed that children who wore equipment for longer durations met these guidelines (Meeting: $n = 23$, mean wear time 776.4 mins; Not meeting: $n = 33$, mean wear time 537.3 mins; $t_{54} = 2.091$, $p = 0.041$).

4.4.4 Physical activity intensities
Analysis was conducted on the HR datasets provided by the 60 children. 31 children (52%) met the 60 minute PA guidelines, and 29 children (48%) did not meet the daily 60 minute MVPA guidelines (Chief Medical Officers, 2019).

When exploring daily mean MVPA minutes, and percentage of MVPA time, no statistically significant results were found between genders, maturational stages or key stage, however, descriptives indicated that KS3 children spent 26.9 minutes (2.3%) longer in MVPA than KS2 children (see Figure 4.1). Additionally, girls demonstrated 38.4 minutes more mean daily MVPA (7.1%) than boys (see Figure 4.2). After investigating gender differences according to key stages, MVPA was similar between KS2 boys and KS2 girls, however, descriptives indicated KS3 girls engaged in more MVPA than KS3 boys (KS3 boys = 9.6%, KS3 girls = 24%, see Figure 4.3). Children in average stages of maturation engaged in 44.1 minutes more mean daily MVPA (6.5%) than those in early stages of maturation.

The percentage of sedentary behaviour (SB) was similar across genders, key stage and maturational stage, and light physical activity (LPA) was similar between key stages and maturational stages (KS2 = 36.5%, KS3 = 36.4% ; Early = 36.7%, Average = 35.6%). However, descriptives show boys spent a higher proportion of their time in LPA (39.6%) compared to girls (33.6%). Further gender differences revealed girls to engage in more moderate physical activity (MPA) (17.9%) than boys (11.7%). Older children engaged in more MPA time than younger children (KS2 = 14%, KS3 = 16.2%), and children in an average stage of maturation engaged in 37.3 minutes more mean daily MPA (5.3%) than those in an early stage of maturation. Vigorous physical activity (VPA) was similar across both genders and key stages, and stages of maturation.

When exploring data for gender by key stage differences, statistically significant results were revealed for mean daily sedentary time between KS3 boys and KS3 girls (p=0.016; KS3 boys = 260.9 mins, KS3 girls = 153 mins; [CI = 22.4:193.5], large effect size: d=1.04, see Figure 4.4). Percentage of SB descriptives also support this finding (KS3 boys = 57.1%, KS3 girls = 37.2%. Descriptives indicated KS2 girls were more sedentary than KS2 boys (KS2 boys = 40.5%, KS2 girls = 53.9%). Descriptives also show KS2 boys engaged in a higher percentage of LPA compared with KS2 girls

(KS2 boys = 42.6%, KS2 girls = 28.4%), however, this pattern was reversed at KS3 with KS3 girls engaging in more LPA than KS3 boys (KS3 boys = 32.9%, KS3 girls = 38.4%). MPA was similar between KS2 boys and girls, however descriptives indicate KS3 girls engaged in more MPA than KS3 boys (KS3 boys = 7.3%, KS3 girls = 21.2%). VPA was similar between boys and girls in KS2, and boys and girls in KS3.

Children's MVPA behaviour was categorised according to being active (≥60 minutes MVPA), minimally active (≥30<60 minutes MVPA), and inactive (<30 minutes MVPA) (Kesaniemi et al., 2010; World Health Organisation, 2011). A Chi-squared analysis revealed no significant findings in the numbers of children in each category according to gender, key stage and maturational stage (p>.05). Details of children's HR intensities and numbers meeting PA guidelines is provided in Table 4.3, and maturational stage details are provided in Table 4.4 (Figures are provided in Appendix 8).

Table 4. 3 Children meeting PA guidelines, mean daily time and percentage of total time spent in different HR intensities.

Variable	Sedentary (mins) Percentage sedentary time (%)	Light (mins) Percentage light time (%)	Moderate (mins) Percentage moderate time (%)	Vigorous (mins) Percentage vigorous time (%)	MVPA (mins) Percentage MVPA time (%)	Meeting PA guidelines	
						No. children	Percent of children (%)
			KS2 (9-11 years)				
Boys	183.6 (±119.6)	204.1 (±143.3)	59.3 (±53.8)	13.3 (±14.2)	72.6 (±63.5)	11	35
	40.5% (±24.1%)	42.6% (±20.1%)	13.6% (±10.9%)	2.8% (±2.8%)	15.7% (±12.1%)		
Girls	259.2 (±163.6)	155.2 (±148.3)	70.1 (±73.8)	13.1 (±23.1)	83.3 (±85.5)	7	23
	53.9% (±30.1%)	28.4% (±24.4%)	14.4% (±14.7%)	3.1% (±6.2%)	17.6% (±17.8%)		
Total	216 (±143)	183.1 (±145.4)	64 (±62.4)	13.2 (±18.2)	77.2 (±72.7)	18	58
	46.2% (±27.3%)	36.5% (±23%)	14% (±12.5%)	2.9% (±4.5%)	16.5% (±14.6%)		
			KS3 (11-13 years)				
Boys	260.9 (±117.5)*	193.7 (±160.3)	41.9 (±51.6)	17.6 (±39)	59.5 (±67.3)	5	16
	57.1% (±25.6%)	32.9% (±18.2%)	7.3% (±7.4%)	2.7% (±4.8%)	9.6% (±8.5%)		
Girls	153 (±87.9)*	189.5 (±140.7)	112.3 (±124.4)	16.8 (±36.5)	129.1 (±140.5)	8	26

	37.2% (±26%)	38.4% (±21.3%)	21.2% (±23.1%)	3.2% (±6.6%)	24% (±25.6%)		
Total	191.8 (±110.6)	191 (±144.7)	87 (±108.4)	17.1 (±36.6)	104 (±122.5)	13	42
	44.4% (±27.2%)	36.4% (±20%)	16.2% (±20%)	3% (±6%)	18.8% (±21.9%)		
Gender							
Boys	207.6 (±122.4)	200.9 (±146)	53.9 (±52.9)	14.6 (±24)	68.6 (±63.8)	16	52
	45.7% (±25.4%)	39.6% (±19.8%)	11.7% (±10.2%)	2.8% (±3.5%)	13.8% (±11.2%)		
Girls	204.4 (±138.8)	172.9 (±143.1)	91.9 (±103.6)	15 (±30.3)	106.9 (±117.5)	15	48
	45.3% (±28.9%)	33.6% (±23%)	17.9% (±19.5%)	3.1% (±6.4%)	20.9% (±22%)		
Maturational Stage							
Early	205.9 (±125.4)	186.2 (±152.2)	65.5 (±83)	13.4 (±22.8)	78.8 (±91.2)	23	74
	46.5% (±27.6%)	36.7% (±22.6%)	13.8% (±16.1%)	2.7% (±4.4%)	16.1% (±17.4%)		
Average	205.9 (±151.2)	187.1 (±114.1)	102.7 (±87.1)	20.2 (±40.1)	122.9 (±111)	8	26
	41.5% (±25.4%)	35.6% (±17.9%)	19.1% (±15%)	3.8% (±7.5%)	22.6% (±19.4%)		
Overall	205.9 (±130)	186.4 (±143.9)	73.5 (±84.6)	14.8 (±27.2)	88.4 (±96.6)	31	100
	45.5% (±27%)	36.5% (±21.6%)	14.9% (±15.9%)	2.9% (±5.2%)	17.5% (±17.9%)		

*Statistically significant difference between gender, key stage, gender within key stage, and maturational stage (p <0.05).

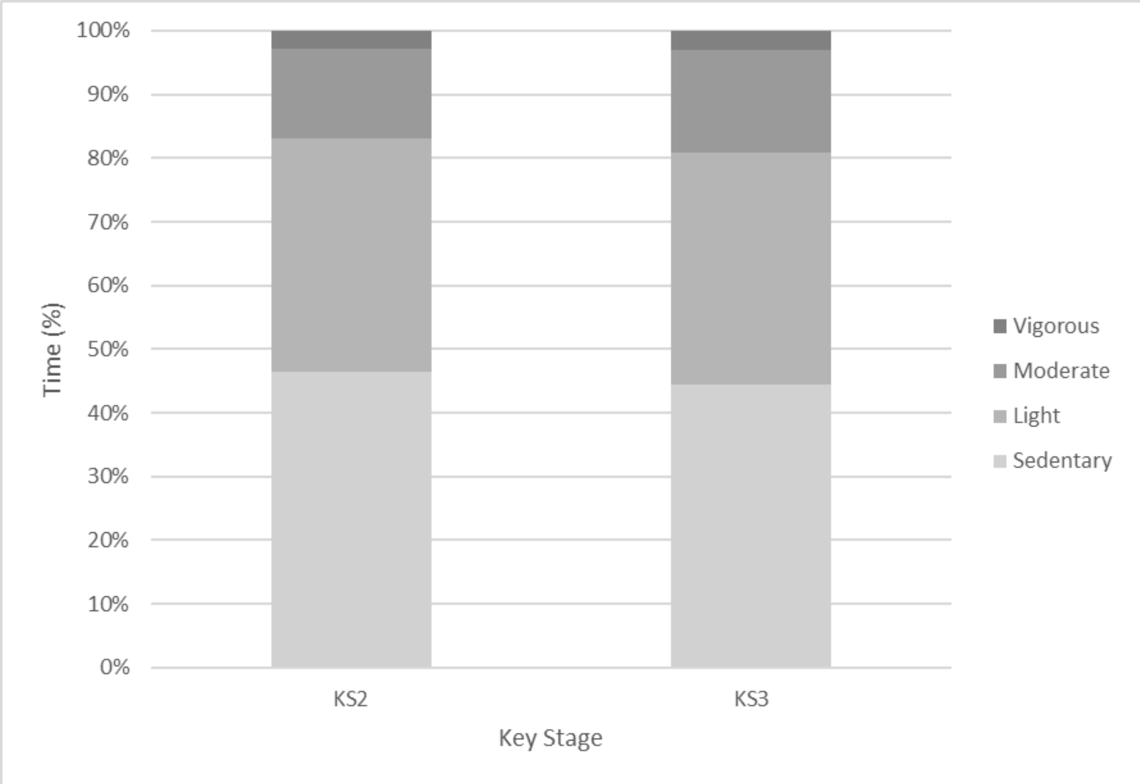


Figure 4. 1 Percentage time of HR intensity according to key stage.

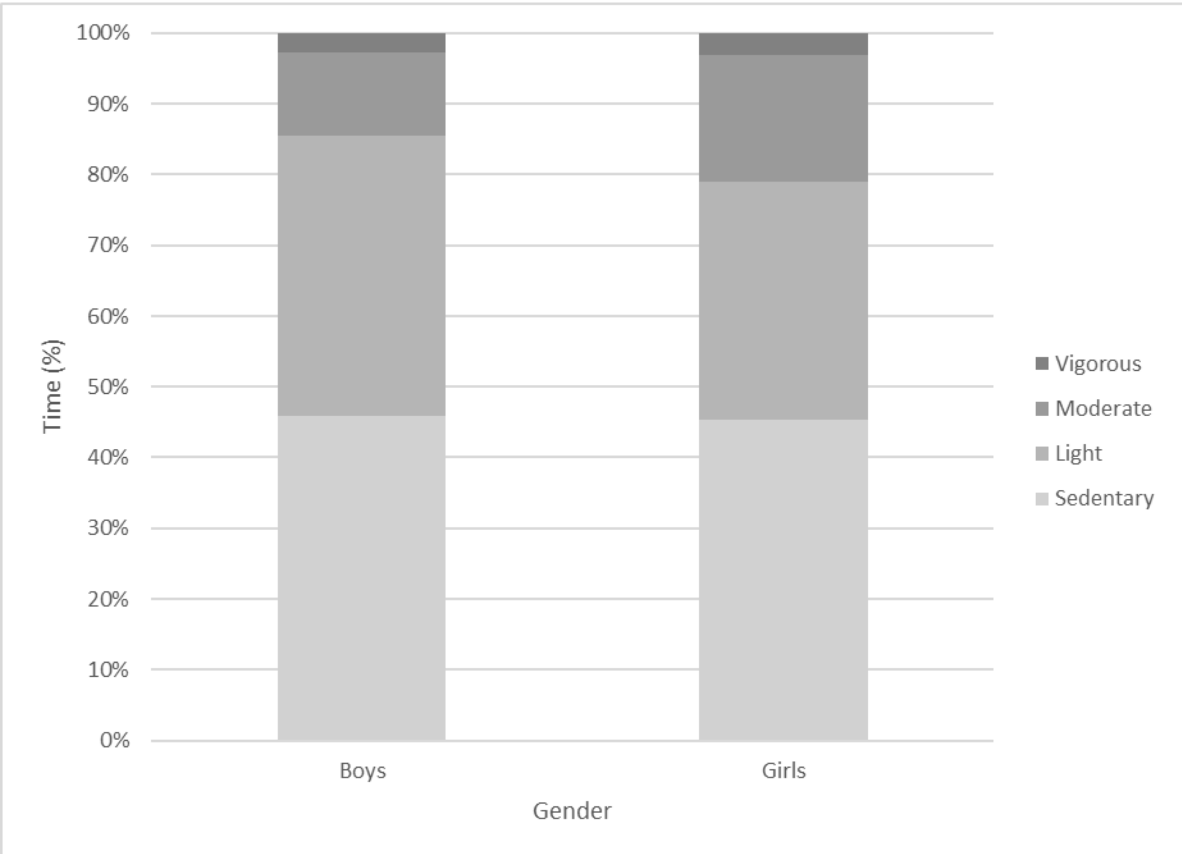


Figure 4. 2 Percentage time of HR intensity according to gender.

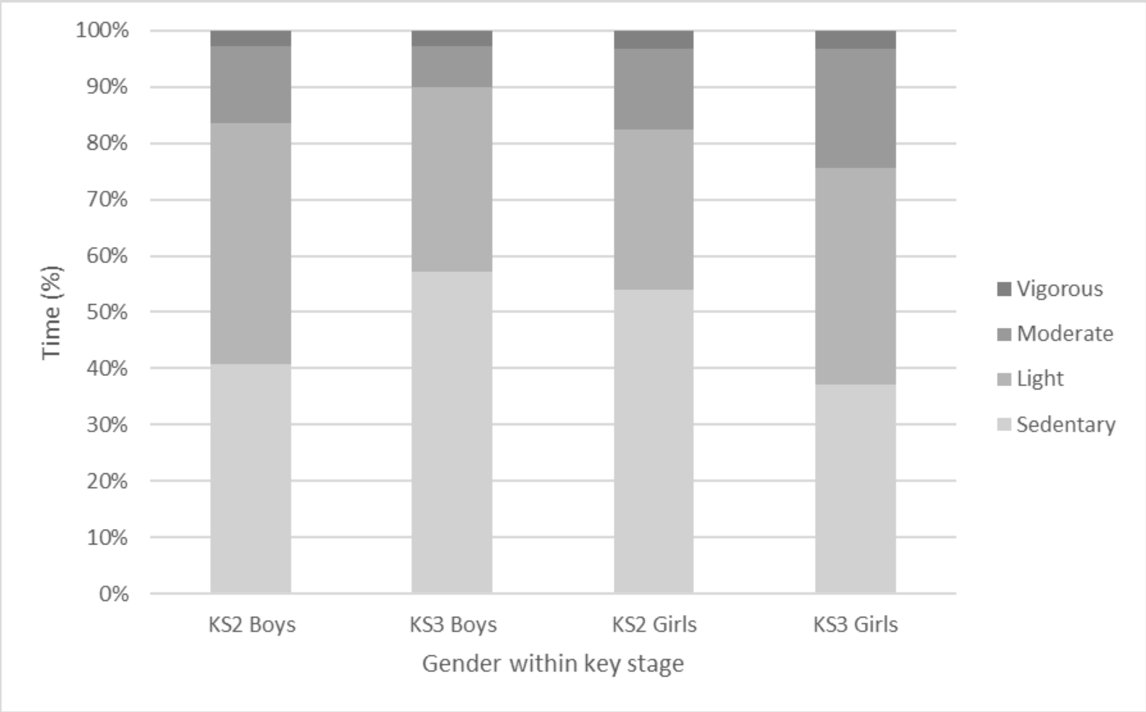


Figure 4. 3 Percentage time of HR intensity according to gender within key stage.

Figure 4. 4 Sedentary time interaction according to key stage and gender.

Table 4. 4 Percentage of children according to PA categories.

	PA category (%)		
Variable	Inactive	Minimally active	Active
	KS2 (9-11 years)		
Boys	30%	10%	60%
Girls	26.7%	26.7%	46.7%
Total	28.6%	17.1%	54.3%
	KS3 (11-13 years)		
Boys	33.3%	33.3%	33.3%
Girls	25%	25%	50%
Total	28%	28%	44%
	Gender		
Boys	31%	17.2%	51.7%
Girls	25.8%	25.8%	48.4%
	Maturational Stage		
Early	29.8%	23.4%	46.8%

Average	23.1%	15.4%	61.5%
Overall	28.3%	21.7%	50%

4.4.5 Weekday vs Weekend physical activity

A paired t-test revealed a significant difference in the amount of time spent in MVPA between weekdays and weekends ($t = 4.917$, $df = 55$, sig = .00). Children spent 88.3 (±95.7) minutes in weekday MVPA, in comparison to 21 (±74.5) minutes on weekends. When exploring gender differences for mean MVPA time spent during weekday and weekend, no significant differences were revealed (weekday MVPA: $t = 1.44$, $df = 54$, sig = .157; weekend MVPA: $t = .438$, $df = 54$, sig = .663). Boys spent a mean of 105.8 minutes (±112.5) in MVPA during weekdays, and 25.2 minutes (±89.3) on weekends, and girls' mean MVPA was 69.4 minutes (±70.9) during weekdays, and 16.4 minutes (±55.8) on weekends. This suggests that both boys and girls engaged in greater MVPA during weekdays compared with weekends.

When exploring any differences between key stages for mean time spent in MVPA during weekdays and weekends, no significant differences were found (weekday MVPA: $t = .545$, $df = 54$, sig = .588; weekend MVPA: $t = .780$, $df = 54$, sig = .439). KS2 children spent a mean of 93.7 minutes (±100.5) in MVPA during weekdays and 27 minutes (±88.3) on weekends. KS3 children spent a mean of 79.2 minutes (±88.7) in MVPA during weekdays, and 10.9 minutes (±43) on weekends. The descriptives suggest that both KS2 and KS3 children engaged in greater MVPA during weekdays compared with weekends.

Analysis exploring differences between maturational stage for both weekday and weekend mean MVPA time, showed no significant differences (weekday MVPA: $t = .441$, $df = 53$, sig = .661; weekend MVPA: $t = -.140$, $df = 53$, sig = .889). 'Early' maturational stage children spent a mean of 92.4 minutes (±105.6) in MVPA during weekdays, and 20.3 minutes (±80.5) on weekends. 'Average' maturational stage children spent a mean of 80.2 minutes (±78.5) in MVPA during weekdays, and 23.3 minutes (±65.8) on weekends. Therefore, children in both early and average maturational stages take part in greater MVPA during weekdays compared with weekends.

As the duration of HR equipment wear time differed, the percentage of MVPA time according to weekday and weekend was calculated to provide a more reflective representation of MVPA behaviour, which revealed no statistically significant findings. Exploring percentage MVPA time revealed that children spent 19.1% (± 17.9) in weekday MVPA, in comparison to 19.9% (± 27.1) on weekends. Despite no significant findings being revealed, the gender pattern shows boys to engage in greater percentage MVPA during weekends, whereas girls appear to engage in more percentage MVPA on weekdays. Boys spent 15% (± 11.7) in MVPA during weekdays, and 17.9% (± 22.6) on weekends. Girls spent 24.3% (±23.1) in MVPA during weekdays, and 22.4% (±32.7) on weekends.

There were no statistically significant findings when exploring percentage MVPA according to key stage. KS2 engaged in 18.3% (±13.1) during weekdays and 20.6% (±23.4) on weekends. KS3 children spent 20.1% (±22.6) MVPA on weekdays, and 19.2% (±31.6) on weekends. This suggests that KS2 children engaged in more MVPA on weekends, whereas KS3 children's MVPA was similar between weekdays and weekends.

Finally, when investigating MVPA according to maturational stage, no statistically significant findings were revealed. Children in 'early' stages engaged in 18.5% (±18.7) during weekdays and 22.7% (±28.5) on weekends. Children in the 'average' stage spent 22.9% (±14) MVPA on weekdays, and 4.2% (±5.3) on weekends. This suggests that those in earlier stages of maturation engaged in more MVPA on weekends, whereas those who were in the average stage of maturation engaged in more MVPA on weekdays.

4.4.6 Physical activity at different times during the school day

When analysing PA according to the different segments of the school day, percentage of MVPA time per segment was explored i.e. percentage MVPA in free time, school lesson time, and lunchtime. Repeated Measures test results showed no statistically significant findings. However, descriptives showed children at lunchtime to engage in less percentage MVPA time (8.6% ± 14.5%) compared with free time (20% ± 19%), and school lesson time (18.4% ± 14.8%). Similar patterns were found when exploring PA during the segmented day according to gender, key stage and maturational stage with exception to KS3 girls who did not engage in MVPA during school lesson time (segmented day results are presented in Table 4.5).

Table 4. 5 Percentage of MVPA in each segment of school day according to gender, key stage, gender within key stage, and maturational stage.

	MVPA (%)		
Independent Variable	Free time	School lesson time	Lunchtime
	KS2 (9-11 years)		
Boys	17.8% (±14.4%)	17.5% (±16.8%)	8.7% (±17.2%)
Girls	12.5% (±12.5%)	14.3% (±6.3%)	11.4% (±16.1%)
Total	14.7% (±13.1%)	16.6% (±14.5%)	9.9% (±16.2%)
	KS3 (11-13 years)		
Boys	39.6% (±24.2%)	31.2% (±11.3%)	3.8% (±6.6%)
Girls	26.5% (±26.3%)	0	7.6% (±13.1%)
Total	31.4% (±24.7%)	31.2% (±11.3%)	6.5% (±11.3%)
	Gender		
Boys	24.3% (±19.5%)	19.8% (±16.6%)	7.4% (±15.1%)
Girls	17.2% (±18.6%)	14.3% (±6.3%)	9.6% (±14.4%)
	Maturational Stage		

Early	21.3% (±18%)	19.3% (±15.6%)	6.7% (±13.7%)
Average	18.2% (±21%)	12.7% (±3.5%)	12% (±16%)
Overall	20% (±19%)	18.4% (±14.8%)	8.6% (±14.5%)

4.4.7 Types of physical activity behaviour

Eighty children returned daily PA diaries (boys = 32, girls = 48, KS2 = 41, KS3 = 39) which provided data on children's PA when they were not wearing the HR chest straps and GPS watches, or when no connectivity was reported due to movement of the HR sensors. Using a PA diary alongside other measures provides an opportunity for data to be cross-referenced, further supporting the validity between this objective tool and other objective measures of PA (Bryman, 2012).

Four children reported removing the HR equipment when participating in swimming activities. The intensity description of the swimming activity varied between children finding it 'tiring', 'very tiring' and 'tough'. These children reported a duration of between 1-3 hours respectively.

PA diaries also indicated that three children did not wear HR/GPS equipment during football activities. This was further explained as children were competing in matches and officials advised against wearing the equipment. There was a separate incident where a coach 'wouldn't allow' the equipment in the specific training session, and one further episode where a child wore the equipment but forgot to switch it on. Children involved in football activities played for between 1-4 hours and described the intensity as either 'tiring' or 'easy'.

Three children removed HR/GPS equipment when engaging in skating activities. The duration of this PA was reported as 2 hours for each child, and was described as either 'easy' or 'tiring'. Other activities children removed HR/GPS equipment for were gymnastics, taekwondo and wrestling. These activities took place for 1-2 hours and children described these as either 'hard' or 'tiring'. There were some instances where children removed equipment for reasons not directly relating to PA, for example, two children removed equipment when attending a party for 4 hours, which was 'fun' or ‘easy’. Other examples involved children helping with ‘challenging’ household tasks, caring for pets, and equipment losing connectivity/signal whilst on a family holiday.

4.4.8 Reasons for physical activity behaviour

The Social-Ecological Model was used as a framework to underpin questions/topics for discussion in the focus groups. As a consequence of this, the majority of key emerging themes could be categorised according to the components of the Social-Ecological Model (McLeroy et al., 1988) (see Table 4.6).

Table 4. 6 Focus group themes categorised according to the components of the Social-Ecological environment.

Individual	**Interpersonal**	**Organisational**	**Community/Policy**	**Other**
Fun/Enjoyment	Friends and Family	Location/Environment	Rewards	Weather
Unhealthy Diet	Socialise	Club	Promotion	Technology
Time		Facilities	Children’s Voice	
Fitness/Health			Awareness	
Equipment cost				

During the focus groups, children described PA behaviours and how these changed according to school term and weather. Furthermore, focus groups also allowed children to discuss different reasons, barriers and facilitators for PA behaviour. This provided greater context and meaning behind PA behaviours, and the researcher was able to gain a deeper, more accurate articulation of children's thoughts of barriers and facilitators for PA, which further supported the quantitative data.

Thematic analysis enabled children's PA behaviour to be explored further. The components of the Social-Ecological Model (McLeroy et al., 1988) provided first order themes for the focus group transcripts to be analysed. Second order themes could then be categorised according to barriers to, or facilitators for PA. Boys and girls in both key stages reported similar barriers and facilitators within their discussions. Themes and raw data that contributed to focus groups are provided below and represented in Table 4.7. Focus group transcripts are provided in Appendix 9.

Table 4. 7 A summary of themes and examples of raw data extracts for barriers to and facilitators for PA.

	Selected quotes from children	
	Barriers to PA	**Facilitators for PA**
Individual		
Fun/Enjoyment	*"They might not like it, so they might not want to do it."* (KS2 Boy)	*"I do it because I like dancing and it just makes me happy"* (KS3 Girl)
Time	*"If I have too much homework, exams and stuff."* (KS3 Girl)	*"…however long you do on a physical activity, you get half that time on technology or something like that"* (KS3 Boy)
Fitness/Health	*"If you're ill"* (KS3 Boy)	*"I don't want to be all weaker when I'm older, I want to stay healthy"* (KS2 Girl)
Equipment cost	*"…if they don't have like the right equipment to do it."* (KS2 Girl)	*"Maybe lower the price a little bit so that people don't have to wait loads to save up"* (KS2 Girl)
Interpersonal		
Friends and family	*"Might have to look after their family and it might stops you [sic] having their social time with their friends and going out"* (KS3 Girl)	*"I do runs with my dad, I go on my bike"* (KS3 Boy)
Socialise	*"…sometimes some of the people might have other plans"* (KS3 Girl)	*"It's a chance to meet up with friends"* (KS3 Girl)

Organisational		
Location/Environment	*"…a club that's fun and active, and people would like to go to it and it's not too far."* (KS2 Girl)	*"I go up to the college car park because it's big and loads of my friends just play there."* (KS3 Boy)
Club	*"…create like clubs or academies that you don't actually have to be good at it to go there and stay there"* (KS3 Boy)	*"…because that's where the club are, it's what I do and I'm a part of that team"* (KS3 Boy)
Facilities	*"That's where you play, that's the home ground or your home team. You have to go there."* (KS2 Boy)	*"There's trampolining at, I can't remember the school now but it's a high school."* (KS2 Girl)
Community/Policy		
Rewards	*"…make it into like a fun game and whoever did the most exercise in that period of time would get a prize or something like that."* (KS3 Girl)	*"…in periods of time when who does the most exercise you win a prize, so you're kind of pushing the children to work for the prize."* (KS3 Girl)
Promotion	*"…posters for like games and stuff which we could get to do after school that will get you fit and healthy."* (KS2 Girl)	*"…put a word on Facebook and tell people what's happening and let everyone know happening and try and bring some people down to it."* (KS2 Boy)
Child Voice	*"People might not like what the variety is"* (KS2 Girl)	*"You can ask what they like the most, and start clubs and get them to come."* (KS2 Boy)
Awareness	*"…have like posters around and like maybe in schools and like outside schools as well."* (KS2 Girl)	*"Like do a survey to see what they would want to do instead of like saying we're going to do hockey today because some people might not like it."* (KS2 Girl)

Other		
Weather	*"…if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy."* (KS2 Girl)	*"…you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that."* (KS3 Boy)
Technology	*"When you've got a phone or like a console, you don't think as much about getting active, you just want to play on them"* (KS3 Girl)	*"You could reduce your time down on a tablet or computer so that you're not always on it"* (KS2 Girl)

Barriers to Physical Activity

Focus group findings revealed technology as a consistent theme when describing potential barriers to PA. KS2 and KS3 children, including both genders raised issues on how the wide range of technologies available was appealing to children. This also generated discussion around how opportunities to engage with the different technologies, would replace the time which may normally be spent engaging in PA. Additional barriers to PA included family commitments and responsibilities where children indicated the need to look after younger siblings, which would consequently reduce/limit the time available to engage in PA. Children also related poor nutritional intake as a barrier to PA, where eating 'treats', 'chocolate', and 'sugary food' which would result in poorer health status, which may hinder motivation for PA. Finally, children felt that weather conditions and fatigue also restricted the amount of PA that could be completed.

KS3 boys focus group:

Researcher: *Superb, okay so I want you to think about what potential barriers there are to stop students from being physically active? So, what barriers do you think there are that stop yourselves, or your friends from being physically active?*

Participant 1: *Playing on the Xbox, consoles, stuff like that.*

Participant 2: *Home life, like if you've got a family member in hospital or anything like that or funerals and stuff like that, to go to it will stop you from doing other stuff.*

Participant 3: *If you're ill, or PlayStation, Xboxes and TV, and like games consoles.*

Participant 4: *Food.*

Researcher: *Can you develop that answer? What do you mean?*

Participant 4: *I don't know, just like chocolate, sugary food.*

Participant 5: *Like people seem to love consoles and stuff and that's what stops them and they're like "mom when I get home from school can I go on my Xbox or something?" That's the only reason they like getting home. It stops them.*

Participant 6: *The phones and the consoles just stop them from like going outside and just actual meeting their friends other than talking to them over the Xbox or PlayStation.*

Participant 7: *Technology, because the point of technology is to provide ease to someone, and that's usually by doing some form of physical activity so they try and block that out.*

Participant 8: *And the bad thing about technology is people can insult you over that so it's a bad reason.*

Participant 9: *If you're really tired or the weather's bad.*

KS2 girls focus group:

Researcher: *Right okay, what barriers do you think there are which stop students from being physically active? So, what do you think stops people from being active?*

Participant 1: *Too much technology like phones because there's all these YouTube videos and stuff, or new music videos and Christmas stuff that have come in so they're all watching TV to see what they really want for Christmas.*

Participant 2: *They're usually watching TV or on their tablet or at home playing games or something and not getting physically active outside, or riding their bike or something.*

Participant 3: *Like in the summer, most people are on their Xboxes or PlayStations and they're not like enjoying the free weather and like they never go out or anything.*

Participant 4: *Some people just can't be bothered to go out in the environment, they just want to stay in bed late and watch some TV and play with each other.*

Participant 5: *Well, they like watching TV and everyday probably eating treats which can make them fat, like chocolates because it's getting near to Christmas now. People do normally get them in their stockings.*

Participant 6: *It's like when you're in a relationship, you go on your phones and you can't get off it because you're waiting for them to text you back. It's really hard so you don't want to go outside.*

Facilitators for Physical Activity

When exploring facilitators for PA, children suggested a 'solution-focused' approach regarding technology, where limitations were in place for the duration of time children could use technology. Children also indicated that the promotion of a variety of PA clubs in school e.g. posters, signs etc, would help engage more children. The children's voice could also be consulted in the choice of PA clubs. Finally, children felt that a school-based PA-related reward system would promote participation.

KS3 boys focus group:

Researcher: *Okay, last one, so what changes would you make to improve students' opportunities to take part in physical activity? So, if you could make any change, what would it be and why?*

Participant 1: *Not always play on the Xbox because it's not healthy for your eyes and you're not going to get as much fit, you're just going to get lazy and like you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that.*

Participant 2: *There's a time limit for like consoles so you're not always like look at them, because it's like you're being lazy because you're sitting down while you're doing it, not running around.*

Participant 3: *I'd create like clubs or academies that you don't actually have to be good at it to go there and stay there, you can be not terrible but you don't have to be really really good at it just to be there.*

Participant 4: *Destroy technology.*

Participant 5: *The thing is that people need thing like that, like phones and technology and that. The gaming and YouTube would be out of jobs and stuff like that.*

Participant 6: *You get like money for it and fair play to them but you just don't want to sit on there every day, hours and hours on the Xbox. But it's their lives so you can't judge their lives, but you can't make them not play on the Xbox or not play on the PlayStation or whatever you have. You can't stop them but you have glasses and it's going to like stop you seeing far and stop you getting good jobs like the police and stuff because you need good eyes and it wrecks it then.*

Participant 7: *Erm, I think we should like encourage parents to like, every hour you do on physical activity and stuff like that so however long you do on a physical activity, you get half that time on technology or something like that so if you're doing something, you're getting rewarded for it.*

Participant 8: *You only live once and you might as well live it to the fullest and instead of staying inside, you might as well go outside.*

KS2 girls focus group:

Researcher: *Brilliant, okay, final question. What changes would you make to change students' opportunities to take part in physical activity? So, what would you do to get more people active?*

Participant 1: *Erm, maybe have like posters around and like maybe in schools and like outside schools as well. You could have posters to say get fit, but especially in like schools because you did this, like maybe we could have like posters for like games and stuff which we could get to do after school that will get you fit and healthy.*

Participant 2: *Maybe when you're at school and it's a nice day, get some people on the field running around and playing some football or maybe if just at home play some football or some stuff like swimming.*

Participant 3: *Well, say if you went to a park and there's not that many people getting active, you could go on the field and like run around, like the little kids and they could go like, if it's massive places they could do sport and stuff if it's sunny.*

Participant 4: *You could like clubs and you could put posters everywhere saying there's a fair where you can sell bikes and unicycles and scooters and then you can also say new park open so people will know. And if they would like to go there it lets them get active.*

Participant 5: *You could invent new bikes and stuff so make more things that people can get out on, maybe lower the price a little bit so that people don't have to wait loads to save up and then get them before they're all ran out. So just lower the price a bit so people can buy them and then just do it.*

Participant 6: *You could reduce your time down on a tablet or computer so that you're not always on it and you're outside having fun.*

4.5 Discussion

The results presented from section 4.4 will be discussed within this section. In accordance with previous literature (Moore et al., 2014), this study's data provided a range of reasons why children are physically active, and also what they perceived as being potential barriers to PA participation, therefore, following a discussion on the weight status and cardiovascular fitness of the children, PA behaviours will be discussed, followed by barriers to and facilitators of PA.

4.5.1 Weight status and cardiovascular fitness

During the year of data collection (2014-15), the Health Survey for England revealed 28% of children were either overweight, or obese, with 14% of children specifically being obese (National Health Service, 2015). Findings from this study showed a greater percentage of children (17.9%) classified as overweight or obese when compared with national statistics. However, there was a lower percent of children (12.8%) within the study classed specifically as obese. This pattern was also revealed when comparing data to the UK National Health Service (NHS) National Child Measurement Programme (NCMP). This programme provides official national and local regional statistics on year 6 (aged 10-11 years) children's weight status according to BMI measurements in England. A greater percentage of children in this study were classed as overweight (22.9%) when compared with NCMP data (national = 14.2%, local regional = 11.9%), however, the study showed fewer children classified as obese (12.8%) when compared with NCMP data (national = 19.1%, local regional = 20.2%) (National Health Service, 2015).

Focus group data revealed children's understanding of the health benefits of PA and may explain the lower percentage of children in the current study classed as obese, when compared with national data: *"I just do it for fun and I like to be fit." ; "To get fit and healthy." ; "….when you're doing sport, it's just like fun and it's getting you fit." ; "To keep your body healthy and strong." ; "…you can keep fit and it will help you have fun whilst staying healthy."*

When exploring weight status according to gender, boys and girls in England are equally likely to be overweight or obese (boys = 30%, girls = 26%) and similar proportions of boys and girls are obese (boys = 15%, girls = 13%) (National Health Service, 2015). However, both genders in this study show a lower percentage classed as overweight or obese (boys = 15.6%, girls = 20.2%) when compared with national statistics, and this pattern further continued with a lower percentage of children in the current study classed specifically as obese (boys = 7.3%, girls = 5.5%).

Key stage findings revealed KS3 children to have significantly higher BMI scores in comparison to KS2 children ($p < 0.01$), however, analysis of weight status categories according to key stage showed no statistical significance ($p > 0.05$). This suggests that despite KS3 children showing a greater BMI score when compared with KS2, this was not reflected when exploring differences in weight status categories between key stages. However, in accordance with national patterns, older children (KS3) within this school were more likely to be overweight, younger children (KS2) were more likely to be underweight, whilst the majority of children were classed as 'healthy weight' (KS2 = 60.6%, KS3 = 46.4%) (National Health Service, 2015).

Weight status according to maturational stage showed a greater percent of children from both 'early' and 'average' stages of maturation as being of 'healthy weight' (early = 57.5%, average = 45.4%). However, there were more children in the 'average' maturational stage who were classed as being 'underweight' and 'overweight' than children in the 'early' maturational stage, and no children in 'average' maturational stage were classified as obese. Therefore, early maturing children in this study were more likely to be either healthy weight or obese when compared with later maturing children. Previous literature exploring maturational stage suggests that those in early stages of maturation are more likely to be overweight or obese (Miranda et al., 2014; Pinto et al., 2018), however, the lack of this type of research within children highlights the need for further maturational stage and weight status investigations. The lack of research in this area could be explained by the limited number of overweight/obese children consenting to engage in such types of study. This may explain why there was a greater proportion of healthy weight children within this study's sample, and hence it is acknowledged that the sample may not be an accurate reflection of the wider school population.

Waist circumference findings showed boys to have significantly larger waist measurements than girls ($p < 0.05$, boys = 72.2cm, girls = 67.4cm), and KS3 children were found to have a significantly larger waist circumference than KS2 children ($p < 0.01$, KS2 = 67cm, KS3 = 73.6cm). As older children's physiological developments may be associated with greater waist circumference, children's stage of maturation was considered as an independent variable alongside chronological age. Children in the early stage of maturation had significantly greater mean waist circumference measurements than those in the average stage of maturation ($p < 0.05$, early = 70.8cm, average = 64.8cm).

Despite no significant findings being revealed when exploring WHtR according to gender, key stage or maturational stage, a statistically significant relationship was revealed between WHtR and BMI ($p < 0.01$). Descriptives reveal that the number of children classed as overweight/obese (combined) according to BMI, and 'at risk' according to WHtR were similar (BMI: Overweight/obese = 34.8%, WHtR: 'at risk' = 39.3%). This indicates that children who were categorised as being overweight/obese according to BMI were likely to be categorised as 'at risk' according to WHtR, and shows consistencies of weight/health status indications between these two measures. Based on these findings, it is suggested that when exploring children's weight/health status, both BMI and WHtR should be used to confirm outcomes, as opposed to using one measure in isolation. This would provide greater confidence in the assessment of children's weight/health status.

When exploring cardiovascular fitness, there were no statistically significant differences according to gender, key stage or maturational stage, however, a positive relationship was revealed between cardiovascular fitness and iBMI ($p < 0.05$). Descriptives indicate that children who had higher levels of cardiovascular fitness had higher iBMI level. This suggests that greater cardiovascular fitness in children within this study is positively associated with greater levels of children's percentage of body fatness. However, it is acknowledged that the use of the multistage fitness test to measure children's cardiovascular fitness is dependent on the children's performance. Therefore, children who may have had greater cardiovascular fitness levels, may not have completed the multistage fitness test to their maximum level, which would consequently affect the accuracy of the positive relationship found between iBMI and cardiovascular fitness.

Despite collecting a range of different weight status and cardiovascular fitness measures, the findings of this study report no significant relationship between daily MVPA and the different measures collected. Previous literature has reported similar findings, with the amounts of PA not differing amongst children in different weight categories (Fernández-Aranda et al., 2014). Additionally, when exploring the relationship between MVPA, BMI and waist circumference, an inverse association has been reported (Fernández-Aranda et al., 2014). However, previous literature suggests that the only HR intensity to reveal any significant relationship with lower BMI scores is VPA (Hamer et al., 2013; Fernández-Aranda et al., 2014). This suggests that there is a need to analyse HR according to its individual categories when exploring relationships with BMI. After adopting this approach within this study, no significant findings were revealed which supports the argument of weight status and cardiovascular fitness not necessarily being associated with PA levels. Although these findings are not directly related to those of previous studies (Hamer et al., 2013; Fernández-Aranda et al., 2014), it could be argued that there is a need for weight status and cardiovascular fitness to be recorded over a longer duration in order to identify any significant associations. Furthermore, the amount of effort children contributed to the multi-stage fitness test is subject to their individual efforts (Mayorga-Vega et al., 2015), meaning children may not have completed the test to their best ability, which consequently would not provide an accurate reflection of their cardiovascular fitness (Mayorga-Vega et al., 2015). Therefore, it is important to note that the multistage fitness test should be used as an estimate of cardiovascular fitness. However, in relation to this study, the multistage fitness was the most practical, cost and time efficient method of gathering cardiovascular fitness data of a large sample. This in turn, allowed for analysis of cardiovascular fitness to be carried out.

4.5.2 Physical activity behaviours

Fifty-two percent of children within the current study met the 60 minute daily minimum MVPA guidelines (Chief Medical Officers, 2019), which is greater than national statistics where eighteen percent of children in England meet the guidelines (Chief Medical Officers, 2019; NHS Digital, 2019). This difference may be explained by differences in sample sizes. However, children within the current study engaged in MVPA for 17.5% of their total time (see Table 4.3). This data will be discussed further according to gender, key stage, and maturational stage.

There was approximately equal percentages of boys and girls meeting the 60 minute daily minimum MVPA guidelines (Chief Medical Officers, 2019), with 52% of boys, and 48% of girls meeting these guidelines. This is a greater percent when compared with national statistics where 20% of boys and 14% girls met recommended guidelines (NHS Digital, 2019). Previous literature has consistently reported that boys are more active than girls (Trost et al., 2002a; Van Sluijs et al., 2008; Brooke et al., 2016; Corder et al., 2016; Farooq et al., 2016; Mitchell et al., 2016; Pate et al., 2016; Rosenfeld, 2017). More specifically, girls engage in smaller amounts of time spent in light, moderate and vigorous activity (Owen et al., 2009; Ridgers et al., 2012a; Health and Social Care Information Centre, 2017). However, despite fewer girls in this study meeting the 60 minute daily minimum MVPA guidelines (25%), girls in the current study spent 7.1% more of their time in MVPA (20.9%), compared with boys (13.8%). This suggests that despite fewer girls meeting the 60 minute daily minimum MVPA guidelines, those girls who did engage in MVPA, engaged in greater MVPA time, which consequently increased girls' mean MVPA. This is in direct contrast to previous literature (Owen et al., 2009; Tudor-Locke et al., 2011; Ridgers et al., 2012a; Farooq et al., 2016; Health and Social Care Information Centre, 2017; Rosenfeld, 2017; NHS Digital, 2019). This novel finding may be due to the PA opportunities provided for girls at the participating school, which may encourage greater MVPA compared with other schools nationally. As previously discussed in Chapter 3.3, the wider school staff, including learning support assistants encouraged children to engage in PA, and staff (not just including PE teaching staff) assisted in leading extra-curricular PA clubs. Therefore, girls within this school may have been offered more opportunities for PA, in comparison to girls in other schools nationally.

Focus groups revealed that girls' PA in this study included unstructured PA whereby engagement in PA was based on availability of 'friends', and 'proximity to location': *"I don't really go anywhere, I just like text friends and like meet up anywhere." ; "I go to the like park and friends' houses to skate and stuff." ; "All my friends are at the park and stuff so I can knock for them."*

Boys' focus group data showed their PA to be more structured based upon clubs, fixtures etc: *"I go to Rugby."; "… astroturf to play football"; " … do football three times a week, and I go to gymnastics three times a week, sometimes I go swimming…"* Therefore, the novel gender MVPA findings showing girls to engage in greater MVPA than boys could be attributed to how girls engage in unstructured PA outside of school, which may last longer in time duration when compared with the structured nature of boys' PA. Future research should explore the duration both boys and girls spend in the environments in which they take part in structured and unstructured PA, including children's free-living environments.

Further investigation into gender by key stage differences showed similar patterns with KS2 girls engaging in 1.9% more MVPA than KS2 boys, and KS3 girls engaging in 14.4% more MVPA than KS3 boys. Once again this opposes literature suggesting that boys are more active than girls (Brooke et al., 2016; Corder et al., 2016; Mitchell et al., 2016; Pate et al., 2016), and shows that even within the older children in this particular school, the girls engaged in greater MVPA than boys. Once again, this reveals novel findings in girls from both key stages being more active than boys in the same key stage. However, whilst there was no significant difference in the amount of PA between gender and key stage, focus groups indicated that the nature and environment of PA between genders was different.

Investigations exploring PA behaviours across transitional periods between age groups has revealed a reduction in PA with age (Trost et al., 2002b; Nader et al., 2008; Dumith et al., 2011; Mitchell et al., 2013; Cooper et al., 2015), and research advocates that the decline in PA begins from children as young as 7 years (Farooq et al., 2016). However, findings from this study revealed that 51.4% of KS2 children and 52% of KS3 children met recommended daily MVPA guidelines (Chief Medical Officers, 2019), which is in contrast with previous literature (Cooper et al., 2015; Farooq et al., 2016). In addition to this, HR analysis showed KS3 children spent a higher proportion of their time in MVPA (18.8%), than KS2 children (16.5%). These findings therefore differ from the age-related decline in PA discussed in previous literature (Trost et al., 2002b; Nader et al., 2008; Dumith et al., 2011; Mitchell et al., 2013). This may be explained by the environment and education structure of the participating school in this study. The majority of children in the UK change schools when transitioning from KS2 to KS3 (i.e., move from primary to secondary school), whereas the participating school in this study was a Middle school, where children stayed at the same school for their transition from KS2 to KS3. Therefore, the environment was consistent, potentially leading to consistent activity behaviours between KS2 and KS3, or even potentially increase MVPA for KS3 children. It can therefore be suggested that UK-based Middle schools provide a consistent environment for PA which encompasses both KS2 and KS3 children, which helps limit reductions in PA which has been associated with transitional stages between UK-based two-tier school systems (i.e. primary and secondary schools) (Mitchell et al., 2013; Cooper et al., 2015; Farooq et al., 2016). As previously highlighted in Chapter 3.3, the school being studied in this thesis consisted of two large separate playgrounds for each key stage, each marked with a range of painted lines encouraging PA. This meant that as children made the transition from KS2 to KS3, they were consistently presented with PA opportunities within their own personal key stage playground, which would limit the age-related decline associated with PA (Cooper et al., 2015; Farooq et al., 2016), and consequently showed opposing PA patterns.

In addition to the structure of the school environment, focus group data also highlighted differences in PA behaviours outside of the school environment. KS2 children described PA which was organised, and often accompanied by a parent: *"I go for a jog with my dad." ; "I do swimming on a Wednesday, I do tennis with my dad sometimes and then I, in the holidays I go with my dad to ride my bike around any park."* In contrast to this, KS3 children described some organised and structured PA (i.e. attending PA clubs etc), but there was a greater prevalence of unstructured PA within the local environment: *"I don't really go to any specific venue, I just run and just go on my bike and stuff and play football. And I go up to the field by my house and play football sometimes."; "I go up to the college car park because it's big and loads of my friends just play there, we play like 60 seconds and stuff like that."* This indicates that older children within this study may have had greater independent mobility and consequently greater opportunity for PA outside of school. Previous literature also indicates that there are greater safety concerns associated with younger children (Meester et al., 2014; Schoeppe et al., 2014a; Schoeppe et al., 2014b; Noonan et al., 2016a), which could restrict unstructured activity outside of the home environment and may be reflective of findings from this study.

There can be almost a calendar years difference between children in UK-based schools, therefore maturational stage was explored to identify those meeting daily MVPA guidelines (Chief Medical Officers, 2019). It was found that 49% of children in initial stages of maturation, and 62% of children in less developed stages of maturation met daily MVPA guidelines (Chief Medical Officers, 2019). In addition to this, children in less developed stages of maturation engaged in 6.5% more MVPA than early maturing children, therefore suggesting that early maturing children engage in less MVPA than peers in less developed stages of maturation.

After categorising PA levels into being active (≥60 minutes MVPA), minimally active (≥30<60 minutes MVPA), and inactive (<30 minutes MVPA) (Kesaniemi et al., 2010; World Health Organisation, 2011), no significant findings of numbers of children in each category according to gender, key stage or maturational stage findings were revealed ($p > 0.05$). Therefore, each HR intensity was analysed individually, an approach that has been supported by previous literature (Hamer et al., 2013; Fernández-Aranda et al., 2014).

When analysing sedentary time, similar durations of time were found according to gender, key stage and maturational stage (see Table 4). However, when exploring data for gender differences within each key stage, KS2 girls engaged in 13.4% more sedentary time than KS2 boys. This pattern was, however, reversed with the older children as KS3 boys engaged in 19.9% more sedentary time than KS3 girls. When this was reported as mean daily time, this result was found to be statistically significant (large effect size: d=1.04), therefore, KS3 boys within this study were significantly more sedentary than KS3 girls.

This pattern of SB within KS3 boys was associated with technology use, previously highlighted as a barrier to PA: *"…people seem to love consoles and stuff and that's what stops them and they're like Mom when I get home from school can I go on my*

Xbox or something? That's the only reason they like getting home. It stops them [being active]." ; "…phones and the consoles just stop them from like going outside and just actual meeting their friends other than talking to them over the Xbox or PlayStation." ; "…because the point of technology is to provide ease to someone, and that's usually by doing some form of physical activity so they try and block that out."

However, both KS2 and KS3 girls associated family commitments/responsibilities and academic study as barriers to PA, which encouraged SB: "*…people might have other plans and like they might have problems with their family and might have to look after their family and it might stops [sic] you having their social time with their friends and going out." ; "If I have too much homework, exams and stuff."* Therefore, focus group data from children within this study highlight how there was consistency for all girls (both KS2 and KS3) with academic/domestic commitments explaining their SB, whereas older boys have increased opportunities to engage in sedentary technology use compared to their KS2 peers.

LPA results were similar between key stages and maturational stage (see Table 4). When exploring gender, there were more obvious differences. Boys spent 6% more of their time in LPA compared to girls, with KS2 boys specifically engaging in 14.2% more LPA than KS2 girls. However, this gender pattern was reversed with the older children, as KS3 girls engaged in 5.5% more LPA than KS3 boys. This suggests that LPA behaviour shows inconsistent patterns, and results from this study shows LPA to differ according to gender by key stage.

MPA results revealed girls to engage in 6.2% more MPA than boys which is in contrast to previous gender patterns (Brooke et al., 2016; Corder et al., 2016; Mitchell et al., 2016; Pate et al., 2016). Additionally, MPA behaviour between key stages showed older children to engage in 2.2% more MPA time than younger children, which again is in contrast to previous age-related findings (Trost et al., 2002b; Nader et al., 2008; Dumith et al., 2011; Mitchell et al., 2013). MPA was similar between KS2 boys and KS2 girls, however KS3 girls engaged in more 13.9% more MPA than KS3 boys. Therefore, these findings suggest that girls within this study consistently engaged in greater MPA than boys. The novelty of this findings is in direct contrast with previous literature (Brooke et al., 2016; Corder et al., 2016; Farooq et al., 2016; Mitchell et al., 2016; Pate et al., 2016; Rosenfeld, 2017). When exploring MPA according to stages of maturation, children in average stages of maturation engaged in 5.3% more MPA than those in early stages of maturation, suggesting that children who are at a more advanced maturational stage for their age, are likely to engage in greater MPA.

Vigorous PA specifically has been identified as the lowest proportion of overall PA among young people (Cooper et al., 2015; Corder et al., 2016), and this is supported by results from the current study. The VPA levels were consistently low across all sub-groups (see Table 4.3). This supports the need for promoting and engaging all school age groups into VPA. Previous literature has encouraged VPA within school children, and this has been related to improvements in children's cardiorespiratory fitness, health and well-being, which is important as children's PA behaviours track into adulthood (Ha et al., 2017). Schools can help promote children's VPA by providing staff training within schools and within local providers, and by adopting whole-school approaches (across the taught curriculum) for promoting PA among children (Hesketh et al., 2016; Reis et al., 2016).

This study also explored the mean MVPA minutes on weekdays and weekends, however, as the duration differed for when HR equipment was worn, the percentage of MVPA time according to weekday and weekends was also established to provide a more reflective account of MVPA behaviour.

Both boys and girls engaged in significantly less mean MVPA over the weekend in comparison with weekdays ($p < 0.01$). Children spent 67.3 minutes more in MVPA on weekdays compared with weekends which is in accordance with previous literature (Li et al., 2019). However, when analysing this as percentage of total time, weekday and weekend PA was similar (weekday = 19.1%, weekend = 19.9%). This example supports the rationale for using the percentage of MVPA time as it accounts for differences in equipment wear time, which provides a more reflective indication of weekday/weekend MVPA behaviours.

When analysing weekday/weekend MVPA according to gender, boys engaged in 80.9 more minutes of MVPA during weekdays compared with weekends. However, this pattern was reversed when analysing percentage of MVPA time, as this revealed boys to spend 2.9% more MVPA on weekends. Girls engaged in 53 more minutes of MVPA on weekdays compared with weekends, and this pattern was supported by percentage of MVPA time analysis which showed girls to spend 1.9% more MVPA time on weekdays compared with weekends. This gender pattern shows boys to engage in greater percentage MVPA during weekends, whereas girls appear to engage in more percentage MVPA on weekdays, which is in accordance with previous findings (Treuth et al., 2007; Brooke et al., 2016). This was reflected in children's focus groups as boys associated weekend behaviour with PA:

"I go to the park, I ride my bike around the block and stuff like that."; "…go there because it might be near where you live."; ": I like to go to this field which is right behind my house to play football."

Although girls did associate weekends with PA, there were responses that showed girls to associate weekends with more social behaviours with peers: *"I like a place where it's quiet and not much [sic] people like the park around the back of my house." ; "I don't really go anywhere, I just like text friends and like meet up anywhere."* Despite these findings, previous literature has indicated that both boys' and girls' MVPA is greater during weekdays, and reduces on weekends (Li et al., 2019), whereas other research indicates the opposite (Zhang et al., 2019). It is therefore suggested that weekday/weekend MVPA differences according to gender have shown inconsistencies and continues to be worthy of further investigation. Additionally, future researchers and policy makers may wish to consider gender-related preferences in PA intervention design.

While no significant differences in MVPA according to key stage were revealed, as both KS2 and KS3 children spent similar mean minutes in MVPA on weekdays compared with weekends (KS2 = 66.7 mins, KS3 = 68.3 mins), percentage MVPA according to key stage showed a different pattern. This analysis showed KS2 to engage in 2.3% more MVPA on weekends than on weekdays. Percentage of MVPA time for KS3 between weekdays and weekends was similar (Weekday = 20.1%, weekend = 19.2%). It is therefore indicated that KS2 engage in more MVPA on weekends, whereas KS3 MVPA is similar between weekdays and weekends. KS2 focus groups revealed children discussing the benefits of being outdoors to engage in PA, and weekends provide greater opportunity for this which would support these key stage MVPA findings: *"It's better outside and you get fresh air and that a lot." ; "It's more fun outside because you can do more physical stuff than inside." ; "There's like the woods down by mine and I go for a jog with my dad."*

KS3 focus groups highlighted how location and proximity affected PA. Examples which children provided could be applied to both weekdays and weekends: *"… it's not out of the way either, like really close so you can get to the places easily." ; "I don't really go to any specific venue, I just run and just go on my bike and stuff and play football. And I go up to the field by my house and play football sometimes."* The differences in key stage MVPA revealed within this study are in contrast to previous research which indicate that all children engage in less MVPA on weekdays (Zhang et al., 2019), or on weekends (Li et al., 2019), and therefore key stage MVPA differences according to weekday/weekend warrants further investigation.

Despite no significant differences in MVPA according to maturational stage being revealed, as both children in early and average maturational stages engaged in greater MVPA on weekdays compared with weekends, percentage MVPA according to maturational stage showed children in early stages to engage in 4% more MVPA on weekends, and children in the average stage spent 18.9% more time in MVPA on weekdays which is in accordance with previous literature (Corder et al., 2016; Jago et al., 2017). In summary, this study's findings combined with previous research supports the rationale for further investigation into gender, age-related differences, and maturational differences according to weekday/weekend MVPA.

Previous literature has indicated that the lunch-time period in schools shows the lowest levels of PA (Brooke et al., 2016). Results from this study support this hypothesis. After segmenting weekdays into three categories (free time which includes before/after school and break time, lesson time which includes taught curricular lessons and assembly, and lunch-time), significant findings were revealed in the amount of MVPA children engaged in within these three different time periods. Children engaged in 15.3% MVPA during free time, 15.8% MVPA in lesson time, and 8.2% MVPA in lunch-time. Similar patterns were found when exploring PA during the segmented day according to gender, key stage, and maturational stage (see Chapter 4.4.6). This indicated that all children engage in less MVPA during lunch periods in comparison to other times of the day which is in accordance with previous findings (Brooke et al., 2016). This suggests that given current low levels of MVPA at lunch, this might be a time in the school day where children could be more active to help to support them in meeting the current guidelines (Chief Medical Officers, 2019). Within the current study, children engaged in MVPA for 8.2% of a 45 min lunch break, which equates to approximately 3-4 minutes per lunch break. Given the pressure on curriculum time (Brusseau and Hannon, 2015; Haddad et al., 2018) and commitments for children before/after school as children discussed in focus groups (see section 4.4.8), lunchtime provides a window during the school time during which MVPA could be increased.

PA diaries provided a further insight and a greater context into the different types of PA behaviours children engaged in with 80 of the original 119 children returning PA diaries. Cross referencing PA diaries alongside other measures is particularly useful when a source of data collection fails (Bryman, 2012), examples being where children removed HR devices for water-based activities (e.g. swimming), and for health and safety factors (during football, skating, gymnastics, taekwondo and wrestling activities). Within this study, eleven boys and fourteen girls removed HR equipment, which meant these children were missing HR data at times when they were could have been engaging in MVPA. Despite girls engaging in greater MVPA than boys based on HR data, this may have been further increased based on the number of girls who removed HR equipment. Additionally, this could be applied with the MVPA patterns between key stage, with HR data showing KS3 to engage in more MVPA compared with KS2. However, actual KS3 MVPA may have been greater based on the sixteen children who removed devices before taking part in PA. The PA diary also allowed children to record appropriate messages to pass on to researcher e.g. A child left a message indicating that they had spent the weekend on a family holiday, and the equipment frequently lost signal due to their location. The types of information provided allows the researcher to gain a deeper and meaningful understanding of the types of PA, which helped make decisions about the credibility of the data, and to inform data cleaning and analysis methods which would not be provided solely using objective measures. Consequently, the data produced assisted in the deductive approach to exploring focus groups.

4.5.3 Barriers to and Facilitator's of physical activity

Findings reported from this study support previous literature (Krops et al., 2017; Wan et al., 2017) in that children identified time and the cost of equipment as being a potential barrier which restricted them from PA participation: *"If I have too much homework, exams and stuff." ; "Maybe lower the price a little bit so that people don't have to wait loads to save up".* Additionally, children highlighted how parents/guardians and the children themselves may have commitments after school meaning some may not have permission to stay outside of school hours: "*sometimes* *some of the people might have other plans and like they might have problems with their family and might have to look after their family and it might stops [sic] you having their social time with their friends and going out."* Break times were also deemed as being too short to engage in PA, and before school 'breakfast PA clubs' may not guarantee children's attendance. Therefore, PA clubs within ordinary school hours (and not the extended school day) help provide access (Dobbins et al., 2013a; Eather et al., 2013; Fairclough et al., 2016; Powell et al., 2016a). These PA clubs are not dependent on family commitments i.e. transport, or incur financial cost, and children's focus group data highlight the importance of considering family responsibilities when considering PA engagement programmes.

Focus groups within this study revealed how the current school policy did not allow access into the main building/school sports hall during the lunchtime period, and children also requested a greater variety of lunchtime PA clubs for greater engagement: *"More clubs as well like at lunchtime and that." ; "…do like a tally vote of their favourite, like physical stuff and then do different some clubs so they're actually be active during the day."* This highlights how children identified the lunchtime period to be an accessible time period in which PA could be promoted, however, more needed to be done to encourage greater participation.

Despite current research indicating that technology can be used as a positive way of monitoring and promoting a PA lifestyle (Carlin et al., 2015; Wan et al., 2017), children within this study often reported technology as a barrier towards PA. *"Consoles are the most distracting thing you can have"; "If we didn't have an Xbox, we would probably still go out." ; "…when you've got a phone or like a console, you don't think as much about getting active, you just want to play on them."* Children identified the need to limit the amount of time spent on technological devices, which also included the amount of time parents spent on technological devices: *"You should plan playing your games consoles before you go out, have a limited time and make your parents have a limited time to play it, so you can't have all day, every* *day on it, and if you do go on it every day, have a certain time and then when you're finished do some exercise."* This would indicate that parents' modelling of behaviour influences children's behaviour, and children highlight this when engaging with technology. Therefore, children in this study outline the dangers of increased opportunities to engage with technology overpowering the prospects of leading a physically active lifestyle.

In accordance with previous literature, factors such as fun, enjoyment, and wanting to keep fit and healthy were all identified as motives for PA participation on an individual level (Krops et al., 2017; Wan et al., 2017): *"I do it for the fun and because I like doing sport." ; "I do it because I like dancing and it just makes me happy." ; "I just do it for fun and I like to be fit." ; "To get fit and healthy."* Therefore, in order to encourage greater PA participation, there is a need to provide a PA environment that has a focus on fun and enjoyment (Dishman et al., 2005; Fairclough and Stratton, 2005a; Smith et al., 2014; Fairclough et al., 2016).

The social environment surrounding the children was also identified as being a facilitator to taking part in PA. Children associated taking part in PA with a chance to 'catch up' or socialise with friends in a fun environment: *"I do it because I want to get more time to hang out with my friends." ; "It's like the closest thing to me and my friends so we can meet up there."* This is in accordance with previous literature which indicates the social aspect of PA encourages participation amongst peers (Krops et al., 2017). This was seen as a positive factor which children felt encouraged them to attend different PA clubs, such as football, dodgeball and table tennis, inside and outside of the school environment. Therefore, PA intervention programmes should consider opportunities to be socially active, which may encourage greater participation.

The physical environment was described as having a direct association with children's participation in PA and this has been supported by previous research (Collins et al., 2012). Children identified the surrounding environment to positively encourage PA participation. This included associations with local parks, lakes, hills and open spaces: *"It's the closest open space near my close and it's right by my friends, they live there." ; "I like to go to this field which is right behind my house to play football, to play tig, to just play loads of games." ; "In the park a lot, I like playing football."* Themes from previous literature were evidenced in the current study with the proximity and location of environments highlighted, describing that children visited such areas because they were the closest for friends to meet (Krops et al., 2017). Therefore, it is concluded that greater PA is associated with proximity of location, and children are more likely to engage in PA which is easier to travel to. PA intervention programmes may wish to consider proximity of location when deciding where to offer children's PA. With children highlighting the importance of the built environment in being conducive to PA, this warrants further research that explores the impact of the built environment, exploring both the children's perceptions of their environment, alongside objectively measuring their utilising of the surrounding built environment.

Previous literature supports the need for promoting and engaging PA behaviours within the school environment and children within this study also referred to this (Hesketh et al., 2016; Reis et al., 2016). Children made reference to school policy on PA. A range of ideas to promote PA at school included setting up a reward scheme for children who partook in a range of differing PA clubs, or meet a certain level: *"…in periods of time when who does the most exercise you win a prize, so you're kind of pushing the children to work for the prize."*

Furthermore, numerous children in different focus groups highlighted the need for consultation with pupils when schools make decisions on the activities to be offered during extra-curricular periods, as the current PA clubs were not always popular: *"You can ask what they like the most, and start clubs and get them to come."*

Previous literature suggests that interventions promoting PA targeting a whole school population, offered within the school environment have proven to be successful (Hesketh et al., 2016; Reis et al., 2016), and therefore consulting the children may further enhance the success of these PA interventions.

As indicated by previous literature (Brooke et al., 2016), children within the current study suggested lunchtimes to be a useful window of opportunity for PA as lunchtime PA helps overcome lunchtime inactivity behaviours, and is more inclusive due to being within school hours: *"More clubs as well like at lunchtime and that" ; "I was going to say that, do like a tally vote of their favourite, like physical stuff and then do different some clubs so they're actually be active during the day."* Other ideas to promote lunchtime PA included promotion in assemblies, using posters/signage around school, and using school online social media platforms to inform children of the PA available: *"You'd like put a word on Facebook and tell people what's happening and let everyone know happening and try and bring some people down to it".* Therefore, combining the use of children's preferences of PA clubs with the lunchtime period, whilst promoting across the school including using online platforms may be an effective strategy to support and promote greater children's PA.

Facilities within particular environments were also identified as being important for PA participation: *"There's trampolining… I can't remember the school now but it's a high school."* This highlights how the facilities within particular locations encourage PA participation. Children also discussed how members of a club had to visit club training grounds in order to access club resources i.e. coaches/instructors, facilities etc, and this would further encourage PA participation. However, with specific clubs for PA there may be associated costs e.g. club membership costs, fees etc. This in turn may act as a barrier to children's PA, consequently meaning these activities may not be accessible to all. Therefore, there is a need for PA intervention programmes to consider cost as a limitation to PA engagement, as this will affect attendance.

Other responses from children included the weather being a factor which either supported or limited PA participation. Some children described poor and 'muddy' weather as a barrier to them participating in regular PA, which prompted a greater demand for indoor PA clubs: *"…if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy."* This is a common theme within literature as many studies have reported children to be more active in warmer weather, allowing for greater outdoor PA (Belanger et al., 2009; Beighle et al., 2012), however there is a lack of literature exploring children's PA behaviour across the school year. Therefore, further investigation is required to identify barriers to and facilitators of children's PA during the different seasons of the year, which allow analysis of patterns of children's PA behaviour. Consequently, a better-informed PA intervention programme can be designed to promote children's PA.

The focus group data produced from this study highlights how useful this method is in understandings children's PA behaviour. As indicated in previous research exploring children's PA (Gilliland et al., 2015; Lassetter et al., 2015; Ha et al., 2017), focus groups provide an informal approach for children interaction, where children feel comfortable to discuss topics openly. Consequently, this allows the researcher to gain an insight into children's thoughts and reasons behind PA behaviours.

4.6 Strengths and Limitations of Study 1

A strength of this study is how it adopted multiple methods, which has been advocated in previous literature (Gilliland et al., 2015; Powell et al., 2016a), and allowed the researcher to gain a more holistic picture of the PA behaviours of children's PA in a case study school – by exploring the intensity, duration, types of PA (on weekdays, weekends and providing a breakdown of PA during schools time, and according to gender, key stage and maturation), the PA barriers and facilitators, and the associations between two health-related markers – weight status and cardiovascular fitness.

In order to increase compliance, children observed a tutorial on how to use all the relevant HR equipment, and also provided with guidance on how to complete the PA diaries. Despite this, there were still instances where HR equipment failed to report HR data. This may have been due to the HR monitors becoming displaced whilst being worn, consequently meaning the HR sensors would not detect the children's heartbeat. To overcome this, the researcher provided additional tutorials on how to tighten HR straps using safety pins or changed the HR strap for a smaller size. In addition to this, as found in previous research, equipment may have been removed in some activities due to the water based activities or for health and safety reasons (Moore et al., 2014), therefore, children may have been engaging in MVPA which may not have been recorded by the HR equipment. The PA diaries provided an indication of the regularity of these circumstances and meant that water-based PA could be noted and considered this when analysing PA behaviours, however, it is acknowledged that this additional information provided from PA diaries cannot contribute towards or replace the missing HR data (when equipment may have been removed), which may have consequently affected the accuracy of HR data collected.

The relationship between device wear time duration and MVPA was explored as previous research indicates that children who engage in regular bouts of PA would be most compliant with wearing the PA/GPS devices (Krenn et al., 2011). This was evident across all days of data collection with a greater device wear time being positively associated with greater MVPA and greater maximum HR. Additionally, there were statistically significant differences between children meeting daily MVPA guidelines (Chief Medical Officers, 2019) and device wear time, with children meeting PA guidelines engaging in greater device wear time than those not meeting PA guidelines.

Mean wear time of equipment (over the four-day period) was also positively associated with children's MVPA, and children's maximum HR. This suggests that greater levels of equipment compliance was related to greater MVPA, a higher maximum HR, and children were more likely to meet daily MVPA guidelines (Chief Medical Officers, 2019). There was a greater compliance of wearing the HR equipment on weekdays, which may be due to children being within a school environment, and amongst peers who may also be involved in the research. Peers may remind/encourage others to wear the devices. However, weekend periods are less controllable as they are outside of the school environment. A previous study which has measured PA behaviours combining GPS and HR over a four-day period also found compliance of wearing equipment to reduce on the weekend (Maddison et al., 2010). Consequently as supported by previous literature (Maddison et al., 2010), and as found within the current study, the majority of recorded data came from weekday periods. This was anticipated based on previous studies (Maddison et al., 2010), and therefore was considered in the multi-methods design of the research (i.e. PA diaries used alongside HR monitors). Additionally, procedures within the school environment encouraged compliance with the lead researcher providing reminders at the beginning/ end of the day, during tutorials, and providing drop in sessions during break/lunchtime to help children resolve with any equipment issues.

The use of the multi-stage fitness test is subject to the amount of effort children are willing to put into the activity. The exhaustive nature of the multi-stage fitness test may deter children from fully applying themselves (Mayorga-Vega et al., 2015) meaning results from this test would not be a true reflection of their cardiovascular fitness. Therefore, the validity of using this dataset when exploring the relationship between MVPA and cardiovascular fitness could be questionable (Mayorga-Vega et al., 2015). Future research should try and measure maximal oxygen uptake in laboratory-based settings, however, when this is not feasible nor practical, then the 20-m shuttle run test is a useful alternative for estimating cardiorespiratory fitness (Mayorga-Vega et al., 2015).

PA diaries are also subject to the children's perception of intensity, and also accuracy of their memory when completing the diary. Therefore, from the diaries which were collected, there may have been some over/under estimation on the duration of PA participation (Biddle et al., 2011), and the PA diaries did not elicit data for statistical analysis. However, the objective nature of HR monitors helped provide an indication of accurate HR data allowing meaningful conclusions to be made on children's PA behaviours.

The cross-sectional nature of this study gathered data at one time point of the school year, and therefore, findings may not reflect children's behaviours across the wider school year. Therefore, future research may wish to monitor children's PA behaviours and health status patterns more repeatedly each school term.

4.7 Future recommendations

Future research exploring PA behaviours should adopt a mixed-methods approach to identify reasons behind PA behaviours, as the objective nature of the quantitative measures provides an accurate reflection of children's PA behaviours, and focus groups allow children to express themselves and explain their PA behaviours accordingly. It is recommended that future PA research in children uses focus groups as a method of gaining a deeper understanding of children's PA behaviours and combining the use of these with objective measures (e.g. HR monitors), allows researchers to make more accurate and reflective conclusions. From the specific context of this study, using HR, weight status, PA diaries or focus groups in isolation would limit the richness of the study, and the effective combination of these measures supports recommendations for future research to adopt such a multi-methods approach. In addition to this, the nature of this study was cross-sectional, and details of PA behaviours were only representative of one particular time period within the school year, therefore, future research may look to explore PA behaviours across the school year. Within focus groups, children highlighted how the weather and playing conditions affected their PA, and this differed according to the time of year. The lunchtime period is highlighted as an area which can offer an inclusive and accessible school-based PA intervention, however, it is noted that there are differences in PA preferences according to gender, and this should be considered in future PA intervention design.

4.8 Conclusions

In the participating case study school, over a four-day period, 52% of children met the one-hour minimum daily MVPA guidelines, however, girls were seen to engage in greater amounts of MVPA than boys and KS3 children spent a higher proportion of their time in MVPA (18.8%), compared with KS2 children (16.5%). These are novel findings in comparison to previous literature which typically shows boys to be more active than girls and to report an age-related decline in PA (Trost et al., 2002b; Nader et al., 2008; Dumith et al., 2011; Mitchell et al., 2013). Although KS2 boys and KS2 girls spent similar amounts of time in MVPA, however, KS3 girls engaged in more MVPA than KS3 boys (KS3 boys = 9.6%, KS3 girls = 24%), which indicates that PA according to gender and key stage may be more complex and there is a need for future research to investigate this further. Additionally, when exploring stages of somatic maturation (which evaluates biological development), children in average stages of maturation engaged in 6.5% more mean daily MVPA than those in early stages of maturation, showing that children of a more advanced maturational stage, to engage in greater MVPA. There was no significant association between PA and weight status within this study which indicates that, children's PA is not associated with weight status.

Children take part in PA for enjoyment, socialising with friends/family and also because many of the PA promoting environments are local to them. However, children suggested a greater need for their voices to be heard when deciding on which activities should be offered as part of the school's extra-curricular programme. Barriers such as technology, time, cost of equipment and poor weather conditions were identified as limiting factors for children to engage in greater levels of PA, therefore, there is a need to better understand seasonal variations in PA patterns and barriers and facilitators, to inform further interventions. This study reports how the use of a mixed-methods approach to PA data collection provides an insightful and deeper understanding to quantitative findings.

Chapter 5
Study 2: Children’s physical activity, location and reasons behind physical activity participation: a school year study

Chapter 5 – (Study 2) 'Children's physical activity, location and reasons behind physical activity participation: a school year study

5.1 Introduction

As discussed within the literature review (Chapter 2.3 and Chapter 2.4.2), previous research has identified that seasonal variation and the surrounding environment influences children's physical activity (PA) levels (Collins et al., 2012; Atkin et al., 2016; Tanaka et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b), however there is a lack of research exploring children's PA across the academic school year. This study will build upon the cross-sectional design of Study 1 (Chapter 4), where PA was researched within a school aged sample, by exploring children's PA across three school terms. This study will explore PA intensity across the school year by monitoring children's PA levels using HR monitors over the three academic school terms. In addition to this, GPS devices will also be used to monitor children's locations throughout the school year. This will enable the researcher to explore children's PA behaviours in the different locations visited. The use of GPS has been used in school-based samples (Collins et al., 2012; Oreskovic et al., 2012; McMinn et al., 2014; Moore et al., 2014), however, there is a lack of literature using GPS with children over the school year. The context for PA will be provided through PA diaries, and PA behaviours will be discussed in a series of focus groups following HR and GPS data collection. The findings from this study will be used to inform the experimental research in Study 3 (Chapter 6). The study aims, methods, results and discussions are included within this chapter.

5.1.1 Background

As discussed in the literature review (Chapter 2), research exploring children's PA indicates that many children fail to meet the 60-minute moderate-vigorous physical activity (MVPA) guidelines (Ekelund et al., 2011; Hallal et al., 2012a) and (sedentary behaviour) SB is highly prevalent (Klitsie et al., 2013). These findings have been related to environmental factors including weather and daylight hours, and it is proposed that seasons have the potential to influence children's PA and SB patterns (Atkin et al., 2016). However, weather variation, a factor that continuously interacts with other environmental variables and has a direct impact on children's PA behaviours, has been consistently underexplored (Katapally et al., 2016). Literature suggests that lower levels of children's PA are consistently observed in winter when compared with summer (Rich et al., 2012), and seasonal variation in relation to PA exerts a stronger influence on children than adolescents (Harrison et al., 2015). Additional research indicates that children's MVPA appears to be optimal when the maximum temperature ranges between 20-25°C (Lewis et al., 2016). Further studies support this as it has been proposed that higher levels of PA are associated with higher temperatures and lower levels of PA with higher precipitation (Katapally et al., 2016). The organisational setting, PA intensity, the number of different PA available, and the motive for participation are strongly correlated with seasonal variation (Schuttoff and Pawlowski, 2017). For example, increased PA participation using indoor sports facilities are associated with poorer outdoor weather conditions (Schuttoff and Pawlowski, 2017).

Children's PA related studies which have combined the use of GPS and accelerometry in measuring children's PA across the school year, report increased amounts of children's MVPA during summer months compared with winter (Oreskovic et al., 2012), with children spending more time in the home environment during cold winter months, and spending more time outdoors on streets and in purpose built outdoor spaces (e.g. parks and playgrounds) during warmer spring and summer months (Oreskovic et al., 2012). Literature indicates that seasonality and weather conditions as determinants of PA should be explored further, particularly in reference to specific countries (Tucker and Gilliland, 2007). UK based research has found higher levels of PA (total, moderate and vigorous) during the summer than winter in both genders (Rowlands et al., 2009), which supports the rationale of supporting public health interventions aimed at increasing PA during winter in UK children (Rich et al., 2012). Study 1 found some unusual findings in relation to age and gender differences, which conflicted with a lot of the previous evidence. Therefore, there is a need to strengthen the current study rationale for needing to explore seasonality before designing and implementing an intervention, as basing this on previous UK-based evidence is insufficient, given the uniqueness of the current school sample, as demonstrated in the Study 1 findings. This study will explore whether seasonality trends from current literature are reflected within this particular school-based sample, or whether seasonal PA patterns are different.

In addition to the season and weather patterns, the surrounding location and environment can be seen to be a key influence on children's PA. For example, green spaces are thought to facilitate the kinds of PA that tend to attract greater long-term adherence, such as walking or other activities that do not require specialist equipment or attendance at a particular facility (Shanahan et al., 2016). However, each child's surrounding environment differs, therefore not all children will be exposed to an environment which supports PA. Ecological models outline that the surrounding physical environments such as sports facilities, open green spaces etc., have an influence on the choice of PA (Lee et al., 2016). Current research confirms this and stipulates that children spend the largest proportion of time in MVPA within their home neighbourhood (Perry et al., 2016). This pattern of behaviour has been reflected in research over the past two decades, and the proximity between an individual's home environment and nearest PA/sports facility is associated with greater PA levels (Addy, 2004). Consequently, it is suggested that investment in sports facilities may help combat PA issues associated with seasonal variation (Lee et al., 2016). Furthermore, safe crossings, pavement, greenness, attractiveness, and proximity to facilities for recreation have been identified as correlates of PA (Jansen et al., 2016), and this can be explored within the current study.

Children's PA promotion is essential with PA levels in childhood influencing lifestyle choices in adulthood, and active children tend to be active adults (Noonan et al., 2016a). It is assumed that children are active by nature, but research indicates that even at early ages, inactive behaviours outweigh active choices (McKenzie et al., 1997; Pate et al., 2004; Pate et al., 2008). The majority of school-aged children attend state funded school classes for lengthy durations for most days of the year, and this provides the opportunity for children to engage in healthy PA during school (Dessing et al., 2013; McIver et al., 2016). Furthermore, the prevalence of children meeting the recommended levels of PA is low, and school-based PA is average at best (McIver et al., 2016), which suggests there is a greater need for schools to contribute towards children's PA.

PE lessons are identified as examples of school based opportunities that can be used to contribute towards children's PA (Klinker et al., 2014). When specifically focusing on time intervals within PE lessons, 15% of intervals were observed in MVPA, 14% observed as light physical activity (LPA) and 70% in SBs (McIver et al., 2016). Break/lunch periods have been highlighted as key influencing factors which may support children's PA (Dessing et al., 2013). During non-timetabled periods (i.e. break time, lunchtime etc.), 14% of time was observed in MVPA, 21% in LPA and 64% in SBs (McIver et al., 2016). Research indicates that children who are classified as being 'obese' are significantly less active during school break times (Thasanasuwan et al., 2016), thus supporting a need to use the break time period to promote PA behaviours, particularly with children who are classified as being obese. After-school PA programmes provide opportunities for children to engage in PA, however, to date, this specific time period has been observed to have mixed effectiveness on increasing MVPA levels (Mears and Jago, 2016). This therefore questions whether the after-school time period is most suitable for staging an effective PA intervention.

Research suggests that locations such as school playgrounds, urban green space and sports facilities are potential locations for PA during leisure time (Klinker et al., 2014). Therefore, children's PA should consider the environments in which they are active, and schools have been identified as having an important role in delivering opportunities for increased PA behaviour. If children are given the relevant information, they will adopt healthy, or healthier, behaviours (Jourdan et al., 2016), and there is a need for school programmes to address risk factors such as obesity

(Thasanasuwan et al., 2016). However, it is important to assess PA in the school setting and inform policymakers how physically active children are (McIver et al., 2016), particularly as opportunities for school PA are dependent on school-level policies (Gamble et al., 2017), and national level policies (Slater et al., 2012). Activities such as female only swim time, building bicycle parking areas, and empowering children through leadership have helped contribute towards children's PA (Jourdan et al., 2016).

Current literature also suggests that schools comprising high levels of low-income and ethnic minority children, face a variety of challenging circumstances, including increased children 'dropout of school' rates and teacher attrition which act as barriers to promoting school based PA (Gamble et al., 2017). Teacher attrition which may include the departure of teachers who are supportive of PA, negatively affects children's PA (Gamble et al., 2017). This therefore highlights the opportunities the school can provide to contribute towards children's PA, but also the challenges faced as a result of departing staff, who may have been particularly supportive of children's PA.

As discussed in Chapter 3.2, mixed method approaches to exploring children's PA produces reflective findings where quantitative research focuses on common trends, and qualitative methods explores 'how' and 'why' questions (Jones, 2012). Research exploring children's PA has largely underrepresented children's voices (Noonan et al., 2016a). Additionally, research has been limited to singular qualitative methods that overlook children's varied linguistic ability and interaction preference (Noonan et al., 2016a). An example of this is a study carried out exploring children's lunchtime PA (Stanley et al., 2012). The focus of the study was to explore barriers and facilitators of children's lunchtime play behaviours, and this was explored using focus groups and field notes. Despite researchers having deep and meaningful qualitative data, no objective quantitative measures were explored which would have added breadth to the study by potentially increasing the sample size, thus making the results more reflective of the wider school population (Stanley et al., 2012). When researching children's PA, both the type and context of PA is important, in addition to what PA, and how much PA they do (Biddle et al., 2011). Qualitative measures including focus groups provide opportunities for children to expand on their reasons for PA behaviour, and allows the researcher to gain meaning behind children's PA, which would therefore support mixed-method research design (Biddle et al., 2011).

When exploring quantitative measures, GPS provides a thorough and accurate measure of children's interaction with the surrounding environment and has been used alongside HR monitors to explore PA intensities in different locations (Duncan et al., 2009a; Collins et al., 2012). Combining GPS with GIS enables researchers to explore the interaction children have with their surrounding environment, including the school and home setting amongst other visited locations (McMinn et al., 2014). Different studies have implemented GPS over a range of days with differing minimum reported GPS hours for data to be included within the findings. Examples of this are data collection over four days and using a reported minimum of 3 hours of GPS data (Cooper et al., 2010b; Collins et al., 2012), and other studies collecting data over a seven-day period and using a reported minimum of 1 hour of GPS data (Oreskovic et al., 2012). These differences may be due to different sample sizes, total amount of reported GPS data and/or a loss of GPS signal, particularly when indoors (McMinn et al., 2014). Future research therefore should consider inclusion criteria which will be dependent on the amount of data that has been reported, which would consequently affect the sample size of study. A full discussion of the use of GPS in exploring PA is provided in Chapter 3.4.3. Further details of how GPS was implemented in this thesis are provided in Chapter 5.2.

Study 1 focus groups highlighted issues such as the weather and having local environments to be active in, as important determinants of PA. Therefore, this provides further justification for exploring seasonal differences in a repeated-measures study and utilising GPS technology, to further investigate how children may utilise their surrounding built environment to participate in PA.

5.1.2 Study aims

The current chapter will build on findings from Study 1 and will explore gender related differences in relation to PA levels, but this will now also include GPS location data. Weight status according to BMI and motives for PA will also be investigated over the school year. Research questions are as follows:

- Does children's PA location and intensity change across the school year?
- Do children's reasons to engage/not engage in PA differ according to different times of the school year?
- Does children's weight status change across the school year?

5.2 Methods

5.2.1 Participants

A head teacher of a Middle school in the West Midlands, United Kingdom, provided consent for the school to be involved in the study (School data: 560 total children, 93 children from ethnic minority groups, 21% free school meals). One hundred and nineteen children (21% of the total school population) aged 9-13 years were recruited through convenience and purposive sampling and agreed to participate with parental consent (boys = 57, girls = 62). Results from a Priori sample size calculation was slightly greater than the sample (Min total sample size: $n = 128$, Min sample size per group 64, Desired power = 0.8, Cohen's d = 0.45, $p = 0.09$). Further information about the participant sampling procedure and breakdown according to gender and school year is provided within Chapter 3.3.

5.2.2 Research measures

5.2.2.1 Weight status measures

Standing height and weight measurements were recorded using a Seca portable height measure. Height measurements were recorded to the nearest 0.5cm. Seca weight scales were used to record children's weight, and these measurements were recorded to the nearest 100g. Anthropometric measurements enabled BMI values to be calculated. Following the guidelines from the International Obesity Task Force (IOTF), age and gender specific cut-off points were used to establish obesity classification. The cut-off points as used in previous literature were applied (Cole et al., 2000). Following on from Study 1, WHtR was also calculated using anthropometric measurements. WHtR guidelines and cut off points applied outlined children to be either 'low risk' or 'at risk' of obesity-related diseases (Ashwell et al., 2012). Further details of how anthropometric measures were carried out are provided in Chapter 3.4.1.

5.2.2.2 Measurement of physical activity location and intensity.

Children wore Garmin Forerunner 305 GPS watches with a chest strap to measure heart rate (HR). These GPS wristwatches provided details of PA location, speed, and distance travelled. The Garmin Forerunner 305 GPS device is synchronised and wirelessly connected to a HR monitor, which provide measurements of PA intensity. These were worn from a Thursday morning until a Sunday evening (i.e. two weekdays and both weekend days. Literature indicates that four days is an appropriate time scale to capture and measure typical levels of PA (Collings et al., 2014). Fjortoft et al. (2010), Jones et al. (2009), Duncan et al. (2009), and Maddison et al. (2010) all support the feasibility of this method in measuring young people's PA. Furthermore, when researching child populations, combining the use of GPS with other data collection methods has been advised (Collins et al., 2012; Dessing et al., 2014; McMinn et al., 2014; Moore et al., 2014). The GPS watch and chest strap were not worn in water-based activities (i.e. swimming, water polo etc.).

Prior to data collection, children observed a tutorial on how the GPS watch and HR strap should be worn. This was demonstrated by the lead researcher and a research assistant. HR straps were demonstrated to be worn across the chest, level with the children's heart. Children were also shown how to tighten and loosen the strap accordingly. GPS watches were worn on the wrist and were set onto a smart recording setting, so data points were recorded when there were significant changes in the children's movements (i.e. speed, direction, distance), or HR intensity, and this approach has been supported by previous research (Collins et al., 2015). Therefore, once the device was turned on and satellite signal had been located, children simply had to press start. A demonstration on how to recharge the GPS devices was also shown. Children administered HR monitors and GPS watches either in the school changing room facilities, or at home prior to start of the school day. A simplified instructions manual was also provided in case children/parents needed information on how to apply/recharge the device correctly whilst outside of school (see Appendix 5).

Before exploring location data, the MVPA in different locations, and the types and reasons behind PA, the study explored MVPA specifically according to segments of the school day. Three segments of the school day were categorised: 'free time' (time spent outside of school), 'school day' (time spent in academic curricular time and morning break time), and 'lunchtime' (time spent during school lunch break). A breakdown of the school day timings is provided in Table 5.1.

Table 5. 1 School day including timings, school sessions and segmented day labels.

Timings	School sessions	Segmented day label
08:45-09:05	Morning registration/assembly	School day
09:05-10:05	Lesson 1	School day
10:05-10:20	Morning break time	School day

10:20-11:20	Lesson 2	School day
11:20-12:20	Lesson 3	School day
12:20-13:05	Lunch break	Lunchtime
13:05-13:15	Afternoon registration	School day
13:15-14:15	Lesson 4	School day
14:15-15:15	Lesson 5	School day

5.2.2.3 Daily physical activity diary

To ensure the current study's findings were comparable to the previous study (Study 1), the same PA diary i.e. modified version of an original 'PA log' (Heyward, 2010), was used to gather information on the types of PA children engaged in within Study 2. The PA diary used within this thesis can be found in Appendix 5. Further details of how the PA diary was utilised are provided in Chapter 3.4.5, and Chapter 4.2.2.4.

5.2.2.4 Focus groups.

Focus groups took place with peers within the same research group (Research groups are outlined in Chapter 3.3): Group 1: Years 7 and 8 boys; Group 2: Year 6 boys; Group 3: Years 6 and 8 girls; Group 4: Years 6 and 7 girls; Group 5: Years 5 and 6 girls; Group 6: Year 5 boys. For consistency in applied methods of Study 1, a deductive approach to this nature of data collection was implemented. A sub-sample of 6-8 children who provided a minimum of one hour of GPS and PA data over the four days were invited to participate in focus groups. Focus groups offer a valuable, versatile, interactive, fun and developmentally effective method for use with children and young people (Gibson, 2007). As mentioned in Chapter 3.4.6, the themes that were utilised within focus groups were based upon either quantitative data, or information provided in PA diaries. Therefore, there was a deductive insight into how and why children engaged in PA and also allowed children to elaborate on ideas behind types and duration of PA behaviours. Further details of focus groups are provided in Chapter 3.4.6.

5.2.3 Research procedure

To ensure consistency in research procedures between studies 1 and 2, and to ensure data was comparable, the same initial procedure outlined in Study 1 was followed (see Chapter 4.2.3). However, this study involved exploring PA intensity according to location, reasons for PA participation, and children's weight status over three school terms - Autumn term, Spring term and Summer term. The research calendar which was planned and followed for all parts of data collection, including specific dates for each group, is provided in Appendix 7.

Ethical approval was obtained from Newman University's Ethics Committee (see Appendix 6), and the research procedure which outlines details of the weekly and daily data collection routine was followed (see Chapter 3.5.1). Ethical considerations relating to the research procedure are provided in Chapter 3.6.

5.2.4 Data Analysis

5.2.4.1 Statistical Analysis

Following previous literature's findings and recommendations for setting inclusion criteria, and after considering continuity and consistency of analyses carried out within this thesis, the same cut off points from Study 1 were applied. After cleaning each participant's profile, and removing any blank fields of HR and GPS information, a 1 hour minimum of complete data criteria was applied to the data set which has been supported by previous literature (Moore et al., 2014). Implementing a 1 hour minimum complete data criteria (including both HR and GPS) allowed for analyses to be completed on children who met the daily 60 minute MVPA guidelines (Chief Medical Officers, 2019), whilst also providing a location context. Further discussion of minimum wear time using GPS and HR are provided in Chapter 3.4.3. Further information about participant breakdown according to age and gender is provided within Chapter 3.3.

As with the dataset from Study 1, a Kolmogorov-Smirnov test of normality originally identified the data set not to be normally distributed (Sig. = .001), therefore a square root algorithm was used to ensure data was normally distributed (Sig. = .2). A range of statistical procedures were carried out to explore PA behaviours, location, and weight status across the school year according to gender and age. Multilevel modelling using MLwiN (version 3.00 beta) was used to explore GPS and HR data across the three school terms, due to the different number of data sets provided from each term (Autumn term = 60, Spring term = 50, Summer term = 41). There were incomplete data sets for some participants as not all children's data sets met inclusion criteria for all three terms). MLwiN has been used to make accurate predictions when analysing data sets that include missing values, as this software assigns a single code value for any specified missing data (Goldstein, 2011). Additionally, data sets which have a hierarchical structure can be explored in order to examine interactions between the 'layers' within data sets (Goldstein, 2011), e.g. within this thesis, the school being one layer, key stage being a second layer, and gender being a third layer. This therefore, maximises the sample of study, allowing for a more reflective interpretation of the given data, and more meaningful conclusions can be made (Goldstein, 2011). Current literature exploring children's PA supports the use of multilevel modelling (Harrison et al., 2015; Ha et al., 2017; Ridgers et al., 2018a). In the context of this study, the results of multi-level modelling analysis were presented using a pooled ordinary least squares (OLS) model, where gender, key stage and school term were set as 'dummy variables'. This therefore allowed for MVPA per location across the three school terms, according to gender and key stage to be explored. Location data was measured in minutes and percentage of total time according to the following location index: home, on foot, motorised transport, school, outdoors, other indoor location, outside (combining on foot and outdoors).

Weight status data (according to BMI) included fewer missing data sets and therefore, repeated measures ANOVA (using SPSS version 22) was carried out to explore these findings across the three school terms. Weight status according to gender and key stage were explored over the school year. A two-tailed significance value of $p < 0.05$ was considered as being significant in all statistical analysis. The process of extracting raw HR and GPS data, including details of the applied heart-rate reserve, and HR intensity categories is provided in Chapter 3.4.3.

5.2.4.2 Qualitative Analysis

To follow a consistent approach to the analysis of qualitative data in the thesis, thematic analysis of focus group data was again implemented (Jones, 2012; Flick, 2018) to further explore and develop an insight into the PA experiences of the children, although this study particularly focused on exploring PA over the academic school year. This reasons/motives for PA and barriers and facilitators affecting children's physical activity (Moore et al., 2014), could now be investigated to highlight any differences between school terms. As with Study 1, themes from the focus groups were categorised according to the components of the Social-Ecological Model i.e. individual, social environment, physical environment and policy components (McLeroy et al., 1988). The rationale for focus groups is provided in Chapter 3.4.6 and is discussed in relation to this study in Chapter 5.2.2.4.

5.3 Results

The following results section has been broken down into subsections to address the research aims outlined in Chapter 5.1.2. This will explore academic school year differences in PA location, PA levels according to gender and key stage, motives for PA, and differences in weight status according to BMI.

5.3.1 Children meeting inclusion criteria

From the original 119 children recruited for the study, the minimum 60-minute requirements for HR and GPS analysis were met by 60 children in Autumn term (50% of total study sample, 11% of the total school population), 50 children in Spring term (42% of total study sample, 9% of the total school population), and 41 children in Summer term (35% of total study sample, 7% of the total school population). Analysis was conducted on the datasets provided by these samples. A breakdown of children according to gender and key stage is provided in Table 5.2. Key stage 2 (KS2) comprise of children in either school years 5 or 6 (aged 9-11), and key stage 3 (KS3) children comprise of children in either school years 7 or 8 (aged 11-13). A breakdown of numbers of children for weight status is provided in Chapter 5.3.2.

Table 5. 2 Children reporting a minimum of 60-minute complete data across the three school terms according to key stage and gender.

	Autumn term		
	KS2	KS3	N
Boys	20	9	29
Girls	15	16	31
Total	35	25	60
	Spring term		
	KS2	KS3	N
Boys	18	7	25
Girls	12	13	25
Total	30	20	50
	Summer term		
	KS2	KS3	N
Boys	13	9	22
Girls	6	13	19
Total	19	22	41

5.3.2 Weight status across the school year

BMI was calculated as measure of children's weight status each term. One hundred and nine children (20% of the total school population) provided BMI data for Autumn term, one hundred and two children (18% of the total school population) for Spring term, and one hundred and six children (19% of the total school population) for Summer term respectively. Ninety-five children (17% of the total school population) provided BMI data for all three school terms, and therefore analysis was carried out using these datasets. Spring term reported the highest mean BMI score (19.22 ± 3.87; see Figure 5.2). When applying the International Obesity Task Force age and gender specific BMI cut-off points (Cole et al., 2000) to establish classification of weight status, results showed that Summer term reported the highest percentage of children being classified as overweight (36.6%). Autumn term reported the highest percentage of children being classified as obese (16.7%). Children's weight status according to gender, key stage and maturational stage for each term is provided in Table 5.3 and Figure 5.1. Details of the method and guidelines used to calculate BMI for classification of weight status are provided in chapters 3.4.1.

Table 5. 3 Percentage breakdown of children's weight status by gender using BMI according to school term.

	BMI Classification							
	Autumn term							
	Underweight		Healthy		Overweight		Obese Class 1	
	N	%	N	%	N	%	N	%
	KS2							
Boys	3	8.3%	21	58.3%	6	16.7%	6	16.7%
Girls	4	13.3%	19	63.3%	5	16.7%	2	6.7%
Total	7	10.6%	40	60.6%	11	16.7%	8	12.1%
	KS3							
Boys	1	7.7%	7	53.8%	3	23.1%	2	15.4%
Girls	2	6.7%	13	43.3%	11	36.7%	4	13.3%
Total	3	7%	20	46.4%	14	32.6%	6	14%
	Gender							
Boys	4	3.7%	28	25.7%	9	8.3%	8	7.3%
Girls	6	5.5%	32	29.4%	16	14.7%	6	5.5%
	Maturational Stage							
Early	6	6.9%	50	57.5%	17	19.5%	14	16.1%

Average	4	18.2%	10	45.4%	8	36.4%	0	
Overall	10	9.3%	60	55%	25	22.9%	14	12.8%

Spring term

	Underweight		Healthy		Overweight		Obese Class 1	
	N	%	N	%	N	%	N	%
				KS2				
Boys	-	-	9	50%	8	44.4%	1	5.6%
Girls	3	27.1%	5	43.8%	1	10.4%	2	18.8%
Total	3	10%	14	46.7%	9	30%	3	10%
				KS3				
Boys	1	14.3%	2	28.6%	3	42.9%	1	14.3%
Girls	-	-	3	25.7%	5	41.1%	4	33.2%
Total	1	5%	5	25%	8	40%	5	25%
				Gender				
Boys	1	4%	11	44%	11	44%	2	8%
Girls	3	12%	8	32%	6	24%	6	24%

	Maturational Stage							
Early	1	3%	13	39.4%	11	33.3%	7	21.2%
Average	3	17.6%	6	35.3%	6	35.3%	1	5.9%
Overall	4	8%	19	38%	17	34%	8	16%

Summer term

	Underweight		Healthy		Overweight		Obese Class 1	
	N	%	N	%	N	%	N	%
	KS2							
Boys	-	-	9	69.2%	2	15.4%	2	15.4%
Girls	-	-	3	50%	3	50%	-	-
Total	-	-	12	63.2%	5	26.3%	2	10.5%
	KS3							
Boys	1	11.1%	2	22.2%	5	55.6%	1	11.1%
Girls	1	7.7%	4	30.8%	5	38.5%	3	23.1%
Total	2	9.1%	6	27.3%	10	45.4%	4	18.2%
	Gender							

Boys	1	4.5%	11	50%	7	31.8%	3	13.6%
Girls	1	5.3%	7	36.8%	8	42.1%	3	15.8%
				Maturational Stage				
Early	2	6.7%	13	43.3%	10	33.3%	5	16.7%
Average	-	-	5	45.4%	5	45.5%	1	9.1%
Overall	2	4.9%	18	43.9%	15	36.6%	6	14.6%

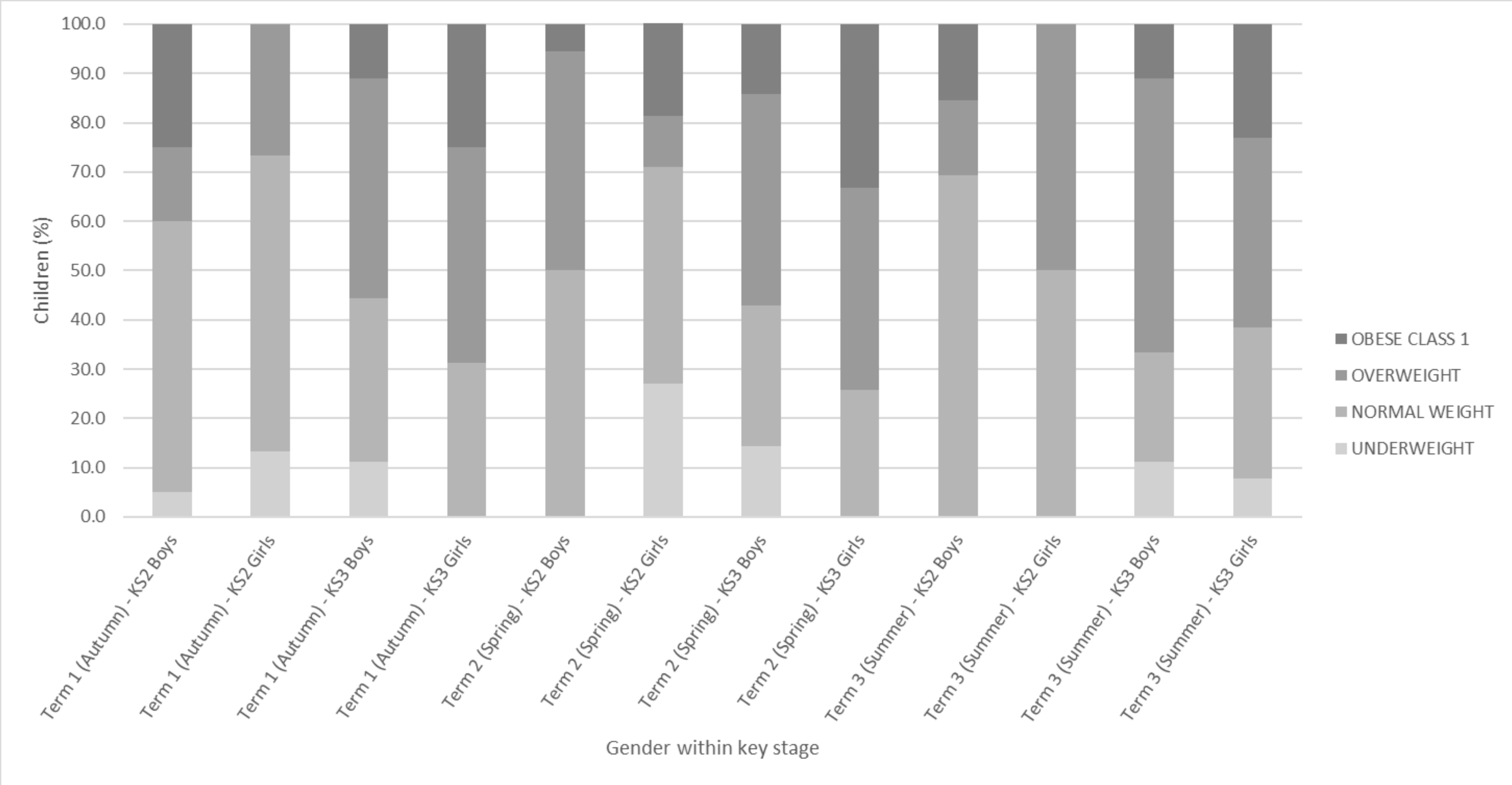


Figure 5. 1 Weight status of children (%) according to gender within key stage each term.

When comparing BMI values for children according to gender, key stage and stage of maturation, a repeated measures ANOVA indicated no significant interactions. Mean descriptives revealed that both boys and girls had greater BMI values in Spring term (see Figure 5.2), additionally when exploring BMI according to key stage, both KS2 and KS3 children had greater mean BMI values in Spring term and lower values in Summer term (see Figure 5.3). However, when exploring maturational stage, early maturers had highest BMI values shown in Spring term, whereas data from children in average stages of maturation showed highest BMI values in Summer term. Children's BMI scores according to gender, key stage and stage of maturation for each school term is presented in Table 5.4.

Table 5. 4 Gender, key stage and maturational stage breakdown for mean children's BMI values according to school term.

	BMI Values	
	Autumn term	
	N	BMI (±SD)
	KS2	
Boys	36	18.1 (±3.3)
Girls	30	17.3 (±3.4)
Total	66	17.7 (±3.4)
	KS3	
Boys	13	19.7 (±4.3)
Girls	30	20.8 (±4.2)
Total	43	20.5 (±4.2)
	Gender	
Boys	49	18.5 (±3.6)
Girls	60	19 (±4.2)
	Maturational Stage	

Early	87	19 (±4.1)
Average	22	18.1 (±3)
Overall sample	109	18.8 (±3.9)

Spring term

	N	BMI (±SD)
	KS2	
Boys	35	18.1 (±3.1)
Girls	27	18.4 (±4)
Total	62	18.2 (±3.5)
	KS3	
Boys	12	19.7 (±4.4)
Girls	28	21.2 (±3.8)
Total	40	20.8 (±4)
	Gender	
Boys	47	18.5 (±3.5)
Girls	55	19.8 (±4.1)
	Maturational Stage	
Early	82	19.5 (±4.1)
Average	20	18.3 (±2.9)
Overall sample	102	19.2 (±3.9)

Summer term

	N	BMI (±SD)
	KS2	
Boys	36	16.6 (±6)

Girls	27	16.3 (±6.8)
Total	63	16.5 (±6.3)
	KS3	
Boys	13	20.1 (±4.3)
Girls	30	18.4 (±8.4)
Total	43	18.9 (±7.4)
	Gender	
Boys	49	17.5 (±5.8)
Girls	57	17.4 (±7.7)
	Maturational Stage	
Early	85	17.1 (±7.5)
Average	21	19.1 (±2.6)
Overall sample	106	17.5 (±6.8)

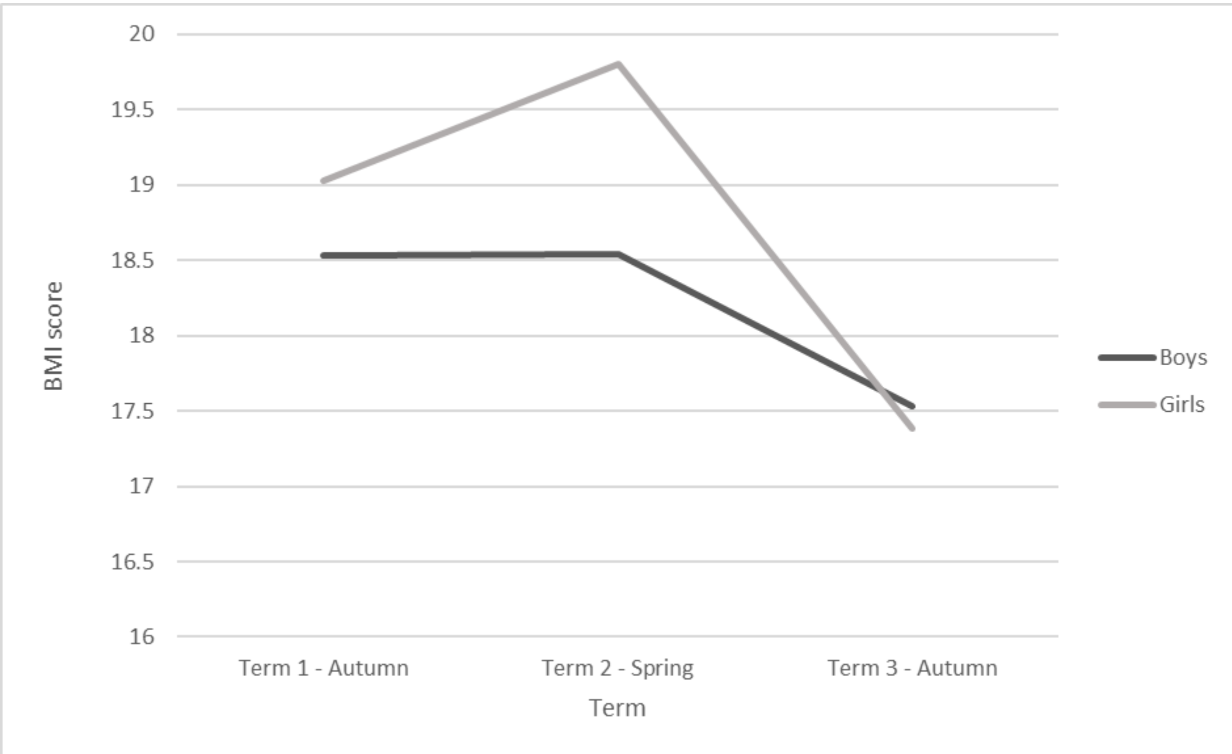


Figure 5. 2 A line graph showing the BMI pattern according to gender over 3 school terms.

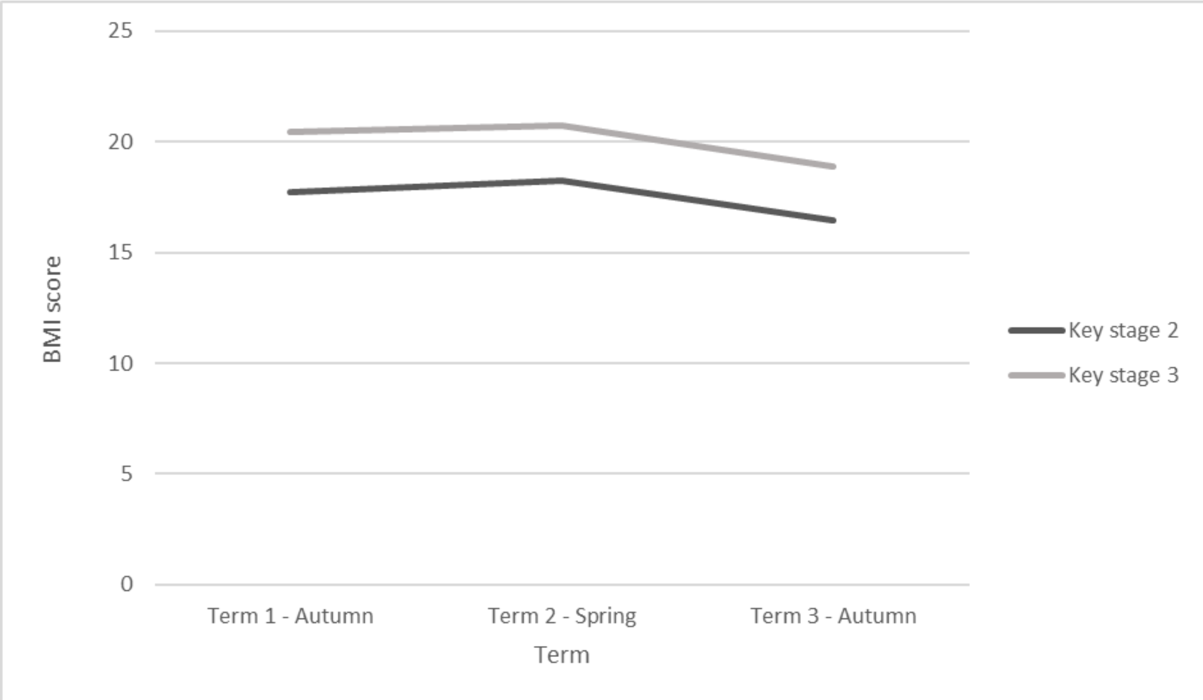


Figure 5. 3 A line graph showing the BMI pattern according to key stage over 3 school terms

When exploring weight status using waist-to-height ratio (WHtR) across the three school terms, a repeated measures ANOVA revealed no statistically significant interactions according to genders and key stage (p > 0.05), however, mean descriptives show more children were 'at risk' during Spring term (n = 48, 46.2%, see Table 5.5).

Table 5. 5 Children's mean waist-to-height ratio scores according to school term.

WHtR risk level	Autumn term	Spring term	Summer term
	n = 109	*n* = 104	*n* = 98
Low risk	*n* = 65	*n* = 56	*n* = 66
	59.6%	53.8%	67.3%
At risk	*n* = 44	*n* = 48	*n* = 32
	40.4%	46.2%	32.7%

5.3.3 Moderate-vigorous physical activity across the school year

The minimum one hour requirements (for HR and GPS analysis) were met by 60 children in Autumn term (50.4%), 50 children in Spring term (42%), and 41 children in Summer term (35%). Thirty-one children in Autumn term (52%), 32 children in Spring term (64%), and 18 children in Summer term (44%) met the 60 minute PA guidelines (Chief Medical Officers, 2019).

No statistically significant findings were revealed when exploring MVPA and the school terms ($p > 0.05$), however, mean descriptives show children in Spring term spend fewer minutes in MVPA (68.8 mins ± 100.7) than during the Autumn and Summer term (see Figure 5.4). MVPA according to gender over the three terms also showed no statistically significant results ($p > 0.05$). Boys engaged in less mean daily MVPA (minutes) in Summer term (53.9 mins ± 26.8), and girls engaged in less mean daily MVPA (minutes) in Spring term (61.6 mins ± 27.4).

When exploring MVPA according to key stage across the school year, KS3 engaged in significantly greater mean daily MVPA (101.6 mins ± 29.9), compared with KS2 (34.3 mins ± 27.1) in Summer term ($p < 0.05$, see Table 5.6 and Figure 5.4).

There were no statistically significant findings when exploring MVPA according to maturational stage. Early maturers engaged in least amounts of mean daily MVPA in Summer term (61.7 mins ± 85.2), and children in the average stage of maturation engaged in least amounts of mean daily MVPA in Spring term (47.8 mins ± 69.5).

Following the analysis of individual HR for each term, the following statistically significant findings were revealed. Within Autumn term, KS3 boys engaged in significantly more ($p < 0.05$) sedentary time than KS3 girls (KS3 boys = 260.9 ±117.5, KS3 girls = 153 ±87.9). During Spring term, children in the average stage of maturation engaged in significantly more ($p < 0.05$) mean daily sedentary time than early maturers (Early = 114 mins ±93, Average = 208 mins ±172.6). Additionally, within Spring term, early maturers engaged in significantly more ($p < 0.05$) moderate physical (MPA) than those in average stages of maturation (Early = 18.4% ±16.5%, Average = 9.2% ±6.8%). Finally, within Summer term, KS3 children engaged in significantly more ($p < 0.05$) MPA than KS2 children (KS2 = 9.7% ±11%, KS3 = 20.4% ±20.4%). A breakdown of children meeting PA guidelines, mean daily time and percentage of total time spent in different HR intensities is provided in Table 5.6.

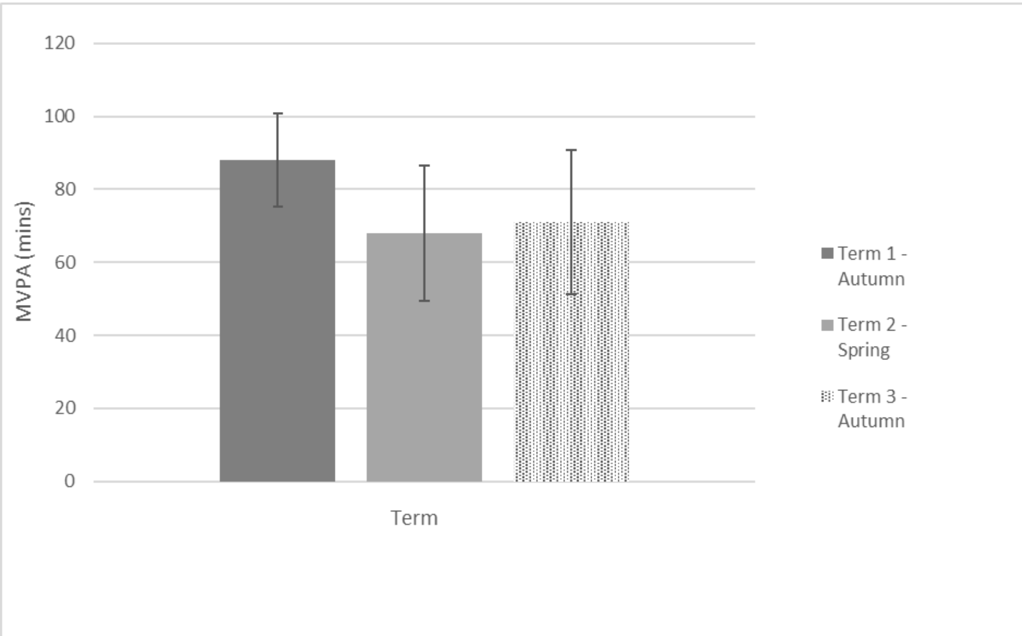


Figure 5. 4 Combined mean daily mins of MVPA over the school year.

Table 5. 6 Children meeting PA guidelines, mean daily time and percentage of total time spent in different HR intensities each school term.

	Autumn term					Meeting PA Guidelines	
	Sedentary (mins) Percentage sedentary time (%)	Light (mins) Percentage light time (%)	Moderate (mins) Percentage moderate time (%)	Vigorous (mins) Percentage vigorous time (%)	MVPA (mins) Percentage MVPA time (%)	No. Children	Percent of children (%)
	KS2 (9-11 years)						
Boys	183.6 (±119.6)	204.1 (±143.3)	59.3 (±53.8)	13.3 (±14.2)	72.6 (±63.5)	11	35
	40.5% (±24.1%)	42.6% (±20.1%)	13.6% (±10.9%)	2.8% (±2.8%)	15.7% (±12.1%)		
Girls	259.2 (±163.6)	155.2 (±148.3)	70.1 (±73.8)	13.1 (±23.1)	83.3 (±85.5)	7	23
	53.9% (±30.1%)	28.4% (±24.4%)	14.4% (±14.7%)	3.1% (±6.2%)	17.6% (±17.8%)		
Total	216 (±143)	183.1 (±145.4)	64 (±62.4)	13.2 (±18.2)	77.2 (±72.7)	18	58
	46.2%	36.5% (±23%)	14% (±12.5%)	2.9%	16.5%		

	(±27.3%)			(±4.5%)	(±14.6%)		
			KS3 (11-13 years)				
Boys	260.9 (±117.5)*	193.7 (±160.3)	41.9 (±51.6)	17.6 (±39)	59.5 (±67.3)	5	16
	57.1% (±25.6%)	32.9% (±18.2%)	7.3% (±7.4%)	2.7% (±4.8%)	9.6% (±8.5%)		
Girls	153 (±87.9)*	189.5 (±140.7)	112.3 (±124.4)	16.8 (±36.5)	129.1 (±140.5)	8	26
	37.2% (±26%)	38.4% (±21.3%)	21.2% (±23.1%)	3.2% (±6.6%)	24% (±25.6%)		
Total	191.8 (±110.6)	191 (±144.7)	87 (±108.4)	17.1 (±36.6)	104 (±122.5)	13	42
	44.4% (±27.2%)	36.4% (±20%)	16.2% (±20%)	3% (±6%)	18.8% (±21.9%)		
			Gender				
Boys	207.6 (±122.4)	200.9 (±146)	53.9 (±52.9)	14.6 (±24)	68.6 (±63.8)	16	52
	45.7% (±25.4%)	39.6% (±19.8%)	11.7% (±10.2%)	2.8% (±3.5%)	13.8% (±11.2%)		
Girls	204.4 (±138.8)	172.9 (±143.1)	91.9 (±103.6)	15 (±30.3)	106.9 (±117.5)	15	48
	45.3% (±28.9%)	33.6% (±23%)	17.9% (±19.5%)	3.1% (±6.4%)	20.9% (±22%)		

	Maturational Stage						
Early	205.9 (±125.4)	186.2 (±152.2)	65.5 (±83)	13.4 (±22.8)	78.8 (±91.2)	23	74
	46.5% (±27.6%)	36.7% (±22.6%)	13.8% (±16.1%)	2.7% (±4.4%)	16.1% (±17.4%)		
Average	205.9 (±151.2)	187.1 (±114.1)	102.7 (±87.1)	20.2 (±40.1)	122.9 (±111)	8	26
	41.5% (±25.4%)	35.6% (±17.9%)	19.1% (±15%)	3.8% (±7.5%)	22.6% (±19.4%)		
Overall sample	205.9 (±130)	186.4 (±143.9)	73.5 (±84.6)	14.8 (±27.2)	88.4 (±96.6)	31	100
	45.5% (±27%)	36.5% (±21.6%)	14.9% (±15.9%)	2.9% (±5.2%)	17.5% (±17.9%)		

	Spring term					Meeting PA Guidelines	
	Sedentary (mins) Percentage sedentary time (%)	Light (mins) Percentage light time (%)	Moderate (mins) Percentage moderate time (%)	Vigorous (mins) Percentage vigorous time (%)	MVPA (mins) Percentage MVPA time (%)	No. Children	Percent of children (%)

	KS2 (9-11 years)						
Boys	100.7 (±83.8)	139.8 (±113.2)	41.5 (±34.9)	16.5 (±26.6)	58 (±47.8)	12	38
	35.7% (±24.3%)	43.9% (±20.8%)	15.6% (±13.5%)	3.9% (±5.4%)	19.8% (±15%)		
Girls	183 (±199.3)	99.2 (±93.8)	35 (±28.6)	4.8 (±4.2)	39.8 (±30.7)	7	22
	50.2% (±22.3%)	34.2% (±19%)	13.6% (±10%)	2% (±3.8%)	15.2% (±10.3%)		
Total	133.7 (±144.4)	123.5 (±106.1)	38.9 (±32.2)	11.8 (±21.4)	50.7 (±42.2)	19	59
	41.5% (±24.3%)	40% (±20.3%)	14.8% (±12.1%)	3.1% (±5%)	17.9% (±13.3%)		
	KS3 (11-13 years)						
Boys	159.7 (±128.5)	137.5 (±63.4)	98.7 (±128.5)	17.9 (±26.7)	116.5 (±154.7)	6	19
	38.1% (±30.7%)	36.9% (±19.1%)	21.3% (±17.1%)	3.7% (±3.5%)	24.7% (±20.3%)		
Girls	167.1 (±106.9)	116.6 (±106.6)	63.1 (±133.6)	21.8 (±66.6)	84.9 (±150.8)	7	22
	46.9% (±22.5%)	33.9% (±25.3%)	13.3% (±18.5%)	6.5% (±18.2%)	18.9% (±26.1%)		
Total	164.5 (±111.5)	123.5 (±92.5)	75.6 (±129.6)	20.4 (±55)	96 (±148.8)	13	41

	43.8% (±25.2%)	34.9% (±22.8%)	16.1% (±18%)	5.5% (±14.4%)	20.9% (±23.8%)		
			Gender				
Boys	117.2 (±99.1)	139.1 (±100.4)	57.5 (±75.3)	16.9 (±26.1)	74.4 (±91.2)	18	56
	36.4% (±25.6%)	41.9% (±20.2%)	17.2% (±14.4%)	3.9% (±4.8%)	21.2% (±16.4%)		
Girls	174.7 (±99.1)	108.3 (±98.9)	49.6 (±97.5)	13.7 (±47.9)	63.3 (±111)	14	44
	48.4% (±22%)	34% (±22%)	13.4% (±14.7%)	4.2% (±13%)	17.1% (±19.8%)		
			Maturational Stage				
Early	114 (±93)*	117.2 (±96.5)	65.8 (±103.5)	13.8 (±23.3)	79.6 (±113)	22	69
	38.1% (±23.8%)	39.7% (±21.4%)	18.4% (±16.5%)*	3.4% (±4.4%)	21.8% (±17.6%)		
Average	208 (±172.6)*	136.3 (±108.1)	29.8 (±22.3)	18 (±58.1)	47.8 (±69.5)	10	31
	50.8% (±24%)	34.7% (±21.3)	9.2% (±6.8%)*	5.3% (±15.5%)	13.9% (±18.4%)		
Overall sample	146 (±131.9)	123.7 (±100)	53.6 (±86.3)	15.3 (±38.2)	68.8 (±100.7)	32	100
	42.4% (±24.4%)	38% (±21.3%)	15.3% (±14.6%)	4% (±9.7%)	19.1% (±18.1%)		

	Summer term					Meeting PA Guidelines	
	Sedentary (mins) Percentage sedentary time (%)	Light (mins) Percentage light time (%)	Moderate (mins) Percentage moderate time (%)	Vigorous (mins) Percentage vigorous time (%)	MVPA (mins) Percentage MVPA time (%)	No. Child ren	Percent of children (%)
	KS2 (9-11 years)						
Boys	122.7 (±117.3)	170.7 (±108.5)	28.3 (±30.8)	2.9 (±3.2)	31.3 (±31.4)	2	11
	38.4% (±25.4%)	50.6% (±24.6%)	9.9% (±12.3%)	0.6% (±0.7%)	10.8% (±12.3%)		
Girls	177.7 (±167.5)	199.6 (±189.6)	33.2 (±27.4)	7.6 (±12.1)	40.9 (±36.2)	4	22
	42.2% (±35.6%)	47.1% (±33.2%)	9.1% (±7.2%)	1.1% (±1.5%)	9.8% (±7.5%)		
Total	140 (±132.9)	179.8 (±134.2)	29.9 (±29.1)	4.4 (±7.2)	34.3 (±32.3)*	6	33
	39.6% (±28%)	49.5% (±27%)	9.7% (±11%)*	0.7% (±1%)	10.5% (±10.8%)		
	KS3 (11-13 years)						

Boys	164.8 (±145.1)	118.7 (±62.9)	66.3 (±87.9)	19.9 (±42)	86.2 (±99.1)	3	17
	39.2% (±20.1%)	37.5% (±20.2%)	16% (±16.2%)	7.2% (±16.6%)	22.8% (±23.5%)		
Girls	113.5 (±124.7)	136.9 (±64.7)	101.1 (±140.6)	10.2 (±12.9)	111.3 (±148.2)	9	50
	31.8% (±26.9%)	41.8% (±20.9%)	23.4% (±22.9%)	3.1% (±4.3%)	26.2% (±24.7%)		
Total	134.5 (±132.6)	129.4 (±63.1)	29.9 (±29.1)	14.1 (±28.1)	101 (±128.3)*	12	67
	34.8% (±24.1%)	40.1% (±20.2%)	20.4% (±20.4%)*	4.8% (±10.9%)	24.8% (±23.7%)		
				Gender			
Boys	139.9 (±127.8)	149.4 (±94.4)	43.9 (±62)	9.9 (±27.4)	53.7 (±71.2)	5	28
	38.7% (±22.9%)	45.3% (±23.3%)	12.4% (±14%)	3.3% (±10.8%)	15.7% (±18.3%)		
Girls	133.8 (±138.3)	156.7 (±116.9)	79.7 (±120.2)	9.4 (±12.4)	89 (±127.1)	13	72
	35.1% (±29.3%)	43.5% (±25%)	18.9% (±20.3%)	2.4% (±3.8%)	21% (±22%)		
				Maturational Stage			

Early	152.1 (±127.7)	142.2 (±84.2)	51.2 (±74.8)	10.5 (±24.6)	61.7 (±85.2)	11	61
	41.2% (±23.1%)	42.2% (±21.8%)	13.3% (±14.8%)	3% (±9.3%)	16.3% (±23.4%)		
Average	96.1 (±137.6)	181.7 (±146.8)	85.7 (±134.9)	7.3 (±9.2)	16.3 (±18.5)	7	39
	25.8% (±30.4%)	50.4% (±28.3%)	21% (±22.5%)	2.7% (±4.6%)	23.4% (±24%)		
Overall sample	137.1 (±131.1)	152.8 (±104.2)	60.5 (±94.1)	9.6 (±21.5)	70.1 (±101.2)	18	100
	37% (±25.8%)	44.4% (±23.6%)	15.4% (±17.3%)	2.9% (±8.2%)	18.2% (±20%)		

*Statistically significant difference between gender, key stage, gender within key stage, and maturational stage (p <0.05).

Table 5. 7 Multilevel regression analysis to estimate academic school term differences for mean daily MVPA (mins) according to key stage.

Fixed Explanatory Variables	Estimate (mins)
Constant (*a*) – KS2 - Autumn term	77.2 ± 16.1
KS2 - Spring term (*b*) – (Δ*a*)	-26.5 ± 23.7
KS2 - Summer term (*c*) – (Δ*a*)	-42.9 ± 27.1
KS3 - Autumn term (*d*) - (Δ*a*)	26.6 ± 25
KS3 - Spring term (*e*) - (Δ*b*)	44.8 ± 27.6
KS3 - Summer term (*f*) - (Δ*c*)	67.4 ± 29.9*
Variance of Random Variables	
	Constant (*a)*
Level 1 (within school terms)	
Constant (*aij)*	136.9 ± 1062.5
Level 2 (between school terms)	
Constant (a_i)	8978.6 ± 1470.8

*Statistically significant difference between key stage (p <0.05).

Values are daily means ± standard error of estimate. KS2 Autumn term was used as the baseline measure (*a*), and other KS2 terms (Spring term and Summer term) were compared with it, indicated by (Δ*a*). KS3 terms (*d*, *e* and *f*) were compared with their relevant KS2 term indicated by (Δ*a*), (Δ*b*) and (Δ*c*).

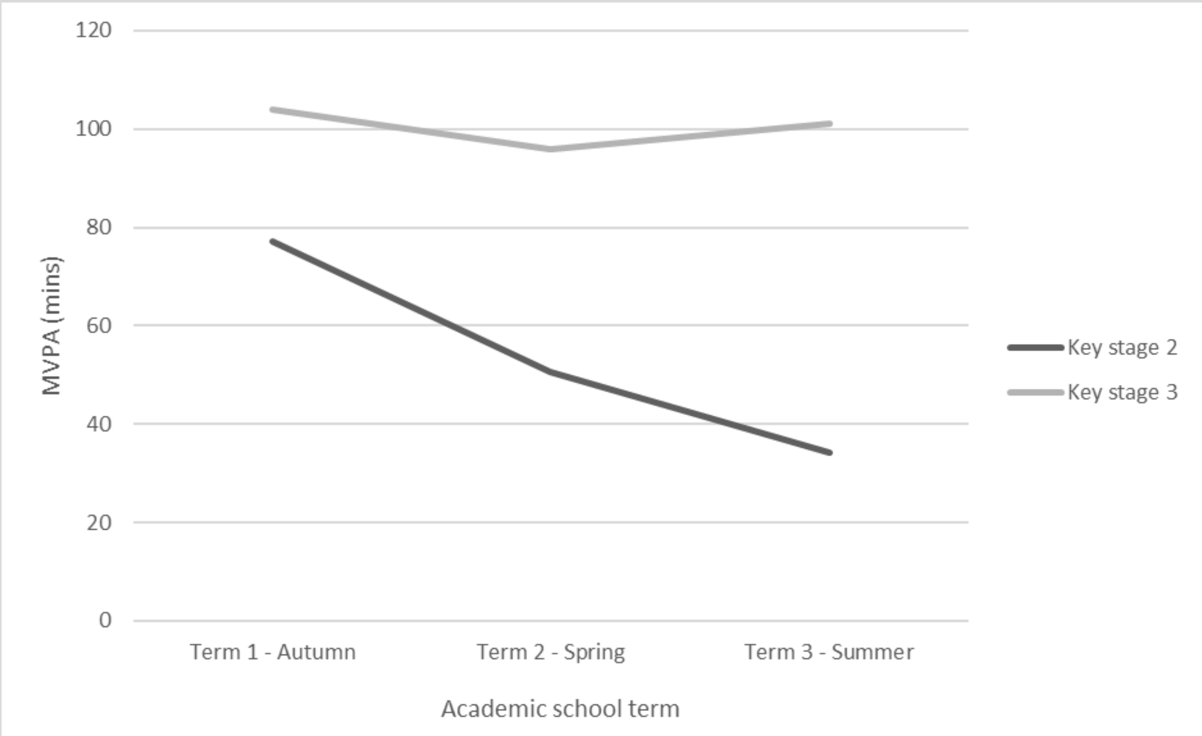


Figure 5. 5 MVPA (mins) across school year according to key stage.

Multilevel regression analysis of individual HR intensities across the three school terms, showed children engaged in significantly less ($p < 0.05$) LPA during Spring term (123.7 ± 99.9). Findings revealed boys in Spring and Summer terms engaged in significantly less ($p < 0.05$) mean daily LPA minutes compared to boys in Autumn term (see Table 5.8). Additionally, KS2 children engaged in significantly fewer minutes ($p < 0.05$) of mean daily LPA in Spring term compared with Autumn term (see Table 5.9). When exploring gender within key stage, KS2 boys engaged in significantly fewer minutes ($p < 0.05$) of mean daily LPA in Spring term (139.8 ± 113.2) compared with Autumn term (204.1 ± 143.3).

Although not statistically significant, mean daily MPA was also revealed to be lowest in Spring term (53.6 ± 86.3) compared with other terms. A breakdown of mean daily minutes and mean percentage of time in each HR intensity across the school terms, according to gender and key stage is provided in Table 5.6.

Table 5. 8 Multilevel regression analysis to estimate academic school term differences of mean daily LPA (mins) according to gender.

Fixed Explanatory Variables	Estimate (mins)
Constant (*a*) – Boys – Autumn term	204.8 ± 21.5
Boys - Spring term (*b*) - (Δ*a*)	-65.8 ± 26.2*
Boys - Summer term (*c*) - (Δ*a*)	-67 ± 26.8*
Girls - Autumn term (*d*) - (Δ*a*)	-31.2 ± 29.9
Girls - Spring term (*e*) - (Δ*b*)	-28.7 ± 32.2
Girls - Summer term (*f*) - (Δ*c*)	22.1 ± 35
Variance of Random Variables	
	Constant (*a)*
Level 1 (within school terms)	
Constant (*aij)*	7374 ± 1977.4
Level 2 (between school terms)	
Constant (a_i)	7222.4 ± 1302.9

*Statistically significant difference between gender (p <0.05).

Values are daily means ± standard error of estimate. Boys in Autumn term was used as the baseline measure (*a*), and other boys terms (Spring term and Summer term) were compared with it, indicated by (Δ*a*). Girls terms (*d*, *e* and *f*) were compared with their relevant boys' term indicated by (Δ*a*), (Δ*b*) and (Δ*c*).

Table 5. 9 Multilevel regression analysis to estimate academic school term differences of mean daily LPA (mins) according to key stage.

Fixed Explanatory Variables	Estimate (mins)
Constant (*a*) – Autumn term	185.5 ± 19.7
KS2 - Spring term (*b*) - (Δ*a*)	-61.6 ± 25*
KS2 - Summer term (*c*) – (Δ*a*)	-23.4 ± 28.5
KS3 - Autumn term (*d*) - (Δ*a*)	7.4 ± 30.4
KS3 - Spring term (*e*) - (Δ*b*)	1.3 ± 33
KS3 - Summer term (*f*) - (Δ*c*)	-26.8 ± 35.3
Variance of Random Variables	
	Constant (*a)*
Level 1 (within school terms)	
Constant (*aij)*	6802.3 ± 1957.1
Level 2 (between school terms)	
Constant (a_j)	7696.1 ± 1378.7

*Statistically significant difference between key stage (p <0.05).

Values are daily means ± standard error of estimate. KS2 Autumn term was used as the baseline measure (*a*), and other KS2 terms (Spring term and Summer term) were compared with it, indicated by (Δ*a*). KS3 terms (*d*, *e* and *f*) were compared with their relevant KS2 term indicated by (Δ*a*), (Δ*b*) and (Δ*c*).

5.3.4 The segmented school day

Results showed children engaged in significantly less MVPA (p <0.05) during the lunchtime period for each school term. A breakdown of mean MVPA mins and MVPA percentage time across the segmented day according to school term is provided in Table 5.1.1. Children engaged in lowest amounts of MVPA minutes in each day segment in Spring term compared with Autumn and Summer terms (see Figure 5.6).

Table 5.1. 1 Mean MVPA and MVPA (%) according to segments of the school day.

Term	N	Mean MVPA (mins) MVPA (%)
		Free time
1	60	32.6 (±39.3)
		20% (±18.9%)
2	50	28.5 (±73.3)
		19.1% (±16.6%)
3	41	30.3 (±59.6)
		15.4% (±23%)
		School day
1	60	50.4 (±67.9)
		18.4% (±14.8%)
2	50	19.4 (±21.9)
		21.6% (±20.7%)
3	41	34.8 (±49.6)
		26% (±20.2%)
		Lunch
1	60	6.4 (±9.8)
		8.6% (±14.5%)
2	50	5.5 (±6.5)
		7.4% (±15.9%)
3	41	8.2 (±25.3)
		9% (±24.5%)

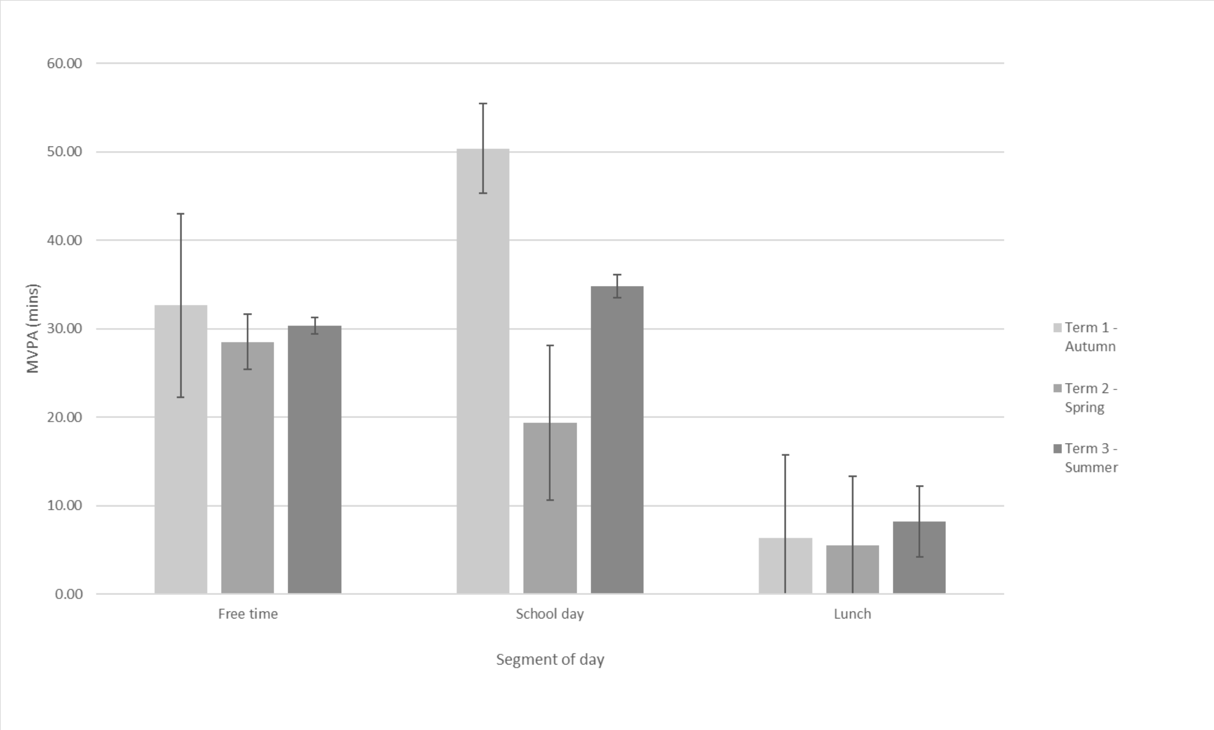


Figure 5. 6 Mean MVPA in each segment of the day according to term

5.3.5 Retention levels across the school year

As no mean daily MVPA minutes statistical differences ($p > 0.05$) had been found between the different school terms, it may have been possible that only the most active children remained in the study for repeated measurements (in Spring and Summer terms), therefore, children's data were explored in relation to retention across the school year. Children were grouped into two categories based on whether they provided data for Autumn term only, or whether they provided data for a minimum of two terms. This is to ascertain whether the least active children 'dropped out' of the study after Autumn term.

There were 134 children who provided information for a minimum of two terms and 16 children who provided information for Autumn term only. An independent t test found no significant difference ($p>0.05$) between the MVPA of the Autumn term only group and the 2 or more terms group, indeed, from looking at the means, the Autumn term group spent 10.2 minutes more in MVPA than the 2 or more terms group over the four day observation period ('Autumn term only' = 142.7 ± 213.3, '2 or more terms' = 132.5 ±189.9). In addition to this, results from an independent samples t-test exploring datasets from both groups of children who met the daily 1 hour MVPA guidelines (Chief Medical Officers, 2019) was non-significant ($p > 0.05$). Fifty six percent (9 out of 16 children) of the 'Autumn term only' group met the 1 hour daily MVPA guidelines and 54% (72 out of 134 children) of the 'Spring term or more' group met the 60-minute daily MVPA guidelines (see Figure 5.7). Therefore, the least active children do not appear to have 'dropped out' of the research after the first phase of data collection.

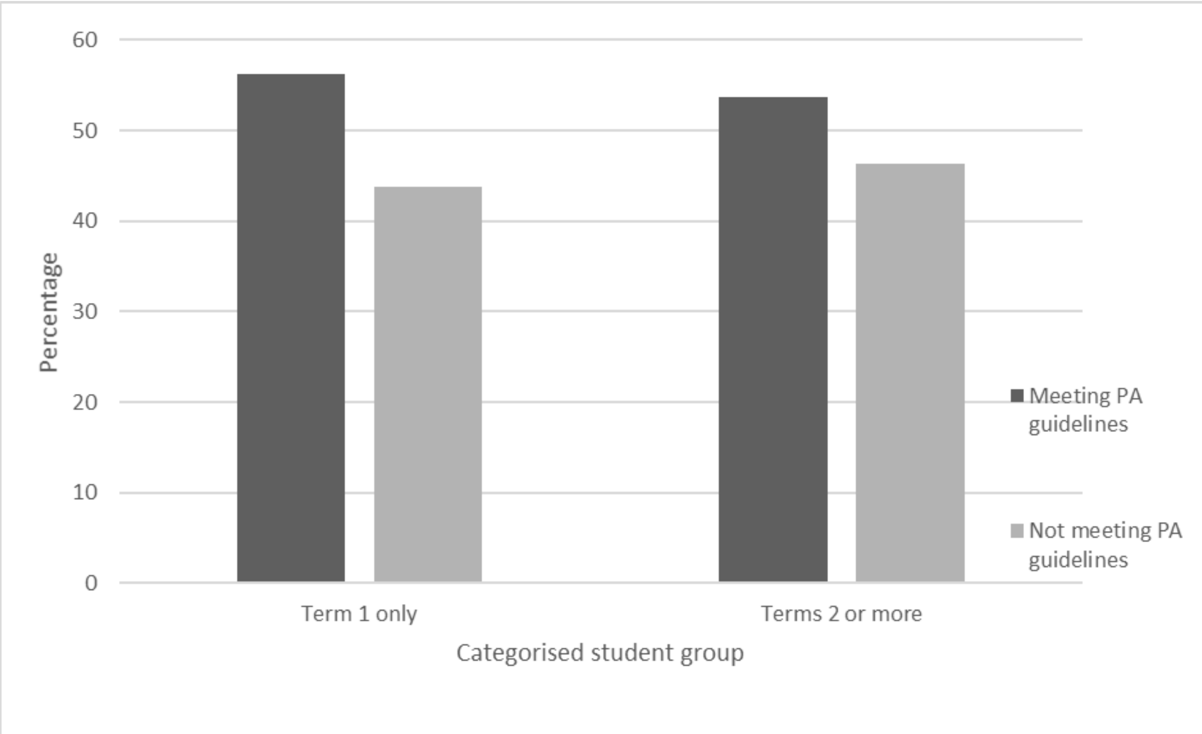


Figure 5. 7 Percentage of children meeting daily 60-minute MVPA guidelines.

5.3.6 Location across the school year

The GPS monitors working alongside the HR monitors meant that location analysis could take place. This meant that it was possible to explore children's movement patterns with their surrounding environment. The following subsection explores the locations children visited and where children chose to engage in PA behaviour. All locations were included but collapsed under descriptive codes to cover the range of locations. These included time at home, on foot, in motorised transport, at school, outdoors, other indoor location, and time outside (combining on foot and outdoors). Descriptive statistics for the mean duration and percentage of time spent in each location for each term is provided in Table 5.1.2.

Multi-level regression analysis was used to explore differences in location per term, which included investigating interactions between gender and key stage.

Time spent at home in Spring and Summer terms were found to be significantly greater ($p < 0.05$) than time spent at home in Autumn term (see Table 5.1.3). However, KS2 boys engaged in significantly greater ($p < 0.05$) mean daily minutes at home in Autumn term (139.7 mins ± 110.8) and Summer term (186.5 mins ± 95.7) than in Spring term (95.99 mins ± 114.34). No such differences were revealed for girls or key stage ($p > 0.05$).

When exploring time spent at school, KS2 boys engaged in significantly greater ($p < 0.05$) mean daily minutes in Autumn term (204.4 mins ± 118.2) than in Summer term (131.4 mins ± 123.6). There were no significant differences when exploring girls or key stage ($p > 0.05$).

Time spent on foot in Spring term was found to be significantly greater ($p < 0.05$) than time spent on foot in Autumn term (see Table 5.1.4). Boys engaged in significantly greater ($p < 0.05$) mean daily minutes on foot in Spring term (49 mins ± 80.1) than boys in Autumn term (27.1 mins ± 33.1). Girls and key stage data revealed no significant differences ($p > 0.05$).

Outdoor time showed that in Spring term, girls spent significantly ($p < 0.05$) more time (54.7 mins ± 95.1) outdoors than boys (20.5 mins ± 25.7). Time spent outside (which combined outdoor time and time spent on foot) in Spring term showed KS3 to engage in significantly more ($p < 0.05$) time outside (107.2 mins ± 129.9) than KS2 children (53.1 mins ± 57.2).

No significant findings were revealed when exploring time spent in motorised transport or other indoor location ($p > 0.05$). Time spent in different locations across three school terms, according to gender and key stage is provided in Figure 5.8, and time spent in different locations for each term, according to gender and key stage are provided in Figures 5.9, 5.10 and 5.11.

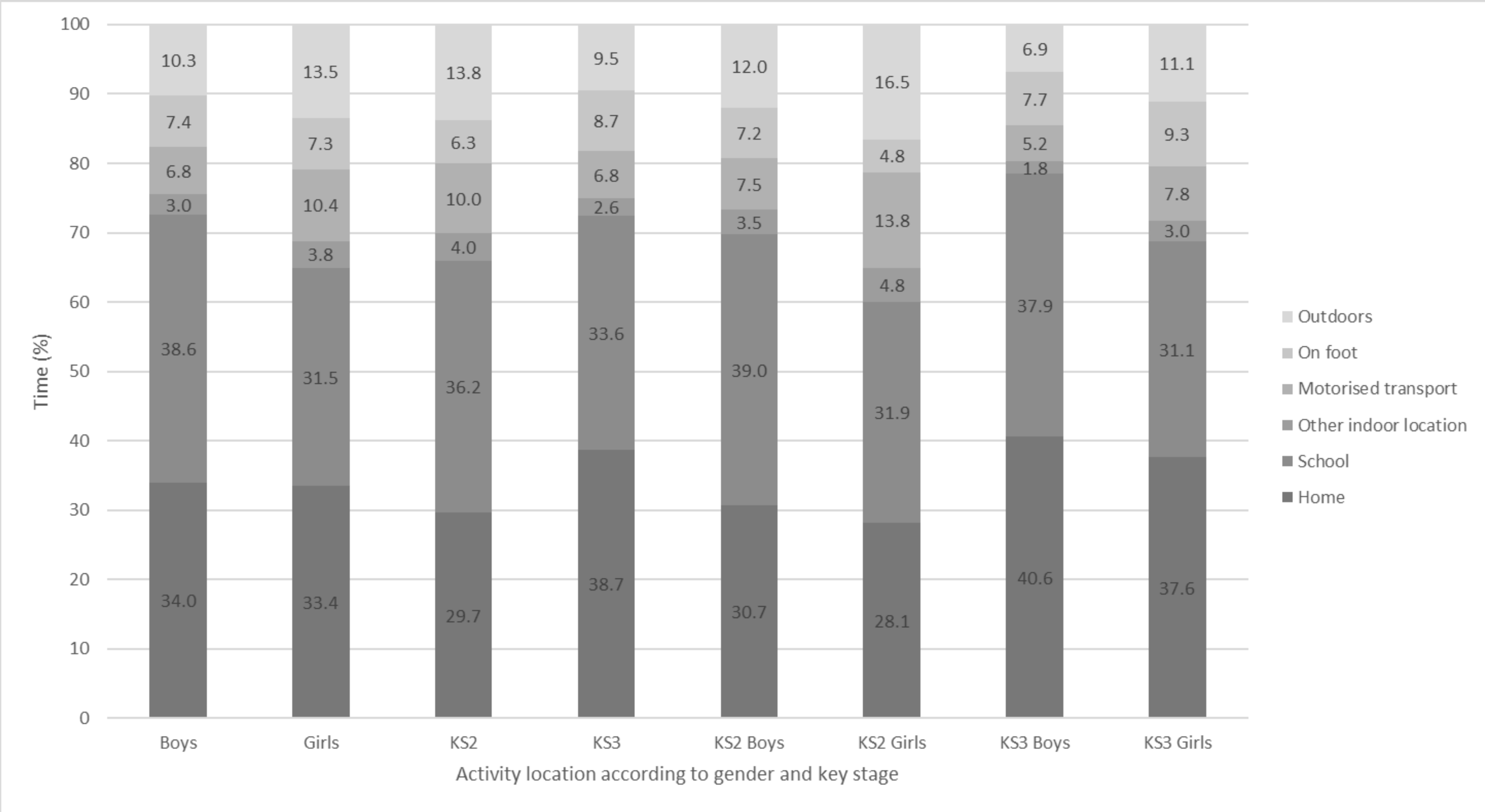


Figure 5. 8 Time (percent) spent in different locations across three school terms, according to gender and key stage.

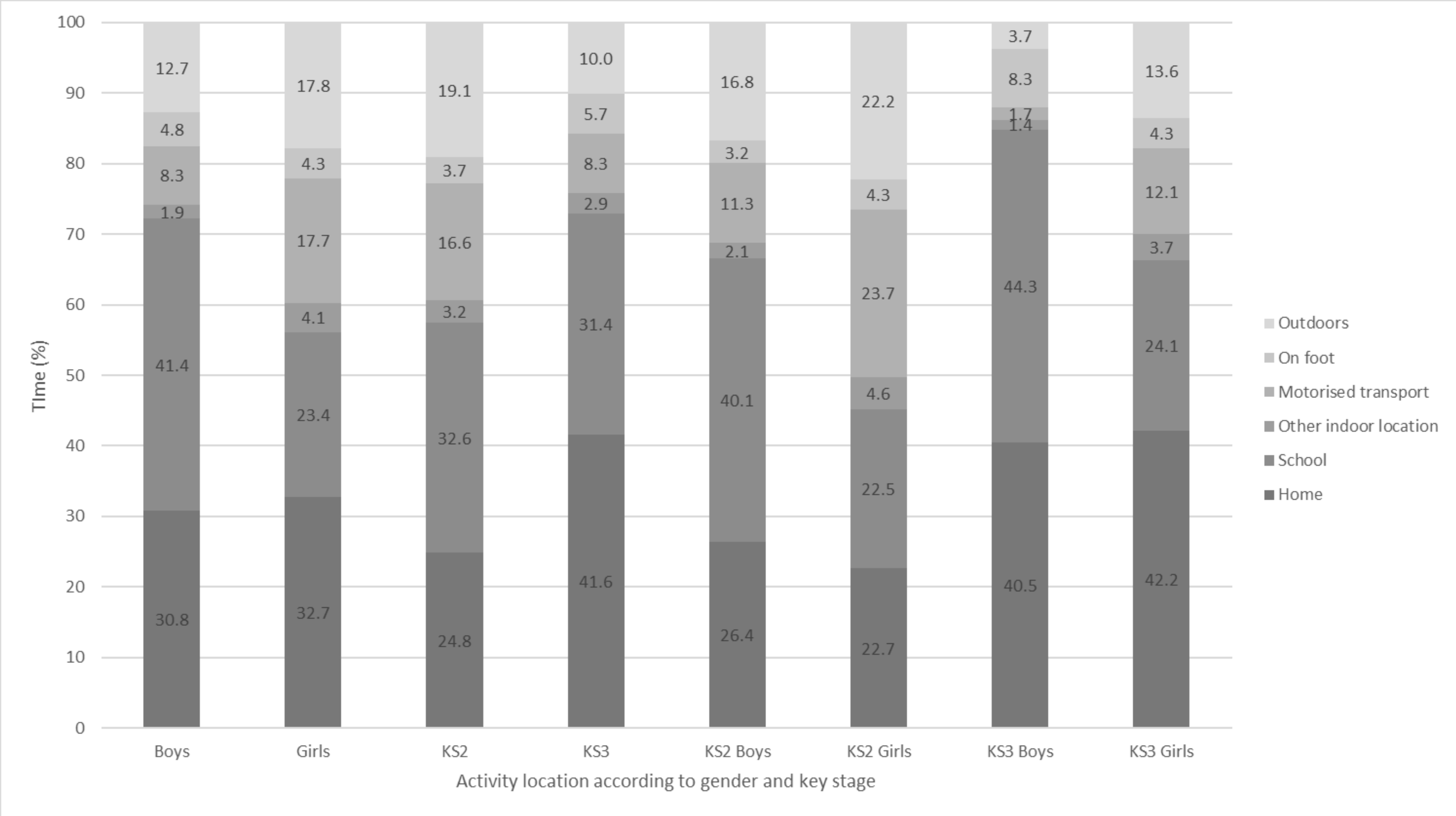


Figure 5. 9 Time (percent) spent in in different locations in Autumn term, according to gender and key stage.

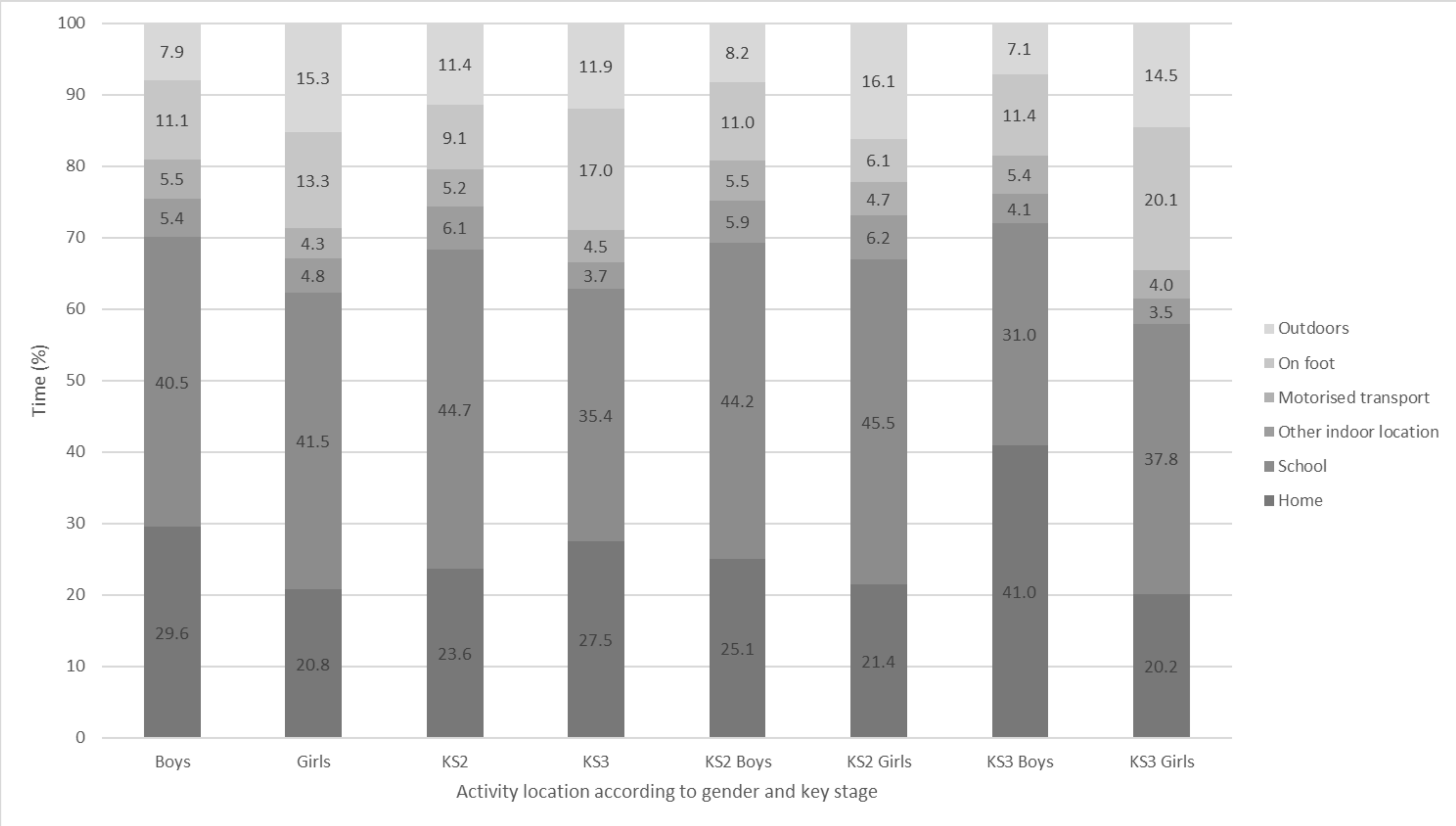


Figure 5. 10 Time (percent) spent in different locations in Spring term, according to gender and key stage.

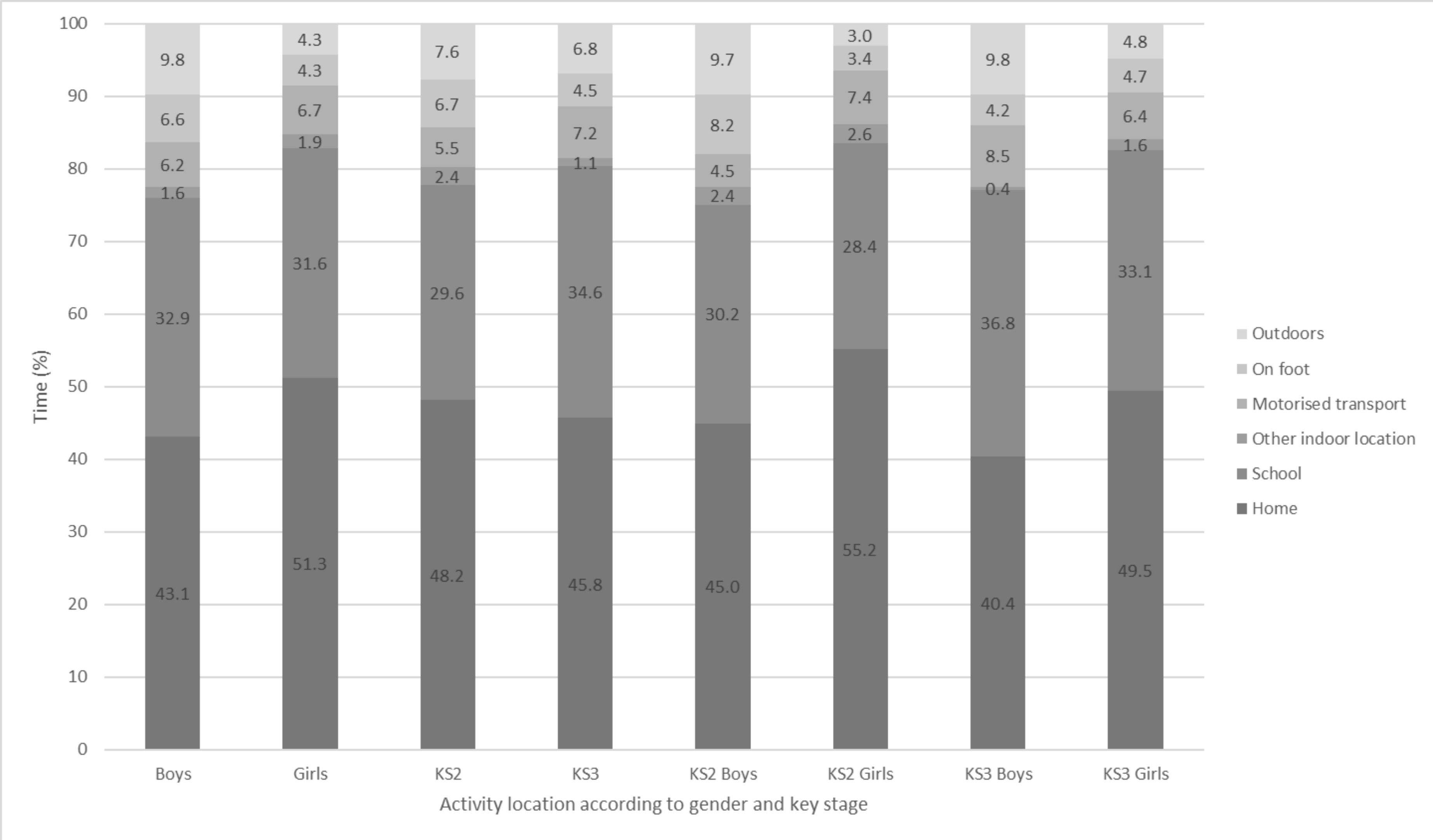


Figure 5. 11 Time (percent) spent in different locations in Summer term, according to gender and key stage.

Table 5.1. 2 Mean (± SD) for duration and percentage of time at each location.

Variable	Combined terms											
	KS2						KS3					
	Boys			Girls			Boys			Girls		
House time (mins)	136.2	±	112.1	151.2	±	169	215.1	±	172.7	199.5	±	184.5
House (%)	30.7%	±	23.2%	28.1%	±	25.5%	40.6%	±	28.8%	37.6%	±	29.7%
School time (mins)	167.3	±	132	134	±	142.7	186.4	±	137.1	146.8	±	139.1
School (%)	39%	±	27.4%	31.9%	±	31%	37.9%	±	28.7%	31.1%	±	26.6%
Other indoor location (mins)	18.7	±	70.7	27.3	±	73.1	8.3	±	18.4	15.7	±	23.5
Other indoor location (%)	3.5%	±	10.8%	4.8%	±	12.1%	1.8%	±	4.1%	3%	±	4.3%
Motorised transport time (mins)	35.5	±	57.2	76.3	±	110.4	28.9	±	61.1	45.1	±	66.1
Motorised transport (%)	7.5%	±	10.8%	13.8%	±	17.5%	5.2%	±	9.1%	7.8%	±	9.3%
On foot time (mins)	29.2	±	32.5	23.5	±	37.7	44.6	±	80.3	40.1	±	52.9
On foot (%)	7.2%	±	7.6%	4.8%	±	6.1%	7.7%	±	10.2%	9.3%	±	14.6%
Outdoors time (mins)	51.5	±	56.7	79.2	±	83.5	32.1	±	41.9	59.5	±	95.1
Outdoors (%)	12%	±	11.3%	16.5%	±	19.7%	6.9%	±	8.1%	11.1%	±	17%
Outside time (mins)	72.2	±	67.2	86.9	±	89.8	73.4	±	96.2	75.8	±	78.1
Outside (%)	16.5%	±	12.8%	16.9%	±	14%	13.6%	±	12.7%	15.8%	±	17%

	Autumn term											
	KS2						KS3					
	Boys			Girls			Boys			Girls		
House time (mins)	139.7	±	110.8	156.4	±	189.8	293	±	190.5	272.3	±	216.2
House (%)	26.4%	±	21.9%	22.7%	±	20.9%	40.5%	±	24%	42.2%	±	30.3%
School time (mins)	204.4	±	118.2	146.6	±	164.8	279.9	±	107.5	139.4	±	165.3
School (%)	40.2%	±	23.8%	22.5%	±	23.8%	44.3%	±	21.2%	24.2%	±	29.4%
Other indoor location (mins)	12.8	±	26.6	26.6	±	65.7	10.3	±	19.7	23.3	±	30.2
Other indoor location (%)	2.1%	±	4.2%	4.6%	±	12%	1.4%	±	2.7%	3.7%	±	4.9%
Motorised transport time (mins)	63.3	±	78.8	141.8	±	136.3	12.3	±	16.8	78.2	±	80.5
Motorised transport (%)	11.3%	±	13.9%	23.7%	±	21.6%	1.7%	±	2.4%	12.1%	±	10.8%
On foot time (mins)	17.2	±	21.6	28.3	±	41.2	48.9	±	44.3	24.6	±	31.1
On foot (%)	3.2%	±	3.8%	4.3%	±	6.1%	8.3%	±	8.1%	4.3%	±	5.7%
Outdoors time (mins)	86.7	±	56.4	135	±	83.8	24.2	±	51.9	84.8	±	99.5
Outdoors (%)	16.8%	±	10.9%	22.2%	±	14.6%	3.7%	±	8.5%	13.6%	±	14.1%
Outside time (mins)	90.7	±	65.9	137.1	±	95.9	69.7	±	52	77.2	±	56.8
Outside (%)	17.3%	±	11.3%	22.3%	±	15.4%	11.5%	±	9%	12.8%	±	8.9%

	Spring term											
	KS2						KS3					
	Boys			Girls			Boys			Girls		
House time (mins)	96	±	114.3	92.7	±	141.4	170.5	±	117.8	94	±	104.9
House (%)	25.1%	±	24.1%	21.4%	±	24.6%	41%	±	31.3%	20.2%	±	18.2%
School time (mins)	152.1	±	148.2	117	±	110.8	101.4	±	73	159.1	±	126.2
School (%)	44.2%	±	32.1%	45.5%	±	37.6%	31%	±	31.9%	37.8%	±	23.6%
Other indoor location (mins)	32.8	±	115	35.2	±	98.5	15	±	26.4	14.4	±	16
Other indoor location (%)	5.9%	±	16.9%	6.2%	±	15.1%	4.1%	±	6.9%	3.5%	±	3.9%
Motorised transport time (mins)	14.7	±	25	14	±	16	22.3	±	31.8	17.3	±	32.5
Motorised transport (%)	5.5%	±	8.8%	4.7%	±	4.8%	5.4%	±	7.2%	4%	±	6%
On foot time (mins)	39.5	±	36.6	22.6	±	43.1	73.2	±	144.6	72.8	±	71.1
On foot (%)	11%	±	7.8%	6.1%	±	7.2%	11.4%	±	16.9%	20.1%	±	21.6%
Outdoors time (mins)	15.5	±	22.3	41.5	±	55.7	33.2	±	30.9	67	±	122.1
Outdoors (%)	8.2%	±	11.3%	16.1%	±	26.6%	7.1%	±	5.1%	14.5%	±	25.4%
Outside time (mins)	51.5	±	48.8	55.5	±	70.4	104.3	±	168.6	108.7	±	108.1
Outside (%)	16.2%	±	14.2%	16%	±	12.4%	17.9%	±	19.5%	27.2%	±	24.4%

	Summer term											
	KS2						KS3					
	Boys			Girls			Boys			Girls		
House time (mins)	186.5	±	95.7	255.5	±	128.9	171.9	±	179.1	215.4	±	165.8
House (%)	45%	±	19.1%	55.2%	±	23.2%	40.4%	±	34.3%	49.5%	±	32.2%
School time (mins)	131.4	±	123.6	136.5	±	161.6	159.1	±	154.4	143.7	±	125.6
School (%)	30.2%	±	25.3%	28.4%	±	27.2%	36.8%	±	34.2%	33.1%	±	25.8%
Other indoor location (mins)	8.2	±	21.8	13.3	±	20	1.2	±	2.5	7.5	±	18.6
Other indoor location (%)	2.4%	±	6.5%	2.6%	±	3.2%	0.4%	±	1%	1.6%	±	3.8%
Motorised transport time (mins)	21.8	±	28	36.9	±	37.4	50.7	±	96.3	32.1	±	57.3
Motorised transport (%)	4.6%	±	5.6%	7.4%	±	8.1%	8.5%	±	13.4%	6.4%	±	8.5%
On foot time (mins)	33.1	±	36.8	13.2	±	9	18.1	±	13.4	26.5	±	40.4
On foot (%)	8.2%	±	8.9%	3.4%	±	2.9%	4.2%	±	2.6%	4.7%	±	6.1%
Outdoors time (mins)	47.2	±	60.2	14.8	±	18.5	39.1	±	41.6	20.9	±	32.9
Outdoors (%)	9.7%	±	9.7%	3.1%	±	3.5%	9.8%	±	9.1%	4.8%	±	6%
Outside time (mins)	72.4	±	85.7	24.4	±	18.4	53	±	49	41.3	±	51.6
Outside (%)	15.9%	±	14.1%	5.4%	±	3.7%	12.2%	±	9.9%	8%	±	8.3%

Table 5.1. 3 Multilevel regression analysis to estimate academic school term differences of mean daily minutes spent at home according to term.

Fixed Explanatory Variables	Estimate (mins)
Constant (*a*) – Autumn term	197.5 ± 42.4
Spring term (Δ*a*)	212.9 ± 64.7*
Summer term (Δ*a*)	294.8 ± 64.1*
Variance of Random Variables	
	Constant (*a)*
Level 1 (within school terms)	
Constant (*aij)*	4998.3 ± 13148.8
Level 2 (between school terms)	
Constant (a_i)	93888.1 ± 16964.5

*Statistically significant difference between school term (p <0.05).

Values are daily means ± standard error of estimate. Autumn term was used as the baseline measure (*a*), and other terms (Spring term and Summer term) were compared with it, indicated by (Δ*a*).

Table 5.1. 4 Multilevel regression analysis to estimate academic school term differences of mean daily minutes spent on foot according to term.

Fixed Explanatory Variables	Estimate (mins)
Constant (*a*) – Autumn term	38 ± 16.9
Spring term (Δ*a*)	80.3 ± 24*
Summer term (Δ*a*)	6.7 ± 25.2
Variance of Random Variables	
	Constant (*a)*
Level 1 (within school terms)	

Constant (*aij)*	599.7 ± 1766.5
Level 2 (between school terms)	
Constant (a_i)	11430.3 ± 2266.2

*Statistically significant difference between school term (p <0.05).

Values are daily means ± standard error of estimate. Autumn term was used as the baseline measure (*a*), and other terms (Spring term and Summer term) were compared with it, indicated by (Δ*a*).

5.3.7 Heart rate intensities according to location

Following on from the previous subsection of this chapter, MVPA and other heart rate intensities were explored in the different locations for each school term, and then combining the terms together to produce overall descriptives of HR intensity (mins and %) according to location. Multilevel regression analysis was used to investigate children's HR and location, and this specifically explored gender and key stage differences. Statistically significant findings are presented below. Mean duration of time spent (mins and %) in different heart rate intensities per location according to school term, is provided in Appendix 10.

When exploring SB at home, KS3 boys in Autumn term spent almost four times as much time being sedentary (208.3 mins ± 180.7; $p < 0.05$) compared with KS2 boys (54 mins ± 75.3). In addition to this, when exploring percent sedentary time, KS3 boys in Autumn term engaged in approximately twice as much SB as KS3 girls whilst at home (KS3 boys = 73% ± 29.4%, KS3 girls = 36.5% ± 34.4%; $p < 0.05$).

LPA results revealed that when combining data for all three school terms, KS2 children engaged in significantly more percent LPA ($p < 0.05$) than KS3 whilst at home (KS2 = 43.3% ± 31.2, KS3 = 33% ± 28.1). Furthermore, boys engaged in almost double the amount of percent LPA at home than girls during Spring term (boys = 44.2% ± 24.4%, girls = 24.4% ± 25.5%; $p < 0.05$).

MPA results found that combined terms data showed KS3 girls engaged in over four times the amount of MPA than KS3 boys when at home (KS3 boys = 4.3% ± 9, KS3 girls = 19.4% ± 29.7; $p < 0.05$). PA behaviours according to the home environment for combined terms and each school term are presented in Figures 5.12 - 5.15.

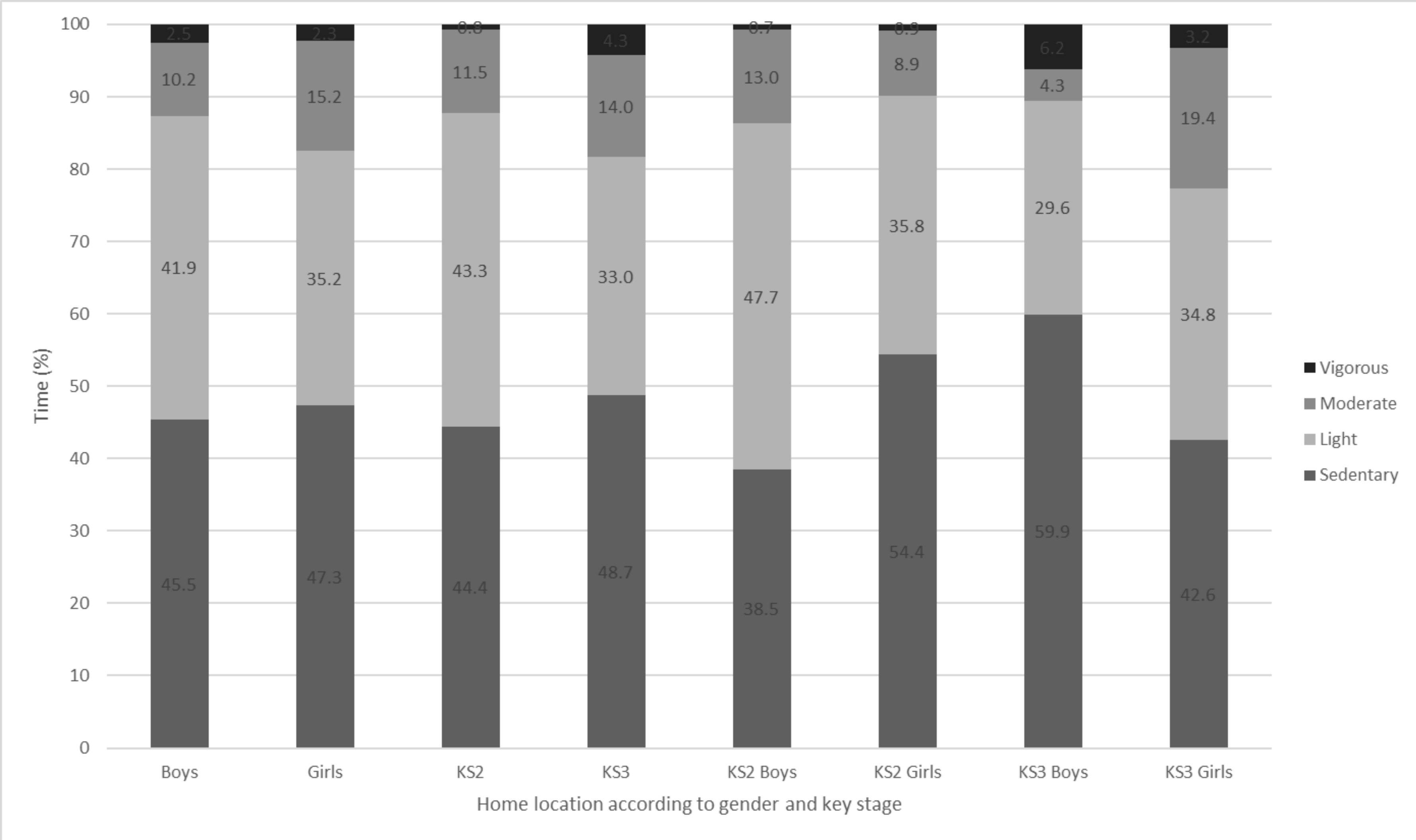


Figure 5. 12 Time (%) in each HR intensity at home across all school terms.

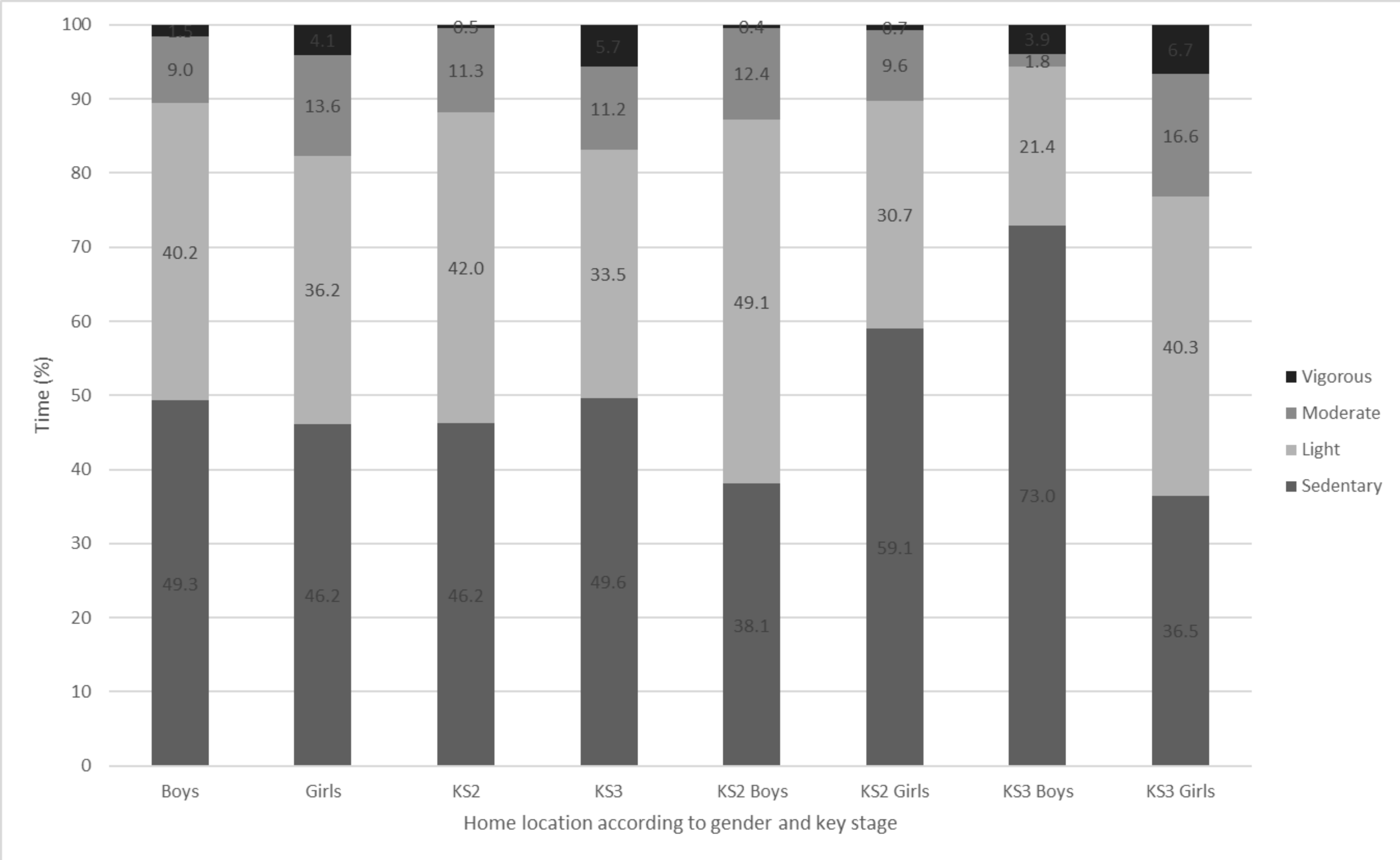


Figure 5. 13 Time (%) in each HR intensity at home according to Autumn term.

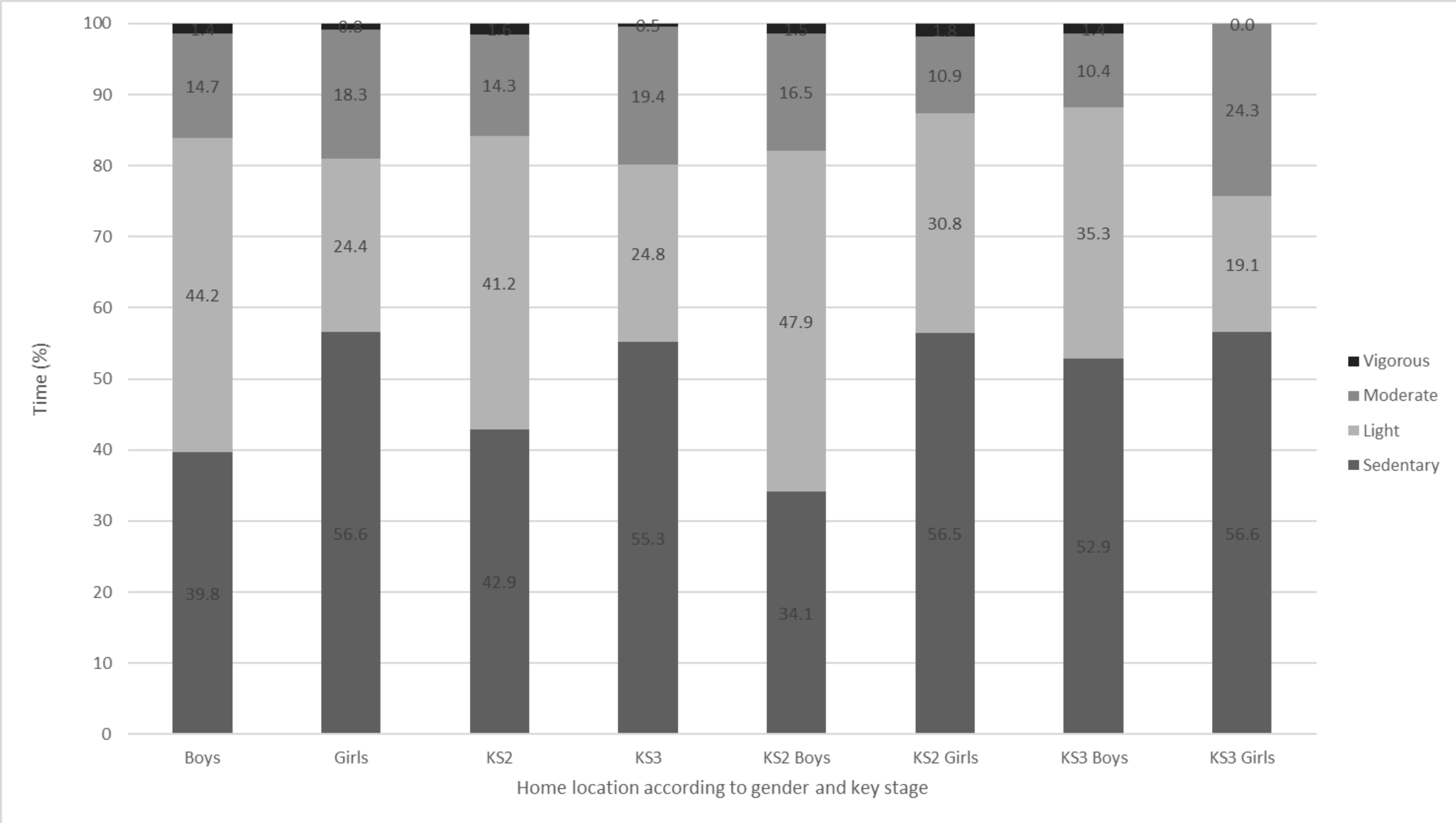


Figure 5. 14 Time (%) in each HR intensity at home according to Spring term.

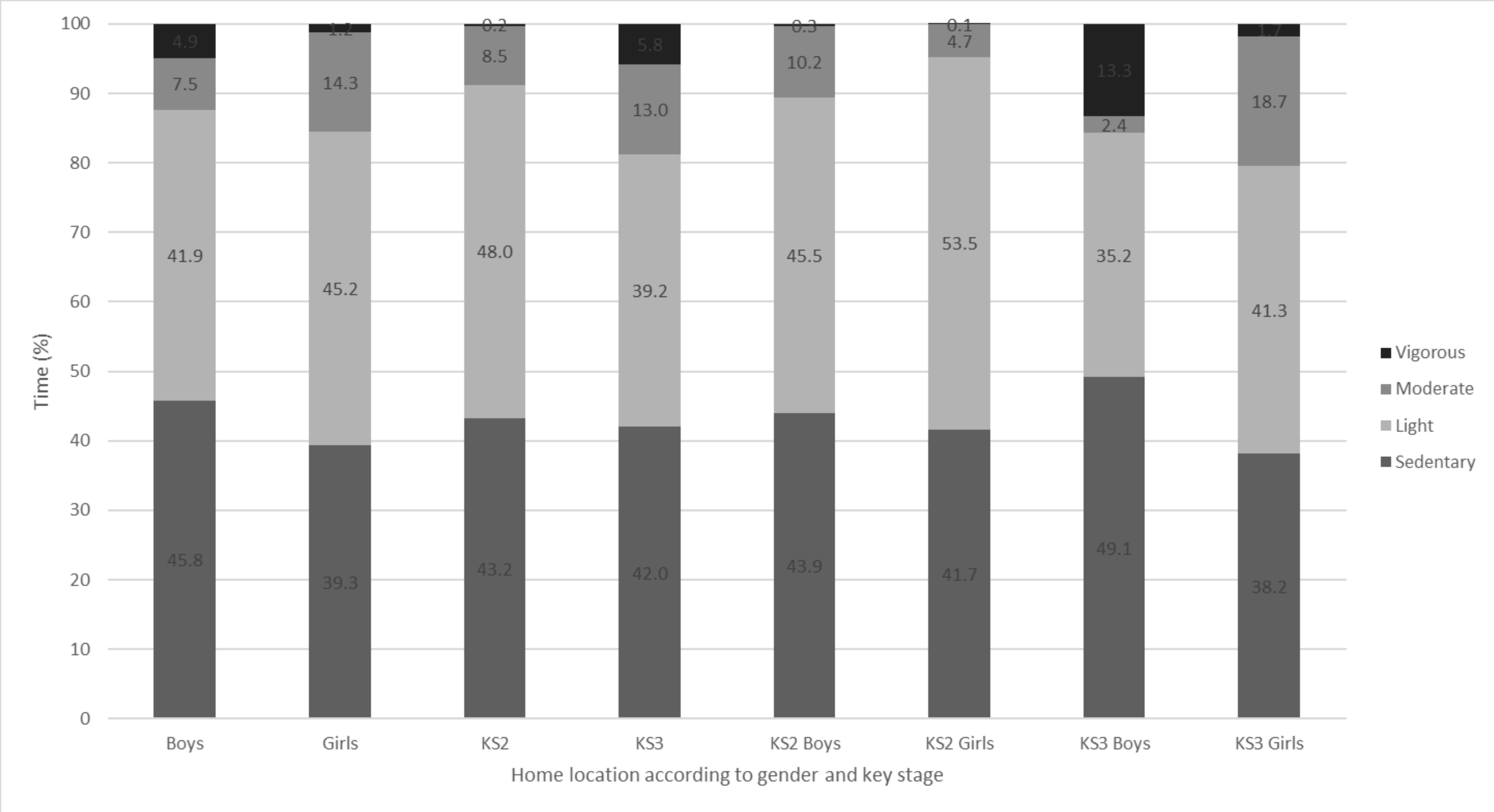


Figure 5. 15 Time (%) in each HR intensity at home according to Summer.

When exploring time spent at school, KS3 girls spent almost twice as much time sedentary at school than KS3 boys (KS3 boys = 29.6% ± 31%, KS3 girls = 57.2% ± 21.6%; $p < 0.05$).

In addition to this, school results showed KS3 boys engaged in more than double the amount of LPA (121.7 mins ± 92.2; $p < 0.05$) than KS3 girls (52.6 mins ± 68.2) during Autumn term. Furthermore, combined data for all three terms revealed KS2 boys to engage in significantly more LPA than KS2 girls (KS2 boys = 46.4% ± 25.6%, KS2 girls = 32.8% ± 25.8%; $p < 0.05$). Further LPA results showed boys engaged in significantly more LPA in Summer term (103.3 mins ± 86.7; $p < 0.05$), than in Autumn term (60.4 mins ± 80.8). Finally, during Autumn term, girls engaged in less than half the amount of LPA (46.6 mins ± 66.3; $p < 0.05$) than boys (103.3 mins ± 86.7).

MPA results during school time revealed that KS3 boys engaged in over twice as much MPA at school than KS3 girls during Spring term (KS3 boys = 18% ± 14.5%, KS3 girls = 7.2% ± 4.2%; $p < 0.05$). Additionally, during Summer term, KS3 engaged in significantly more MPA (47.8 mins ± 69.4; $p < 0.05$) than KS2 (9.6 mins ± 12.3). More specifically, school time during Summer term showed KS3 boys engaged in significantly more MPA (55 mins ± 90.4; $p < 0.05$) than KS2 boys (7.2 mins ± 12.1). However, percent MPA showed KS2 girls engaged in over three times as much MPA than KS2 boys during Summer term (KS2 boys = 7% ± 6.4%, KS2 girls = 22.2% ± 21.6%; $p < 0.01$).

Finally, when combining data for all three school terms, KS3 engaged in significantly more percent MPA than KS2 (KS2 = 12.8% ± 12%, KS3 = 18.8% ± 18.1%; $p < 0.05$).

MVPA findings within school showed during Spring term, KS3 boys engaged in more than double the amount of MVPA than KS3 girls (KS3 boys = 21.9% ± 17.1%, KS3 girls = 8.7% ± 5.2%; $p < 0.05$). PA behaviours according to time at school for combined terms and each school term are presented in Figures 5.16 – 5.19.

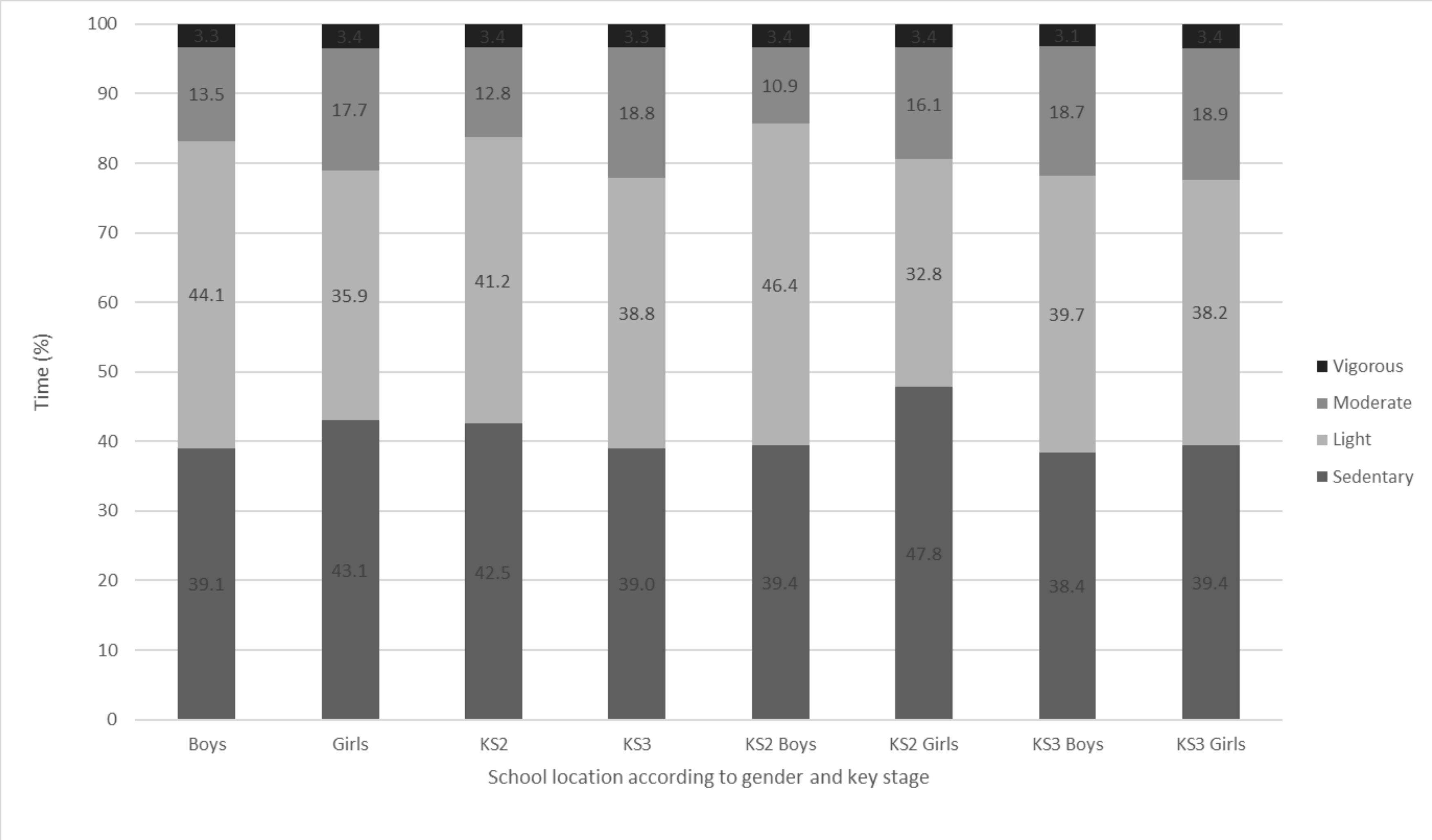


Figure 5. 16 Time (%) in each HR intensity at school across all school terms.

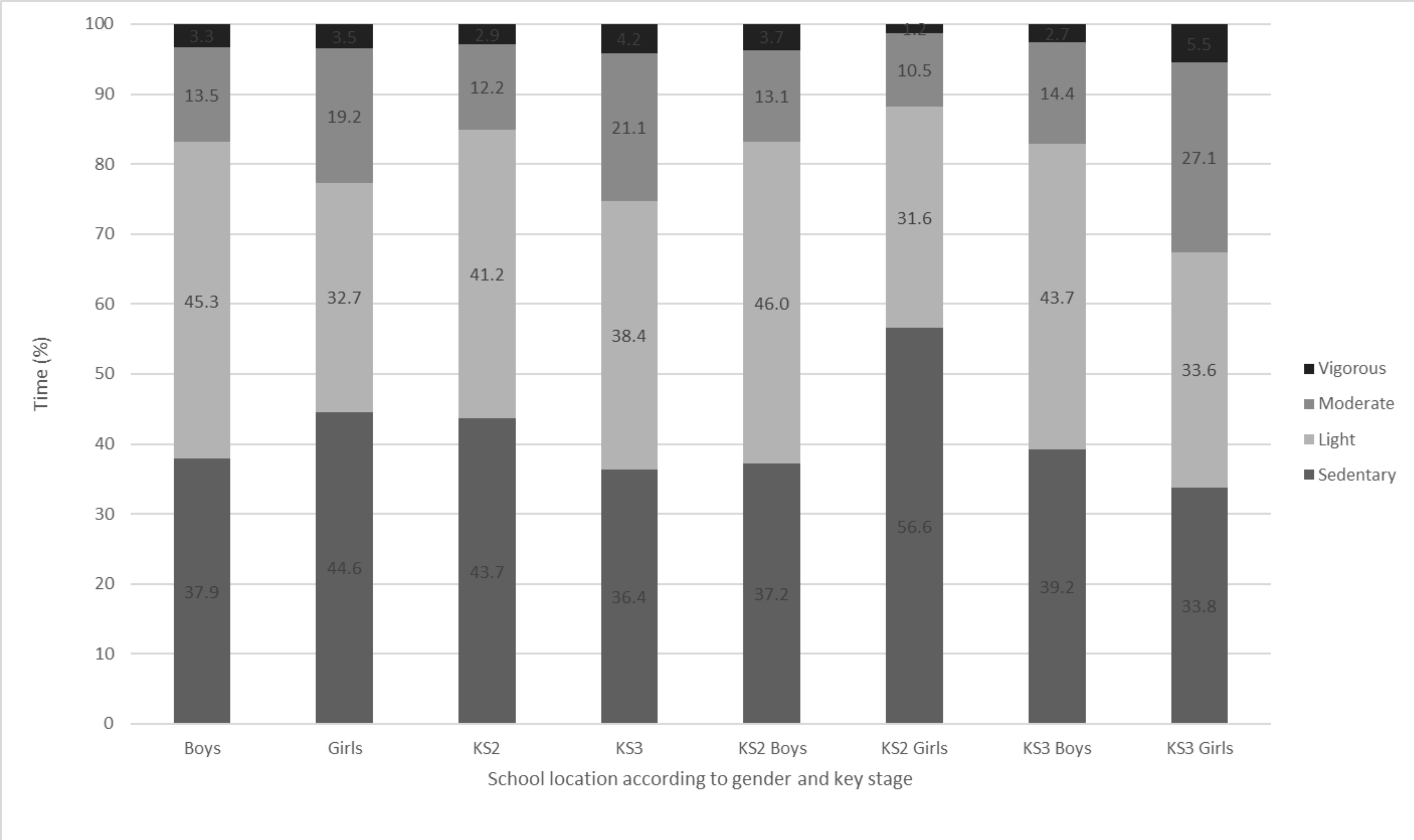


Figure 5. 17 Time (%) in each HR intensity at school according to Autumn term.

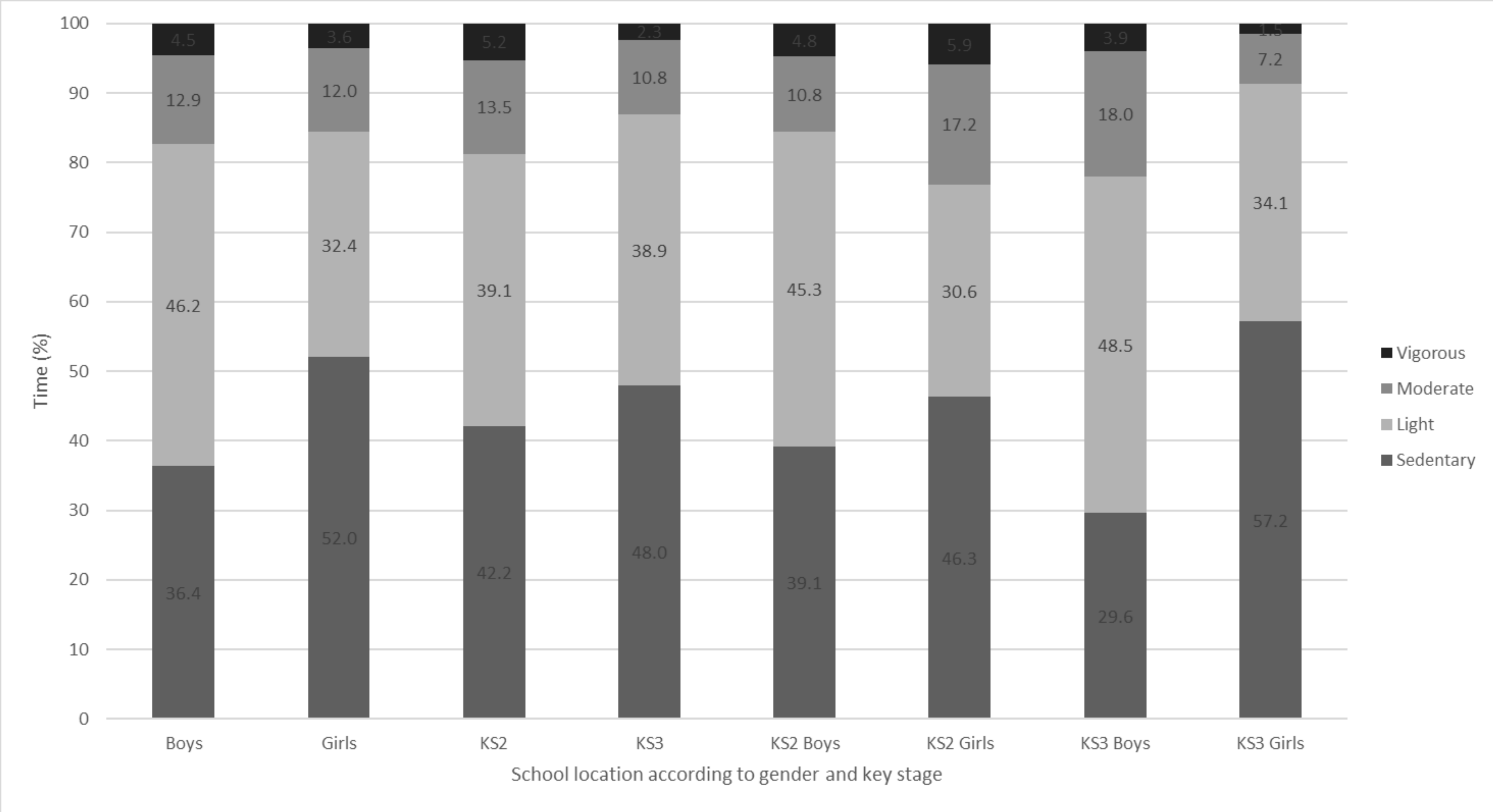


Figure 5. 18 Time (%) in each HR intensity at school according to Spring term.

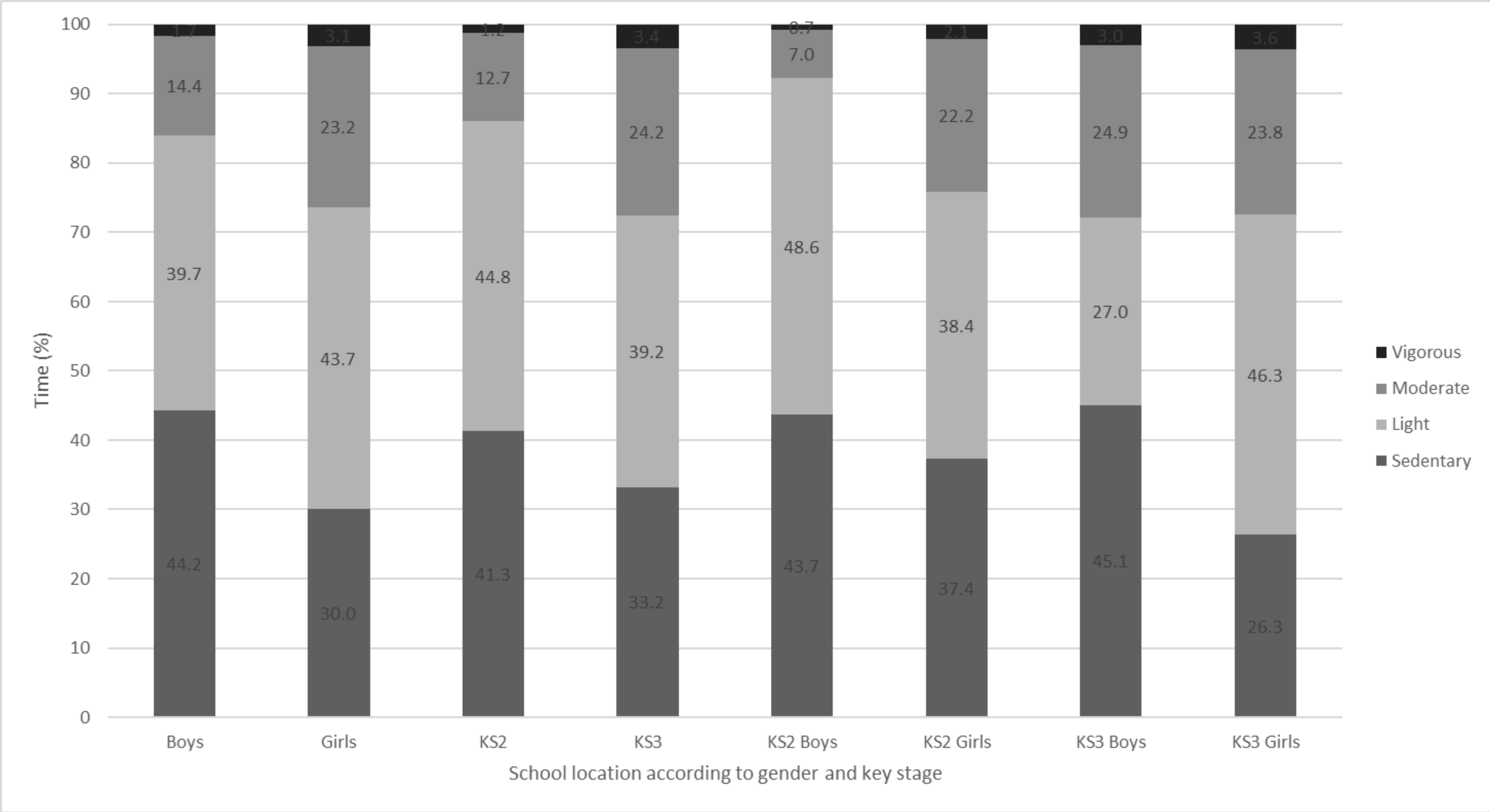


Figure 5. 19 Time (%) in each HR intensity at school according to Summer term.

There were no significant findings reported for time spent (mins) in other indoor location ($p > 0.05$). However, when combining data for all three school terms, KS3 boys engaged in almost double the amount of percent LPA than KS3 girls (KS3 boys = 61.9% ± 29.7%, KS3 girls = 34.8% ± 29.2%; $p < 0.05$) when in other indoor locations. PA behaviours according to time in other indoor locations for combined terms and each school term are presented in Figures 5.2.3 – 5.2.6.

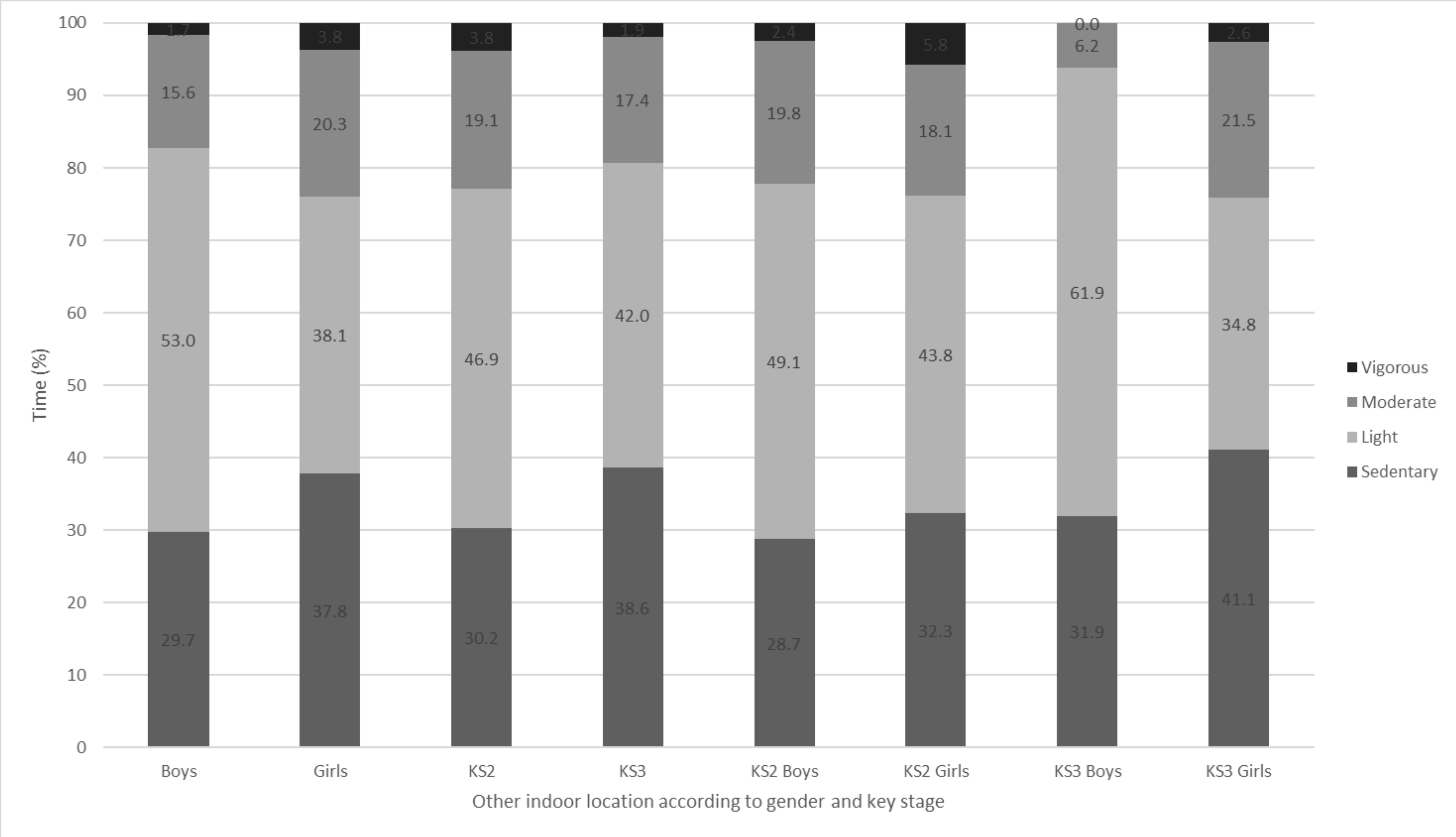


Figure 5. 20 Time (%) in each HR intensity in other indoor location across all school terms.

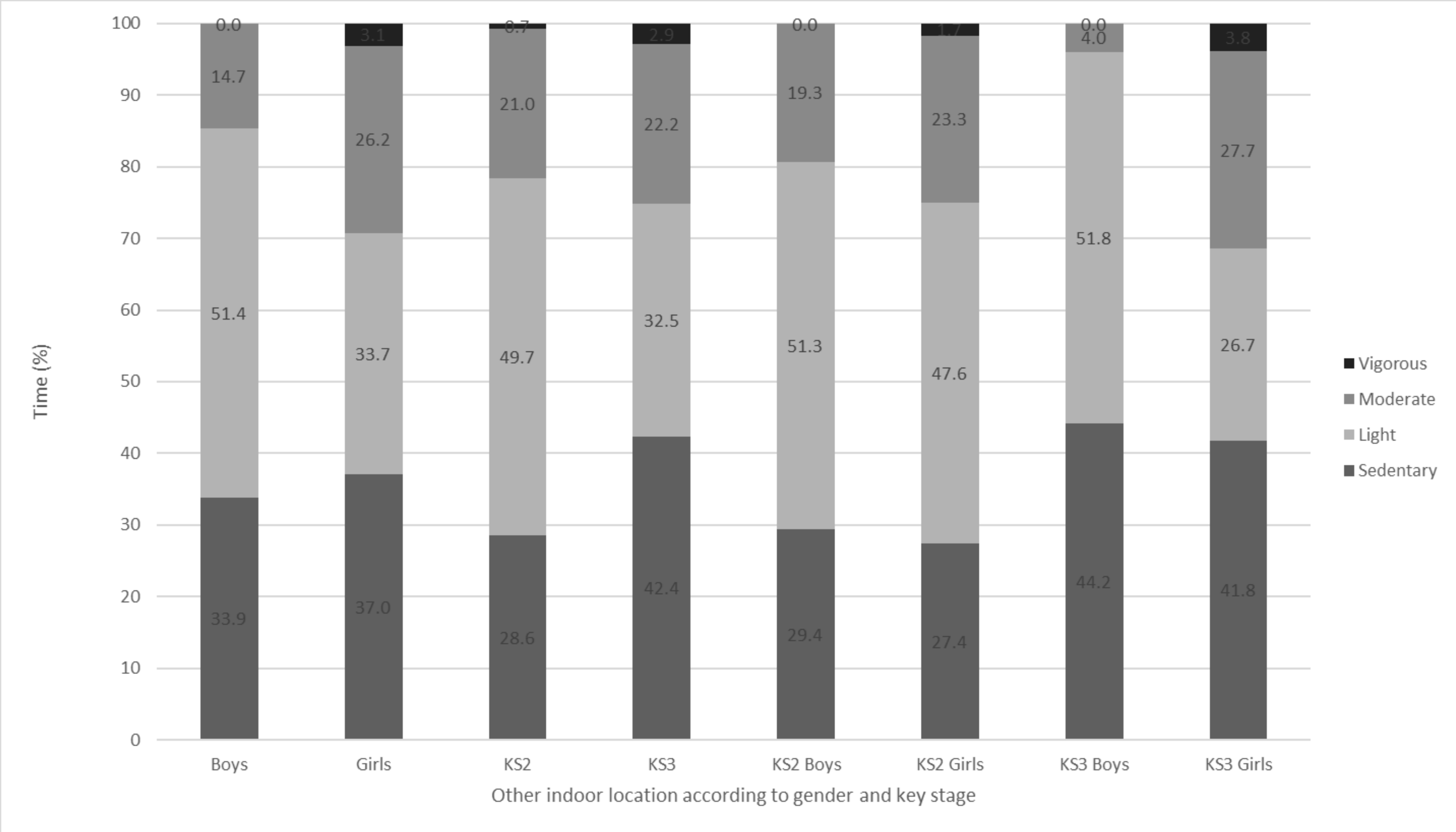


Figure 5. 21 Time (%) in each HR intensity in other indoor location according to Autumn term.

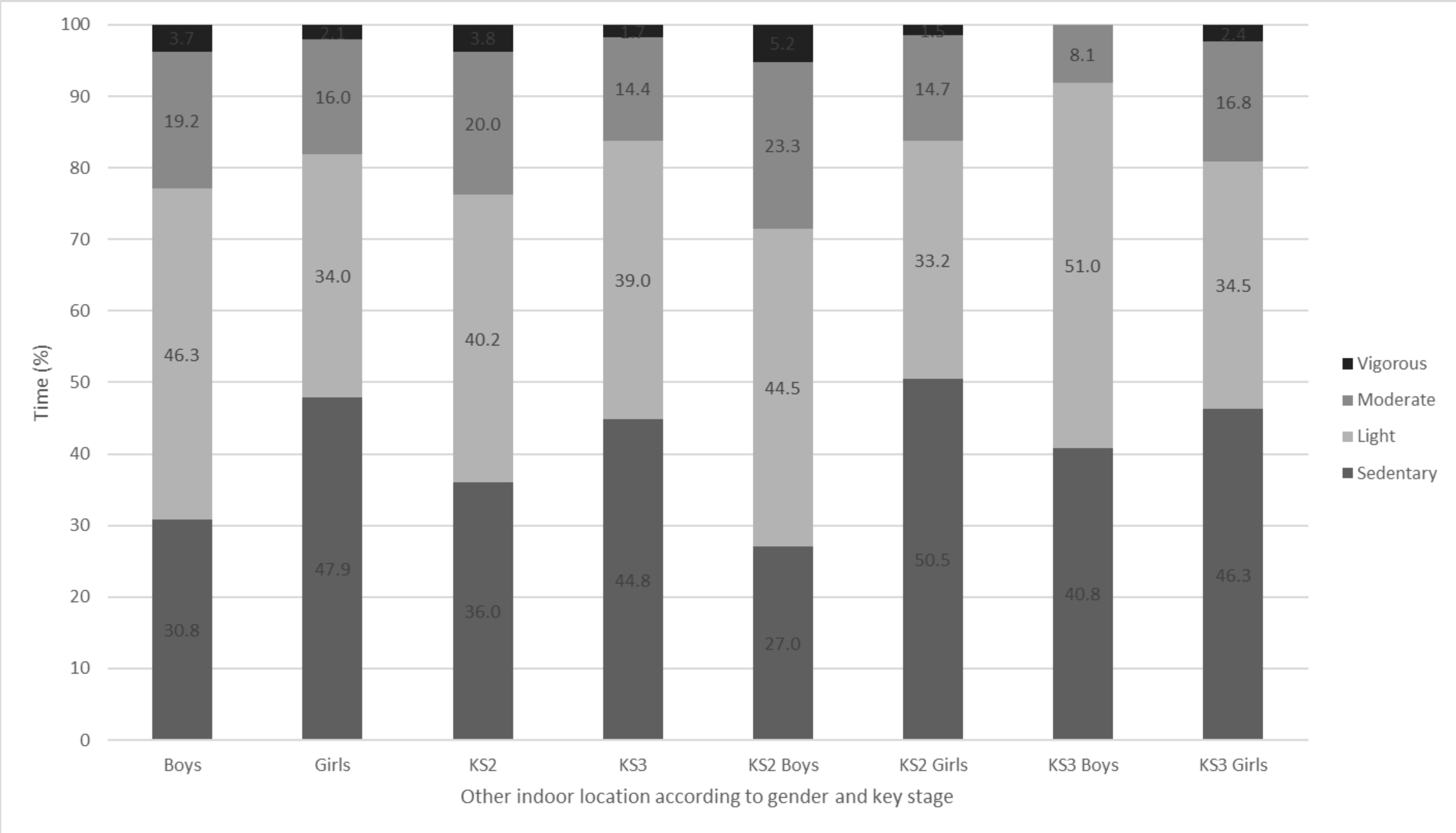


Figure 5. 22 Time (%) in each HR intensity in other indoor location according to Spring term.

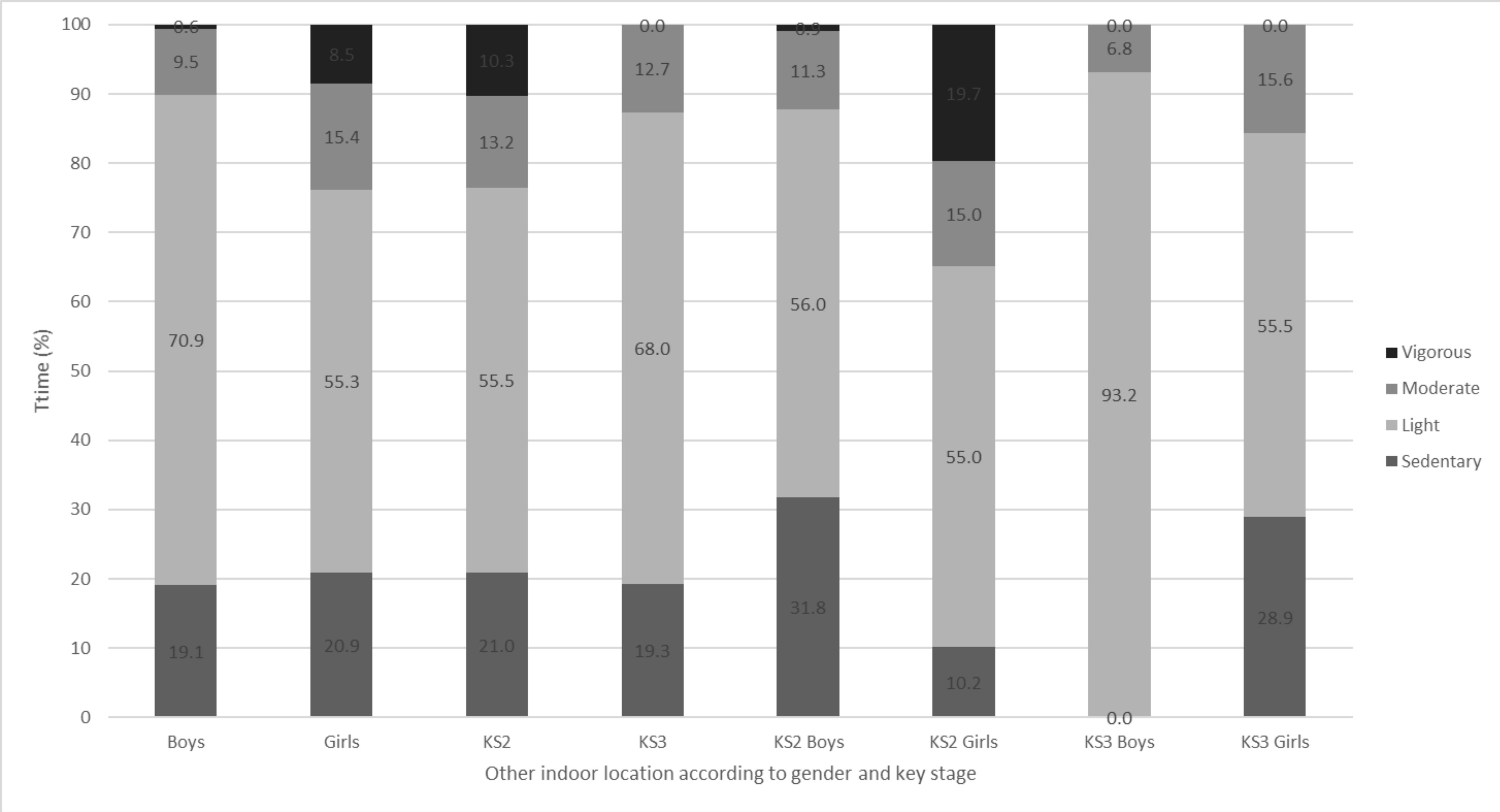


Figure 5. 23 Time (%) in each HR intensity in other indoor location according to Summer term.

When exploring motorised transport, KS2 boys engaged in four times as much LPA in Autumn term (20 mins ± 27; $p < 0.05$), than Spring term (4.6 mins ± 6.4). Additionally, during Autumn term, data showed boys to engage in significantly more LPA than girls (boys = 40.2% ± 27.1%, girls = 25% ± 20.2%; $p < 0.05$), and more specifically KS3 boys engaged in over twice as much LPA than KS3 girls (KS3 boys = 50.8% ± 27.7, KS3 girls = 24.2% ± 16.2; $p < 0.05$) whilst in motorised transport.

MPA behaviours within motorised transport in Autumn term showed KS2 boys to engage in significantly more MPA (6.8 mins ± 8.5; $p < 0.05$) than KS3 boys (0.5 mins ± 0.9). Additionally, during Autumn term, KS3 girls engaged in significantly more MPA (11.9 mins ± 22.7; $p < 0.05$) than KS3 boys (0.5 mins ± 0.9).

When combining data for all three school terms for motorised transport, KS3 girls engaged in over four times the amount of percent MPA than KS3 boys (KS3 boys = 3.6% ± 6%, KS3 girls = 18.3% ± 24.6%; $p < 0.05$).

Finally, vigorous physical activity (VPA) findings in motorised transport revealed KS3 girls engaged in significantly more VPA (2.3 mins ± 3.7; $p < 0.05$) than KS3 boys (0.0 mins ± 0.1) during Autumn term.

MVPA time in motorised transport revealed that KS2 boys engaged in significantly more ($p < 0.05$) MVPA time (7.5 mins ± 8.6) than KS3 boys (0.5 mins ± 1) during Autumn term. Additionally, KS3 girls also engaged in significantly more ($p < 0.05$) MVPA (13.9 mins ± 24.4) than KS3 boys (0.5 mins ± 1) during Autumn term.

Finally, when combining data for all three terms KS3 girls engaged in over five times the amount of MVPA than KS3 boys (KS3 boys = 3.9% ± 7%, KS3 girls = 21.1% ±

27%; $p < 0.05$). PA behaviours according to time in motorised transport for combined terms and each school term are presented in Figures 5.24 -5.27.

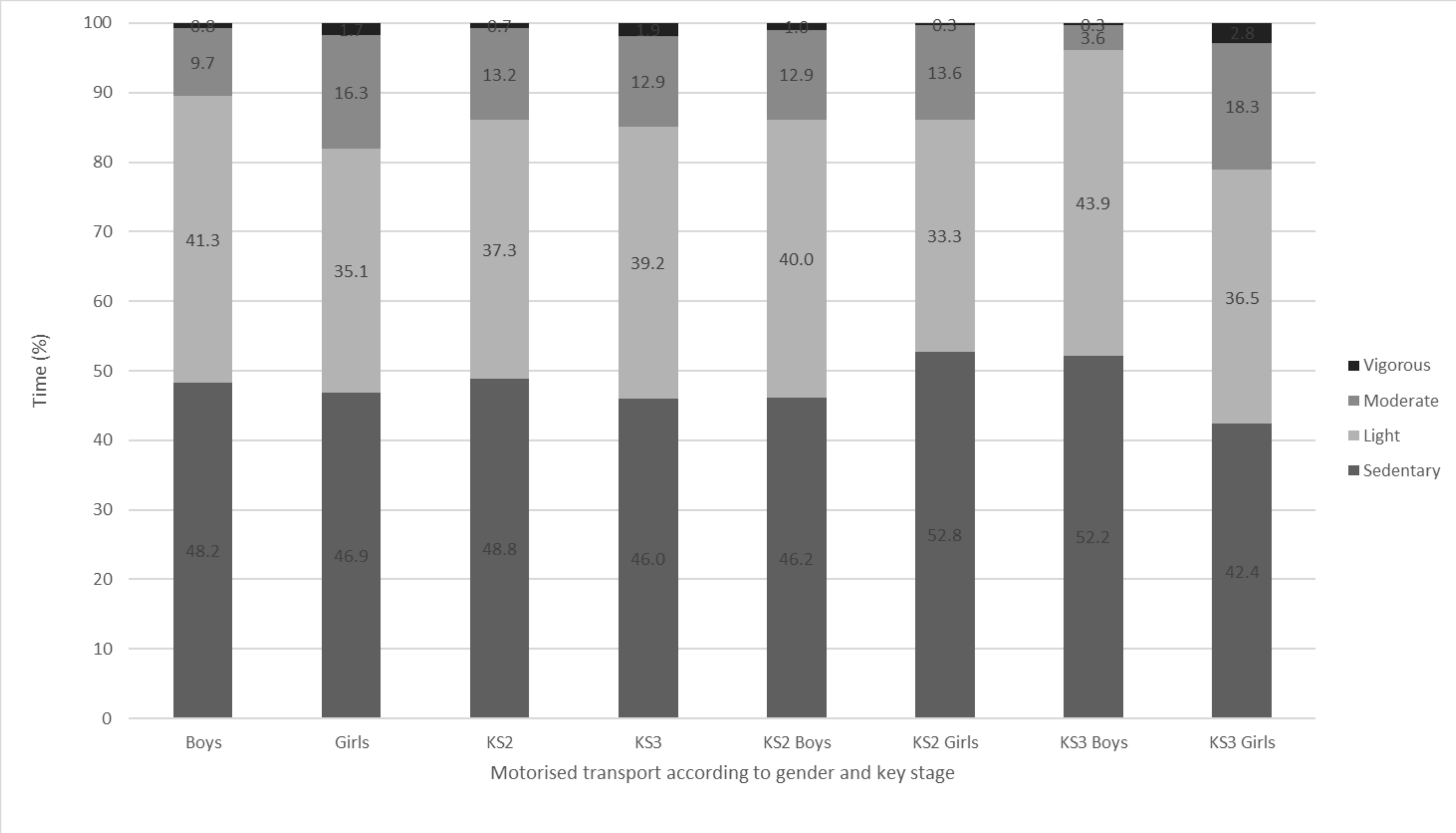


Figure 5. 24 Time (%) in each HR intensity in motorised transport across all school terms.

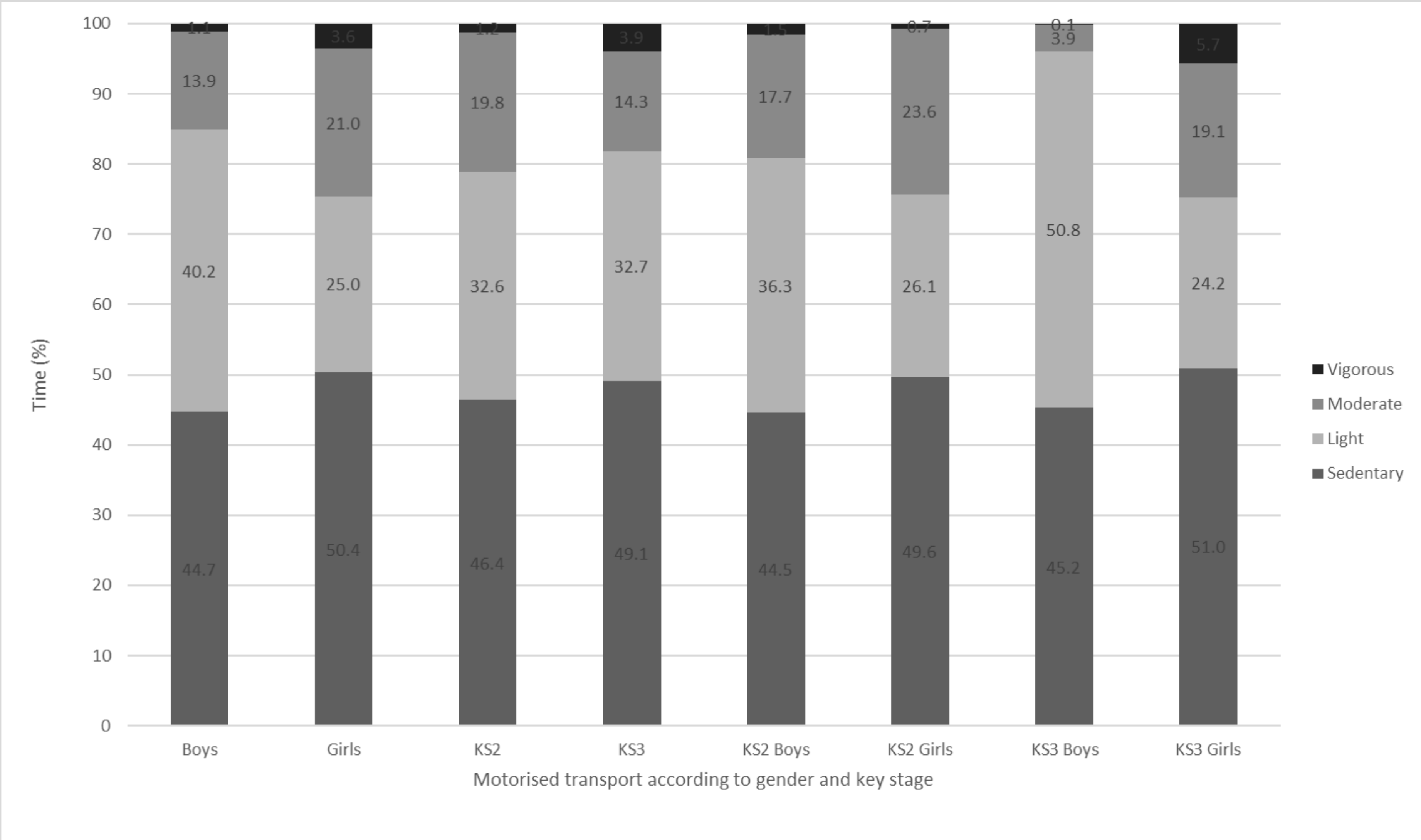


Figure 5. 25 Time (%) in each HR intensity in motorised transport according to Autumn term.

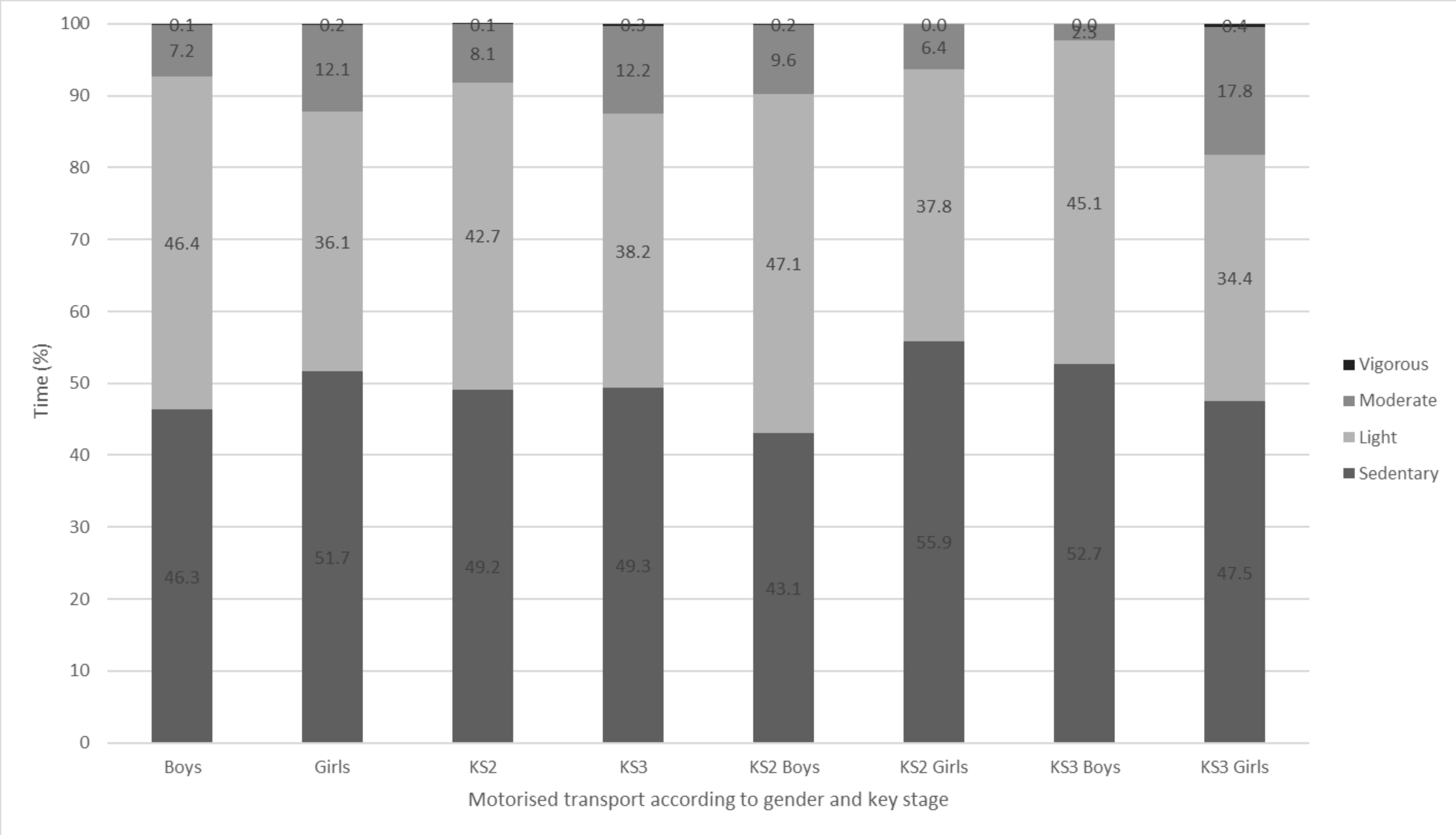


Figure 5. 26 Time (%) in each HR intensity in motorised transport according to Spring term.

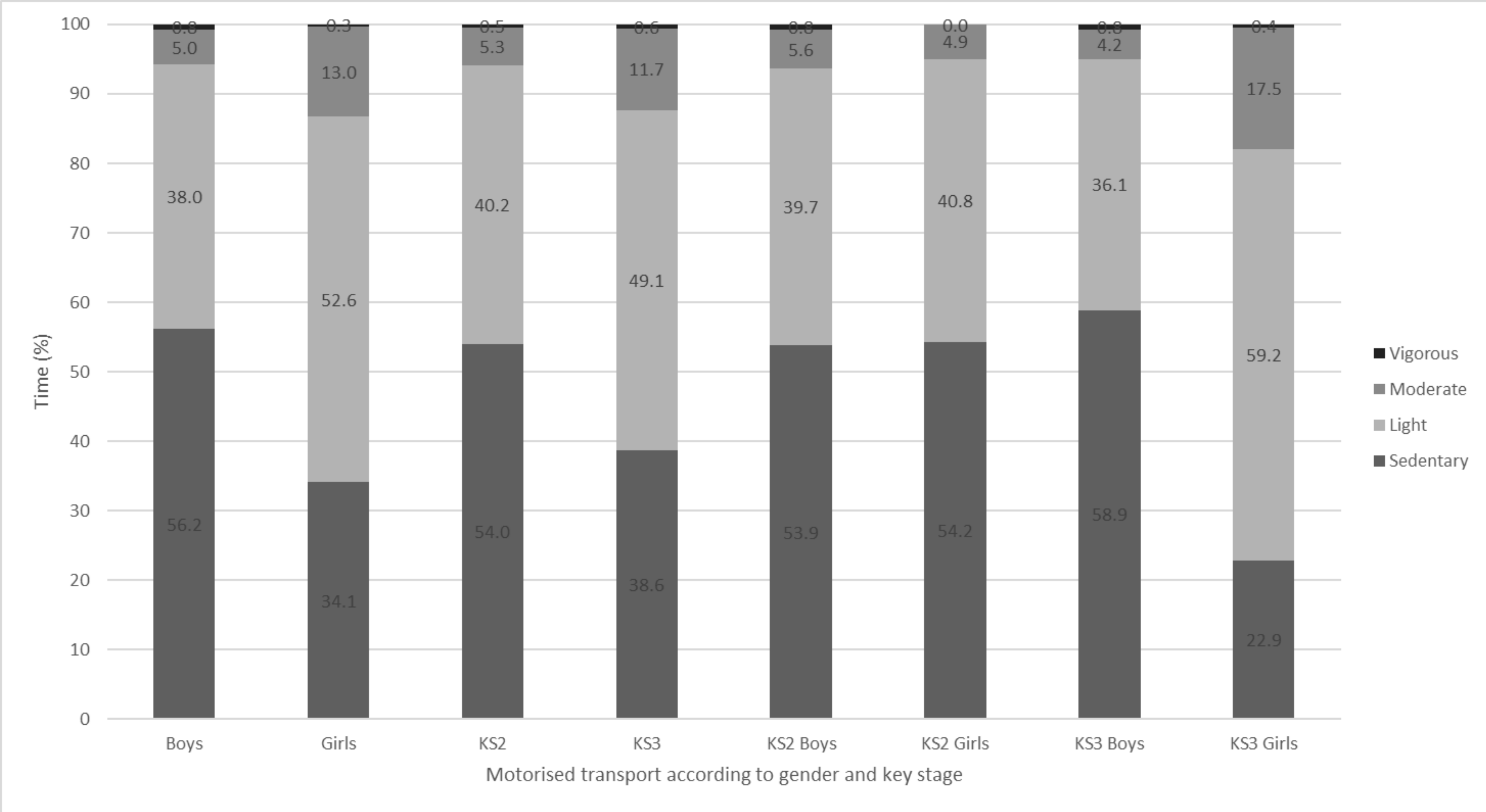


Figure 5. 27 Time (%) in each HR intensity in motorised transport according to Summer term.

When analysing time spent on foot, children spent almost double the amount of time ($p < 0.05$) in LPA in Spring term (17.5 mins ± 27.8) when compared with Autumn term (8.8 mins ± 12.8). More specifically within Spring term, KS2 children engaged in over three times the amount of LPA (19 mins ± 31.6; $p < 0.05$) than KS2 in Autumn term (6.5 mins ± 9.5).

Analysis of percent time on foot showed KS2 engaged in more LPA than KS3 during Spring term (KS2 = 50.7% ± 20.7%, KS3 = 32.4% ± 27.7%; $p < 0.05$). PA behaviours according to time on foot for combined terms and each school term are presented in Figures 5.28 - 5.31.

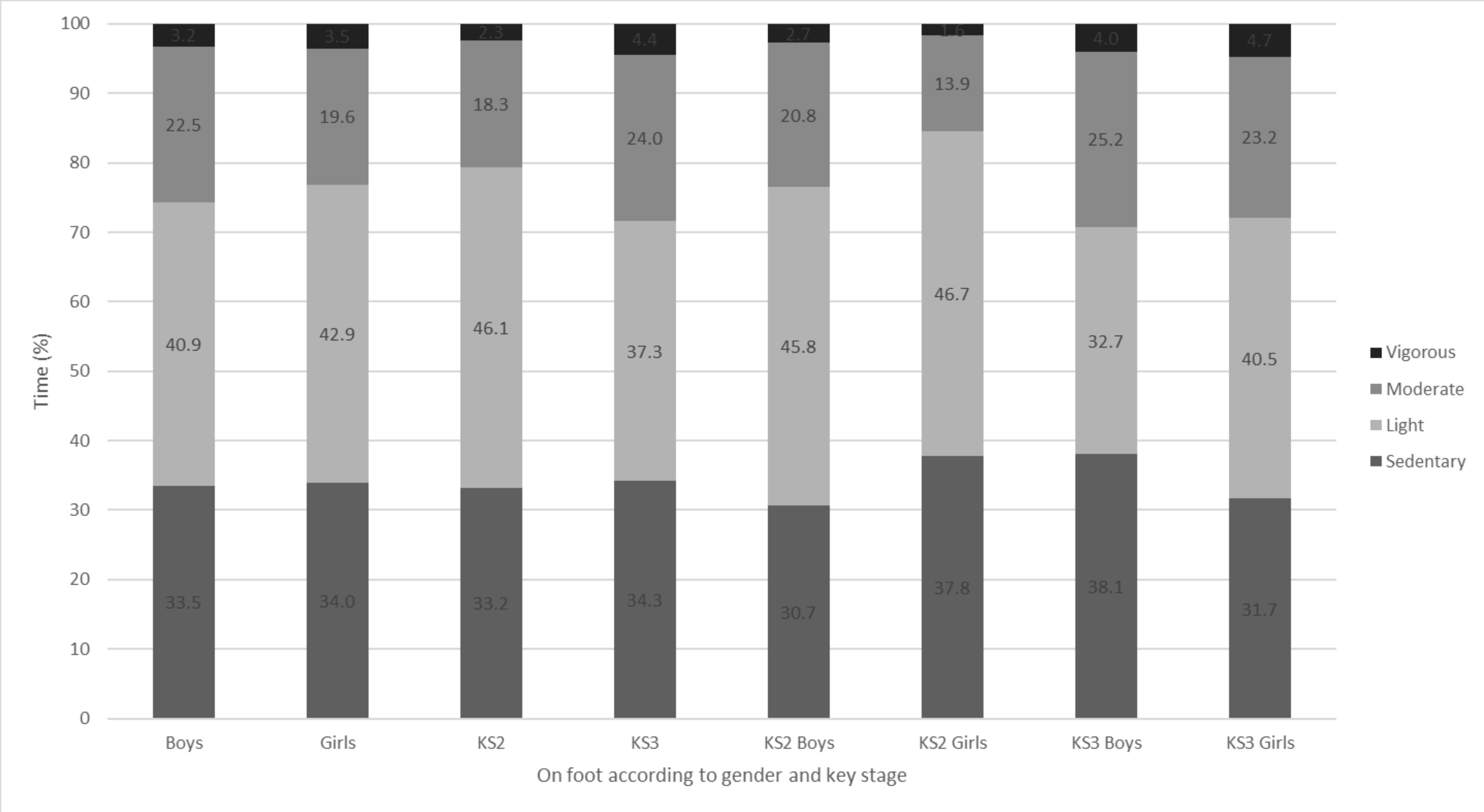


Figure 5. 28 Time (%) in each HR intensity on foot across all school terms.

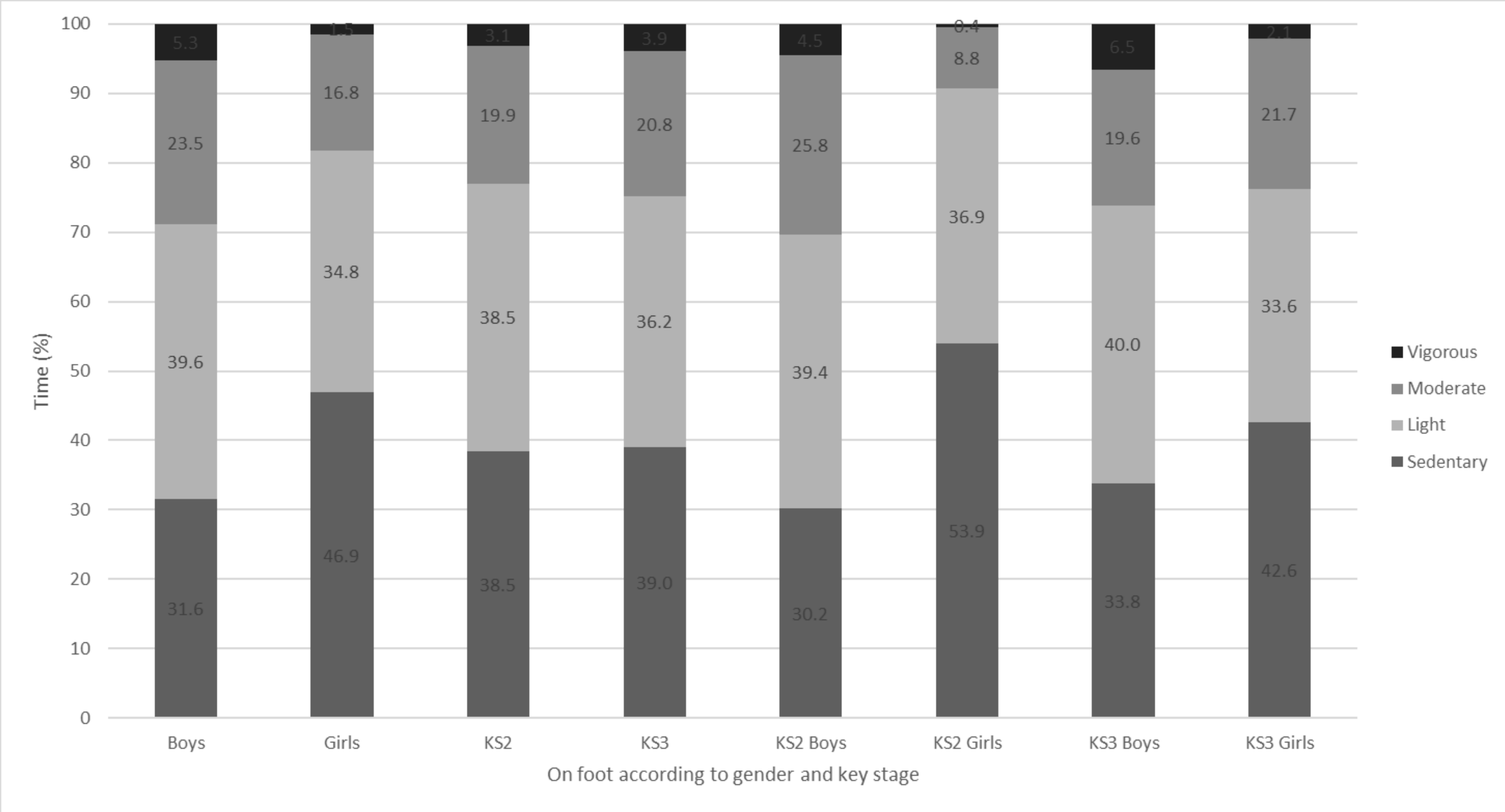


Figure 5. 29 Time (%) in each HR intensity on foot according to Autumn term.

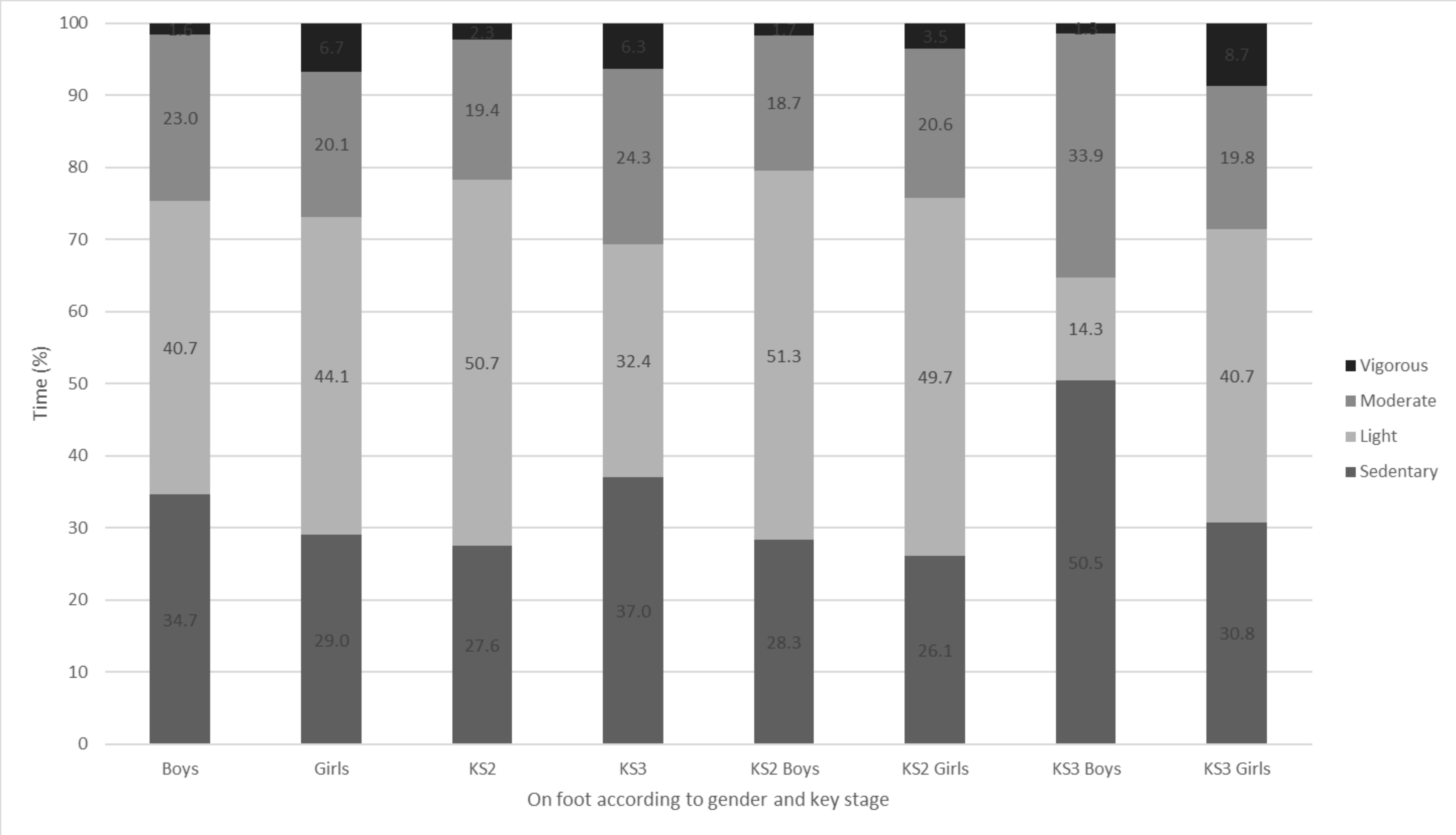


Figure 5. 30 Time (%) in each HR intensity on foot according to Spring term.

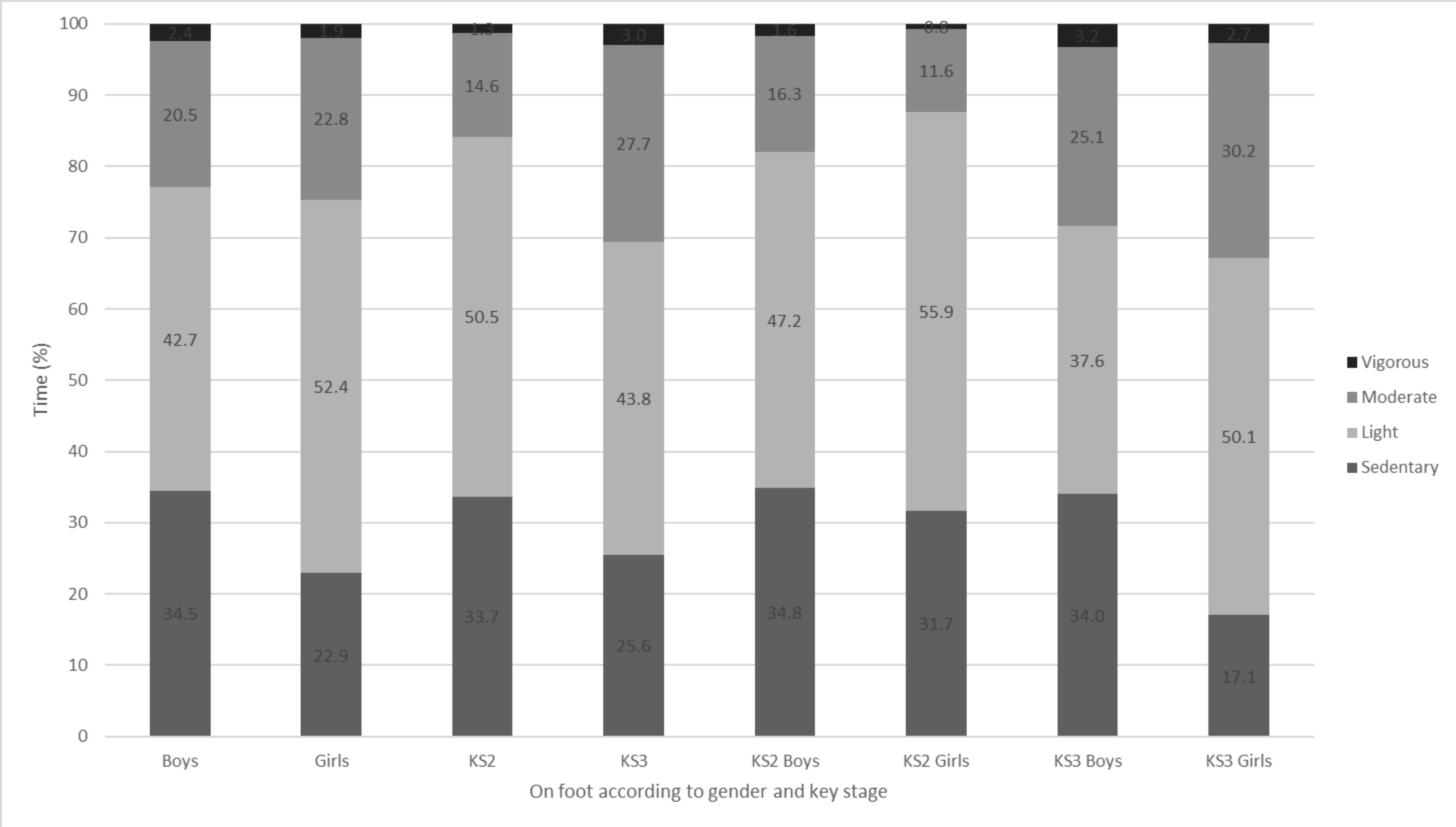


Figure 5. 31 Time (%) in each HR intensity on foot according to Summer term.

When exploring SB during outdoor time, girls engaged in more than double the amount of SB than boys in Spring term (boys = 16.5% ± 23.8%, girls = 47.6% ± 31.3%; $p < 0.05$). However, in Summer term, the pattern was reversed with boys engaging in over three times the amount of SB than girls (boys = 38.8% ± 33.3%, girls = 10.8% ± 18.6%; $p < 0.05$). In addition to this, data from Summer term revealed KS2 engaged in more than double the amount of SB than KS3 (KS2 = 42.9% ± 36%, KS3 = 14.2% ± 18.8%; $p < 0.01$).

LPA in outdoor time showed boys engaged in significantly more LPA in Autumn term (23.9 mins ± 26.7; $p < 0.05$) than Spring term (4.9 mins ± 6.5). Within Autumn term, girls engaged in nearly double the amount of outdoor LPA (45.4 mins ± 53.4; $p < 0.05$) than boys (23.9 mins ± 26.7).

KS2 engaged in more than double the amount of time in Autumn term (39.5 mins ± 36.1) and Summer term (17.9 mins ± 36.1) than in Spring term (7.6 mins ± 13.1). Further outdoor findings revealed KS2 boys to engage in significantly more LPA in Autumn term (95 mins ± 85; $p < 0.05$) than Spring term (4 mins ± 5.5). In addition to this, during Autumn term, KS3 girls engaged in more than four times the amount of LPA (40.2 mins ± 61.5; $p < 0.05$), than KS3 boys (8.3 mins ± 22.3).

LPA results from Spring term revealed children engaged in less than half the amount of LPA in Spring term (14.2 mins ± 42.4; $p < 0.05$) than Autumn term (35 mins ± 43.7). Additionally, girls engaged in more than four times the amount of LPA (23.4 mins ± 58.8; $p < 0.05$) than boys (4.9 mins ± 6.5) during Spring term.

LPA findings from Summer term revealed children engaged in significantly less LPA (17 mins ± 29.6; $p < 0.05$) than Autumn term (35 mins ± 43.66). In addition to this, during Summer term, KS3 engaged in significantly more percent LPA than KS2 (KS2 = 31.7% ± 25.4%, KS3 = 54% ± 29.1%; $p < 0.05$).

MPA results from time spent outdoors showed that within Autumn term, KS3 children engaged in less than half the amount of MPA (6.2 mins ± 9.7; $p < 0.05$) than KS2 children (13.2 mins ± 18.6). Additionally, KS2 engaged in more than double the amount of MPA in Autumn term (13.2 mins ± 18.6; $p < 0.05$), than Spring term (3.9 mins ± 6.5) and Summer term (MPA = 5.3 mins ± 10). More specifically, KS2 boys engaged in over double the amount of MPA in Autumn term (16 mins ± 22.5; $p < 0.05$), than Spring term (4.5 mins ± 7.3) and Summer term (5.8 mins ± 11.8). Additionally, within Autumn term, KS2 boys engaged in significantly more MPA (16 mins ± 22.5; $p < 0.05$) than KS3 boys (2 mins ± 4.4).

Finally, during Spring term, children engaged in less than half the amount of outdoor MPA (4.5 mins ± 7.6; $p < 0.05$) than Autumn term (10.3 mins ± 15.8), with gender differences showing that boys engaged in less than half the amount of MPA in Spring term (4.6 mins ± 6.5; $p < 0.05$) than Autumn term (11.6 mins ± 19.8).

MVPA findings for time spent outdoors showed during Autumn term, KS2 boys engaged in significantly more MVPA (18.5 mins ± 26; $p < 0.05$) than KS3 boys (2.2 mins ± 4.7). PA behaviours according to time outdoors for combined terms and each school term are presented in Figures 5.32 – 5.35.

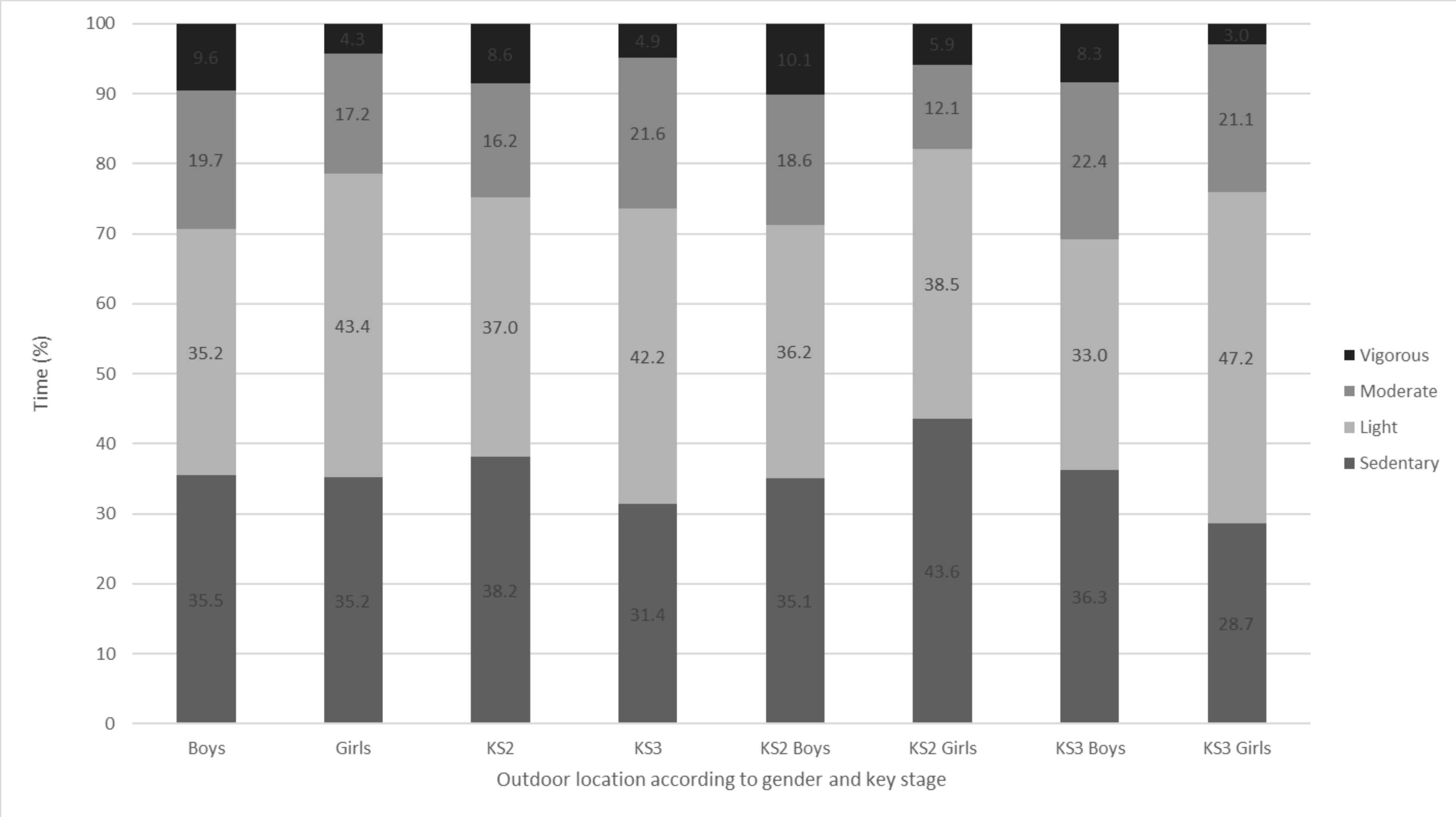


Figure 5. 32 Time (%) in each HR intensity outdoors across all school terms.

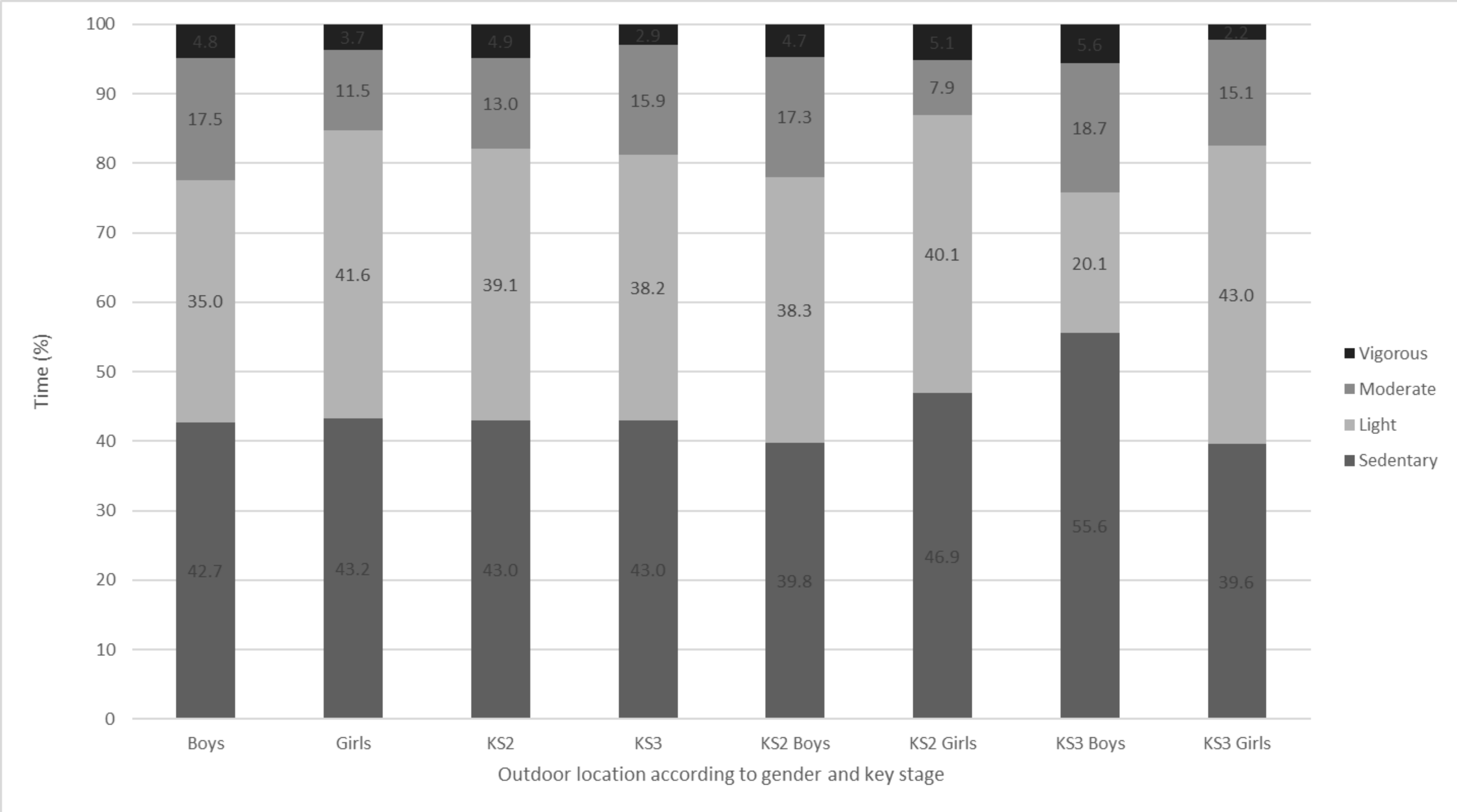


Figure 5. 33 Time (%) in each HR intensity outdoors according to Autumn term.

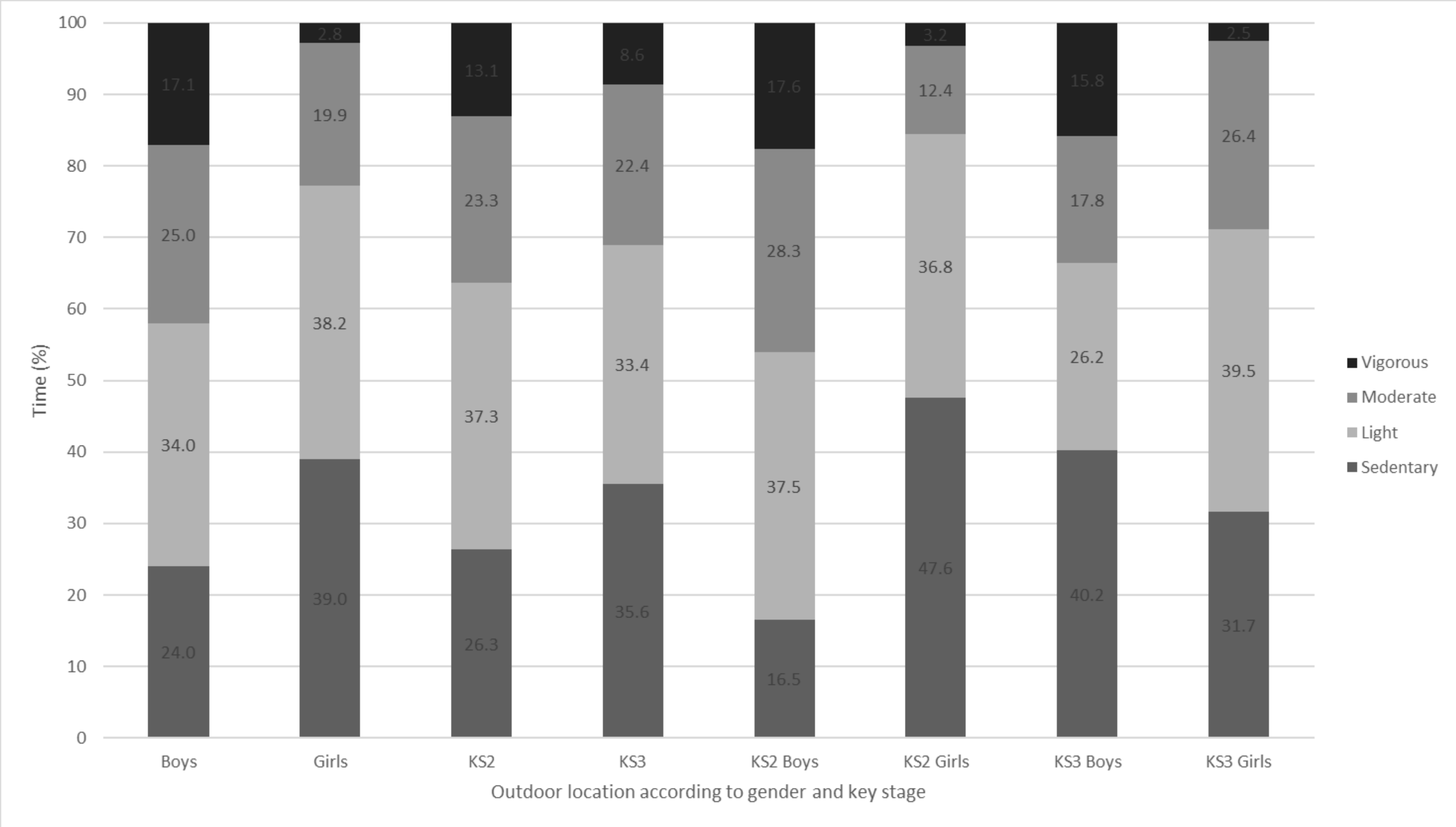


Figure 5. 34 Time (%) in each HR intensity outdoors according to Spring term.

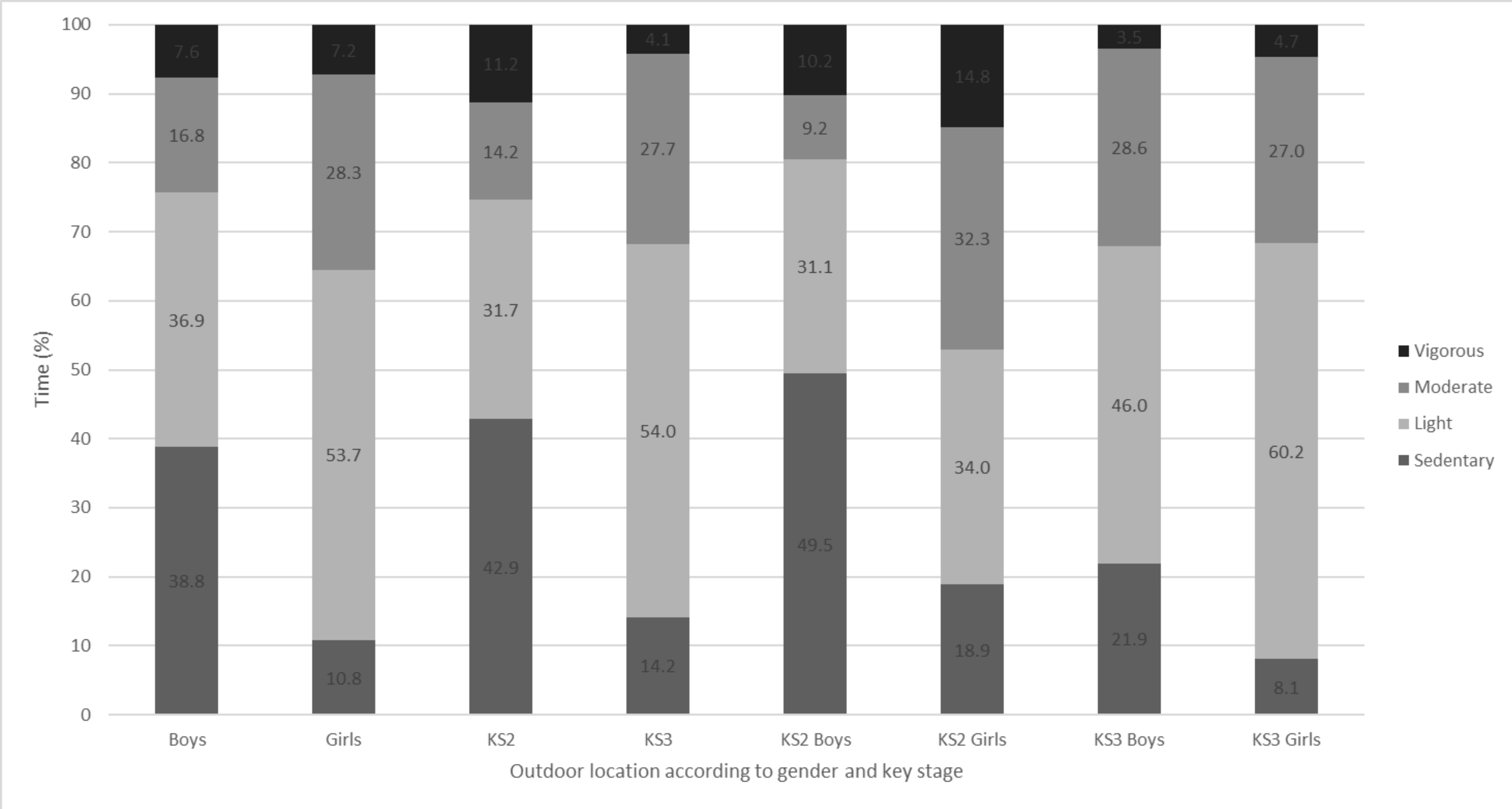


Figure 5. 35 Time (%) in each HR intensity outdoors according to Summer term.

The final location analysed was time spent 'outside', which combined the time on foot and time outdoors. The following 'outside time' findings were revealed.

During Autumn term, girls engaged in significantly more sedentary time (62.7 mins ± 59.3; $p < 0.05$) than boys (38.9 mins ± 35.3). More specifically within this term, KS3 girls engaged in significantly more sedentary time (48.6 mins ± 50.8; $p < 0.05$) than KS3 boys (33.6 mins ± 29.4).

KS2 boys engaged in over three times as much sedentary time in Autumn term (41.2 mins ± 38.1; $p < 0.05$) than Spring term (12.5 mins ± 15). Furthermore, during Summer term, KS2 engaged in over twice as much percent sedentary time than KS3 (KS2 = 48.1% ± 37.3%, KS3 = 17.7% ± 23.2%; $p < 0.01$).

LPA results for time spent outside revealed, within Summer term, boys engaged in almost three times as much LPA (31 mins ± 48; $p < 0.05$) than girls (10.2 mins ± 13.2). More specifically, within this term, KS3 boys engaged in more than half the amount of LPA (25.2 mins ± 28.4; $p < 0.05$) than KS3 girls (11.4 mins ± 15.7).

MPA results revealed that when combining data for all three school terms, KS3 engaged in significantly more MPA than KS2 (KS2 = 19.1% ± 20.1%, KS3 = 27.6% ± 28.4%; $p < 0.05$). More specifically within this term, KS3 boys engaged in more than five times as much MPA (58.7 mins ± 138.3; $p < 0.05$) than KS2 boys (9.9 mins ± 10). Furthermore, within Summer term, KS3 engaged in more than double the amount of MPA than KS2 (KS2 = 14.2% ± 16.6%, KS3 = 37.1% ± 34.3%; $p < 0.05$).

MVPA findings for time spent outside revealed KS2 children engaged in more than double the amount of MVPA in Autumn term (51 mins ± 82; $p < 0.05$) than Spring term (19.4 mins ± 24.7). Additionally, during Spring term, KS3 children engaged in over three times the amount of MVPA (68.6 mins ± 126.1; $p < 0.05$) than KS2 children (19.4 mins ± 24.7). More specifically, within this term, KS3 boys engaged over three times the amount of MVPA (78 mins ± 164.3; $p < 0.05$) than KS2 boys (22.1 mins ± 26.9).

MVPA findings for time spent outside within Summer term revealed KS3 engaged in more than double the amount of MVPA than KS2 (KS2 = 19.4% ± 25.3%, KS3 = 42% ± 39.4%; $p < 0.05$). PA behaviours according to time outside for combined terms and each school term are presented in Figures 5.36 – 5.39.

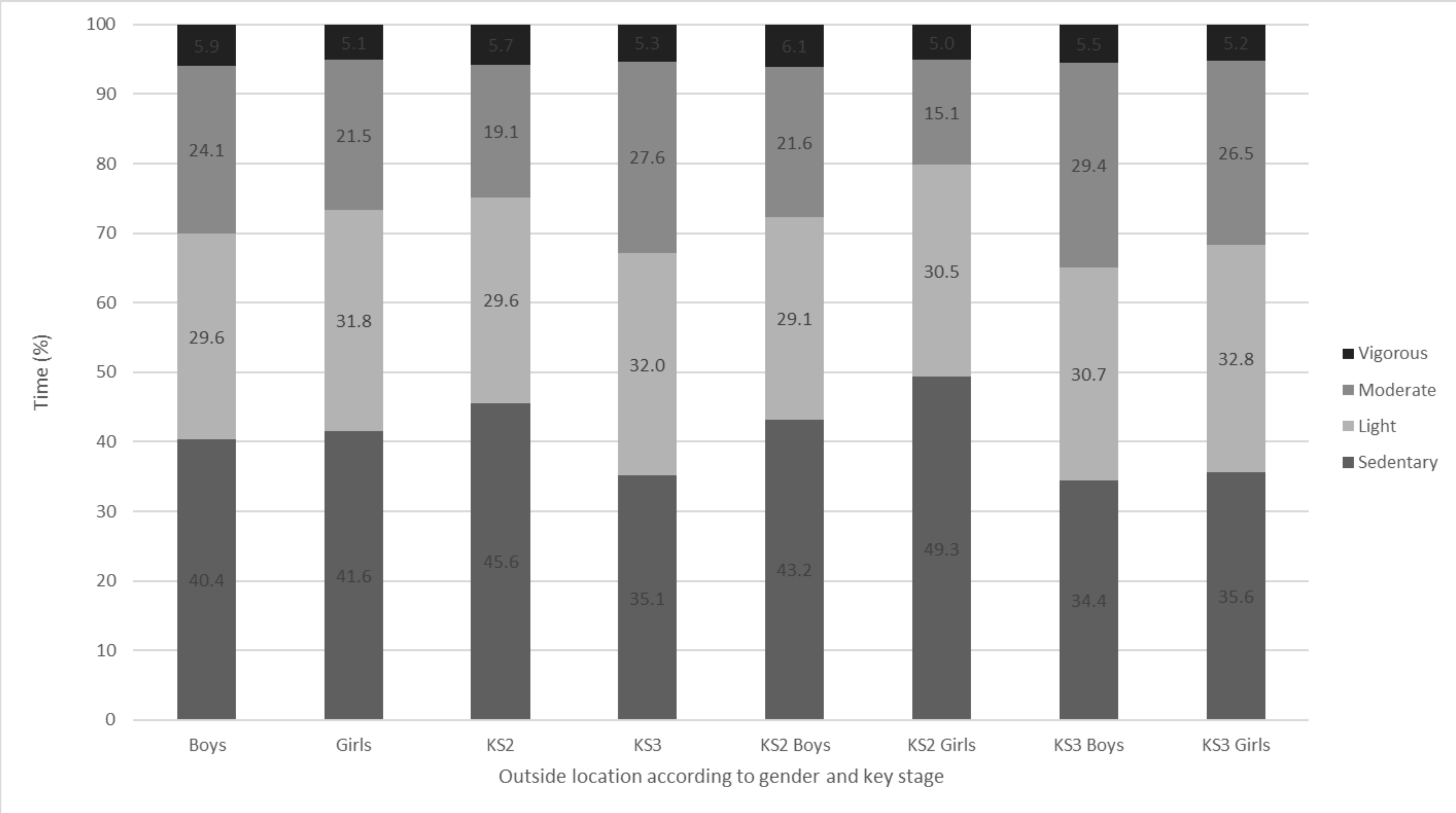


Figure 5. 36 Time (%) in each HR intensity outside across all school terms.

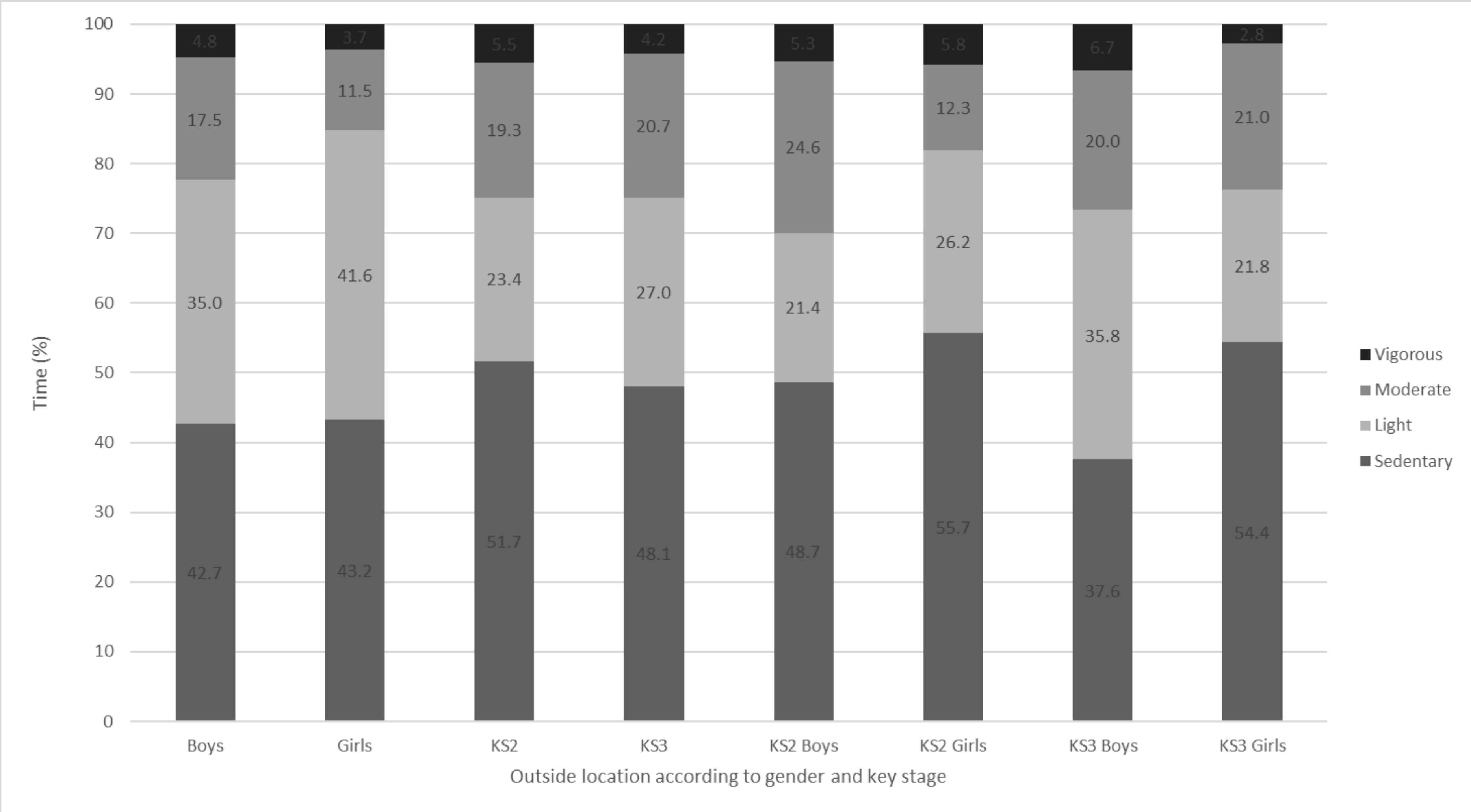


Figure 5. 37 Time (%) in each HR intensity outside according to Autumn term.

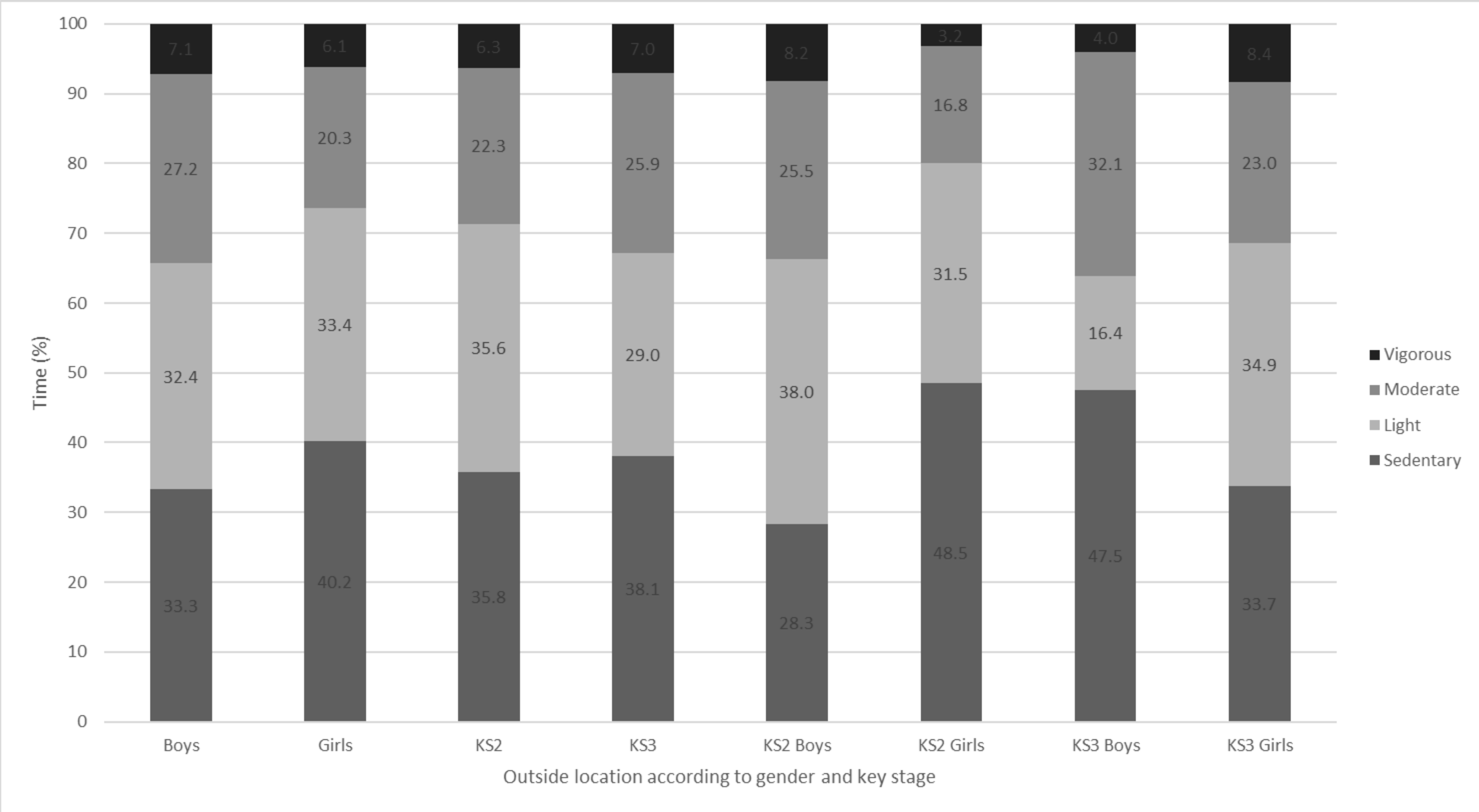


Figure 5. 38 Time (%) in each HR intensity in outside location according to Spring term.

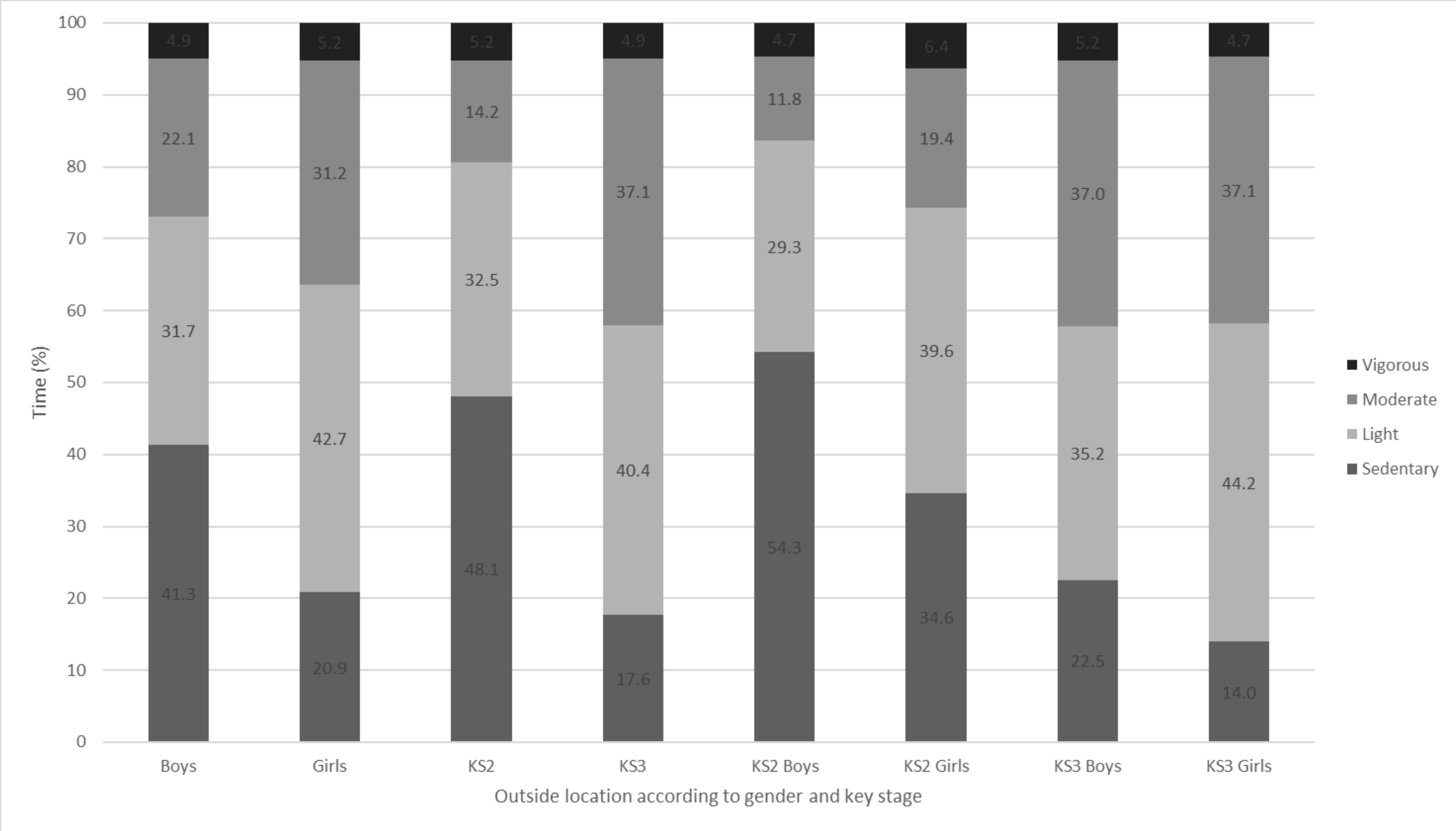


Figure 5. 39 Time (%) in each HR intensity outside according to Summer term.

5.3.8 Types of physical activity behaviour

PA diaries were collected from children following their participation in the study. 80 PA diaries were returned in Autumn term, 54 in Spring term, and 43 in Summer term. The PA diaries were useful in providing greater context to the PA reported from the HR monitors, and location data reported from the GPS monitors.

PA diaries showed the greatest number of children to engage in PA during Autumn term (n = 49), and the least amount of PA in Spring term (n = 21). However, the greatest range of PA children engaged in was in Summer term (n = 14), and lowest in Spring term (n = 10). When combining all three terms, PA diaries revealed 95 occurrences of children engaging in PA.

Screen time, which combined number of children watching television and using electronic devices was found to be greatest in Spring term (n = 100), and lowest in Autumn term (n = 78). These findings may reflect the colder, darker winter months of Spring term, which are associated with lower levels of PA, and consequently greater amounts of children's screen time. Complete PA diary findings are presented in Table 5.1.5.

Table 5.1. 5 PA diary findings according to each school term.

Event	Reported activity	Autumn term	Spring term	Summer term	Combined terms
		No. Occurrences	No. Occurrences	No. Occurrences	Total Occurrences
Physical Activity	Football	25	8	5	38
	Swimming	4	2	4	10
	Taekwondo	3	2	2	7
	Gymnastics	2	1	1	4
	Dance	2	2	2	6
	Bike ride	4	1	2	7
	Cubs	1	1	1	3
	Ride Scooter	1		1	2
	Skating	3		1	4
	Basketball		2	1	3

	Brownies		1	1	2
	Netball	2			2
	Hockey		1		1
	Cricket			1	1
	Running	2			2
	Trampolining			2	2
	Boxing			1	1
	Total	49	21	25	95
School lesson	Non-PE lesson	80	54	43	177
	PE lesson	18	11	11	40
Extra-curricular activity	Drama		1	2	3
	Singing		1		1
	Rounders			1	1
Commute	Walk home	15	4	1	20
	Travel	1			1
Recreation	Playing in the park	4	1	1	6
	Watch TV	41	52	41	134

	Electronic device	37	48	41	126
	Bowling	1		1	2
	Cinema	1			1
	Playing outside		1		1
Domestic task	Household chores	1	2		3
	Care for pet	7		5	12
	Shopping	2			2
	Gardening			1	1
Educational task	Homework		1		1
No. children removing equipment		28	23	24	75
No. occurrences of removing equipment		30	23	24	77

5.3.9 Barriers to and facilitators of physical activity

As outlined in Chapter 4.3.3.5, the Social-Ecological Model underpinned questions/topics which were discussed in children's focus groups. For continuity of the study, and for the ease for the children, a similar and consistent approach was implemented across all three school terms.

In a similar fashion to Study 1 and as outlined in Chapter 5.2.2.4, focus groups allowed research questions to be explored further and results were produced regarding barriers and facilitators according each school term. Boys and girls in both key stages reported similar topics within their discussions which were highlighted within the themes. Examples of quotations according to themes relating to barriers and facilitators for PA are provided in Table 5.1.6. Focus group transcripts are provided in Appendix 9.

Table 5.1. 6 Focus group themes categorised according to the components of the Social-Ecological Model.

	Selected quotes from children	
	Barriers to PA	**Facilitators for PA**
Individual		
Time	*"If I have too much homework, exams and stuff."* (KS3 Girl - Autumn term) *"It might be affecting them by their home routine."* (KS3 Girl - Spring term) *"Not having the time to do it"* (KS3 Girl - Summer term)	*"…however long you do on a physical activity, you get half that time on technology or something like that"* (KS3 Boy - Autumn term) *"Like having a certain time or place where you can do a P.E challenge in school time"* (KS3 Girl - Spring term) *"Make it more often because we only have two lessons of it (PE), we should have more."* (KS2 Boy - Summer term)
Fitness/Health	*"If you're ill"* (KS3 Boy - Autumn term)	*"I don't want to be all weaker when I'm older, I*

	"Asthma…..Illness….. Not being able to run a long distance." (KS3 Girl - Spring term) *"I've got asthma so it like stops you"* (KS2 Girl - Summer term)	*want to stay healthy"* (KS2 Girl - Autumn term) *"To keep fit and I enjoy it."* (KS3 Girl - Spring term) *"I like doing physical activity because it gets me out of the house and I like staying fit."* (KS2 Boy - Summer term)
Fun and enjoyment	*"They might not like it, so they might not want to do it."* (KS2 Boy - Autumn term) *"…they kick somebody and they don't get a yellow card for it so it's not fair."* (KS2 Boy - Spring term) *"if someone said you were bad at that sport, you would think yes I'm really bad at sport and they probably won't even give it more of a go and there would be more like not enjoying it and doing it."* (KS3 Girl - Summer term)	*"I do it because I like dancing and it just makes me happy"* (KS3 Girl - Autumn term) *"I take part in physical activity because I think it's fun and it gets you out of mischief."* (KS3 Girl - Spring term) *"…name like different sports to see if anyone would enjoy playing…"* (KS3 Boy - Summer term)

Equipment cost	*"…if they don't have like the right equipment to do it."* (KS2 Girl - Autumn term) *"…having equipment or anything like that, because sometimes most students can't get them"* (KS3 Girl - Summer term)	*"Maybe lower the price a little bit so that people don't have to wait loads to save up"* (KS2 Girl - Autumn term) *"…bring some more equipment for people to play with…"* (KS2 Boy - Summer term)
Interpersonal		
Friends and family	*"Might have to look after their family and it might stops [sic] you having their social time with their friends and going out"* (KS3 Girl - Autumn term) *"…say there's something wrong going on in the family and they've got to go and help, it's fitting into their routine."* (KS3 Girl - Spring term) *"…if you have little sisters you have to look after, or little brothers and you sometimes struggle…"* (KS3 Boy - Summer term)	*"I do runs with my dad, I go on my bike"* (KS3 Boy - Autumn term) *"Not only is it helping my dad get prepared for the marathon, it's also helping me with my legs so that I can run faster as well."* (KS2 Boy - Spring term) *"Friends because they've got the same life as what you do, so you can do the same thing."* (KS3 Boy - Summer term)

Socialise	*"…sometimes some of the people might have other plans"* (KS3 Girl - Autumn term) *"Friends, say that you want to do something active and they just want to like sit around…"* (KS2 Girl - Summer term)	*"It's a chance to meet up with friends"* (KS3 Girl - Autumn term) *"…it's got to be somewhere where they know other people because otherwise they won't go because they don't know anyone else."* (KS3 Girl - Summer term)
Organisational		
Location/Environment	*"…a club that's fun and active, and people would like to go to it and it's not too far."* (KS2 Girl - Autumn term) *"…not being allowed to go outside or anything like, like being set rules like you can't go very far or anything."* (KS2 Boy - Spring term) *"The availability of places that you go to do it."* (KS3 Boy - Summer term)	*"I go up to the college car park because it's big and loads of my friends just play there."* (KS3 Boy - Autumn term) *"Because they're your team and it's the usual place to go and that's where your team plays."* (KS3 Boy - Spring term) *"It helps to be somewhere local to most people…"* (KS3 Girl - Summer term)

Club	*"…create like clubs or academies that you don't actually have to be good at it to go there and stay there"* (KS3 Boy - Autumn term) *"Get the school more active and more sporty and more sports clubs."* (KS3 Boy - Spring term) *"…and also offer more opportunities for clubs…"* (KS3 Boy - Summer term)	*"…because that's where the club are, it's what I do and I'm a part of that team"* (KS3 Boy - Autumn term) *"At break time and lunchtime and after school, you should do running club or some club where you get active and that like the GPS thing."* (KS2 Girl - Spring term) *"I think we could have a little more P.E clubs…"* (KS2 Boy - Summer term)
Facilities	*"That's where you play, that's the home ground or your home team. You have to go there."* (KS2 Boy - Autumn term) *"the bottom bit of the field that we don't actually use that much unless we're doing shot put…"* (KS3 Girl - Summer term)	*"There's trampolining at, I can't remember the school now but it's a high school."* (KS2 Girl - Autumn term) *"I think the back part of it we should set up obstacles and stuff and should put on and then it's more fun and people will be like more happier to like do it."* (KS3 Girl - Summer term)

Community/Policy

Rewards	*"…make it into like a fun game and whoever did the most exercise in that period of time would get a prize or something like that."* (KS3 Girl - Autumn term) *"…you could like as rewards, like if you, you know at lunchtimes, you don't have to do this but if you choose to like run like, every one hundred metres you run round the field, like if it's obviously dry, you get like a reward or something."* (KS2 Boy - Spring term)	*"…in periods of time when who does the most exercise you win a prize, so you're kind of pushing the students to work for the prize."* (KS3 Girl - Autumn term) *"…the longer you run, and the longer the distance, you get a better reward or something like that."* (KS2 Boy - Spring term)
Promotion	*"…posters for like games and stuff which we could get to do after school that will get you fit and healthy."* (KS2 Girl - Autumn term) *"They might not have anyone to encourage them to do it."* (KS2 Boy - Summer term)	*"…put a word on Facebook and tell people what's happening and let everyone know happening and try and bring some people down to it."* (KS2 Boy - Autumn term) *"Persuade them like how good sport is and everything so they can take part in sports."* (KS2

		Boy - Summer term)
Child Voice	*"People might not like what the variety is"* (KS2 Girl - Autumn term) *"There's like a lot of people that don't want to do the physical activity like the football and the rugby, and a lot of people like prisoner and dodgeball"* (KS3 Boy - Spring term) *"See what they like the most and start things to do with them."* (KS3 Boy - Summer term)	*"You can ask what they like the most, and start clubs and get them to come."* (KS2 Boy - Autumn term) *"How about have a lunchtime fitness club, how about that?"* (KS2 Boy - Spring term) *"Give them a choice of what they want to do for like P.E or something, so what they want to do for P.E."* (KS2 Boy - Summer term)
Awareness	*"…have like posters around and like maybe in schools and like outside schools as well."* (KS2 Girl - Autumn term)	*"Like do a survey to see what they would want to do instead of like saying we're going to do hockey today because some people might not like it."* (KS2 Girl - Autumn term)

Other		
Weather	*"…if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy."* (KS2 Girl - Autumn term)	*"…you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that."* (KS3 Boy - Autumn term)
	"…if it's raining, I don't think people will have the motivation." (KS3 Girl - Spring term)	*"If it's sunny then I think more people like to go outside."* (KS3 Girl - Spring term)
	"…the weather, because you can't really run on a track, if the track is covered in puddles because you'll probably like slip over." (KS3 Boy - Summer term)	*"…rather than having football just at one point in the year, have it all round because some people prefer that."* (KS3 Boy - Summer term)
Technology	*"When you've got a phone or like a console, you don't think as much about getting active, you just want to play on them"* (KS3 Girl - Autumn term)	*"You could reduce your time down on a tablet or computer so that you're not always on it"* (KS2 Girl - Autumn term)
	"I think it's mainly most of the computer clubs and like all the Xboxes and all that at home, it's stopping them from getting out and getting active." (KS2 Boy -	*"…you should do running club or some club where you get active and that like the GPS thing."* (KS2 Girl - Spring term)

	Spring term) *"Technology. Because a lot of people just sit at home and play on a computer or on an iPad or a phone and they don't really go out and do anything else."* (KS2 Boy - Summer term)	*"…the more modern stuff that everybody's into because if more people are into it, they'll do it more often."* (KS3 Girl - Summer term)

The qualitative results suggested a range of influential factors that children felt affected their PA, both encouraging PA, and barriers towards PA (see Table 5.1.6).

5.3.9.1 Barriers to Physical Activity (categorised according to relevant Social-Ecological Model component)

'*Individual* component:

Children identified the personal effort levels when engaging in PA to be a potential limitation to future participation. Additionally, children made reference to technology, and sanctions for poor behaviour which also limited engagement in PA.

> KS2 boys spring term focus group:
>
> Researcher: *And what are the barriers to physical activity, what stops us from getting active?*
>
> Participant 1: *Like normally, kids, computers or what they do is the moment they're just out of breath, not out of breath but when they're like "oh no I've got a stich or something," they just get like really weak and they don't push themselves they're like "I'm stopping,". They could have only done a few metres and then they'd stop because they're out of energy, not pushing themselves.*
>
> Participant 2: *I push myself.*
>
> Participant 1: *I didn't said you didn't.*
>
> Participant 3: *Like not being allowed to go outside or anything like, like being set rules like you can't go very far or anything.*
>
> Participant 4: *And instead of like at home, try and improve behaviour because I get banned on sunny days in the holidays if I've been naughty, so instead of being naughty just be good yes and if it's like a wet day, you can go out on a sunny day.*
>
> Participant 5: *I think it's mainly most of the computer clubs and like all the Xboxes and all that at home, it's stopping them from getting out and getting active.*

'*Organisational'* component:

Children discussed the specialist equipment clubs or schools had as part of their facilities which were not always accessible to them outside of school, or outside of their clubs. Additionally, children highlighted how some PA clubs may be on at times which they could not attend, or if two PA clubs were being staged simultaneously, it meant children could only choose one to attend, whereas in reality, they would engage in both.

KS3 girls spring term focus group:

Researcher: *And what barriers do you think there are to stopping us from getting active?*

Participant 1: *Safety, because some things might not be safe in school areas.*

Researcher: *Any example?*

Participant 1: *Like with gymnastics when you have bars and vaults and everything and springboards, they can be dangerous.*

Researcher: *Is there anything else that stops us from getting active?*

Participant 2: *Some people just can't be bothered sometimes.*

Participant 3: *The weather as well, if it's an outside sport.*

Participant 4: *If it's sunny then I think more people like to go outside but if it's raining, I don't think people will have the motivation.*

Participant 5: *And sometimes it's the days that they're on.*

Researcher: *Right, what do you mean by that?*

Participant 5: *Well, because with some clubs, like another club is on at the same time, that one is quite popular so no-one actually goes to the other club even though they might want to.*

Participant 6: *It might be affecting them by their home routine, say there's something wrong going on in the family and they've got to go and help, it's fitting into their routine.*

'*Interpersonal'* component:

Family commitments and responsibilities were highlighted as potential barriers to PA as time spent looking after younger siblings meant there was less time available for PA.

In addition to this, children discussed how location was as an influencing factor towards PA. A local college car park was referred to as a recreational area for friends and a platform for PA. Although this location was not specifically designed to promote PA, children saw this location as an opportunity to increase their own personal PA.

> KS3 boys summer term focus group:
>
> Researcher: *Okay, final question then, what barriers are there that stop you guys from getting active? So, what stops you from getting active?*
>
> Participant 1: *The availability of places that you go to do it, like for example car parks, if its full up or if there's one car straight in the middle, it's a bit difficult to play around it, and yeah, stuff like that.*
>
> Participant 2: *Availability of sometimes sports aren't like promoted in different areas and sometimes your family can get in the way of because they make plans and something you wanted to do, even if you're physically active, sometimes the times you do want to do something, there's already plans going on and they won't either let you or, certain members in your family if you have little sisters you have to look after, or little brothers and you sometimes struggle with going out with mates and that.*
>
> Participant 3: *Family events, events like when you have to go with your friends and family. Also if like training gets cancelled and you stay indoors.*
>
> Participant 4: *And like the weather, because you can't really run on a track, if the track is covered in puddles because you'll probably like slip over.*

'Community/Policy' component:

Alongside technology and poor nutritional choices as barriers to PA, children also referred to changes and developments in local communities, density of motorised transport, and local health and safety policies which would limit the opportunity for PA.

KS2 boys summer term focus group:

Researcher: *Final question, what barriers are there which stop students from getting physically active? So, what stops you from getting active?*

Participant 1: *Well in the olden days when my dad was around there wasn't as many cars on the road and health and safety wasn't as good, and he could go pretty much anywhere he liked, and play maybe football or maybe basketball with his friends or, he used to do this thing, they had a sign and nobody obeyed it, no ball games, and he used to do this with his friend, kick the ball straight at the sign, see how hard you could hit it.*

Participant 2: *Well I suppose obesity and more people are becoming obese so that might be stopping them.*

Participant 3: *Like if there's your favourite TV show on and you don't want to miss it or sweets and chocolate.*

Participant 4: *Unhealthy food because if you're full, you don't really want to go out and play like a game of football so yes a lot more healthy food really.*

'*Other'* component:

Children felt that technology and weather restricted the amount of PA that could be completed. This would therefore suggest that during winter seasons specifically, children preferred to either stay indoors for PA, or substitute PA time with time spent on technology. This shows that children are aware of the implications of technology on PA engagement.

KS2 girls autumn term focus group:

Researcher: *Right okay, what barriers do you think there are which stop students from being physically active? So, what do you think stops people from being active?*

Participant 1: *Too much technology like phones because there's all these YouTube videos and stuff, or new music videos and Christmas stuff that have come in so they're all watching TV to see what they really want for Christmas.*

Participant 2: *They're usually watching TV or on their tablet or at home playing games or something and not getting physically active outside, or riding their bike or something.*

Participant 3: *Like in the summer, most people are on their Xboxes or PlayStations and they're not like enjoying the free weather and like they never go out or anything.*

Participant 4: *Some people just can't be bothered to go out in the environment, they just want to stay in bed late and watch some TV and play with each other.*

5.3.9.2 Facilitators for Physical Activity (categorised according to relevant Social-Ecological Model component)

'*Individual'* component:

In addition to the 'fun' element of PA clubs, children also highlighted the importance PE, and individual preferences of PA that was currently being offered, as some PA was identified as not being particularly popular with all children. This could be further related to children identifying a need for their voices to be heard when designing extra-curricular PA programmes.

KS2 boys spring term focus group:

Researcher: *Right okay, are there any other changes that you can think of which would improve students' physical activity? So how can we get you more active? What can we do?*

Participant 1: *I think you should put like more clubs because like I don't think we have benchball or like somebody might want to play benchball, or some people they're not allowed to go to clubs after school, but they're allowed to go to clubs at break and lunchtime, so I think you should have more clubs at lunchtime as well because then more people will go to those instead of after school clubs.*

Participant 2: *Have more P.E lessons.*

Participant 3: *In P.E make the game times longer and the training time shorter.*

Participant 4: *To encourage the students like so, if you encourage students they might start doing more physical activities.*

'*Organisational'* component:

The activities the school offered as part of the PA extra-curricular programme was highlighted by children. It was also found that children felt some PA clubs were better suited to those in the 'school team', and there may be a need for a more inclusive extra-curricular programme which was accessible by the wider school community.

KS3 boys spring term focus group:

Researcher: *Are there any other changes which you'd make, even if it was as a school?*

Participant 2: *Get the school more active and more sporty and more sports clubs after school because there's more like art, DT and we need some more sports ones.*

Participant 3: *Not just like one sports club, when you have rugby for P.E, have like other clubs like football club and rugby club.*

Participant 3: *Even though football has finished, still have it on.*

Participant 4: *How the school has just the one team that goes away, like good athletes, they should do less.*

'Interpersonal' component:

Children raised the importance of the social environment which would encourage others to engage in PA, which suggests that children are more likely to engage in PA when their peers are also present. The locations available to the children were also highlighted as providing opportunities for PA. The school would therefore be an ideal location as it encompasses both peer groups and a common time where the children could engage in PA together.

KS3 girls spring term focus group:

Researcher: *Right and you've all mentioned a few different areas where you go to do your activities, why do you choose to be physically active at those venues?*

Participant 1: *My dad makes me.*

Participant 2: *I don't really choose, it's just because I know that people who roller blade there and it's fun to do it there.*

Participant 3: *I don't really know but I sometimes go with a couple of people from dance or I just wanted to try it.*

Participant 4: *Because there's lots of different things there and there's loads of different variety.*

Participant 5: *Don't know really, it's fun, I don't know.*

Participant 6: *It's because it's where my dance is based and it's close to me and it's just where I know they go roller skating, and it's close to me.*

Participant 7: *It's fun.*

'Community/Policy' component:

In addition to consulting the children in designing extra-curricular programmes, children also felt that a PA-related reward system would promote further PA. This proposition would encourage a new school policy on rewarding PA behaviours.

KS2 boys spring term focus group:

Researcher: *Are there any other changes you can think of which would improve student's physical activity and would help us to break down any barriers to physical activity? Perhaps at school? How can we get you more active?*

Participant 1: *Like, I'm not saying this is what you have to do, but you could like as rewards, like if you, you know at lunchtimes, you don't have to do this but if you choose to like run like, every one hundred metres you run round the field, like if it's obviously dry, you get like a reward or something. And like the longer you run, and the longer the distance, you get a better reward or something like that.*

Participant 2: *I think you could like on a certain day say for example Wednesday like one class goes onto the field and has a run and then the next day the other class goes. Or, you could have like in P.E when someone doesn't do it properly, the thing that they have to do, they can just do it for a forfeit.*

Participant 3: *I think it's fine how it is.*

Participant 4: *At lunchtime people should join in to more physical activities like football or basketball because it keeps you fit and plus then you can get in trouble like for fighting but you can instead of like losing your anger you can play football or something.*

Participant 5: *I think you should like have a few competitions with like some of the things like on a special day maybe Wednesday, like Abdullah said we can have a team of football trying to have who wins the match like every Wednesday.*

Participant 6: *How about have a lunchtime fitness club, how about that?*

Participant 7: *One more point, you could have more physical activity clubs and less like, I'm not saying don't have homework cubs or I.T clubs but like less of them and more physical activity ones like football and stuff, and ones for girls as well.*

'*Other'* component:

In addition to seasonal PA, a broader, more diverse and inclusive extra-curricular PA programme, children suggested a 'solution-focused' time limitation approach regarding technology which would increase PA engagement.

KS3 boys autumn term focus group:

Researcher: *Okay, last one, so what changes would you make to improve students' opportunities to take part in physical activity? So, if you could make any change, what would it be and why?*

Participant 1: *Not always play on the Xbox because it's not healthy for your eyes and you're not going to get as much fit, you're just going to get lazy and like you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that.*

Participant 2: *There's a time limit for like consoles so you're not always like look at them, because it's like you're being lazy because you're sitting down while you're doing it, not running around.*

Participant 3: *I'd create like clubs or academies that you don't actually have to be good at it to go there and stay there, you can be not terrible but you don't have to be really really good at it just to be there.*

5.4 Discussion

This section provides an in-depth discussion of the results in relation to the research questions, which are then used to summarise the study's findings. The section is categorised according to children's weight status, PA behaviours and locations across the school year, before discussing barriers and facilitators of PA.

5.4.1 Children's weight status across the school year

Findings from the study indicate that in the Spring term children have the highest mean BMI score (19.2 ± 3.9). The Spring term in UK-based schools begins in early January until the end of March, and it is acknowledged that this term encompasses the meteorological winter months of January and February. Spring term data collection in this study took place from 13th January 2015 until 18th March 2015 (research calendar is provided in appendix 7).

When comparing genders and key stages, no statistically significant findings were revealed, however, similar trends were revealed, with both boys and girls and children in both key stages having the highest BMI levels in Spring term. In comparison with national data produced for children in the UK (NCD Risk Factor Collaboration, 2017), both boys' and girls' mean BMI scores are below the national average (UK national data: boys = 19.8, girls = 20.3).

When exploring BMI values according to maturational stage, children who were in initial stages of maturation had highest BMI values in Spring term, whereas children who were later in stages of maturation had highest BMI levels in Summer term. This highlights differences in BMI values between children in different stages of maturation according to school term, and future research should explore this further.

After applying age and gender specific BMI cut-off points (Cole et al., 2000), weight status classification was calculated. Although no statistically significant findings were revealed, all three terms revealed below mean national trends for percentage of children classed as overweight (NCD Risk Factor Collaboration, 2017), with Summer term showed the highest percent of overweight children (36.6%). National UK data on weight classifications indicate 30.8% of boys and 31.5% of girls are overweight (NCD Risk Factor Collaboration, 2017). This study revealed within Summer term, there were 31.8% of boys and 42.1% of girls who were classed as overweight. When making comparisons to national data of children classed as being obese, national UK data reports that 10.9% of boys and 9.4% of girls are obese (NCD Risk Factor Collaboration, 2017). The school within this study had a lower percentage of obese boys and girls in Autumn term, however, when compared with national UK data, there were a greater number of obese boys in Summer term, and a greater number of obese girls in Spring and Summer terms (Autumn term: boys = 7.3%, girls = 5.5%; Spring term: boys = 8%, girls = 24%; Summer term: boys = 13.6%, girls = 15.8%). The greatest proportion of children classed as being healthy weight was in Autumn term.

KS2 children's weight status data showed the greatest number of overweight children in Spring term, whereas the greatest number of KS3 children was in Summer term. When exploring children classed as obese, the highest number of obese KS2 children was revealed in Autumn term, and KS3 children in Spring term respectively. The greatest amounts of KS2 and KS3 children classed as healthy weight was in Autumn term. This suggests that there were inconsistencies in overweight children according to key stage between terms. The findings indicate that older children are more likely to be obese within the second school term, and overweight later in the academic year, whereas younger children are more likely to be obese earlier within the school year, and overweight in Spring term. However, it is acknowledged that the sample's attrition rate may have contributed to these findings as opposed to a change in children's weight status.

Weight status according to maturational stage revealed the greatest number of overweight children in initial stages of maturation to be equal in Spring and Summer terms. In comparison to this, the greatest number of overweight children in later stages of maturation was revealed in Summer term. Furthermore, when exploring children classed as obese, the highest number of obese children who were early in maturation was revealed in Spring term, and obese later stage of maturation children revealed in Summer term. These findings suggest that early and later maturers within this study are more likely to be overweight later in the year, with early maturers also being overweight within Spring term. Additionally, early maturers are more likely to be obese within Spring term, and later maturers are more likely to be obese later within the academic year. Children's weight status according to gender for each school term is provided in Table 5.3.

Data from the UK National Health Service (NHS) National Child Measurement Programme in England, provides official national statistics on year 6 (aged 10-11) children's weight status according to BMI measurements. This data is also provided according to school year and specific region within England, UK. This allowed for weight status comparisons to be made for year 6 children nationally, and regionally for the specific academic year of data collection (2014-15). National weight status data for year 6 in 2014-15 showed 1.4% of year 6 children as underweight, 65.3% healthy weight, 14.2% overweight, and 19.1% as obese (National Health Service, 2015). The school's local regional data for year 6 children in 2014-15 showed 0.8% of children as underweight, 67% healthy weight, 11.9% overweight, and 20.2% of children as obese.

When comparing the patterns of year 6 children's weight status across the three school terms, there were consistently no children classified as being underweight. The healthy weight category showed a greater percentage of year 6 children above national and regional means in Autumn term, however this fell below national and regional means for the following two terms (National Health Service, 2015). This indicates that there was a higher proportion of year 6 children with a healthy weight in Autumn term, compared with Spring and Summer terms.

The overweight category consistently showed a higher proportion of year 6 children as overweight compared to national and regional means across every term (National Health Service, 2015), suggesting that the school had a greater percentage of year 6 children who were overweight when compared to others nationally and regionally; and this weight status category was consistent throughout the year.

During Autumn and Spring terms, there were less obese year 6 children in this school when compared to national and regional means (National Health Service, 2015), however, in Summer term, the reported data was above national means, but below local means. This indicates that there were consistent findings regarding the school having less obese year 6 children than other local children across all three terms, and this was similar when compared with national comparisons, although Summer term school obesity data was slightly higher.

Over the past three decades, research has indicated that children's obesity levels are highest when measured in autumn and winter (December-March), while a lower prevalence of obesity is present in summer (May-September) (Dietz and Gortmaker, 1984). However, the consistent findings from this study contrast with this, as findings reveal year 6 children's overweight and obesity status to be consistent across the school year. Therefore, it is argued that the children's weight status in the current study is more consistent than in previous years, and greater focus should be on targeting overweight and obese children throughout the academic year, as opposed to individual school terms. Despite this argument, whole group WHtR data revealed that the greatest number of children 'at risk' were in Spring term (n = 48, 46.2%). This would therefore suggest that the WHtR risk level of children appears to be highest in Spring term according to WHtR categories (Ashwell et al., 2012), and previous literature suggests PA interventions are effective strategies to combat children's obesity levels (Tucker and Gilliland, 2007; González-Cutre et al., 2018; Haddad et al., 2018; Pearce et al., 2018), which may be most appropriate during Spring term within this study.

5.4.2 Physical activity behaviours and locations across the school year

As outlined in Chapter 2.1, PA for children is critical for motor development, cognitive improvement, psychosocial health, and cardio-metabolic health (Donnelly et al., 2016). MVPA has been used as a valid indication of health-related benefits in children and adults in the UK (Bakrania et al., 2017; Elmesmari et al., 2017; Hollis et al., 2017), with PA guidelines informing children to engage in a minimum of 60 minutes daily MVPA (Chief Medical Officers, 2019). In the current study, 52% of children in Autumn term, 64% of children in Spring term, and 44% of children in Summer term met these guidelines. These findings are consistently greater than national statistics where 18% of children in England meet the guidelines (Chief Medical Officers, 2019; NHS Digital, 2019).

In addition to this, findings from this study are in accordance with current literature which shows PA behaviour patterns differ according to season (Atkin et al., 2016). Children have been reported to have reduced levels of PA during winter months, particularly in UK based school children (Atkin et al., 2016). Although, mean percent of MVPA was found to be similar across all three terms, results from this study show children in the Spring term (including winter months) engaged in the least amount of MVPA minutes (68.82 ± 100.7) which is in accordance with previous findings (Atkin et al., 2016). Focus group data supports this as children highlighted the negative impact winter dark nights, and poor weather conditions had on PA: *"…if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy."*; *"…the weather, because you can't really run on a track, if the track is covered in puddles because you'll probably like slip over."*

Findings from PA diaries also support these results as children reported the fewest number of occurrences of PA during Spring term (*n* = 21) compared with Autumn and Summer terms. Additionally, PA diaries also showed children to report the smallest variation of PA (*n* = 10) in Spring term. This suggests that children's lower

PA associated with winter months was consistently indicated from GPS and HR data, children's focus groups and PA diaries.

Each term showed a greater percentage of both boys and girls meeting PA guidelines which is in accordance with previous research (Chief Medical Officers, 2019; Health and Social Care Information Centre, 2019), however, literature has consistently reported that girls are less active than boys (Trost et al., 2002a; Van Sluijs et al., 2008; Brooke et al., 2016; Corder et al., 2016; Farooq et al., 2016; Mitchell et al., 2016; Pate et al., 2016; Rosenfeld, 2017). Within this study, girls engaged in greater amounts of MVPA than boys in the Autumn and Summer term, and girls' focus group data revealed how they often took part in PA for enjoyment and social reasons, and these motives helped to explain their increased engagement in PA across the year: *"I do it because I like dancing and it just makes me happy"; "It's a chance to meet up with friends".* Boys' focus group data also revealed social reasons to influence engagement in PA, but fitness and family were also highlighted as influential factors: *"I like doing physical activity because it gets me out of the house and I like staying fit."* ; *"I do runs with my dad, I go on my bike"* ; *"Not only is it helping my dad get prepared for the marathon, it's also helping me with my legs so that I can run faster as well."*

The novel finding of the current study showing girls to engage in greater MVPA than boys may be due to the opportunities provided for girls' PA at the participating school, which may encourage greater MVPA compared with other schools nationally. The wider school staff, including learning support assistants within this school encouraged children to engage in PA, and staff of all subjects (not just PE staff) assisted in leading extra-curricular PA clubs. Further details of the school setting are provided in Chapter 3.3.

The objective tools used to measure HR within this study provides an accurate measure of children's HR, whereas previous research has relied on children's self-report data, which has been associated with over estimation of PA (Pearce et al., 2014; Cooper et al., 2015). Children referred to how the GPS and HR monitors were associated with monitoring personal HR and PA clubs, and identified how they could be used to promote PA: *"…you should do running club or some club where you get active and that like the GPS thing.*"

When analysing the breakdown of children meeting daily MVPA guidelines further, Autumn and Spring terms showed a greater number of KS2 children meeting guidelines than KS3. However, this pattern was reversed in Summer term where there was a greater proportion of KS3 children meeting daily MVPA guidelines. Despite these differences, KS3 children consistently engaged in greater amounts of MVPA each term than KS2. This suggests that despite fewer KS3 children meeting the 60 minute daily minimum MVPA guidelines, those KS3 children who did engage in MVPA, engaged in greater MVPA time, which consequently increased KS3 mean MVPA. KS3 focus group data revealed how they engaged in PA outside of school with friends and in locations that were nearby. This may have contributed to them accumulating greater levels of MVPA: *"It helps to be somewhere local to most people…"*; "*…it's got to be somewhere where they know other people because otherwise they won't go because they don't know anyone else."*; *"I go up to the college car park because it's big and loads of my friends just play there."*; *"Because they're your team and it's the usual place to go and that's where your team plays."* These findings indicate how older children within the study often engaged in PA based on peer support, location, and team association, and this can be used to explain the greater levels of MVPA compared with KS2 children.

Previous literature has suggested that levels of PA decline with age (Trost et al., 2002b; Nader et al., 2008; Dumith et al., 2011; Mitchell et al., 2013). However, the contrasting results produced from this study may be due the structure of this school. As previously discussed in Chapter 4.5.2, many UK-based schools adopt a two-tier school system which involves a transition from KS2 to KS3 (i.e., move from Primary to Secondary school). However, the participating school in this study was a Middle school, where children stayed at the same school for their transition from KS2 to KS3. The consistency in a Middle school environment could explain the consistency in PA behaviours across all three school terms which showed the older children to be more active than younger children, which is in contrast to previous research findings (Mitchell et al., 2013; Cooper et al., 2015; Farooq et al., 2016). The school within this study consisted of two large separate playgrounds for each key stage. Both of which were marked with a range of painted lines encouraging children's PA. Consequently, this meant that PA opportunities were presented to children throughout the transitional period from KS2 to KS3. As a result of the children having their own personal key stage allocated playground, an opposite trend to the age-related PA decline (Cooper et al., 2015; Farooq et al., 2016) was produced. Further details of the school setting are provided in Chapter 3.3.

In addition to this, within focus groups, KS2 children indicated that engagement in PA outside of school was subject to parent permission, and further engagement in PA was dependent on family/friend commitments and responsibilities: *"…not being allowed to go outside or anything like, like being set rules like you can't go very far or anything."*; *"…sometimes some of the people might have other plans."* This highlights how younger children's independent mobility and family commitments may have had a negative impact on PA participation within the current sample.

As within Study 1, maturational stage was explored to accommodate the weekly/monthly age difference between children. During Autumn term, results showed that 74% of children in early stages of maturation, and 26% of children in average stages of maturation met daily MVPA guidelines (Chief Medical Officers, 2019). During Spring term, 69% of children in early stages of maturation, and 31% of children in average stages of maturation met the guidelines, and finally within Summer term, 61% of children in early stages of maturation, and 39% of children in average stages of maturation respectively. This shows that a greater proportion of early maturers within the study consistently met daily MVPA guidelines (Chief Medical Officers, 2019) than children in later stages of maturation.

Despite a greater number of early maturers consistently meeting daily MVPA guidelines (Chief Medical Officers, 2019) each term, children in later stages of maturation engaged in greater MVPA during Autumn and Summer terms than early maturers. Spring term was the only term to show children in early stages of maturation engage in greater amounts of MVPA than later maturers. This suggests that children within this study who are in more advanced stages of maturation, are more active in winter months, whereas children in early stages of maturation are more active in autumn and summer months.

Following the analysis of MVPA, each individual HR intensity was explored (i.e. SB, LPA, MPA, VPA) and findings will be discussed in relation to the whole sample, each gender and key stage, and finally maturational stage. Statistically significant findings for each HR will then be discussed. Analysing HR intensities according to individual intensities has been supported by previous research (Hamer et al., 2013; Fernández-Aranda et al., 2014).

SB was greatest during Autumn term, and lowest during Summer term. This was reflected in KS2 and KS3, and boys' SB across the school year. However, girl's SB showed highest levels in Spring term. Focus group data showed that SB, which led to reduced PA, was often associated with academic work, home routines, time restrictions and peer influences: *"If I have too much homework, exams and stuff."; "It might be affecting them by their home routine."* ; *"Not having the time to do it…"; "Friends, say that you want to do something active and they just want to like sit around…"* This demonstrates a need for PA interventions to reduce SB including long periods sitting down, and consider these different influential factors children discussed, for example, PA interventions may be more effective when not influenced by home routines and timetabled so that it does not interfere with academic study time.

When analysing SB according to maturational stage, it was found that children in earlier stages of maturation engaged in greater SB during Autumn term. However, children in average stages of maturation engaged in most SB during Spring term. This suggests that boys, children in both key stages, and children in early stages of maturation were most sedentary during autumn, whereas girls were more sedentary during the winter months.

When analysing each term specifically, during Autumn term, KS3 boys engaged in significantly more sedentary minutes than KS3 girls (KS3 boys = 260.9 mins, KS3 girls = 153 mins). In addition to this, during Spring term, children in later stages of maturation engaged in significantly more SB than children in initial stages of maturation ($p < 0.05$; initial = 114 mins, later = 208 mins). This indicates that during autumn months, older boys were more sedentary than older girls, and during winter months, children in later stages of maturation were more sedentary than early maturers. The overall pattern of results shows children's lower MVPA minutes in autumn and winter months is replaced with higher levels of SB, therefore these findings suggest that children within this study adopted a more sedentary lifestyle during autumn and winter months, and poor weather and lack of motivation which were discussed in focus groups may explain this increase in SB: *"…if it's raining, I don't think people will have the motivation."*

Statistically significant findings ($p < 0.05$) were revealed when exploring LPA, with children in Spring term participating in the least amount of mean daily minutes of LPA (123.7 ± 99.9). This indicates that in addition to Spring term showing children to engage in the least amount mean daily MVPA minutes, and higher levels of SB, children also engaged in the least amount of LPA, therefore suggesting that this particular term showed children to be less active in comparison to other times of the year. This pattern was also reflected in gender, key stage and maturational stage results and the associations with this term, which encompasses the winter season, is associated with lower levels of PA (Belanger et al., 2009; Beighle et al., 2012).

After further investigation into key stage and gender, KS2 boys engaged in significantly fewer ($p < 0.05$) minutes of mean daily LPA in Spring term (139.8 ± 113.2) compared with Autumn term (204.1 ± 143.3). These findings highlight how KS2 boys specifically, engaged in significantly less LPA during winter months, therefore supporting a rationale for PA intervention at this particular school during this period.

Percent MPA levels for the cohort as a whole were similar across all three terms, although mean daily MPA minutes showed children engaged in fewer minutes during Spring term (53.57 ± 86.32). However, gender results showed boys engaged in most MPA during Spring term and lower levels of MPA during Autumn term. Girls engaged in greatest amounts of MPA during Summer term and lowest amounts in Spring term. This indicates that previous literature advocating winter seasons being associated with lower levels of children's PA (Atkin et al., 2016; Tanaka et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b), was only reflected in girls' findings, as boys' results within this study revealed highest MPA levels in winter months.

Although not specific to MPA, this gender difference in PA behaviour was evident in focus groups during Spring term. Within this particular term, girls highlighted how they felt the poor weather prevented them from engaging in PA: "*If it's sunny then I think more people like to go outside.*" , whereas boys discussed solutions to promote PA during winter seasons: *"Like having a certain time or place where you can do a P.E challenge in school time."* This suggests that despite seasonal weather conditions which may not facilitate PA, boys were more likely to consider solutions to carry out a PA lifestyle.

KS2 and KS3 children engaged in similar amounts of MPA during Autumn and Spring terms, however there were contrasting results for MPA during Summer term. KS2 children engaged in lowest levels and KS3 engaged in highest levels of MPA during Summer term. This suggests that during summer months, older children are more likely to engage in greater MPA and younger children engage in lower MPA, and this demonstrates inconsistencies in PA behaviour according to season. Future research may wish to explore seasonal PA behaviour according to age further and interventions promoting school PA should target the terms which limit children's PA due to seasonal differences (Atkin et al., 2016).

Children who were in the initial stages of maturation engaged in greatest MPA during Spring term, and lowest levels during Summer term, whereas children in later stages of maturation engaged in highest levels of MPA during Summer term, and least amounts of MPA during Spring term. The contrasting findings during Spring term were statistically significant ($p < 0.05$), which shows that during winter months, children in this study who were more advanced in maturation stage, engaged in significantly more MPA than children in later stages (initial = 18.4%, later = 9.2%). The finding of those in later stages of maturation engaging in least MPA during winter months supports previous findings from this study, and it is suggested that Spring term may be best suited to implement a PA intervention within this particular school.

The HR which children engaged in the least was VPA. Children's VPA levels across the year were relatively similar, with the greatest amount revealed in Spring term, and lower durations in Autumn and Summer terms (Autumn term = 2.9%, Spring term = 4%, Summer term = 2.9%). This pattern was reflected in gender, key stage and maturational stage findings. Despite no statistically significant findings, it is proposed that PA interventions should focus on increasing children's VPA in the Spring term as this encompasses colder and darker Winter months, which showed lowest MVPA levels of children within this school. A breakdown of children meeting

PA guidelines, mean daily time and percentage of total time spent in different HR intensities is provided in Table 5.6.

The rigour of the data collected was further tested exploring children who provided data within the study. The objective of carrying out this analysis was to determine whether children who provided data for Autumn term only, were those who engaged in less PA, and children who provided data for two or three terms, the more active children; particularly as no statistical differences had been found exploring mean daily MVPA minutes between the different school terms. Therefore, children were grouped into two categories based on whether they provided data for Autumn term only, or whether they provided data for a minimum of two terms.

Results showed that 16 children reported information for Autumn term only, and 134 children provided information for a minimum of two terms. MVPA levels appeared to be similar across the two groups with the 'Autumn term only' group reporting a mean of 142.7 (±213.34) minutes MVPA compared with the '2 or more terms' group reporting 132.5 (±189.9) minutes MVPA. In addition to this, datasets from both groups of children were analysed to explore the numbers of children meeting the 1 hour daily MVPA guidelines (Chief Medical Officers, 2019). As outlined in Chapter 5.3.5, the 'Autumn term only' group reported 9/16 children (56%) as meeting the PA guidelines, and 7/16 children (44%) not meeting PA guidelines. The '2 or more terms' group reported 72/134 children (54%) as meeting PA guidelines, and 62/134 children (46%) as not meeting PA guidelines. Therefore, it can be concluded that the children who provided data for Autumn term only, did not appear to be the least active children, and that children within the study appear to be consistently active across the three school terms.

The most frequently visited locations reported from GPS data within this study were: home, school other indoor location (excluding home and school) motorised transport, on foot, and outdoors. Previous spatial analysis research indicates that children engage with the home, school, daily commute and local environments i.e. green space and parks (Webber and Porter, 2009; Oliver et al., 2010; Rainham et al., 2012), and the locations visited by children within this study support this. It was decided to also create a location called 'time outside' which combined time on foot with time outdoors. This would produce a more reflective indication of children's total time spent outside.

Children spent significantly more time ($p < 0.05$) at home in Spring and Summer terms compared with Autumn term, suggesting that children were less likely to engage in time at home during autumn months. Focus group data suggests that children spent more time at home during winter months in Spring term due to lower temperatures, and fewer daylight hours: *"…if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy." ; "If it's sunny then I think more people like to go outside."* These findings are in accordance with previous literature indicating warmer summer climates to be associated with greater PA (Pearce et al., 2014).

When exploring gender and key stage, a different pattern emerged, with KS2 boys spending significantly more time ($p < 0.05$) at home in Autumn term and Summer term than in Spring term. Focus group data from KS2 boys explained this finding, as during Spring term focus groups, children explained how set rules during winter months on distance/location prevented them from engaging in greater PA: *"…not being allowed to go outside or anything like, like being set rules like you can't go very far or anything."* In addition to this, Spring term comprises of winter months which have fewer daylight hours (Pearce et al., 2014; Ridgers et al., 2014), which may mean children slept earlier, and consequently removed GPS and HR devices earlier.

When investigating children's HR whilst at home children spent the majority of their time either sedentary or in LPA. More specifically, KS3 boys engaged in significantly more sedentary minutes ($p < 0.05$) than KS2 boys during in Autumn term. This shows older boys in this study to be significantly more sedentary than younger boys when at home during the Autumn term. Previous literature highlights how the home environment is a useful platform to encourage PA behaviours (Haddad et al., 2018), however this study's findings suggests that the home environment was not supportive of PA. Children's focus group data also supports this: *"It might be affecting them by their home routine."*; *"If I have too much homework, exams and stuff."* This shows the home environment to be associated with academic work, and family routines as opposed to PA. Further literature develops this argument, suggesting rather than the home environment, it is in fact the 'home neighbourhood' which is a better suited platform for encouraging PA behaviours amongst children (Perry et al., 2016). This suggests that the surrounding home neighbourhood encourages children's PA, as opposed to the home specifically (Perry et al., 2016).

Gender patterns at home revealed KS3 girls to engage in greater amounts of MPA than KS3 boys ($p < 0.05$). In addition, during Autumn term, KS3 boys engaged in significantly more sedentary time than KS3 girls ($p < 0.05$). These patterns advocate that older girls within the study were more likely to engage in MPA, and older boys were more likely to spend their home time engaging in sedentary-related behaviours. Consequently, results from the home environment indicate that this location was not supportive of MVPA and is in contrast to previous literature (Haddad et al., 2018).

Research suggests that the school environment supports PA promotion with children, through extra-curricular activities, PE lessons, a wider physically activity taught curriculum, and educating children of the health benefits of PA (Morgan et al., 2007; Alderman et al., 2012; Sallis et al., 2012; Dobbins et al., 2013b; Eather et al., 2013; Fairclough et al., 2016). This study's school time findings show that children spend their greatest duration of time in this location, outside of their home environment. This would therefore support previous literature in using the school environment to stage and implement PA interventions (Engelen et al., 2018; Pearce et al., 2018), as this can attract a wider school audience, and is more accessible for children to engage (González-Cutre et al., 2018; Haddad et al., 2018).

KS2 boys in Autumn term engaged in significantly more school time compared to Summer term ($p < 0.05$). This implies that children spent more time at school in Summer term than in Autumn term, however, this is subject to GPS maintaining a consistent, strong satellite signal, as will be discussed in Chapter 5.5.

When exploring HR intensities at school, boys engaged in significantly more LPA during Autumn term than Summer term ($p < 0.05$). Additionally, during Autumn term, boys engaged in significantly more LPA than girls ($p < 0.05$), indicating that boys engaged in greater LPA earlier in the school year, and also engaged in greater LPA than girls which is in accordance with previous literature (Labbrozzi et al., 2012). A similar gender pattern was revealed specifically within older children, as during Autumn term, KS3 boys engaged in greater LPA than KS3 girls ($p < 0.05$). Furthermore, during Summer term, KS3 boys engaged in greater MPA than KS2 boys ($p < 0.05$). These findings suggest that older boys within this study appeared to be a more active cohort within the school, as they appeared to be more active than older girls, and younger boys. Focus group data supports this as KS2 children raised concerns regarding the types of PA clubs currently offered to children: *"People might not like what the variety is."* Therefore, this highlights a need to consider school-based PA clubs which younger children may enjoy.

Current literature suggests there is a decline in MVPA with age (Ortega et al., 2013; Cooper et al., 2015; Corder et al., 2016), however, a similar pattern as revealed with LPA in the school environment was also shown in MVPA. KS3 often engaged in greater amounts of MVPA than KS2, and more specifically, during Summer term, KS3 children engaged in significantly more MPA than KS2 ($p < 0.05$). These findings are in contrast to literature outlining age-related declines in PA (Ortega et al., 2013; Cooper et al., 2015; Corder et al., 2016). KS2 children's focus groups highlighted a need for younger children to be consulted in designing PA extra-curricular programmes, which offered greater variety: *"They might not like it, so they might not want to do it."* ; *"See what they like the most and start things to do with them."* ; *"Get the school more active and more sporty and more sports clubs."* ; *"…and also offer more opportunities for clubs…"*

This indicates that the opportunities for PA within this particular school encourage PA for older children specifically, and there is a need to consider PA opportunities for younger children. However, the school-based PA findings do support the concept of the school being a supportive platform for PA promotion (Bandhauer, 2016; Fairclough et al., 2016; Smedegaard et al., 2016; Ha et al., 2017), and therefore schools are effective locations for staging PA interventions.

As presented in section 5.3.4, the school day was explored with regards to which parts revealed elevated levels of MVPA. Three segments of the school day were categorised, including 'free time' which was time spent outside of school; 'school day' was time spent in academic curricular time and break time; and 'lunchtime' was time spent during school lunch break. Statistically significant differences in MVPA ($p = <0.05$) were revealed between the three segments of the school day for all three school terms, with lunchtime reporting the least amount of MVPA. However, it could be argued that the 45-minute window for children to engage in MVPA is restricting, particularly if children are to eat lunch in a designated area (e.g. school hall, classroom etc.), which may involve time spent queuing, and would utilise a potential PA environment i.e. the school hall. Furthermore, a lack of structured PA clubs, or a limited variety of clubs offered may not facilitate a physically active environment (Fairclough et al., 2016). Further results revealed Spring term reporting the least amount of mean MVPA minutes in every segment of the school day compared with Autumn and Summer terms.

When exploring time spent outside (combining outdoor time and time on foot), during Spring term, KS3 children spent significantly more time outside ($p < 0.05$) than KS2 children, which is in accordance with previous research indicating that older children have greater independent mobility than younger children (Mackett et al., 2007; Brown et al., 2008). It is further suggested that despite time spent outside being consistently associated with higher daily PA in children, research has indicated that parents limit levels of outdoor play due to safety concerns (McMinn et al., 2013; Gray et al., 2015), and this may explain the outside time differences revealed between key stages in this study. As a consequence of KS2 children having reduced opportunities to go outside, they may be limited to the home environment, which will inevitably produce reduced levels of MVPA, and greater levels of sedentary time (Atkin et al., 2013). This is supported by focus group data, as KS2 children highlighted difficulties in gaining parental permission to go outside or visiting local areas: *"…not being allowed to go outside or anything like, like being set rules like you can't go very far or anything."* This therefore limited amounts of PA younger children could do outside and would restrict these children to the indoor environments.

When investigating HR intensities in time spent outside, children spent similar durations either sedentary or in MVPA. The outside location showed children to engage in increased LPA, MPA and MVPA, and this follows on from similar findings in previous literature (Pearce et al., 2018). Despite KS3 children spending significantly more time outside than KS2 children ($p < 0.05$), MVPA between key stages was similar. This highlights that despite spending less time outside, younger children engaged in similar amounts of MVPA when outside. This suggests that both key stages are equally as active in MVPA when spending time outside and both key stages may have access to equal PA opportunities. During Spring term, KS2 children engaged in less outside MVPA compared with Autumn term ($p < 0.05$), supporting literature highlighting PA declines in winter months (Atkin et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). In comparison to this, KS3 (boys in particular) engaged in more outside MPA and MVPA in Spring term than KS2 children

($p < 0.05$). This is further supported as KS3 children discussed the importance of PA when outside during focus groups: *"…you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that."* This pattern of older children being more active than younger children has been found within other locations within this study and is in contrast to previous research (Corder et al., 2016; Farooq et al., 2016; Jago et al., 2017).

When exploring gender differences, data showed that girls engaged in more outside SB (particularly KS3 girls in Autumn term) than boys ($p < 0.05$), which is in accordance with previous literature (Collings et al., 2014; Rosenfeld, 2017). This was further evident from girls' focus group data: *"Friends, say that you want to do something active and they just want to like sit around…"* This highlights how girls felt that peers influenced PA, which includes time spent outside. However, MVPA was similar between genders, which would suggest that both genders had equal opportunities to engage in outside PA.

When exploring time on foot, children spent significantly more time ($p < 0.05$) in Spring term than Autumn term, with gender differences showing boys spending significantly more ($p < 0.05$) time on foot in Spring term compared with Autumn term. This suggests that despite lower temperatures and fewer daylight hours in Spring term, boys were still likely to spend time on foot when compared with Autumn term.

Although not statistically significant, all children engaged in greater LPA when on foot. However, KS3 children engaged in greater MVPA whilst on foot, thus supporting previous literature regarding older children having greater freedom, and independent mobility (Brown et al., 2008; Page et al., 2009a). However, during Spring term, KS3 children engaged in significantly less on foot LPA than KS2 children ($p < 0.05$), which would suggest that the seasonal differences related to fewer daylight hours and lower temperatures (McCrorie et al., 2015; Atkin et al., 2016;

Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b) consequently reduced older children's PA when on foot.

Previous literature has revealed that time spent outdoors is associated with PA amongst children (McMinn et al., 2013; Gray et al., 2015; Pearce et al., 2018). In addition to this, boys have greater opportunity to engage in PA outside within their local neighbourhoods (Mackett et al., 2007; Brown et al., 2008), however after exploring the outdoor location within this study, girls spent a greater amount of time outdoors in Autumn term and significantly more time outdoors than boys ($p < 0.05$) in Spring term. This indicates that girls within the study may also have the same levels of independent mobility as boys, which contrasts with previous findings (Mackett et al., 2007; Brown et al., 2008).

Children's HR intensity data when outdoors showed children to spend the majority of time sedentary or in LPA. Despite the home environment being associated with SBs (Atkin et al., 2013), findings suggest that the outdoor environment is also associated with children's SB. However, it does encourage LPA, and girls within this study engaged in greater sedentary and LPA when outdoors. Further outdoor gender patterns showed boys' LPA and MPA during Spring term to be lower than Autumn term ($p < 0.05$), which highlights the lack of outdoor PA in winter months (Atkin et al., 2016; Katapally et al., 2016), and supports the rationale for PA to be promoted in alternative venues during winter months.

KS2 children engaged in significantly less outdoor LPA in Summer term when compared with Autumn term ($p < 0.05$), and significantly less LPA and MPA in Spring term compared with Autumn term ($p < 0.05$). This suggests that Autumn term offered more opportunities for younger children to engage in outdoor LPA. Additionally, during Autumn and Spring terms, KS3 girls engaged in more outdoor LPA than KS3 boys ($p < 0.05$), which is in contrast to previous literature indicating that girls are less active than boys (Magoc et al., 2016; Chief Medical Officers, 2019). This may be due to girls taking greater advantage of the outdoor PA opportunities on offer at school or in the local community. Findings from girls' focus groups support this as the benefits of outdoor PA were highlighted: *"I like doing physical activity because it gets me out of the house and I like staying fit."* This indicates that girls would rather engage in outdoor PA as opposed to being within the home environment.

During Spring term, KS2 boys engaged in significantly less outdoor LPA and MPA than Autumn term ($p < 0.05$), further supporting the previous Spring term findings demonstrating reduced PA levels, and also supports literature highlighting PA reductions in colder months (Atkin et al., 2016; Tanaka et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b).

When exploring MPA, KS2 boys engaged in greater amounts of outdoor MPA, and MVPA than KS3 boys ($p < 0.05$) during Autumn term, which highlights that during autumn months, the younger children were engaging in more outdoor MPA and MVPA than older children, which is supported by previous literature (Corder et al., 2016; Farooq et al., 2016; Jago et al., 2017). Findings from focus groups also support this as younger children highlighted the need for school PA programmes to offer popular clubs throughout the year as opposed to during only one school term: *"…rather than having football just at one point in the year, have it all round because some people prefer that."* This indicates that younger children suggest schools should offer popular PA clubs throughout the year, including winter months, which would help promote greater participation.

When exploring time spent indoors, it is acknowledged that the loss of satellite signal coverage indoors meant GPS connection may have been interrupted, which has been identified in previous GPS research of PA (Krenn et al., 2011). Therefore, data was manually checked to confirm children were indoors based on their last GPS location point, i.e. child approaching an indoor location, before analysing HR data.

Results revealed children's time spent indoors was spent mostly sedentary or in LPA, with findings highlighting KS3 boys to engage in almost twice as much indoor LPA than KS3 girls ($p < 0.05$). This suggests that older boys were more likely to engage in greater indoor LPA than older girls. Girls' focus group data indicates the lack of girls' indoor PA could be attributed to greater family responsibilities, or the indoor location being associated with socialising with peers as opposed to engaging in PA: *"…say there's something wrong going on in the family and they've got to go and help, it's fitting into their routine."*; *"…if you have little sisters you have to look after, or little brothers and you sometimes struggle…" "It's a chance to meet up with friends"; "…it's got to be somewhere where they know other people because otherwise they won't go because they don't know anyone else."* Therefore, it is suggested that there is a need to promote girls' indoor PA, and also promote PA which encourage greater MVPA amongst all children.

Time spent in motorised transport is typically associated with lower intensities of PA (due to the seated/sedentary aspect of this transport method), however, the current study found the children to have elevated HR when in motorised transport. It was established that school policy allowed children to leave school immediately after extra-curricular after-school PA clubs, without the need to get changed. This resulted in children finishing an extra-curricular activity with an elevated HR, and then make use of either public transport (i.e. local bus), or parental transport, therefore, children were engaged in SB, and HR would gradually return to resting HR during this recovery period whilst in motorised transport. Future research exploring HR according to motorised transport may wish to have a standardised 'break' period before taking HR readings, to allow for a more reflective HR whilst in motorised transport.

As in Study 1 (Chapter 4), PA diaries continued to provide further insight into types of PA, particularly when HR and GPS equipment was not worn, for example in water-based activities, swimming etc. Additionally, as indicated by previous literature, children removed equipment due to health and safety aspects of some activities (Westerterp, 2009; Biddle et al., 2011). Eighty PA diaries were returned in Autumn term, fifty-four in Spring term, and forty-three in Summer term.

During Autumn term, children removed GPS and HR equipment whilst engaging in football, gymnastics and taekwondo activities. In addition to this, there were four children who engaged in swimming activities, which also meant equipment was removed.

During Spring term, there were similar findings, although children began to describe weather conditions in descriptions of activities and intensities. One child described an intensity as 'cold and tiring'. This provided the researcher with an indication of temperature/weather conditions when children engage in PA during the winter months, which related to seasonal variation patterns discussed earlier in relation PA (Collings et al., 2014; Atkin et al., 2016; Katapally et al., 2016). Similar activities were described by children including taekwondo, football and gymnastics, and two children removed the GPS and HR equipment when engaging in swimming activities. Additionally, there were reports of children participating in 'cubs' or 'brownies' which are part of a UK Scout Association designed to provide children with greater opportunities for PA.

During Summer term children engaged in a greater number of outdoor activities, potentially due to the improved temperature/weather conditions. Activities included football, rounders, cricket, riding a scooter/bike, visiting parks/skate parks, gardening and walking the pet dog. Two children removed GPS and HR equipment for swimming activities, and other children continued to participate in taekwondo, gymnastics and cubs and brownie clubs. Additional clubs were also visited by children including drama, trampolining and dance clubs.

PA diaries revealed Autumn term to have the greatest number of PA occurrences (*n* = 49), and Spring term to have the lowest number of PA occurrences (*n* = 21), which infers that children were most active during the Autumn term, and least active the Spring term (which included winter months). When exploring the variety in types of PA children engaged in, Spring term showed children engage in the smallest variety of PA (*n* = 10), and Summer term showed children engage in the greatest variety of PA (*n* = 14). PA diaries also revealed Spring term as showing the greatest number of occurrences for watching television, and engaging with electronic devices. This could be explained by the shorter days and darker early evenings associated with Spring term, which encourages greater SB, and greater daylight hours and warmer summer climate in Summer term being more conducive to PA (Atkin et al., 2016).

Although levels of MVPA were similar across the three school terms, there were a greater number of children who removed HR and GPS devices in Autumn term (*n* = 25), and the lowest number of children removing devices was revealed in Spring term (*n* = 10). Therefore, it could be suggested that actual levels of MVPA may have been greatest in Autumn term and lowest in Spring term, as children may have been engaging in MVPA when devices were removed.

Within Autumn term, fourteen girls and eleven boys removed HR and GPS equipment whilst engaging in PA. HR data in this term showed girls to engage in greater MVPA than boys, however, this difference in MVPA may have been greater based on the number of girls removing equipment. Additionally, this term showed KS3 to engage in greater MVPA than KS2, however, nine KS2 children and sixteen KS3 children removed equipment, which means once again, the actual difference in MVPA between key stages may have been greater.

Spring term revealed boys to engage in greater MVPA than girls, however, 6 girls and 4 boys removed HR and GPS equipment. Therefore, the actual difference in MVPA may have been smaller based on the number of girls who removed devices. In addition to this, key stage findings revealed KS3 children to engage in greater MVPA than KS2 children, however, eight KS2 children, and two KS3 children removed equipment. This means that the actual difference in MVPA between key stages may have been smaller as a greater number of KS2 children removed devices.

Within Summer term, HR data revealed girls engaged in greater MVPA than boys. The difference in actual MVPA may have been greater, as fourteen girls and six boys removed HR and GPS equipment when engaging in PA. KS3 children also engaged in greater amounts of MVPA than KS2 children, however, the difference in MVPA between key stages may have been smaller as fourteen KS2 children and six KS3 children removed equipment.

Findings from this study support previous school-based research where self-report measures have been used to help inform PA intervention programmes, particularly when exploring reasons behind PA, perceived exertion and enjoyment factors (Goudas and Biddle, 1994; Fairclough et al., 2016). Furthermore, information provided also indicated how types of PA differed according to academic term and seasonal differences (Atkin et al., 2016).

5.4.3 Barriers and facilitators of physical activity

Throughout the academic year, children highlighted barriers to PA, with many being referred to consistently each term. The first barrier to be discussed was time for PA, which has been supported by previous findings (Wan et al., 2017). In the context of this study, time was associated with parents/guardians', and home responsibilities, which consequently affected children's PA: *"Not having the time to do it…"; "It might be affecting them by their home routine."* In addition to this, the timing of PA clubs was identified to affect PA participation. Some children felt that if PA clubs were offered at the same time, then they would have to choose one to attend, whereas ideally, they would have liked to engage in different activities.

After school clubs were identified as limiting attendance, because children would not have parental permission to attend, potentially due to transport arrangements, or safety aspects of allowing children to walk home independently (McMinn et al., 2014; Gray et al., 2015): *"…not being allowed to go outside or anything like, like being set rules like you can't go very far or anything."* This suggests that children enjoyed having school-based PA opportunities such as lunchtime, as it was more accessible, and was not dependent on transport arrangements, extra parental permission etc. These factors should be considered in PA intervention design, in order to widen participation.

On occasion, children made reference to the cost of equipment which has been identified in previous research (Krops et al., 2017), who proposed investing in more PA equipment (e.g. bikes) to help promote greater PA behaviour: *"…if they don't have like the right equipment to do it."; "Maybe lower the price a little bit so that people don't have to wait loads to save up."* There was limited discussion on the cost of equipment relating to PA that they already engaged in, but future research may wish to consider equipment cost to increase PA accessibility and children's participation levels.

Policy aspects of PA within the school were highlighted by children. Many children felt that they should be consulted with regards to the types and variety of clubs offered, as opposed to decisions being made by staff: *"There's like a lot of people that don't want to do the physical activity like the football and the rugby, and a lot of people like prisoner and dodgeball"; "People might not like what the variety is"; "You can ask what they like the most, and start clubs and get them to come." ; "How* *about have a lunchtime fitness club, how about that?"* Additionally, children felt that greater promotion and awareness of the clubs would help encourage others to attend: *"…posters for like games and stuff which we could get to do after school that will get you fit and healthy."; "They might not have anyone to encourage them to do it."; "Persuade them like how good sport is and everything so they can take part in sports."* Children also proposed that popular PA clubs were offered more frequently throughout the school year, as currently some PA clubs were offered for half a term, potentially due to deteriorating weather conditions and staff commitments: *"…rather than having football just at one point in the year, have it all round because some people prefer that."* This supports findings from previous literature that proposes that extra-curricular promotion and participation, that is shaped by student voice would increase motivation for PE (Lonsdale et al., 2016), and therefore there is a need for schools to consult children in designing extra-curricular PA programmes.

Children felt that poor weather conditions at certain times of the year limited PA options, and motivation to participate in PA: *"…the weather, because you can't really run on a track, if the track is covered in puddles because you'll probably like slip over."; "…you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that."* Football matches and training sessions were often cancelled in winter months, and children described their behaviour as 'have to stay inside'. Children also discussed the impact poor weather conditions had on motivation for PA engagement. Wet weather conditions specifically was highlighted as a hindrance for PA motivation: *"…if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy."; "…if it's raining, I don't think people will have the motivation."* In contrast to this, children described 'sunny weather' as an encouraging factor that supported and motivated them to participate in PA: *"If it's sunny then I think more people like to go outside."* This supports previous literature related to PA seasonal variation (Atkin et al., 2016; Schuttoff and Pawlowski, 2017), and this should be considered when designing extra-curricular PA programmes and PA-related interventions.

Finally, children highlighted technology, such as games consoles, mobile phones and tablets to distract them from engaging in PA: *"When you've got a phone or like a console, you don't think as much about getting active, you just want to play on them"; "I think it's mainly most of the computer clubs and like all the Xboxes and all that at home, it's stopping them from getting out and getting active."; "Technology. Because a lot of people just sit at home and play on a computer or on an iPad or a phone and they don't really go out and do anything else."* Children suggested limiting time allowances on these devices, particularly in the home environment, would help provide more time to engage in PA: *"You could reduce your time down on a tablet or computer so that you're not always on it."* These findings are in line with previous research where the increased accessibility to sedentary-related technology, has reduced levels of children's PA (Tudor-Locke et al., 2006; Atkin et al., 2008), and therefore PA interventions which are designed, may be in competition with the sedentary-related technology.

Children discussed a range of motives for engaging in PA and made further suggestions to help encourage wider participation. The most common reason for PA engagement was fun and enjoyment: *"I do it because I like dancing and it just makes me happy."* Additionally, children often outlined the health benefits of PA as a reason why they chose to participate: *"I don't want to be all weaker when I'm older, I want to stay healthy."* This shows that children within this study, who may be as young as nine years of age, have a good educational awareness of the positive health benefits PA can provide, and this has been supported by previous literature (Donnelly et al., 2016).

Children felt that greater use of social media to help promote PA clubs would encourage greater participation: *"…put a word on Facebook and tell people what's happening and let everyone know happening and try and bring some people down to it."* These findings suggest that children are exposed to social media on a regular basis, and therefore this can be used as a platform to promote PA amongst the wider school population.

Further ideas included a rewards policy, where as part of the school's rewards system, children would be recognised and rewarded for attending a number of PA clubs: *"…make it into like a fun game and whoever did the most exercise in that period of time would get a prize or something like that."; "…in periods of time when who does the most exercise you win a prize, so you're kind of pushing the students to work for the prize."; "…you could like as rewards, like if you, you know at lunchtimes, you don't have to do this but if you choose to like run like, every one hundred metres you run round the field, like if it's obviously dry, you get like a reward or something."; "…the longer you run, and the longer the distance, you get a better reward or something like that."* Following these findings, it is proposed that the school rewards policy could be used to encompass children's PA which would therefore further encourage greater PA participation. The participating school's 'Positives' reward system is similar to a traditional UK 'Merit' point style reward system, where the more points collected, the greater the certificate and prize. The school also uses 'celebration assemblies' where children are presented with their reward certificates and prizes.

In accordance with previous literature, children discussed how their family and peers could influence their PA participation (Trang et al., 2009; Trost and Loprinzi, 2011). Children highlighted friends and family to encourage PA engagement, largely due to the social aspects of the activities, where children met friends or family and could have a 'catch up': *"Friends because they've got the same life as what you do, so you can do the same thing."; "It's a chance to meet up with friends" However*, children also outlined how if peers did not wish to attend a PA club, then this would influence others' decisions on attending. A similar pattern was discussed regarding family, where family encouragement (brothers, sisters or parents), would influence PA behaviour. This is in accordance with previous literature which suggests that a less supportive family towards PA, reduces children's PA participation (Hamilton and White, 2012): *"…sometimes some of the people might have other plans"; "…if you have little sisters you have to look after, or little brothers and you sometimes struggle…"; "Friends, say that you want to do something active and they just want to like sit around…"* This highlights the influence both family and friends have on children's decisions to participate in PA, and future PA research should consider this in PA intervention design.

As suggested by previous literature, children indicated that the physical and surrounding environment is influential to PA engagement (Rahman et al., 2011; Chaix et al., 2014). Children proposed that if a specific PA venue was within close proximity to areas of residence, they were more likely to visit to engage in PA, and this is in accordance with previous research (Dunton et al., 2013): *"…a club that's fun and active, and people would like to go to it and it's not too far."; "I go up to the college car park because it's big and loads of my friends just play there."* Areas children identified as supportive of PA were local parks, leisure centres, open fields and college car parks. Sports clubs and facilities were also discussed, as children suggested that if a club was based at a particular location, then this would explain their reasons for visiting that environment. The facilities at such clubs would also justify why PA would take place at these venues: *"…because that's where the club are, it's what I do and I'm a part of that team"; "Because they're your team and it's the usual place to go and that's where your team plays."* Therefore, future research may wish to explore locations and proximity when designing PA programmes. As findings from this study reveal, children are more likely to engage in PA if it is easily accessible, and is not associated with great cost, or equipment. It is concluded that children would prefer to be involved in the design of school extra-curricular PA programmes, and it is suggested that this will encourage greater participation.

5.5 Strengths and limitations of Study 2

The combination of HR and GPS monitors provided information of HR intensities in the different locations children visited. These provided an indication of PA behaviour according to location over a four-day period, and adds to current literature which has used GPS and HR monitors to explore children's commuting patterns (McMinn et al., 2014; Chillon et al., 2015; Collins et al., 2015; Harrison et al., 2015). In addition to this, the range of ages included within the study (9 – 13 years) enabled for differences in PA behaviour according to key stage, specifically between KS2 and KS3. However, the novelty of the study lies within the use of a UK-based Middle school, where both KS2 and KS3 children are taught within the same school environment, which allows the researcher to explore key stage differences. Findings of which can be compared with research in UK-based two-tier school systems (i.e. Primary and Secondary schools), where KS2 children are taught in Primary schools, and KS3 children are taught in Secondary schools.

The mixed-methods approach to measuring and exploring PA behaviours implemented in this study allows the researcher to gain a deeper understanding of children's reasons for PA. Children's voice added another dimension to the research and provided children with an opportunity to discuss reasons and thought processes behind PA participation and potential barriers. It also gave children an opportunity to reflect upon personal PA behaviours, and indicate how they felt PA participation could be further supported. This highlights the importance of consulting children when designing school extra-curricular PA programmes, as children's preferences on types and timings of PA, are likely to encourage greater levels of participation.

The repeated measures design to this study allowed for information to be collected over each term across the school year, allowing for patterns of behaviour to be monitored over a greater period of time, as opposed to one time point. This also allowed for investigation into whether children's PA was affected by seasonality as indicated by previous literature (Atkin et al., 2016; Tanaka et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). Children had the opportunity to voice their reasons for PA behaviour each school term, allowing for discussions to take place where children could compare PA behaviours. Additionally, other measures such as BMI and WHtR ratio could be compared across the school year, which allowed analysis to take place of how these differed according to each school term.

Previous literature raises concerns with the use of self-report measures as these measures have been known to over-estimate amounts of PA that have been completed, particularly when compared against more objective measures (Walsh et al., 2004; Tully et al., 2014). However, combining the use of these measures alongside GPS, HR monitors and focus groups in a mixed-methods approach, consequently supported the reliability of the produced data.

As indicated by previous literature, GPS data loss may be attributable to problems with the GPS device (e.g. lack of signal, inaccurate positioning or loss of battery power) and/or children' handling i.e. forgetting to wear or switch on the device (Krenn et al., 2011). Within this study, there was a lack of GPS signal reported for time spent indoors due to inconsistent/interrupted satellite connectivity. Therefore, to overcome this, data was manually checked to confirm children were indoors based on their last GPS location point, i.e. child approaching an indoor location, before analysing HR data.

Finally, as previously discussed, sample sizes for each term reduced when reporting HR and GPS data according to school term, with the final term including 41 children, compared with 60 children in Autumn term. This can be explained by the demands for participants to continue with the requirements of the investigation, and some children may have found it difficult to continue participating throughout the school year. Previous literature supports this as it is suggested that sample size is not associated with data loss, but longer measurement periods are associated with greater data loss and it seems that participant adherence decreases with time (Krenn et al., 2011).

5.6 Future recommendations

In accordance with current literature, findings from this study support the need for PA interventions to take into account the seasonal differences in children's PA behaviours. The influence seasonal variation has on children's weight status and PA specifically may facilitate precise behaviour change interventions, which can be with greater intensity during periods of the year when PA levels are at their lowest (Atkin et al., 2016). Current literature confirms that there should be an increased focus on engaging youth in PA during unstructured leisure time (Pearce et al., 2018). From the findings of this study, it is recommended that schools are an ideal platform to support children's PA, particularly during the winter months associated with the Spring term. Break and lunchtime periods are perfectly placed to offer children an accessible opportunity to engage in PA and can attract a higher attendance rate. However, it is advised that children are consulted in the design of PA programmes to ensure that PA offered are in line with children's preferences.

5.7 Conclusions

This study provided an insight into children's PA behaviour, PA location and weight status across the school year, with a focus on exploring gender and key stage differences. There has been limited research that adopts a repeated measures mixed-method design across the school year incorporating the use of GPS technology. In support of previous research findings (Atkin et al., 2016; Pearce et al., 2018), results from this study support how seasonal variation has been associated with differences in PA, with the Spring term comprising of reduced daylight hours, and poorer temperatures, resulting in significantly less PA. The study outlined weight status patterns across the school year signifying Spring term as revealing the greatest number of children classed as overweight. Autumn term revealed the greatest number of children classed as obese. WHtR risk level and BMI scores for both genders and key stages were also reported highest in Spring term.

Previous literature suggests that boys are more active than girls (Chief Medical Officers, 2019; Health and Social Care Information Centre, 2019), and there is an age-related decline in children's PA (Ortega et al., 2013; Cooper et al., 2015; Corder et al., 2016). However, this study's findings contrast this as during Autumn and Summer terms, girls engaged in greater MVPA than boys, and KS3 children engaged in greater MVPA consistently across the school year compared with KS2 children.

Children highlighted the importance of being consulted in the design of school-based extra-curricular PA programmes, and indicated that poor weather conditions, technology, and family/peers were influential in PA participation. A PA programme that was well promoted, attached to a school-reward system, and easily accessible were suggested to encourage greater participation. The study extended PA knowledge exploring gender and age interactions in a school-based sample and highlights how the Social-Ecological Model can be used to underpin a mixed-methods research design.

Chapter 6
Study 3: A lunchtime intervention to increase physical activity during the school day

Chapter 6 - (Study 3) A lunchtime intervention to increase physical activity during the school day.

6.1 Introduction

Previous studies within this thesis have been either observational or cross-sectional (Chapter 4), providing an indication of physical activity (PA) and weight/health status in one specific term, or repeated measures (Chapter 5), focusing on children's PA and location across the academic year. This chapter (Study 3) will monitor children's PA levels at school, which will include a lunchtime intervention programme consisting of a range of lunchtime PA clubs. The school term and time of day when this PA intervention is implemented is informed by the findings from Chapter 5 (repeated measures study), and the findings from focus groups in both Chapters 4 and 5 informed the intervention design in relation to the PA clubs offered (see Chapter 5.4).

6.1.1 Background

Literature suggests that the wider environment can be a barrier to children's PA, for example, accessibility, costs, transport and insufficient information and knowledge from health professionals (Newitt et al., 2016). However, the school environment specifically has been proven to implement numerous successful PA interventions promoting PA behaviours, which has had a positive effect on children's PA (Lonsdale et al., 2016; Gamble et al., 2017; Ha et al., 2017; Hollis et al., 2017; Jago et al., 2017; Engelen et al., 2018; González-Cutre et al., 2018; Pearce et al., 2018). Further research indicates that schools play a critical role to provide opportunities for children to learn and practice healthy lifestyles, reinforcing a positive development of desired healthy behaviours (Lau et al., 2018; Meier et al., 2018). Despite this, literature also suggests that school policies need to be revisited, and developed further to promote children's PA (Haddad et al., 2018), which indicates that school-based PA practice warrants further investigation.

Other factors which have been associated with poor PA include a lack of motivation, feeling of self-consciousness and embarrassment, anxiety, frustration and anger

(Newitt et al., 2016). Consequently, if children or young people experience a consistent lack of enjoyment, this may lead to reduced levels of PA and PA avoidance (Ekkekakis et al., 2016). However, the school as a platform to promote positive PA behaviours can help reduce these poor PA behaviours, as the school offers social support, goal setting and achieving, enjoyment, feeling good, motivation and optimism, which are facilitators to PA participation (Newitt et al., 2016).

Extracurricular school PA programmes encourage children to practice what they have learned in PE, work toward the nationally recommended 60 minutes of daily PA (Chief Medical Officers, 2019), become more adequately prepared for learning, engage in safe, social, and supervised activities, and identify activities they enjoy and might engage in long term (Brusseau and Hannon, 2015). However, schools are not fully utilised when adopting and implementing effective extracurricular PA clubs (Lau et al., 2018). As schools are facing greater pressures of improving academic test scores, opportunities for PA programmes during the school day have declined considerably (Haddad et al., 2018). Despite previous literature supporting extracurricular programmes (Cleland et al., 2005; Brusseau and Hannon, 2015; Mears and Jago, 2016; Lau et al., 2018; Whooten et al., 2018), many schools have significantly reduced time allocated to lunchtime (Trost et al., 2008; Brusseau and Hannon, 2015). There is a need to encourage schools to implement PA programmes involving PA before and after school, and PA during school including during school time i.e. lunchtime, which should feature staff involvement and encouragement (Brusseau and Hannon, 2015). Additional literature also highlight the positive impact school PA has on cognition, academic performance and executive functioning (Gao et al., 2018; McPherson et al., 2018; Padulo et al., 2019), and further supports the rationale for school-based PA.

Current literature has highlighted school lunchtimes as windows of opportunity to explore and promote children’s PA (Haapala et al., 2014; Klinker et al., 2014; Boddy et al., 2015; Pate et al., 2016; Powell et al., 2016a). However, children spend less than half of this time being physically active (Nettlefold et al., 2011; Saint-Maurice et al., 2011; McIver et al., 2016), and this was reflected within findings in Study 2 (see Chapter 5.3.4). Therefore, there is potential for this time window to contribute towards half of the recommended 60 minutes of daily moderate-vigorous physical activity (MVPA), for at least 5 days of the week (Howe et al., 2018).

Studies have indicated that lunchtime PA levels differ according to season, with children showing significantly reduced levels of MVPA in spring and summer, compared with MVPA levels in winter (Ridgers et al., 2018b). This finding is in direct contrast to previous research exploring seasonal differences in total daily MVPA, where autumn and winter months have been associated with lower PA levels, and summer months are associated with greater MVPA (Tucker and Gilliland, 2007; Gracia-Marco et al., 2013; Atkin et al., 2016). The latter findings are supported by results from Study 2 within this thesis, as children's MVPA during lunchtime was lowest during winter months, and greater during autumn and summer months (see Chapter 5.3.4). Despite this, there is also literature indicating that no clear seasonality differences in MVPA exist for in-school settings (Saint-Maurice et al., 2018). This would therefore suggest that there are inconsistencies in findings exploring seasonal variation during school lunchtimes. A consistent finding in the literature is however, that lunchtime provides the highest contribution for total minutes of PA during school time (Fairclough et al., 2012; Cohen et al., 2014; Ridgers et al., 2018b; Saint-Maurice et al., 2018).

Interventions focusing on maintaining PA in young people may help confront the public health challenges associated with insufficient activity (Brooke et al., 2016), and break and lunchtimes are ideal settings to promote PA times because most children attend school and these time periods do not impede on academic time which is prioritised by many schools (Baquet et al., 2018; Haddad et al., 2018). In addition to this, children have indicated that they would prefer a structured and more formal opportunity to participate in PA during lunchtime (Chalkley et al., 2018), and these findings were also revealed in Chapter 5.3.9 where lunchtime showed lowest levels of MVPA (7.4%): "*More clubs as well like at lunchtime and that*" ; "*I* *was going to say that, do like a tally vote of their favourite, like physical stuff and then do different some clubs so they're actually be active during the day."* Previous interventions focusing on lunchtime, have explored the effect of playground markings on children's PA behaviours (Baquet et al., 2018), the surrounding built environment on children's PA (Collins et al., 2012), and the implementation of loose play equipment to increase children's PA (Frost et al., 2018). However, there is a lack of research which accommodates children's voice to help promote PA behaviours, and this should be explored further.

Interventions focusing on promoting children's PA, should consult children prior to implementation, and PA offered should not solely be based upon initial researcher observations or interpretations of objectively measured data (Ekkekakis et al., 2016). Therefore, PA promotion will not be designed in isolation, it should be part of a wider and more integrated approach to enhance lifestyle behaviours. Children's voice has been highlighted as an area that schools have not considered fully, particularly when constructing PE and PA policies (Brooker and Macdonald, 1999; Warburton and Bredin, 2016), and there is little research that involves children's voice in the development and implementation of a school's positive education strategy (Halliday et al., 2018). Teacher-child interactions are important in promoting positive PA behaviours, and this can be established by consulting children's voice in schools (Brooker and Macdonald, 1999). Furthermore, children's involvement allows the school to better understand children's well-being (Halliday et al., 2018), which can consequently help inform PA policies (Brooker and Macdonald, 1999; Warburton and Bredin, 2016). This is further supported by current literature as it is suggested that the importance of children's personal experiences is meaningful and integral to shaping PA behaviours (Ní Chróinín et al., 2018). Therefore, involving children in the design of PA programmes allows them to express their own personal thoughts and preferences of PA to create a child-driven PA programme. The youth physical activity model highlights the importance of children believing that PA is 'worth it' and that 'they are able' (Welk, 1999b). Therefore, creating bespoke PA programmes that are child-centred and meet the specific needs of the children, will enhance the likelihood that children will engage and value PA, as well as develop self-confidence (Welk, 1999b). Giving children greater empowerment and autonomy in the design and implementation of PA programmes, allows for the children to take greater ownership of the PA programme, and consequently will encourage wider participation (Warburton and Bredin, 2016).

Previous studies exploring children's perceptions of PA revealed influencing factors such as 'being with friends', 'variety in activity content', 'experiencing fun', 'time constraints' and 'opportunity to be outside' (Tannehill et al., 2015). Additionally, PA that allows young people to 'be active, socialise, and work with and against friends and classmates' have been identified as key determinants based on student voice (Hastie and Mesquita, 2016). Findings from studies 1 and 2 within this thesis revealed similar results: *"It's a chance to meet up with friends" ; "Friends because they've got the same life as what you do, so you can do the same thing."* After consulting children and young people when designing PA programmes, meaningful learning experiences can be constructed through the design and selection of PA, creating a welcoming PA environment (Haegele and Sutherland, 2015). Children and young people are more likely to engage and show less oppositional defiance when they would interact with a PA programme which has elements of autonomy rather than being teacher dictated (De Meyer et al., 2016). It is proposed that if we are to encourage and provide opportunities for young people to choose active lifestyles, it is important to address what young people report affects involvement in PA across a number of contexts (Tannehill et al., 2015). The student body is a platform that should be consulted and are capable of providing rich accounts of their experience that could potentially inform school improvement (Simmons et al., 2015). This highlights the positive impact consulting children has on the providing a physically active learning environment, which should be adopted in future research.

There have been numerous studies exploring the idea of children's PA compensation (Ridgers et al., 2014; Costigan et al., 2018; O'Sullivan et al., 2018; Wadsworth et al., 2018), which proposes that children compensate for increased PA in one part of the day by decreasing their PA in another part of the day to maintain an innate total PA set point (Rowland, 1998). However, literature suggests differences amongst findings. When investigating PA behaviour and compensation between days, research indicates that children compensate their PA or sedentary time (Ridgers et al., 2014), however when exploring compensation within the same day, it was found that children do not compensate their sedentary time and/or physical activity levels (Ridgers et al., 2018a). Further research findings also support the fact that engaging in PA may not necessarily lead to compensated behaviours (Costigan et al., 2018), or equally, allowing for additional periods of sedentary behaviour (SB) may encourage greater compensatory PA behaviour (Dale et al., 2000; Saunders et al., 2014; Gribbon et al., 2015; O'Sullivan et al., 2018). Therefore, due to inconsistent findings on children's PA compensation it can be concluded that further research is required into exploring children's daily PA, and PA interventions should measure PA beyond the specific PA intervention.

Literature indicates gender differences in response to PA interventions, with girls displaying a greater intervention effect when compared with boys (Pate et al., 2016). However, this pattern is not consistent with some studies revealing a greater intervention effect for boys, and greater levels of PA for boys than girls when compared with baseline measurements (McKenzie et al., 2004; Goldfield et al., 2008; Magnusson et al., 2011; De Craemer et al., 2014). In contrast to these results, additional research indicates that there are no significant differences in intervention effects between genders, but there are trends towards girls responding more positively to interventions than boys (Metcalf et al., 2012). Therefore, it can be concluded that school-based PA interventions show differences in gender responses, with girls potentially favouring educational interventions and boys responding better to environmental interventions (Dobbins et al., 2013b). Therefore, the design of PA intervention programmes should consider differences in PA preferences, and both boys and girls should be consulted in the design and implementation of PA programmes.

When exploring age differences in school-based PA, current research suggests PA declines with age (Basterfield et al., 2011; Perry et al., 2016; Jago et al., 2017), particularly during lunchtime (Ridgers et al., 2012b; Andersen et al., 2015). When exploring further PA interventions, age differences within genders are prevalent, as research shows older girls to participate in less vigorous PA in comparison to younger girls during the school day (Labbrozzi et al., 2012). Therefore, it is concluded that PA interventions have had mixed effectiveness on increasing MVPA levels, and that further evaluations of extracurricular PA interventions are required, particularly studies that use objective assessment of PA as these measures produce accurate and reflective indications of PA behaviours (Mears and Jago, 2016). Age differences in PA have been discussed in Chapter 2.2.3.

The current study aims to consider findings from previous research and overcome barriers to PA which are informed by findings from Studies 1 and 2 (Chapters 4 and 5). The Social-Ecological Model (McLeroy et al., 1988) which underpinned Studies 1 and 2, is a useful model to put the child at the centre of PA intervention design, and allows the PA to be implemented so that the surrounding environments can be considered i.e. social environment, physical environment, policy etc. The youth physical activity model (Welk, 1999b) also supports how bespoke children's PA programmes enhances participation and self-confidence. The current study will enhance existing knowledge to PA interventions by adopting the child-centred approach of the Social-Ecological Model, and bespoke nature of PA from the youth physical activity model, through a mixed-methods approach to PA intervention design and evaluation.

6.1.2 Study aims

The current thesis study is informed by the findings of the previous research studies (Studies 1 and 2), where PA behaviours were explored in a cross-sectional approach and repeated measures design across the school year. This study will design, implement and evaluate a PA intervention delivered during the school term that had the lowest level of MVPA in Study 2, (i.e. Spring term – January to March). The study will use mixed methods (heart rate monitors to measure children's PA intensity and duration, and focus groups to assess the effectiveness of the PA intervention).

Through utilising this mixed-methods approach, the study aims to assess the effects of a lunchtime PA intervention programme on children's MVPA, whilst exploring gender and key stage differences. PA behaviours across the segmented school day will also be investigated. Research questions are as follows:

- Does a child-informed lunchtime PA intervention increase children's levels of MVPA during the school day?
- Are there PA differences between non-intervention days and intervention days?
- Are certain lunchtime activities more effective in increasing PA?
- Are there PA differences in the segmented school day according to non-intervention/intervention days?
- Do children feel the PA intervention has helped promote greater PA behaviours?

6.2 Methods

6.2.1 Intervention design

As discussed in Chapter 3.1, the mixed-methods approach to this intervention study design supports a pragmatic approach whereby the researcher will use thoughts as an instrument/tool for prediction, problem solving and action (James et al., 1978). The findings from Study 2 were used to inform the researcher which school term showed children to engage in least amount of MVPA. This therefore allows for a PA intervention promoting children's MVPA to be implemented at a time of year which has demonstrated lower children's PA levels.

Study 2 was underpinned by the Social-Ecological Model (McLeroy et al., 1988) which was useful for the researcher to consider the different influential factors which may affect children's PA behaviours (i.e. social environment, physical environment etc. – see Figure 6.1).

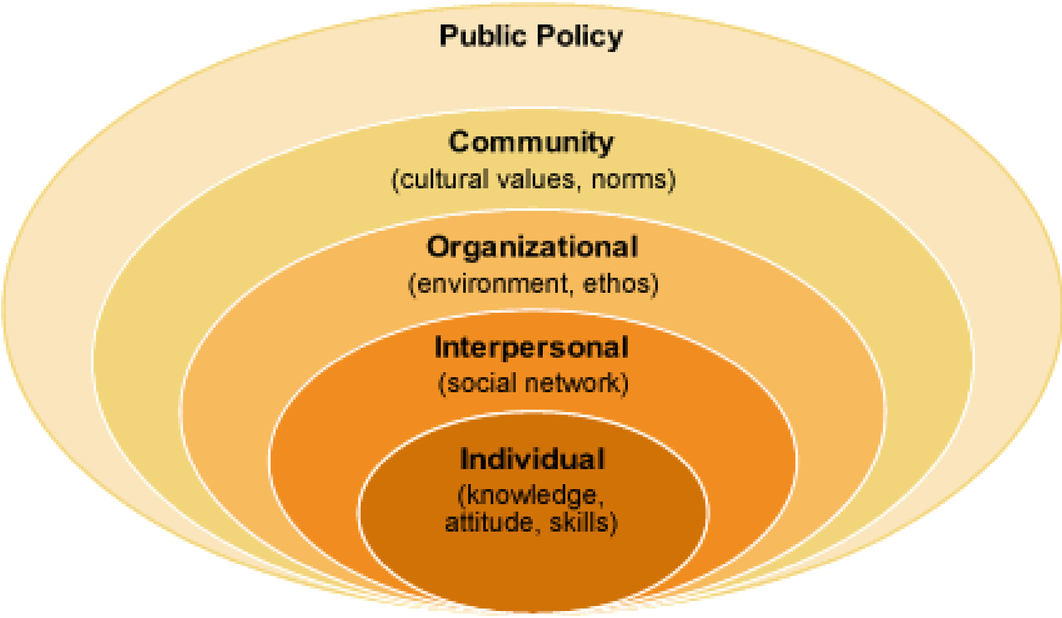


Figure 6. 1 Social-Ecological Model (McLeroy., 1988).

Figure 6.2 shows how the influential factors for PA which were explored through consulting children's voice, helped plan, design and shape the PA intervention with particular reference to the types of PA offered, and where children felt the PA programme was best suited to be implemented. This approach embeds the individual layer of the Social-Ecological Model (McLeroy et al., 1988), and is in accordance with the youth physical activity model which identifies the need to consult children in the design of PA programmes (Welk, 1999b). Figure 6.2 also outlines the repeated measures design of Study 2, which highlighted how children engaged in lower amounts of MVPA in Spring term. Consequently, this informed the time of year of the PA intervention within this study.

Study 2 also indicated that it was the lunchtime period specifically in all three terms which showed children to engage in least amount of MVPA, when compared with 'free time' and the 'school day'. The lunchtime period in Spring term (winter months) showed children to engage in the lowest amounts of MVPA, and this informed the time of day when the PA intervention would be offered. Focus groups highlighted children's PA preferences to be associated with MVPA, for example, children referred to a fitness club, football, and dodgeball activities. This therefore shaped the nature of the PA intervention, which focused on increasing children's MVPA.

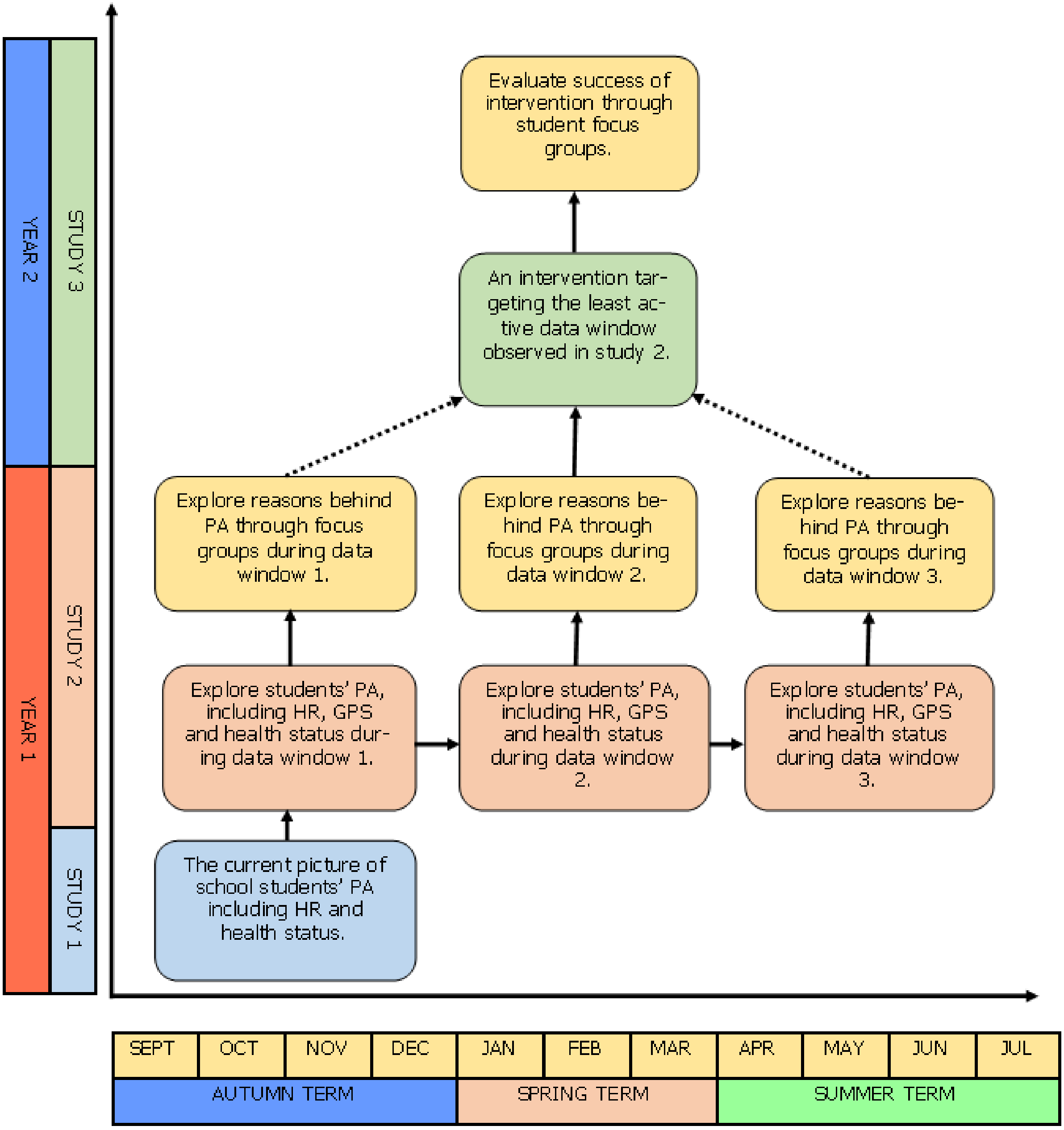


Figure 6. 2 Intervention study design informed by previous research studies.

6.2.2 Participants

The same school participated in this study as for Studies 1 and 2, which resulted in a deeper case study approach into children's PA behaviours within this particular school. The head teacher of this urban town Middle school in the West Midlands, United Kingdom, provided consent for the school to be involved in the study (School data: 560 total children, 93 children from ethnic minority groups, 21% free school meals). 60 children (aged 9-13) were recruited through convenience and purposive sampling (11% of the total school population) and agreed participant (and parental) consent was obtained (Boys = 31, Girls = 29). Key stage 2 (KS2) children comprised of children in school years 5 or 6 (aged 9-11), and key stage 3 (KS3) children comprised of children in school years 7 or 8 (aged 11-13). A breakdown of children according to gender and key stage is provided in Table 6.1.

Table 6. 1 Number of children according to key stage and gender.

	KS2	KS3	Total
Whole sample	30	30	60
Boys	16	15	31
Girls	14	15	29

The PA intervention programme was available to all children within the school, and monitoring a sample of 60 children was chosen as a manageable and reflective sample of those who engaged in the PA intervention programme. A stratified approach was implemented to divide children into one of four groups according to school year (ranging from years 5-8) as it ensures each subgroup within the population receives proper representation within the sample (Orcher, 2016). Stratified random sampling provides better coverage of the population as the researcher has control over the subgroups to ensure all of them are represented in the sampling (Orcher, 2016). Study 2 highlighted that girls engaged in greater MVPA than boys, and KS3 engaged in greater MVPA than KS2, however, focus group data outlined how children from all year groups highlighted a need for greater PA opportunities. Therefore, encompassing children from all year groups, and adopting a stratified sampling approach allowed analysis to take place on the impact of the PA intervention on the wider school population.

6.2.3 Research measures

6.2.3.1 Physical activity measurement

In a similar approach to Study 1 (Chapter 4), heart-rate monitors were used to measure PA intensity and duration throughout the school day which consisted of three main time periods: lesson time (including registration/assembly), morning break time and lunchtime. Previous studies (Study 2) highlighted the school day (particularly lunchtime) as revealing lowest levels of MVPA. Collecting heart rate (HR) data throughout the school day enabled the researcher to explore children's PA compensation, which previous literature indicates involves children compensating for higher levels of PA by reducing PA in other time periods (Ridgers et al., 2014). Therefore, findings from this study's sample could be compared with previous research.

Heart-rate monitors (Polar H1 – Polar, Kempele, Finland) were used within this study, and this specific model is widely used and has been shown to have good reliability (Lacome et al., 2018a; Lacome et al., 2018b; Stock et al., 2018), and has been used in children's PA research (Frawley et al., 2018). Furthermore, HR monitors are popular tools as an objective measure of PA in school children as there is no paired wrist-watch which provides feedback, which reduces reactivity (Duncan et al., 2009b; Fjørtoft et al., 2009; Fjortoft et al., 2010; Schoeppe et al., 2014a; Collins et al., 2015; Tompkins et al., 2015; Hollis et al., 2016; Hollis et al., 2017). The context of how HR monitors have been used differs, with research exploring HR in small-sided and large-scale PA studies (Póvoas et al., 2018), school children's commuting patterns (Collins et al., 2015), and measuring PA in the classroom (Mullender-Wijnsma et al., 2015), this evidences the wide range of literature that has utilised HR monitors, and how they are a valid and versatile way to explore different PA research questions.

In a school context, HR monitors could be argued to be particularly useful due to the compactness, light-weight and simple operative nature (Åstrand, 2003). Furthermore, as new technology evolves, the cost and affordability of HR monitors makes these more accessible to schools (Åstrand, 2003). As in the previous two studies, a HR reserve was calculated (see Chapter 3.4.3) for each participant using the Karvonen method (Kenney et al., 2015). This ensured each child had personalised HR intensities calculated for sedentary, light, moderate and vigorous PA behaviours, and literature indicates that utilising this method accommodates the different levels of fitness within a sample (Fairclough and Stratton, 2005b), and ensures HR data produced is reflective of each child. Further information on HR monitors is provided in chapters 2.6.1, and 3.4.3.

6.2.2.2 Focus groups - The effectiveness of lunchtime physical activity clubs

Focus groups were previously carried out in Studies 1 and 2 and a rationale for the use of focus groups in research is provided in Chapter 3.4.6. In this study, focus groups were conducted to explore the children's experiences of the lunchtime PA clubs, and to collect rich description of those experiences. A convenience and purposive selected sub-sample of children were invited to participate in one of two focus groups (focus group 1: n = 10, focus group 2: n = 11). These groups were organised according to school key stage (KS2 = 9-11 years, KS3 = 11-13 years). For consistency, the same approach applied in studies 1 and 2 was used in this study (see Chapter 3.4.6). Focus group questions were constructed deductively, as HR data formulated a theory/hypothesis. Focus groups helped to explore the children's experiences of the lunchtime PA clubs in order to identify the strengths of the PA clubs, and how they felt the lunchtime PA intervention programme could be further improved. This also included providing reasons for choice of club attendance and the impact this has had on their PA behaviour during the school day.

6.2.3 Research procedure

Data collection took place between 11th January 2016 – 15th March 2016 (eight weeks), where 60 children wore HR monitors for 10 school days (weekdays), within a designated week (see Appendix 13). Children chose six lunchtime PA clubs to attend (one PA club per day), and four days were 'non-intervention' days, where they did not attend lunchtime PA clubs. Participants were aware of the intervention requirements i.e. the need to engage in six PA clubs, at the time of providing consent. The lunchtime PA clubs offered, and intervention schedule is provided in Appendix 13.

Children collected HR monitors at the beginning of the school day (08:45) and wore these throughout the school day before returning HR monitors to the lead researcher at the end of the school day (15:15). Children received a tutorial of how to wear the HR monitors, and applied HR monitors themselves in school changing rooms. As with equipment in Studies 1 and 2, HR monitors were not to be worn in water-based activities such as swimming, showering etc., as the HR monitors were not water resistant. At the end of each week, HR data was downloaded from each monitor, and equipment was checked and recharged in preparation for the following week. The intervention schedule showing each group's data collection week is provided in Appendix 13.

After eight weeks of HR data collection, a convenience and purposive sample of 10 children (focus group 1), and 11 children (focus group 2) took part in focus groups on either 14th or 15th March 2016 at the end of the intervention. Focus groups have been used previously to explore children's perspectives and attitudes towards PA (Mackintosh et al., 2011; Lassetter et al., 2015). Focus groups took place in a classroom during the school day based around convenient times of children's timetables, and were recorded in mp3 format by the researcher.

In the context of this study, the researcher adopted a reflexive approach to data collection to avoid personal bias, as the researcher being a teacher within the school had a degree of personal knowledge of the setting and children. The lead researcher consulted the wider research team when arranging sample recruitment and grouping, and also questions for focus groups were shared and discussed to ensure questions were not misleading, and were fit to gather information related to the study's specific research questions. Further ethical considerations and details of insider research are provided in chapters 3.6, and 3.6.1.

6.2.4 Data Analysis

6.2.4.1 Quantitative data

After quantitative HR data had been downloaded and cleaned (see Chapter 3.4.3), a total of 55 children's data was included within the analysis. Five children's downloaded files were corrupt and therefore could not be used. Data was organised to compare children's HR on intervention days and non-intervention days. HR was split into segmented day comprising of academic time, break time and lunchtime in order to explore PA compensation. A number of statistical procedures were carried out using IBM SPSS Statistics Software (Version 25) in response to the research questions. Descriptive statistics and repeated measures ANOVA tests were used to explore gender and key stage differences in HR, and also any differences between intervention days and non-intervention days. Descriptive statistics and repeated measures ANOVA tests were also applied when investigating the segmented day to explore PA compensation. Analysis of the segmented school day allowed for this to be explored in this study. The school day consisted of three main time periods: lesson time (including registration/assembly), morning break time and lunchtime. As the time durations differed according to each segment of the school day, HR data was also analysed using percentage of time in order to provide comparable data. For all statistical analysis, a two-tailed significance value of $p < 0.05$ was considered significant.

6.2.4.2 Qualitative data

Focus group data were transcribed and analysed according to a thematic approach, which involves a process of data familiarisation, followed by categorising into a 'semantic/latent' code across the dataset (Smith et al., 2009). The use of focus groups in research including information on strengths and limitations is provided in Chapter 2.7.3, and further details of how focus groups were implemented are provide in Chapter 3.4.6.

6.3 Results

The following results section has been organised into subsections to address the research aims outlined in Chapter 6.1.2. This study will explore PA behaviours following a lunchtime PA club intervention programme. PA behaviours according to school key stage and gender will be discussed, and children's feedback on the intervention programme will be explored.

6.3.1 Physical activity

From the original 60 children recruited for the study, 55 children's data was successfully downloaded (92% of total study sample, 10% of the total school population, 5 children's files were corrupt and therefore could not be used). Analysis was conducted on the datasets provided by these samples.

Mean MVPA for non-intervention days was 35.5 minutes, and for intervention days MVPA was 43.7 minutes, 8.2 minutes higher than non-intervention days. There were 5 children (9.1%) who met the 60 minute PA guidelines (Chief Medical Officers, 2019) on non-intervention days, and 10 children (18.2%) who met the guidelines on intervention days. A breakdown of children meeting these guidelines on non-intervention and intervention days, according to gender and key stage is provided in Table 6.2.

Analysis was carried out exploring the difference in mean daily MVPA according to each PA lunchtime club. This provided an indication of differences in children's MVPA on specific PA days compared with non-intervention days. Football, dodgeball and table-tennis activities showed significantly greater amounts of MVPA compared with non-intervention days. In addition to this, dodgeball intervention days showed children to engage in the most MVPA (17.6 minutes), and consequently showed the largest difference in minutes of MVPA. Details of children's MVPA according to each specific PA is provided in Table 6.3.

Table 6. 2 Children meeting PA guidelines on non-intervention and intervention days according to gender and key stage.

Variable	Meeting PA guidelines	Non-Intervention		Intervention	
		N	Percent of Children %	N	Percent of Children %
Overall	Meeting	5	9.1	10	18.2
	Not meeting	50	90.9	45	81.8
Boys	Meeting	3	9.7	7	22.6
	Not meeting	28	90.3	24	77.4
Girls	Meeting	2	8.3	3	12.5
	Not meeting	22	91.7	21	87.5
KS2	Meeting	3	10.3	5	17.2
	Not meeting	26	89.7	24	82.8
KS3	Meeting	2	7.7	5	19.2
	Not meeting	24	92.3	21	80.8
KS2 Boys	Meeting	1	6.3	3	18.8
	Not meeting	15	93.8	13	81.3
KS2 Girls	Meeting	2	15.4	2	15.4
	Not meeting	11	84.6	11	84.6

KS3 Boys	Meeting	2	13.3	4	26.7
	Not meeting	13	86.7	11	73.3
KS3 Girls	Meeting	0	0	1	9.1
	Not meeting	11	100	10	90.9

Table 6. 3 Mean MVPA for children's daily MVPA according to each lunchtime PA club.

Non – intervention MVPA (mins)	Intervention PA MVPA (mins)	MVPA difference (mins)	MVPA difference (%)
		Football	
9.8	14.5**	4.7	3.8
		Dodgeball	
	17.6**	7.8	1.1
		Circuits	
	11.5	1.7	3.6
		Table-tennis	
	15.3**	5.5	1

*Statistically significant difference between non-intervention and intervention days (p <0.05);

**Statistically significant difference between non-intervention and intervention days (p <0.01).

Due to differences in children's wear time of HR equipment, each HR as a percentage of total wear time was calculated to provide a more reflective indication of children's time spent in each HR intensity throughout the day and used in further analyses. This approach is supported by previous literature (Fairclough et al., 2016; Hollis et al., 2017).

Repeated measures ANOVA revealed significant findings when exploring differences in moderate physical activity (MPA) ($F_{(1,51)}$= 13.61 , 1.8% increase, p = 0.001), vigorous physical activity (VPA) ($F_{(1,51)}$= 6.70 , 0.6% increase, p = 0.011), and MVPA ($F_{(1,51)}$= 13.451 , 2.4% increase, p = 0.001) between non-intervention and intervention days, with percentage time in PA significantly higher on intervention days. There were no significant differences elsewhere (as highlighted in Table 6.4).

Table 6. 4 Mean (±SD) PA intensities (%) for non-intervention days and intervention days.

	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention
Whole cohort	53% (±19.5)	51.4% (±17.1)	35.8% (±15.2)	34.9% (±13.23)	8.9% (±4.8)	10.7%** (±4.6)	2.4% (±2)	3%* (±1.4)	11.3% (±6.2)	13.7%** (±5.3)
Male	53.4% (±17.9)	52.3% (±16.3)	34.7% (±14.3)	33.9% (±12.8)	9% (±3.5)	10.4% (±3.5)	2.9% (±2)	3.5% (±1.3)	11.9% (±5)	13.9% (±4.3)
Female	52.5% (±21.7)	50.3% (±18.4)	37.1% (±16.5)	36.2% (±14)	8.7% (±6.2)	11.2% (±5.8)	1.7% (±1.7)	2.3% (±1.3)	10.4% (±7.4)	13.5% (±6.4)
KS2	49.7% (±22.2)	48.7% (±19.9)	37.8% (±16.7)	36.9% (±14.8)	9.9% (±6)	11.6% (±5.7)	2.6% (±2.1)	2.9% (±1.5)	12.5% (±7.4)	14.4% (±6.4)
KS3	56.6% (±15.5)	54.5% (±13)	33.5% (±13.2)	32.7% (±11)	7.8% (±2.7)	9.8% (±2.9)	2.1% (±1.9)	3.1% (±1.4)	9.9% (±4.1)	12.9% (±3.6)
Male KS2	51.5% (±21.5)	51.4% (±19)	35.7% (±16.8)	34.6% (±14.5)	9.8% (±4.1)	10.7% (±4.4)	3% (±2.1)	3.3% (±1.5)	12.8% (±5.7)	14.1% (±5.5)
Male KS3	55.3% (±13.6)	53.2% (±13.5)	33.7% (±11.4)	33.1% (±11.2)	8.2% (±2.5)	10.1% (±2.5)	2.9% (±2)	3.7% (±1.1)	11% (±4.2)	13.7% (±2.9)

Female KS2	47.4% (±23.7)	45.4% (±21.3)	40.4% (±16.9)	39.7% (±15.4)	10% (±7.9)	12.6% (±7)	2.2% (±2)	2.3% (±1.4)	12.2% (±9.4)	14.9% (±7.6)
Female KS3	58.4% (±18.3)	56.2% (±12.7)	33.3% (±15.9)	32.1% (±11.4)	7.2% (±2.8)	9.5% (±3.6)	1.1% (±1.1)	2.2% (±1.3)	8.3% (±3.6)	11.7% (±4.2)

*Statistically significant difference between non-intervention and intervention days (p <0.05);

**Statistically significant difference between non-intervention and intervention days (p <0.01).

The following section will present findings according to the different PA offered as part of the intervention. Children engaged in six PA of their choice from the PA offered, with four non-intervention days. There were differences in PA attendance due to children's personal choice.

When exploring football intervention days, repeated measures ANOVA revealed children's MVPA to be significantly greater on football intervention days compared with non-intervention days ($F_{(1,48)} = 12.494$, 3.8% increase, $p = 0.001$). This can be explained by both children's MPA and VPA time being significantly higher on football intervention days than non-intervention days (MPA: $F_{(1,48)} = 11.25$, 2.9% increase, $p = 0.002$; VPA $F_{(1,48)} = 8.84$, 0.9% increase, $p = 0.005$). In addition to this, football significantly reduced the percentage of sedentary time compared with non-intervention days (Sedentary: $F_{(1,48)} = 8.12$, 5.3% decrease, $p = 0.006$). Children's light physical activity (LPA) was similar between football intervention days and non-intervention days.

There were significant increases (2%) when exploring VPA according to key stage ($p = 0.004$), with KS3 engaging in greater VPA (4.2% ± 2.3) on football days compared with non-intervention days (2.2% ± 1.9). Key stage MVPA findings were approaching statistical significance ($p = 0.05$). This showed both key stages to engage in greater MVPA on football intervention days, compared with non-intervention days, and KS3 engaged in greater (2.2%) MVPA (16.1% ± 7.9) than KS2 (13.9% ± 10.2). Statistically significant football intervention day findings are presented in Figure 6.1 and football intervention descriptives are presented in Table 6.5.

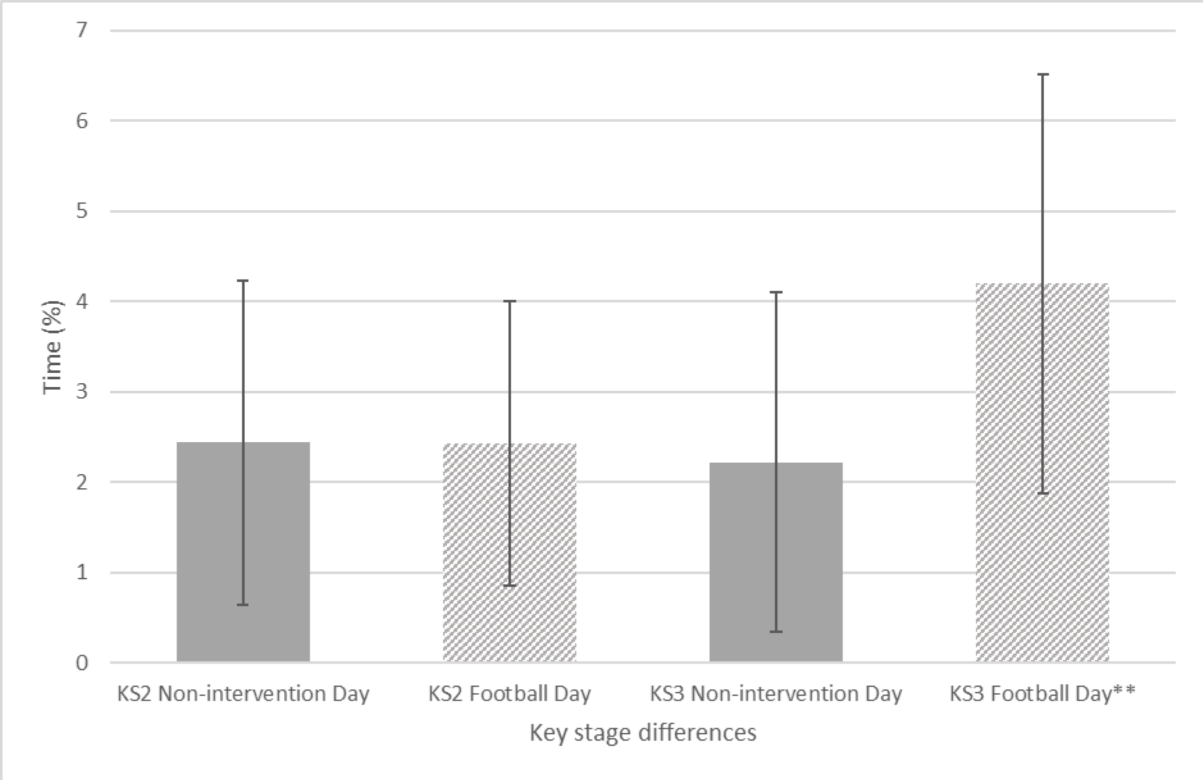


Figure 6.1. Mean time (percent) spent in VPA on non-intervention day and football intervention day according to key stage.

Table 6. 5 Mean (±SD) PA intensities (%) for non-intervention days and football intervention days.

	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Football Intervention	Non-intervention	Football Intervention	Non-intervention	Football Intervention	Non-intervention	Football Intervention	Non-intervention	Football Intervention
Whole cohort	54% (±19.2)	48.7%** (±20.3)	34.9% (±14.9)	36.4% (±14.7)	8.8% (±4.9)	11.7%** (±7.9)	2.3% (±1.8)	3.2%** (±2.1)	11.1% (±6.2)	14.9%** (±9.1)
Male	54.7% (±16.6)	50.9% (±17.8)	33.7% (±13.3)	34.2% (±12.6)	8.9% (±3.5)	11.2% (±5.8)	2.8% (±1.8)	3.8% (±2.3)	11.7% (±4.8)	15% (±7.6)
Female	53.1% (±22.6)	45.8% (±23.3)	36.5% (±17.2)	39.4% (±16.9)	8.6% (±6.4)	12.2% (±10.2)	1.8% (±1.8)	2.6% (±1.7)	10.4% (±7.8)	14.8% (±11.1)
KS2	51% (±21.4)	48.6% (±22.7)	36.8% (±16.2)	37.5% (±16.6)	9.8% (±6.1)	11.4% (±9.2)	2.4% (±1.8)	2.4% (±1.6)	12.2% (±7.3)	13.9% (±10.1)
KS3	57.6% (±15.8)	48.9% (±17.5)	32.7% (±13.4)	35.1% (±12.3)	7.6% (±2.7)	11.9% (±6.2)	2.2% (±1.9)	4.2%** (±2.3)	9.8% (±4.2)	16.1% (±7.9)
Male KS2	54.1% (±19.53)	54.1% (±19.1)	33.7% (±15.4)	33% (±14.1)	9.6% (±4.1)	10.1% (±5.9)	2.6% (±1.6)	2.8% (±1.9)	12.2% (±5.4)	12.9% (±7.5)
Male KS3	55.3% (±13.6)	47.7% (±16.4)	33.7% (±11.4)	32.3% (±11.2)	8.2% (±2.5)	12.3% (±5.6)	2.9% (±2)	4.7% (±2.3)	11.1% (±4.2)	17% (±7.4)
Female KS2	47.4% (±23.7)	42.3% (±25.5)	40.4% (±16.9)	42.7% (±18.2)	10% (±7.9)	13% (±12)	2.2% (±2)	2% (±1.1)	12.2% (±9.4)	15% (±12.8)
Female KS3	61.3% (±19.2)	50.9% (±20.2)	30.9% (±16.8)	34.6% (±14.6)	6.6% (±2.7)	11.2% (±7.4)	1.1% (±1.1)	3.3% (±2.2)	7.7% (±3.7)	14.5% (±8.9)

*Statistically significant difference between non-intervention and intervention days (p <0.05);

**Statistically significant difference between non-intervention and intervention days (p <0.01).

All children engaged in significantly more MVPA on circuit intervention days compared with non-intervention days ($F_{(1,31)}$ = 5.038, 3.57% increase, p = 0.032), and this can be explained by the 2.7% increase in MPA, and the significant increase in VPA on circuit intervention days compared with non-intervention days ($F_{(1,31)}$ = 7.84, 0.9% increase, p = 0.009).

Additionally, KS2 engaged in significantly more (p = 0.028) MVPA (7%), on circuit intervention days (18.9% ± 15.9) than non-intervention days (11.9% ± 5.7). This is explained by KS2 children engaging in significantly more (p = 0.033) MPA (5.6%) on circuit intervention days (14.8% ± 14.2) than non-intervention days (9.2% ± 4.1). KS3 children's MPA and MVPA remained consistent between circuit intervention days and non-intervention days. Statistically significant circuit intervention day findings are presented in Figures 6.3-6.4, and circuit intervention descriptives are presented in Table 6.6.

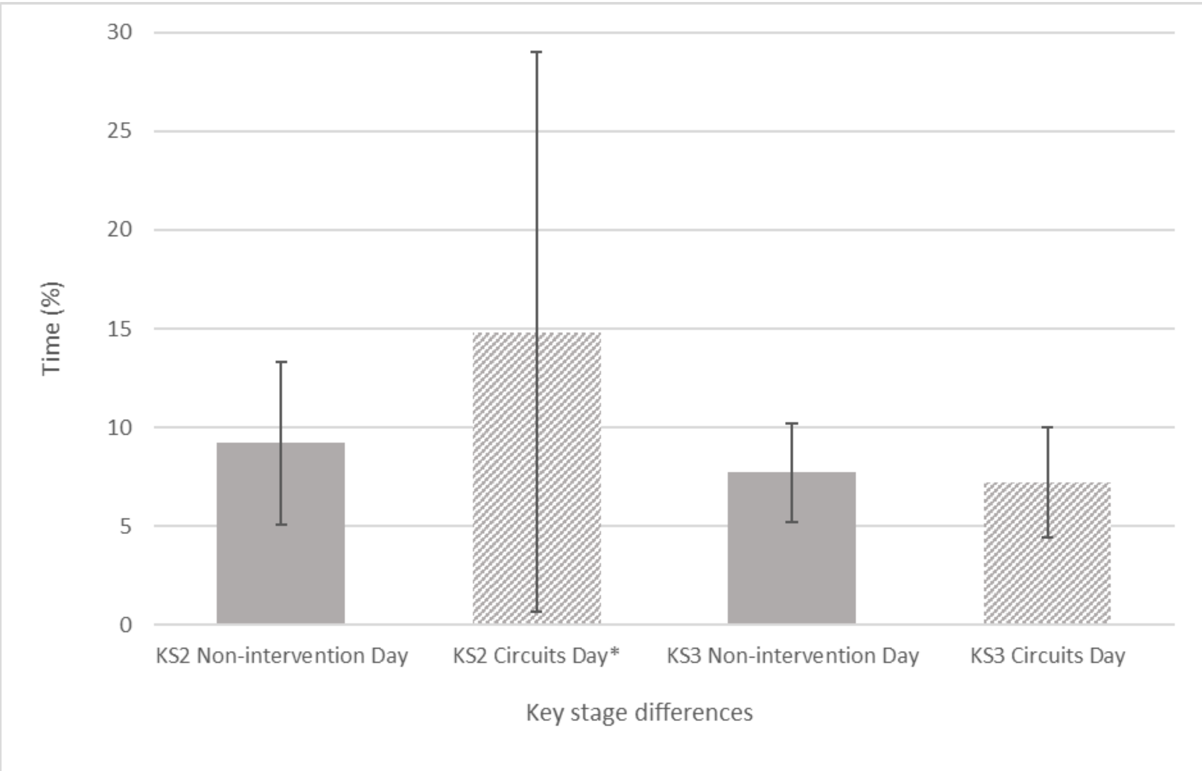


Figure 6. 3 Mean time (percent) spent in MPA on non-intervention day and circuit intervention day according to key stage.

Table 6. 6 Mean (±SD) PA intensities (%) for non-intervention days and circuit intervention days.

	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention
Whole cohort	53.6% (±16.5)	51.7% (±21.6)	35.6% (±13.6)	33.8% (±15)	8.4% (±3.5)	11.1% (±10.9)	2.4% (±2.1)	3.3%** (±2.4)	10.9% (±5)	14.4*% (±12.5)
Male	52% (±17.4)	49.2% (±19.6)	35.3% (±14.00)	36.4% (±14.7)	9.4% (±3.7)	10.7% (±5.3)	3.3% (±2.2)	3.7% (±1.9)	12.7% (±5.4)	14.4% (±6.5)
Female	55.7% (±15.5)	55.1% (±24.2)	35.9% (±13.6)	30.4% (±15.3)	7.2% (±2.7)	11.7% (±15.9)	1.3% (±1.3)	2.8% (±2.9)	8.4% (±4)	14.5% (±18)
KS2	50.1% (±19.7)	45.6% (±20.1)	38.1% (±15.9)	35.5% (±15.9)	9.2% (±4.1)	14.8%* (±14.2)	2.7% (±2.1)	4.1% (±2.7)	11.9% (±5.7)	18.9%* (±15.9)
KS3	57.3% (±11.7)	58.2% (±16.8)	33% (±10.5)	32.1% (±14.4)	7.7% (±2.5)	7.2% (±2.8)	2.1% (±2.1)	2.5% (±1.7)	10% (±4.1)	10% (±4.1)
Male KS2	48.1% (±20.4)	45% (±20.2)	37.7% (±16.1)	38.3% (±13.7)	10.7% (±4)	12.8% (±5.7)	3.4% (±2.2)	3.9% (±2.2)	14.1% (±6)	16.7% (±7.1)
Male KS3	56.7% (±12.6)	54.4% (±18.8)	32.4% (±11)	34.2% (±16.3)	7.8% (±2.7)	8% (±3.4)	3.1% (±2.3)	3.4% (±1.6)	11% (±5)	11.5% (±4.7)

Female KS2	53.1% (±19.9)	46.6% (±31.13)	38.6% (±16.8)	31% (±19)	6.8% (±3.2)	18% (±22.3)	1.5% (±1.4)	5% (±3.5)	8.3% (±4.2)	22.4% (±24.7)
Female KS3	57.9% (±11.4)	62.5% (±14.3)	33.5% (±10.7)	29.9% (±12.6)	7.5% (±2.3)	6.3% (±1.8)	1% (±1.1)	1.4% (±0.9)	8.5% (±3)	7.6% (±2.2)

*Statistically significant difference between non-intervention and intervention days (p <0.05);

**Statistically significant difference between non-intervention and intervention days (p <0.01)

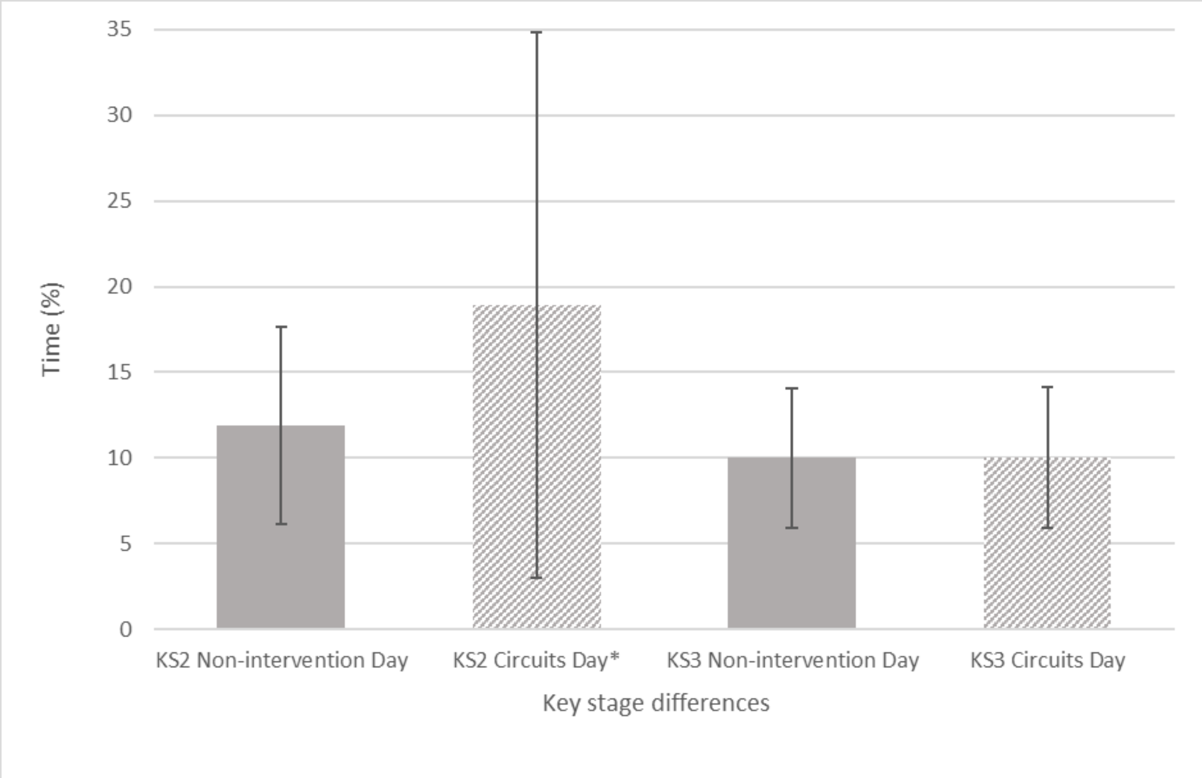


Figure 6. 4 Mean time (percent) spent in MVPA on non-intervention day and circuit intervention day according to key stage.

On intervention days that implemented a table-tennis activity, children engaged in significantly less LPA compared with non-intervention days $F_{(1,39)} = 7.26$, 2.9% decrease, $p = 0.01$). Although not statistically significant ($p > 0.05$), children did engage in greater mean MVPA on table-tennis intervention days, compared with non-intervention days (1.03% increase). Table-tennis intervention descriptives are presented in Table 6.7.

Table 6. 7 Mean (±SD) PA intensities (%) for non-intervention days and table-tennis intervention days.

	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention
Whole cohort	53% (±20)	54.9% (±19.9)	35.4% (±15.2)	32.5%* (±16)	9.2% (±5.2)	9.5% (±5.1)	2.4% (±2)	3.1% (±3.3)	11.6% (±6.5)	12.6% (±7.3)
Male	54% (±17.7)	54.7% (±18.4)	34.2% (±14)	32% (±16.1)	9.7% (±3.9)	9.7% (±3.9)	3% (±2.1)	4.2% (±4)	12.2% (±5.1)	13.8% (±7.1)
Female	52.3% (±22.8)	55.1% (±22)	36.9% (±16.8)	33.7% (±16.1)	9.4% (±6.3)	9.4% (±6.3)	1.8% (±1.8)	1.8% (±1.6)	10.9% (±7.9)	11.2% (±7.4)
KS2	51% (±22.9)	53.2% (±20.8)	36.2% (±16.7)	33.3% (±17)	10.3% (±5.6)	10.4% (±5.7)	2.6% (±2.1)	3.2% (±3.7)	12.9% (±8)	13.6% (±8.3)
KS3	55.2% (±16.6)	56.7% (±19.3)	34.7% (±13.9)	32% (±16)	8% (±2.7)	8.7% (±4.3)	2.2% (±2)	2.9% (±3)	10.2% (±4.2)	11.6% (±6.1)
Male KS2	53.8% (±21.8)	56% (±17)	33.5% (±16.9)	29.5% (±15.8)	9.9% (±4.4)	10.3% (±3.9)	2.8% (±2.2)	4.2% (±4.7)	12.7% (±6)	14.5% (±8.1)
Male KS3	53.5% (±14)	53.5% (±20.2)	34.8% (±11.4)	33.3% (±16.8)	8.5% (±2.7)	9.1%	3.2% (±2.1)	4.1%	11.7% (±4.4)	13.2% (±6.3)

						(±3.9)		(±3.5)		
Female KS2	48.1% (±24.8)	50.3% (±24.5)	38.8% (±16.7)	37% (±17.2)	7.3% (±2.8)	10.5% (±7.2)	2.5% (±2.1)	2.2% (±2)	13.1% (±9.9)	12.6% (±8.7)
Female KS3	57.3% (±20.3)	61% (±18.2)	35% (±18)	29.6% (±14.6)	7.3% (±2.8)	8.1% (±5)	0.9% (±0.7)	1.4% (±0.9)	8.2% (±3.3)	9.5% (±5.5)

*Statistically significant difference between non-intervention and intervention days (*p* <0.05);

**Statistically significant difference between non-intervention and intervention days (*p* <0.01).

Intervention days that included dodgeball activities did not reveal any statistically significant differences when compared with non-intervention days, however there was a 1% increase in mean MVPA on dodgeball intervention days compared with non-intervention days. Dodgeball intervention descriptives are presented in Table 6.8.

Table 6. 8 Mean (±SD) PA intensities (%) for non-intervention days and dodgeball intervention days.

	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention
Whole cohort	52.4% (±19.7)	53.6% (±18.6)	36.1% (±15.4)	33.8% (±14.6)	9% (±4.9)	10.2% (±4.9)	2.5% (±2)	2.4% (±1.9)	11.5% (±6.2)	12.5% (±6)
Male	53.4% (±17.9)	55% (±18.6)	34.7% (±14.3)	32.8% (±14.9)	9% (±3.5)	9.5% (±4.3)	2.9% (±2)	2.7% (±2)	11.9% (±5)	12.2% (±5.8)
Female	51.2% (±22.2)	51.8% (±19)	38.1% (±16.9)	35.3% (±14.3)	9% (±6.4)	11% (±5.6)	1.8% (±1.8)	2% (±1.7)	10.8% (±7.7)	13% (±6.3)
KS2	49.7% (±22.2)	51.2% (±22.1)	37.8% (±16.7)	36% (±17.1)	9.9% (±6)	10.4% (±5.3)	2.6% (±2.1)	2.4% (±1.9)	12.5% (±7.4)	13% (±6.4)
KS3	55.8% (±15.9)	56.6% (±13.1)	34.1% (±13.6)	31.2% (±10.6)	7.9% (±2.7)	9.9% (±4.3)	2.2% (±1.9)	2.4% (±1.9)	10.2% (±4.1)	12.2% (±5.5)
Male KS2	51.5% (±21.5)	52.6% (±22.7)	35.7% (±16.8)	35.1% (±18.1)	9.8% (±4.1)	9.5% (±4.6)	3% (±2.1)	2.9% (±2.2)	12.8% (±5.7)	12.4% (±6.4)
Male KS3	55.3% (±13.6)	57.6% (±13.1)	33.7% (±11.4)	30.4% (±10.5)	8.2% (±2.5)	9.6% (±4.1)	2.9% (±2)	2.5% (±1.8)	11% (±4.2)	12.1% (±5.2)

Female KS2	47.4% (±23.7)	49.5% (±22.2)	40.4% (±16.9)	37.2% (±16.3)	10% (±7.9)	11.5% (±6.1)	2.2% (±2)	1.8% (±1.5)	12.2% (±9.4)	13.3% (±6.6)
Female KS3	56.6% (±20)	55% (±13.8)	34.7% (±17.3)	32.4% (±11.3)	7.6% (±3.1)	10.3% (±4.9)	1.2% (±1.1)	2.2% (±2.1)	8.8% (±3.8)	12.6% (±6.2)

*Statistically significant difference between non-intervention and intervention days (p <0.05);

**Statistically significant difference between non-intervention and intervention days (p <0.01)

6.3.2 Physical activity across the segmented school day

When exploring differences in PA behaviour according to the segmented school day, repeated measures ANOVA revealed MPA during lesson time was significantly higher on intervention days compared with non-intervention days ($F_{(1,51)} = 4.14$, $p = 0.047$). Lesson time PA descriptives are presented in Table 6.9.

Table 6. 9 Mean (±SD) PA intensities (%) according to academic time on non-intervention day and intervention day.

Lesson time	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention
Whole cohort	59% (±21)	57.9% (±18.6)	34.2% (±17.2)	33.8% (±16)	5.6% (±4.6)	6.6%* (±4.1)	1.3% (±1.6)	1.6% (±1.1)	6.9% (±5.8)	8.2% (±4.6)
Male	59.9% (±19.4)	59.3% (±17.8)	33.4% (±16)	33% (±15.6)	5.2% (±4)	5.9% (±3.1)	1.5% (±1.7)	1.8% (±1.2)	6.7% (±5.3)	7.7% (±3.9)
Female	57.7% (±23.4)	56.2% (±19.9)	35.2% (±18.9)	34.9% (±16.7)	6% (±5.4)	7.5% (±5)	1.1% (±1.4)	1.4% (±1.1)	7.1% (±6.4)	8.9% (±5.5)
KS2	55.1% (±23.8)	55.1% (±21.9)	36.4% (±19)	36.2% (±18.3)	6.8% (±5.6)	7.1% (±5)	1.8% (±1.8)	1.6% (±1.3)	8.6% (±6.8)	8.7% (±5.6)
KS3	63.3% (±16.9)	61.1% (±13.8)	31.7% (±14.8)	31.2% (±12.7)	4.1% (±2.7)	6% (±2.8)	0.9% (±1.1)	1.6% (±1)	5% (±3.6)	7.7% (±3.3)
Male KS2	57.4% (±22.9)	58.4% (±21)	34.1% (±18.7)	33.9% (±17.9)	6.6% (±4.4)	5.9% (±4)	2% (±2)	1.8% (±1.4)	8.5% (±5.7)	7.7% (±5)
Male KS3	62.6% (±15.2)	60.1% (±14.3)	32.6% (±13)	32.1% (±13.2)	3.8% (±3.1)	6%	1%	1.8% (±0.9)	4.8% (±4.2)	7.8% (±2.4)

						(±2)	(±1.2)			
Female KS2	52.2% (±25.5)	50.9% (±23.2)	39.2% (±19.7)	39.1% (±19.1)	7.2% (±6.9)	8.7% (±5.8)	1.5% (±1.7)	1.4% (±1.1)	8.7% (±8.2)	10% (±6.2)
Female KS3	64.3% (±19.7)	62.5% (±13.7)	30.5% (±17.6)	30.1% (±12.6)	4.5% (±2.2)	6.1% (±3.7)	0.6% (±0.8)	1.3% (±1.1)	5.2% (±2.8)	7.5% (±4.4)

*Statistically significant difference between non-intervention and intervention days ($p<0.05$);

**Statistically significant difference between non-intervention and intervention days ($p<0.01$).

When exploring SB during break time, KS2 were less sedentary (19.1% ± 13.8) than KS3 (26.1% ± 14.8) during intervention day break times, and this was approaching statistical significance (p = 0.051). On intervention days both KS2 and KS3 children had similar LPA (KS2 = 42.3% ± 12.8, KS3 = 42.6% ± 13), however, KS2 engaged in significantly more (p = 0.011) LPA (6.9%) on intervention break times compared with non-intervention break times (KS2 = 35.4% ± 14.4, see Figure 6.5). KS3 children's break time LPA remained similar between intervention and non-intervention days. Children also engaged in significantly less break time VPA on intervention days compared with non-intervention days ($F_{(1,51)}$ = 5.67, p = 0.021). Break time PA descriptives are presented in Table 6.1.1.

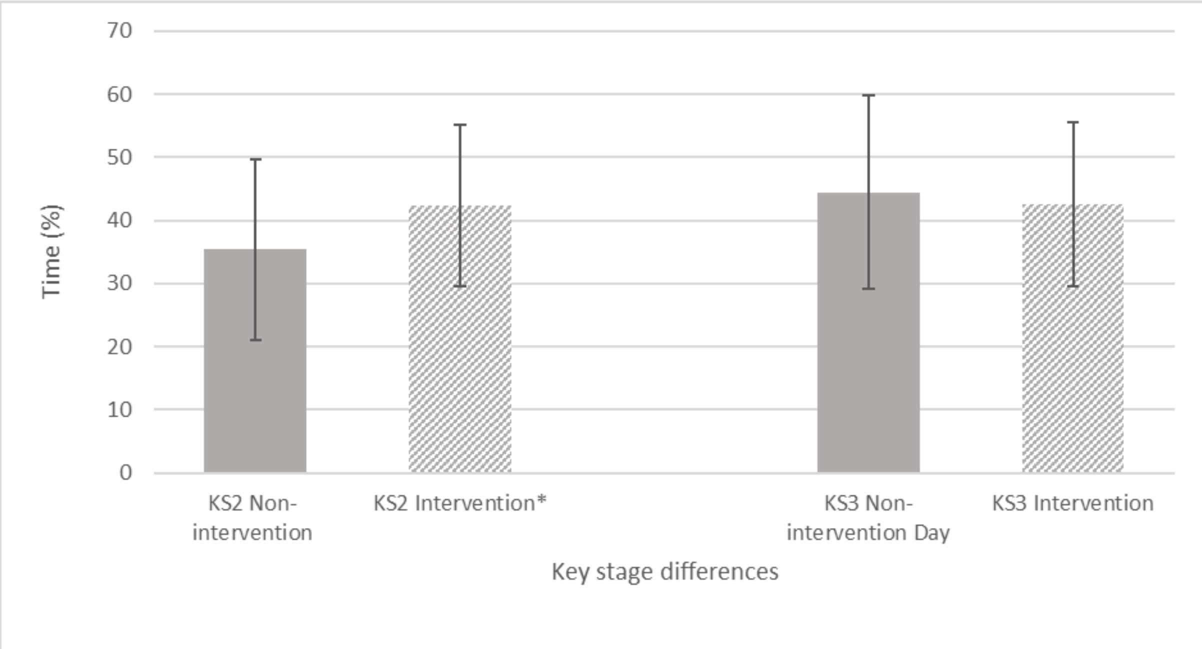


Figure 6. 5 Mean time (percent) spent in LPA during break time on non-intervention day and intervention day according to key stage.

Table 6.1. 1 Mean (±SD) PA intensities (%) according to break time on non-intervention day and intervention day.

Break time	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention
Whole cohort	22.4% (±19.2)	22.4% (±14.6)	39.7% (±15.4)	42.5% (±12.8)	27.5% (±13.8)	27.1% (±12)	10.4% (±11.5)	8%* (±7.7)	38% (±21.7)	35.1% (±18.6)
Male	21.6% (±17.9)	19.7% (±13.8)	34.4% (±10.7)	38.1% (±12.6)	31.1% (±10.7)	31.4% (±10.7)	12.9% (±11.5)	10.8% (±8)	44% (±17.6)	42.2% (±17.6)
Female	23.4% (±21.1)	25.9% (±15.1)	46.5% (±17.9)	48.2% (±10.82)	23% (±16.1)	21.6% (±11.4)	7.2% (±10.9)	4.4% (±5.7)	30.2% (±30.2)	25.9% (±15.9)
KS2	23.3% (±23.5)	19.1% (±13.8)	35.4% (±14.4)	42.3%* (±12.8)	28.9% (±15.6)	29.8% (±12.5)	12.5% (±13.2)	8.8% (±8.3)	41.4% (±24.6)	38.6% (±19.5)
KS3	21.4% (±13.2)	26.1% (±14.8)	44.5% (±15.3)	42.6% (±13.02)	26% (±11.5)	24.1% (±10.9)	8.1% (±8.9)	7.2% (±7.1)	34.2% (±17.6)	31.3% (±17.1)
Male KS2	22.6% (±22.6)	17.6% (±11.9)	31% (±9.6)	38.6% (±13.6)	31.2% (±13.2)	33% (±12)	15.2% (±13.5)	10.8% (±9)	46.4% (±21.9)	43.8% (±19.7)
Male KS3	20.5% (±11.7)	22% (±15.7)	38.2% (±10.8)	37.5% (±11.8)	30.8% (±7.8)	29.8% (±9.4)	10.5% (±8.6)	10.8%	41.4% (±11.6)	40.5% (±15.5)

								(±7)		
Female KS2	24% (±25.6)	21% (±16.1)	40.9% (±17.5)	47% (±10.4)	26% (±18.3)	25.9% (±12.5)	9.1% (±12.5)	6.2% (±6.7)	35.1% (±27.1)	32.1% (±17.9)
Female KS3	22.7% (±15.5)	31.6% (±12.1)	53% (±16.7)	49.7% (±11.6)	19.4% (±12.9)	16.5% (±7.8)	4.9% (±8.5)	2.2% (±3.6)	24.3% (±20)	18.7% (±9.6)

*Statistically significant difference between non-intervention and intervention days ($p < 0.05$);

**Statistically significant difference between non-intervention and intervention days ($p < 0.01$).

When investigating PA behaviours at lunchtime, children significantly reduced SB and LPA on intervention days compared with non-intervention days (sedentary: $F_{(1,51)}$ = 14.37, p = 0.000 ; LPA: $F_{(1,51)}$ = 7.82, p = 0.007). Children reported significantly more MPA and VPA on intervention day lunchtimes compared with non-intervention day lunchtimes (MPA: $F_{(1,51)}$ = 28.22, p = 0.000 ; VPA: $F_{(1,51)}$ = 23.97, p = 0.000). This consequently meant that children engaged in significantly more MVPA on intervention day lunchtimes, compared with non-intervention day lunchtimes ($F_{(1,51)}$ = 34.31, p = 0.000).

MVPA results show boys and girls from both key stages to engage in significantly more MVPA (p =0.04) on intervention lunchtimes (KS2 male: 49.4% ± 17.8; KS2 female: 44.4% ± 20.1; KS3 male: 46.9% ± 13; KS3 female: 40.9% ± 10.6) than non-intervention lunchtimes (KS2 male: 32.3% ± 13.6; KS2 female: 30.9% ± 17.1; KS3 male: 44.8% ± 11.1; KS3 female: 24.7% ± 11.6). This increase in MVPA can be attributed to significant lunchtime VPA findings (p =0.014) for gender and key stage. Results show boys and girls from both key stages to engage in significantly more VPA on intervention lunchtimes (KS2 male: 11.8% ± 5.4; KS2 female: 8% ± 5.1; KS3 male: 14.4% ± 8.3; KS3 female: 8.8% ± 4.7) than non-intervention lunchtimes (KS2 male: 5.7% ± 4.1; KS2 female: 5.2% ± 4.3; KS3 male: 13.4% ± 9.2; KS3 female: 2.8% ± 3). Statistically significant lunchtime intervention day findings are presented in Figures 6.6-6.7, and lunchtime PA descriptives are presented in Table 6.1.2.

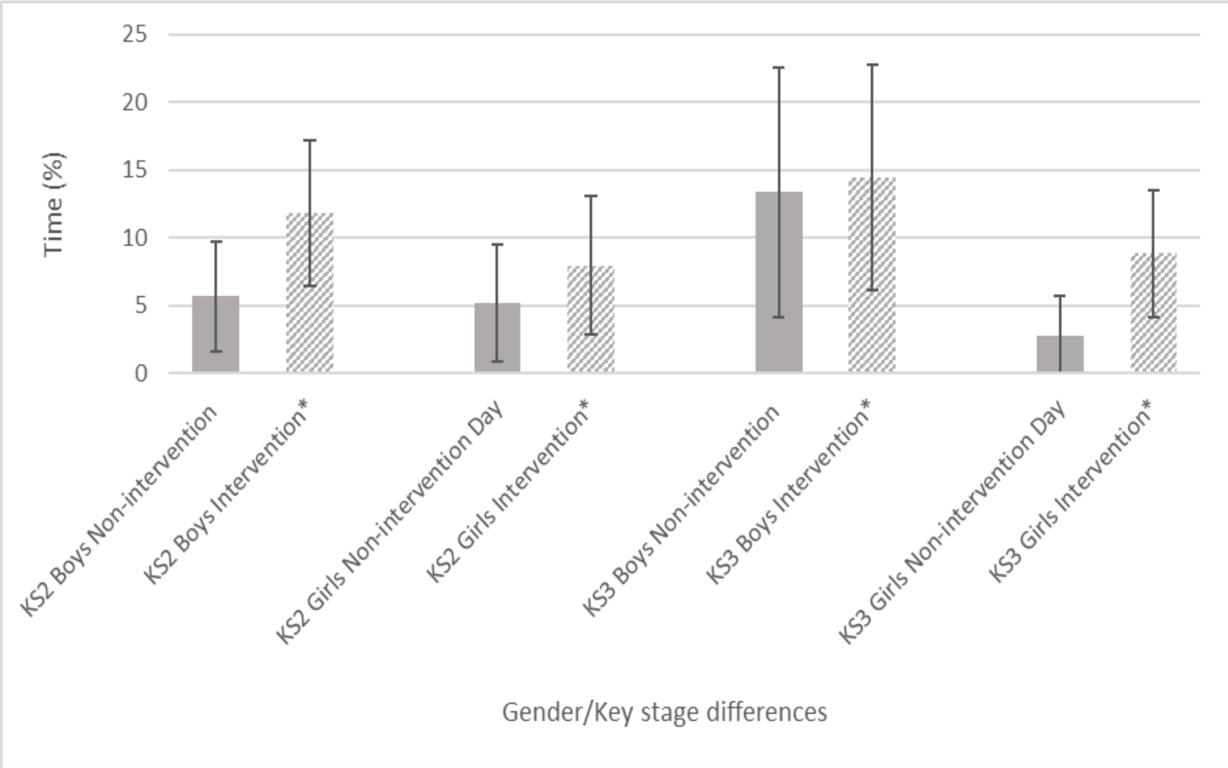


Figure 6. 6 Mean time (percent) spent in VPA during lunchtime on non-intervention day and intervention day according to key stage and gender.

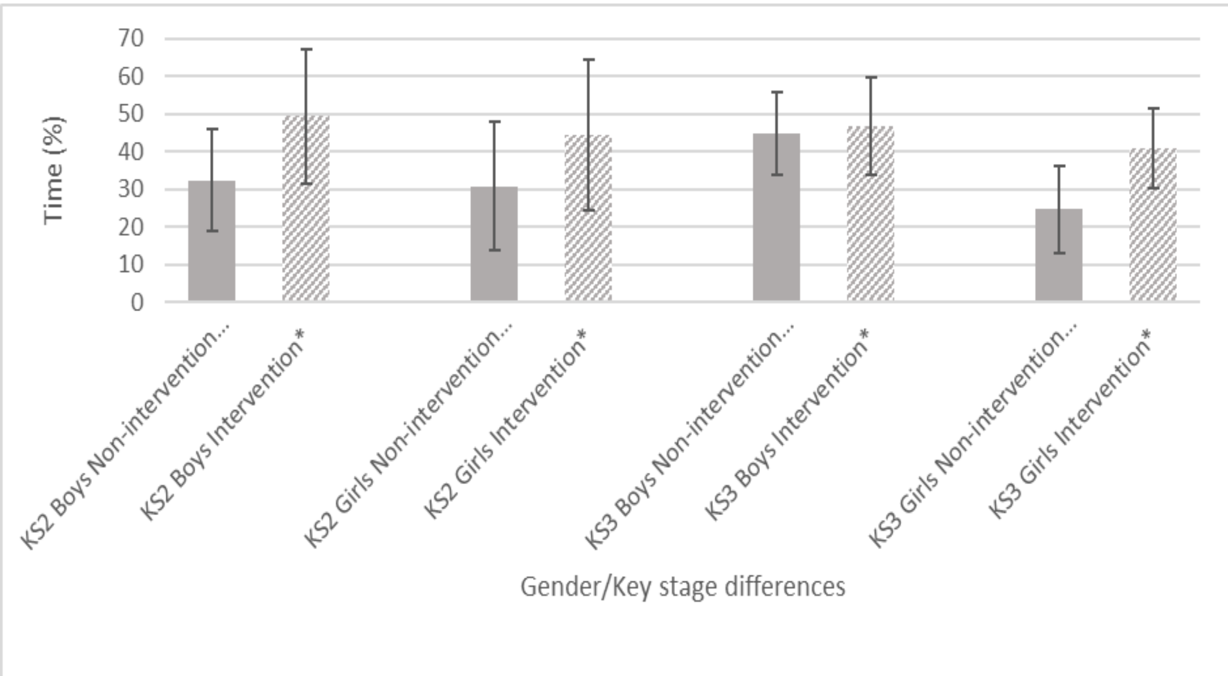


Figure 6. 7 Mean time (percent) spent in MVPA during lunchtime on non-intervention day and intervention day according to key stage and gender.

Table 6.1. 2 Mean (±SD) PA intensities (%) according to lunchtime on non-intervention day and intervention day.

Lunchtime	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention
Whole cohort	20.4% (±16.3)	14.1%** (±11.6)	45.7% (±12.8)	40.1%** (±9.7)	26.8% (±11.4)	34.8%** (±12.5)	7.1% (±7)	11%** (±6.5)	33.9% (±15)	45.9%** (±15.9)
Male	17% (±16.4)	13.1% (±12.4)	44.6% (±13)	38.7% (±9.3)	29% (±9.8)	35.1% (±11.1)	9.4% (±8)	13.1% (±7)	38.4% (±13.8)	48.2% (±15.5)
Female	24.8% (±15.5)	15.4% (±10.6)	47.2% (±12.7)	41.9% (±10)	23.9% (±12.8)	34.4% (±14.4)	4.1% (±3.9)	8.4% (±4.8)	28% (±14.9)	42.8% (±16.2)
KS2	19.3% (±18.3)	12.3% (±12.5)	49.1% (±13)	40.5% (±10.6)	26.2% (±12.9)	37.1% (±15.1)	5.5% (±4.1)	10.1% (±5.5)	31.7% (±15)	47.2% (±18.7)
KS3	21.7% (±14.1)	16.1% (±10.3)	42% (±11.8)	39.6% (±8.7)	27.4% (±9.63	32.3% (±8.2)	8.9% (±8.9)	12.1% (±7.5)	36.3% (±15)	44.4% (±12.2)
Male KS2	18.4% (±21.4)	11.9% (±13.7)	49.3% (±14)	38.6% (±9)	26.7% (±11)	37.7% (±13.1)	5.7% (±4.1)	11.8%* (±5.4)	32.3% (±13.6)	49.4%* (±17.8)
Male KS3	15.6% (±9.1)	14.4% (±11.2)	39.6% (±10)	38.7% (±9.9)	31.4% (±7.9)	32.5% (±7.9)	13.4% (±9.2)	14.4%* (±8.3)	44.8% (±11)	46.9%* (±13)
Female KS2	20.4% (±14.4)	12.7% (±11.5)	48.8% (±12.3)	42.8% (±12.2)	25.7% (±15.3)	36.5% (±17.8)	5.2% (±4.3)	8%*	30.9% (±17.1)	44.4%* (±20.1)

								(±5.1)		
Female KS3	30.1% (±15.8)	18.4% (±8.8)	45.3% (±13.6)	40.7% (±7)	21.9% (±9.3)	32% (±9)	2.8% (±3)	8.8%* (±4.7)	24.7% (±11.6)	40.9%* (±10.6)

*Statistically significant difference between non-intervention and intervention days ($p < 0.05$);

**Statistically significant difference between non-intervention and intervention days ($p < 0.01$).

When combining lesson and break times together, to explore PA outside of the lunchtime window during which the intervention took place, a significant finding within key stage when exploring VPA (*p*=0.033) was revealed. This showed KS3 to engage in greater VPA on intervention days (1.9% ± 1), compared with non-intervention days (1.2% ± 1.2), however KS2 engaged in less VPA on intervention days (1.9% ± 1.3), compared with non-intervention days (2.3% ± 2.1). Statistically significant combined lesson/break time intervention day interactions are presented in Figure 6.8, and combined lesson/break time PA descriptives are presented in Table 6.1.3.

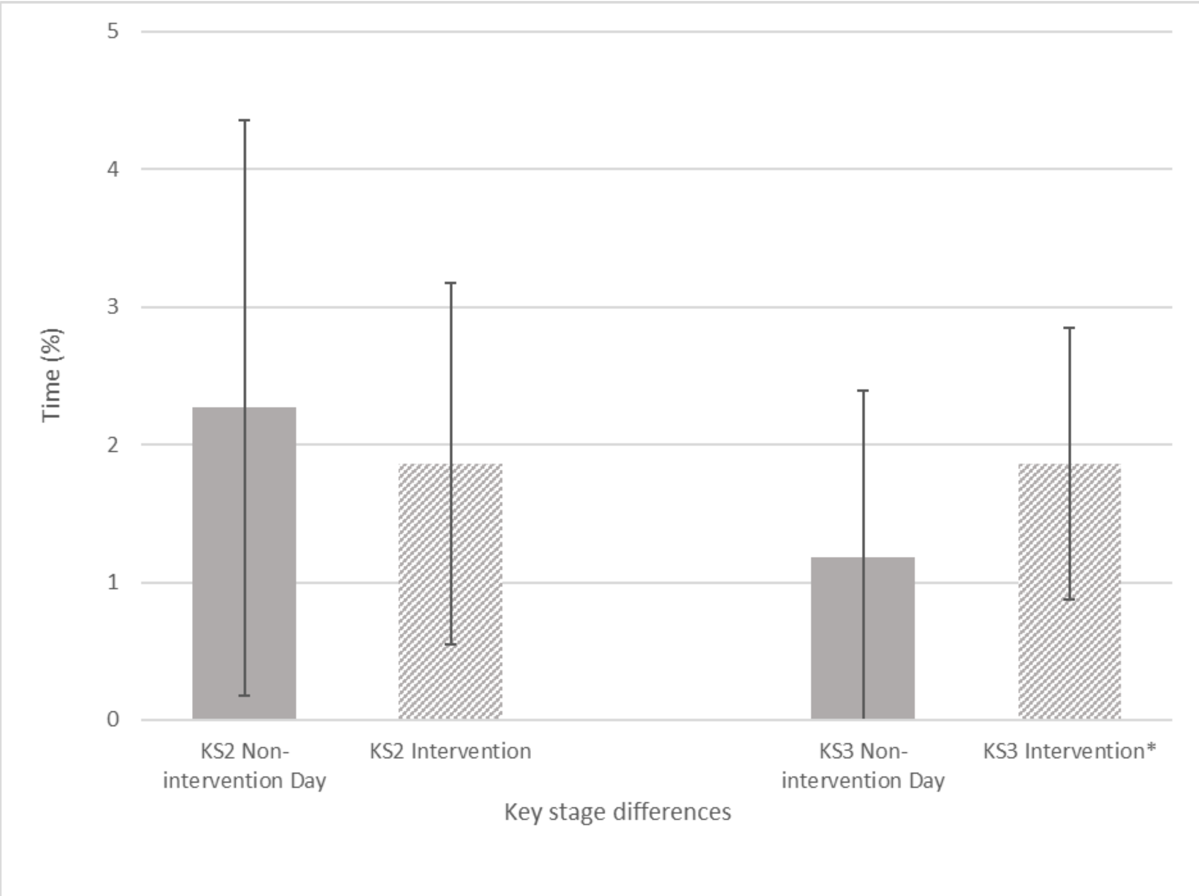


Figure 6. 8 Mean time (percent) spent in VPA in combined lesson-break time on non-intervention day and intervention day according to key stage.

Table 6.1. 3 Mean (±SD) PA intensities (%) according to combined academic/break time on non-intervention day and intervention day.

Combined lesson/break time	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention	Non-intervention	Intervention
Whole cohort	57.2% (±20.6)	56.4% (±18.2)	34.4% (±16.4)	34.3% (±15.4)	6.6% (±4.7)	7.5% (±4.1)	1.8% (±1.8)	1.9% (±1.2)	8.3% (±6)	9.3% (±4.7)
Male	58.1% (±18.9)	57.6% (±17.4)	33.4% (±15.2)	33.2% (±15)	6.4% (±3.8)	7% (±3.1)	2% (±1.9)	2.2% (±1.2)	8.5% (±5.4)	9.1% (±3.9)
Female	56.1% (±22.9)	54.8% (±19.5)	35.7% (±18.1)	35.6% (±16.1)	6.8% (±5.7)	8.2% (±5.1)	1.4% (±1.6)	1.5% (±1.1)	8.2% (±6.9)	9.6% (±5.7)
KS2	53.5% (±23.4)	53.6% (±21.4)	36.3% (±18.1)	36.5% (±17.5)	7.9% (±5.7)	8.1% (±5)	2.3% (±2.1)	1.9% (±1.3)	10.2% (±7.2)	9.9% (±5.7)
KS3	61.4% (±16.4)	59.6% (±13.6)	32.3% (±14.3)	31.7% (±12.4)	5.1% (±2.6)	6.8% (±2.8)	1.2% (±1.2)	1.9%* (±1)	6.3% (±3.6)	8.7% (±3.3)
Male KS2	55.7% (±22.3)	56.9% (±20.4)	34% (±17.8)	34.1% (±17.1)	7.7% (±4.2)	6.9% (±4)	2.6% (±2.2)	2.1% (±1.4)	10.3% (±5.9)	9% (±5)

Male KS3	60.7% (±14.7)	58.5% (±14.1)	32.9% (±12.5)	32.3% (±12.9)	5% (±2.9)	7% (±1.9)	1.4% (±1.4)	2.2% (±0.8)	6.5% (±4.1)	9.2% (±2.2)
Female KS2	50.8% (±25.3)	49.5% (±22.7)	39.2% (±18.9)	39.5% (±18.2)	8.1% (±7.3)	9.5% (±5.8)	1.9% (±2)	1.6% (±1.1)	10% (±8.7)	11% (±6.4)
Female KS3	62.4% (±19.1)	61.1% (±13.4)	31.6% (±17)	30.9% (±12.4)	5.2% (±2.3)	6.6% (±3.7)	0.8% (±0.9)	1.4% (±1)	6.1% (±2.8)	8% (±4.4)

*Statistically significant difference between non-intervention and intervention days (p <0.05);

**Statistically significant difference between non-intervention and intervention days (p <0.01).

As intervention activities were implemented at lunchtime, repeated measures ANOVA analysis investigated this specific segment of the school day according to each PA. When exploring lunchtimes which staged football, data revealed a SB by gender finding which was approaching statistical significance ($p = 0.053$). This showed boys to engage in greater SB (19.2% ± 19.2), and girls engaged in less SB (17.9% ± 16.9) during lunchtimes which implemented a football PA. Therefore, football activities appeared to promote greater SB amongst boys.

Data also revealed an MPA by gender and key stage result which was approaching statistical significance ($p = 0.052$). This showed girls in both key stages, and KS2 boys, to engage in greater amounts of MPA during football lunchtimes (KS2 girls: 29.7% ± 22.1 ; KS3 girls: 29.1% ± 11.9 ; KS2 boys: 32.1% ± 15.1), compared with non-intervention lunchtimes. However, KS3 boys engaged in less MPA during football lunchtimes (27.8% ± 11) compared with non-intervention lunchtimes.

Children engaged in significantly more VPA and MVPA during football lunchtimes compared with non-intervention day lunchtimes (VPA: $F_{(1,47)} = 9.36$, $p = 0.004$; MVPA: $F_{(1,47)} = 6.30$, $p = 0.016$), and data revealed a significant gender by key stage finding according to VPA and MVPA (VPA: $p = 0.013$; MVPA: $p = 0.014$). This shows KS2 and KS3 girls, and KS2 boys to engage in greater VPA and MVPA on football intervention lunchtimes compared with non-intervention lunchtimes, whereas KS3 boys who engaged in a less VPA and MVPA on football intervention lunchtimes compared with non-intervention lunchtimes. Therefore, football activities promoted greater MPA, VPA and MVPA with younger children and older girls within the study. Statistically significant football lunchtime interactions are presented in Figures 6.9-6.10, and PA descriptives for football lunchtimes are provided in Table 6.1.4.

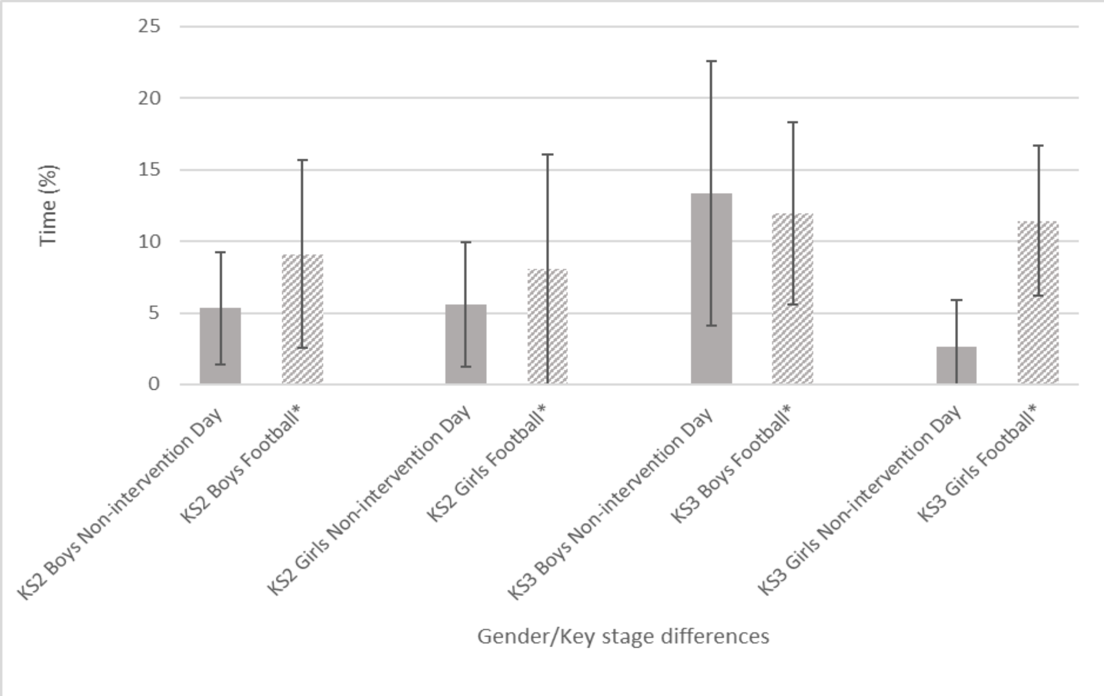


Figure 6. 9 Mean time (percent) spent in VPA on non-intervention lunchtimes and football lunchtimes according to gender and key stage.

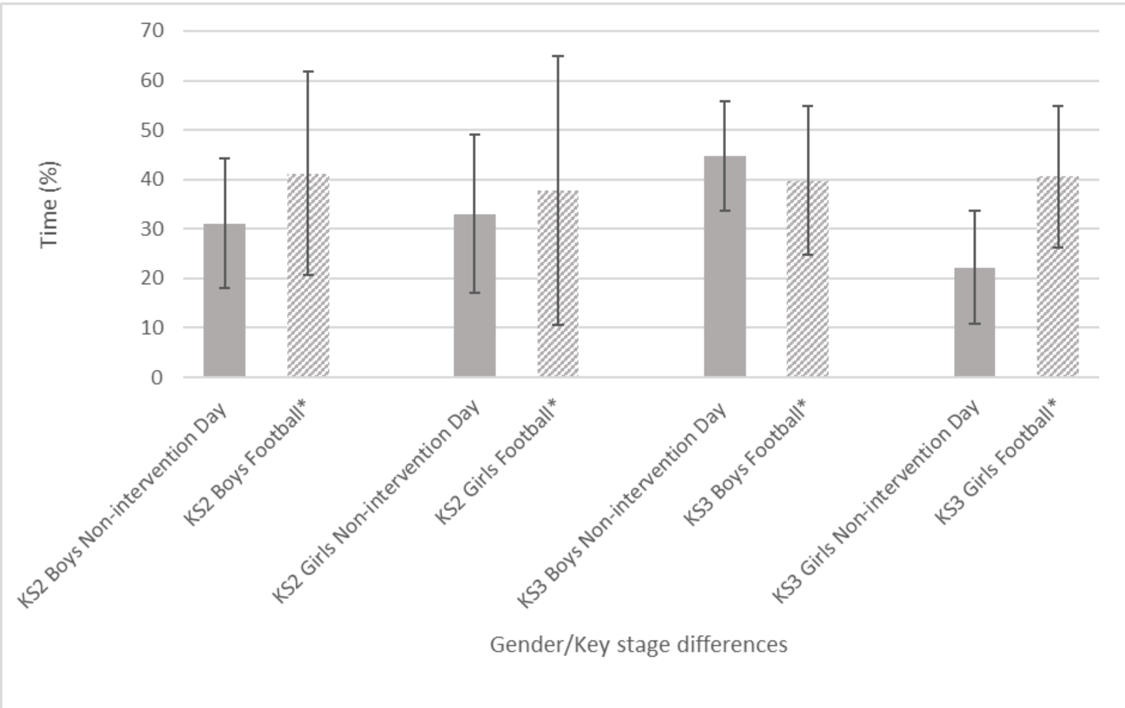


Figure 6. 10 Mean time (percent) spent in MVPA on non-intervention lunchtimes and football lunchtimes according to gender and key stage.

Table 6.1. 4 Mean (±SD) PA intensities (%) according to lunchtime non-intervention day and lunchtime football intervention.

Lunchtime	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Football Intervention	Non-intervention	Football Intervention	Non-intervention	Football Intervention	Non-intervention	Football Intervention	Non-intervention	Football Intervention
Whole cohort	20.6% (±16.6)	18.7% (±18.1)	45.5% (±13.2)	41.5% (±12.6)	26.7% (±11.2)	29.8% (±15.2)	7.3% (±7.1)	10.1%** (±6.7)	34% (±14.9)	39.9%* (±19.4)
Male	17.3% (±16.6)	19.2% (±19.2)	44.8% (±13.2)	40.3% (±10.5)	28.6% (±9.7)	30% (±13.2)	9.3% (±8.1)	10.5% (±6.5)	37.9% (±13.8)	40.5% (±17.7)
Female	25.2% (±15.7)	17.9% (±16.9)	46.4% (±13.5)	43.2% (±15.1)	24.1% (±12.7)	29.5% (±18)	4.3% (±4.1)	9.5% (±7)	28.4% (±14.9)	39% (±22.1)
KS2	18.8% (±18.4)	18.4% (±19.9)	49.3% (±13.3)	41.9% (±14.9)	26.5% (±12.3)	31.1% (±18.2)	5.4% (±4.1)	8.6% (±7)	31.9% (±14.2)	39.7% (±23.2)
KS3	22.5% (±14.4)	18.9% (±16.3)	41.2% (±11.9)	41.1% (±9.6)	27% (±9.9)	28.3% (±11.1)	9.4% (±9.1)	11.8% (±5.9)	36.3% (±15.6)	40.1% (±14.5)
Male KS2	18.9% (±22)	19.9% (±22)	50% (±14.2)	38.9% (±10.7)	25.8% (±10.8)	32.1% (±15.1)	5.3% (±3.9)	9.1%* (±6.6)	31.1% (±13.1)	41.3%* (±20.5)
Male KS3	15.6% (±9.1)	18.5% (±16.7)	39.6% (±10)	41.7% (±10.5)	31.4% (±7.9)	27.8% (±11)	13.4% (±9.2)	12%* (±6.4)	44.8% (±11.1)	39.8%* (±15)
Female KS2	18.6% (±13.6)	16.7% (±17.8)	48.4% (±12.7)	45.6% (±18.7)	27.4% (±14.5)	29.7% (±22.1)	5.6% (±4.4)	8%* (±8)	33% (±16)	37.7%* (±27.1)

Female KS3	34% (±14.6)	19.5% (±16.5)	43.7% (±14.7)	39.9% (±8.3)	19.6% (±8.7)	29.1% (±11.9)	2.7% (±3.2)	11.4%* (±5.3)	22.2% (±11.5)	40.6%* (±14.4)

*Statistically significant difference between non-intervention and intervention days (p <0.05);

**Statistically significant difference between non-intervention and intervention days (p <0.01).

Lunchtimes that implemented dodgeball showed children to engage in significantly less SB ($F_{(1,47)}$ = 13.50, p = 0.001), compared with non-intervention lunchtimes. Children also engaged in significantly more MPA and MVPA (MPA: $F_{(1,47)}$ = 19.20, p = 0.000 ; MVPA: $F_{(1,47)}$ = 13.82, p = 0.001) during dodgeball lunchtimes.

Data showed a statistically significant LPA by key stage finding (p =0.038). This showed KS3 to engage in greater LPA (44.3% ± 14), whereas KS2 engaged in less LPA (40.5% ± 17.5) during dodgeball lunchtimes when compared with non-intervention lunchtimes.

Data also revealed a statistically significant VPA by gender and key stage finding (p = 0.038). This showed KS2 boys, and both KS2 and KS3 girls to engage in greater VPA during dodgeball lunchtimes compared with non-intervention lunchtimes. However KS3 boys engaged in less VPA during dodgeball lunchtimes (KS2 boys: 13.6% ± 7.8 ; KS2 girls: 6.2% ± 9.7 ; KS3 boys: 9.8% ± 10.7 ; KS3 girls: 5.3% ± 6.1), when compared with non-intervention lunchtimes. This shows that dodgeball activities promoted greater VPA with younger children and older girls within the study. Statistically significant dodgeball lunchtime interactions are presented in Figures 6.11-6.12, and PA descriptives for dodgeball lunchtimes are provided in Table 6.1.5.

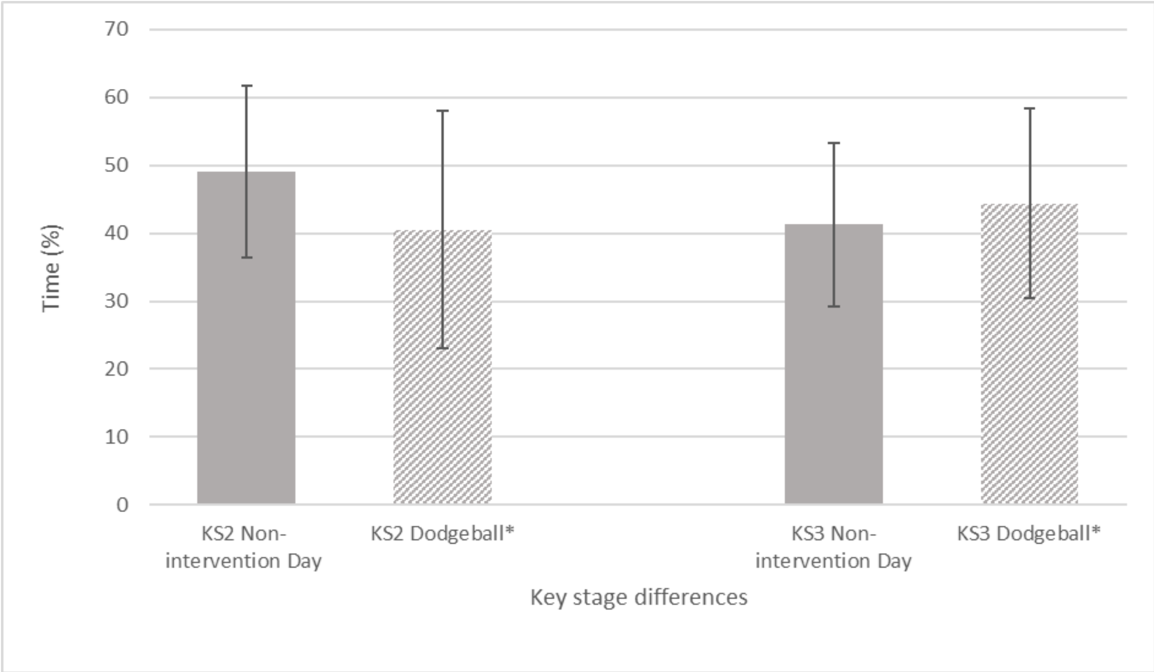


Figure 6. 11 Mean time (percent) spent in LPA on non-intervention lunchtimes and dodgeball lunchtimes according to key stage.

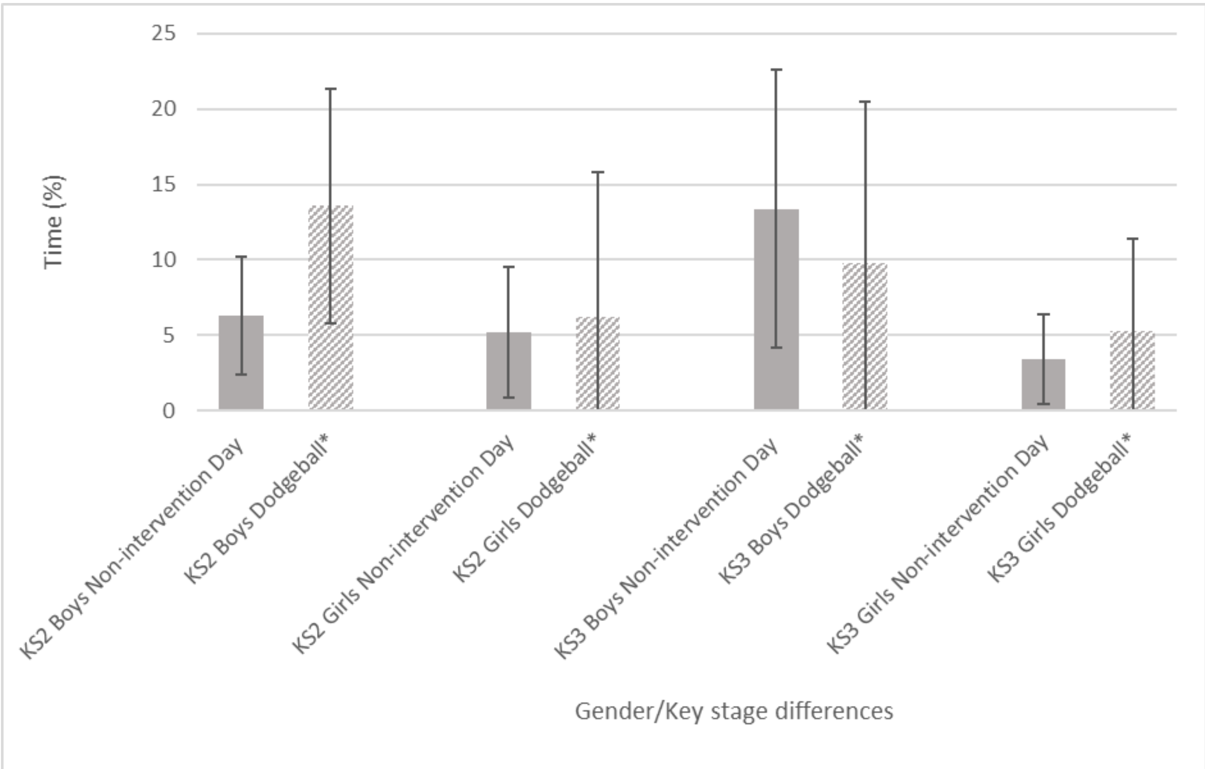


Figure 6. 12 Mean time (percent) spent in VPA on non-intervention lunchtimes and dodgeball lunchtimes according to gender and key stage.

Table 6.1. 5 Mean (±SD) PA intensities (%) according to lunchtime non-intervention day and lunchtime dodgeball intervention.

Lunchtime	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention	Non-intervention	Dodgeball Intervention
Whole cohort	19.3% (±15.7)	11.7%** (±12.3)	45.4% (±12.9)	42.3% (±15.9)	27.7% (±11.1)	36.8%** (±15.9)	7.6% (±7)	9.1% (±9.3)	35.3% (±14.5)	45.9%** (±21.1)
Male	15.6% (±14.8)	10.8% (±11.7)	44.4% (±12.7)	40.3% (±14.6)	30.1% (±9)	37.2% (±13.4)	10% (±7.9)	11.6% (±9.4)	40.1% (±12.4)	48.8% (±19.7)
Female	24.1% (±15.9)	12.9% (±13.1)	46.8% (±13.3)	45% (±17.6)	24.6% (±13)	36.3% (±19)	4.5% (±3.9)	5.8% (±8.2)	29.1% (±15)	42.1% (±22.6)
KS2	17.9% (±17.2)	10.3% (±14.1)	49.1% (±12.7)	40.5%* (±17.5)	27.2% (±12.7)	39.2% (±19.5)	5.8% (±4.1)	10% (±9.4)	33% (±14.6)	49.2% (±24.7)
KS3	20.8% (±14.2)	13.4% (±9.7)	41.3% (±12)	44.3%* (±14)	28.3% (±9.3)	34.2% (±10.2)	9.6% (±8.9)	8.1% (±9.3)	37.9% (±14.4)	42.3% (±15.8)
Male KS2	15.6% (±19.6)	8.7% (±12.9)	49.4% (±13.6)	37.1% (±14.2)	28.7% (±10.1)	40.7% (±16.3)	6.3% (±3.9)	13.6%* (±7.8)	35% (±12.1)	54.3% (±21.9)
Male KS3	15.6% (±9.1)	12.9% (±10.6)	39.6% (±10)	43.3% (±14.7)	31.4% (±7.9)	34% (±9.4)	13.4% (±9.2)	9.8%* (±10.7)	44.8% (±11.1)	43.8% (±16.6)

Female KS2	20.4% (±14.4)	12% (±15.7)	48.8% (±12.3)	44.3% (±20.5)	25.7% (±15.3)	37.6% (±23.1)	5.2% (±4.3)	6.2%* (±9.7)	30.9% (±17.1)	43.7% (±27.2)
Female KS3	29.5% (±17.2)	14.2% (±8.8)	44% (±14.9)	46% (±13.3)	23% (±9.5)	34.5% (±12.1)	3.4% (±3)	5.3%* (±6.1)	26.4% (±11.9)	39.8% (±15.1)

*Statistically significant difference between non-intervention and intervention days ($p < 0.05$);

**Statistically significant difference between non-intervention and intervention days ($p < 0.01$).

During lunchtimes that included circuits, children engaged in significantly less SB and LPA than non-intervention lunchtimes (SB: $F_{(1,28)} = 6.30$, $p = 0.018$; LPA: $F_{(1,28)} = 17.50$, $p = 0.000$). Data revealed a LPA by key stage finding which showed both key stages to engage in less LPA during circuit lunchtimes compared with non-intervention lunchtimes (KS2: 36% ± 12 ; KS3: 36.5% ± 12), which was approaching statistical significance ($p = 0.54$).

Children also engaged in significantly more MPA, VPA, and MVPA compared to non-intervention lunchtimes (MPA: $F_{(1,28)} = 32.90$, $p = 0.000$; VPA: $F_{(1,28)} = 31.44$, $p = 0.000$; MVPA: $F_{(1,28)} = 40.81$, $p = 0.000$). Data revealed a statistically significant MPA and MVPA by key stage result (MPA: $p = 0.000$, MVPA: $p = 0.005$), which showed both key stages to engage in greater MPA and MVPA during circuit lunchtimes (MPA: KS2: 42.4% ± 13.3 ; KS3: 29% ± 9.1 ; MVPA: KS2: 56% ± 18.2 ; KS3: 44.9% ± 16.9) compared with non-intervention lunchtimes. Therefore, circuit intervention activities promoted greater MPA, VPA and MVPA with all children within the study. Statistically significant circuit lunchtime interactions are presented in Figures 6.13-6.14, and PA descriptives for circuit training lunchtimes are provided in Table 6.1.6.

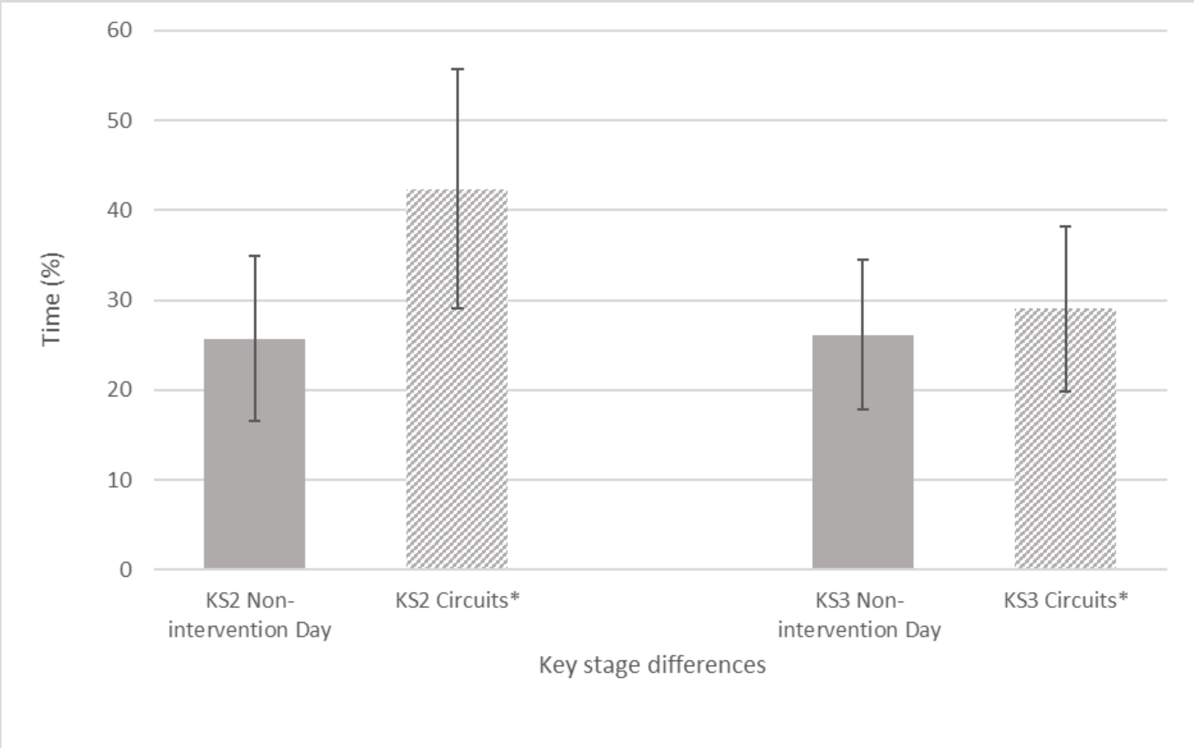


Figure 6. 13 Mean time (percent) spent in MPA on non-intervention lunchtimes and circuit lunchtimes according to key stage.

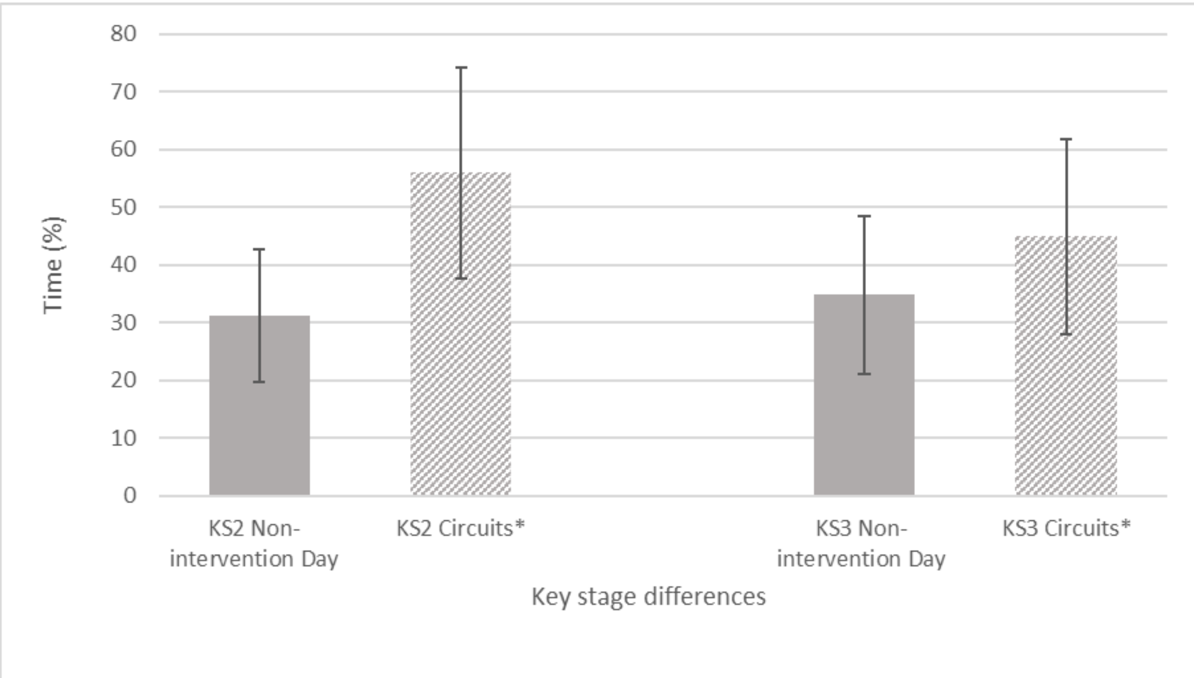


Figure 6. 14 Mean time (percent) spent in MVPA on non-intervention lunchtimes and circuit lunchtimes according to key stage.

Table 6.1. 6 Mean (±SD) PA intensities (%) according to lunchtime non-intervention day and lunchtime circuits intervention.

Lunchtime	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention	Non-intervention	Circuits Intervention
Whole cohort	18.8% (±12.3)	13.3%* (±14.3)	48.3% (±13)	36.2%** (±11.8)	25.9% (±8.7)	35.7%** (±13.1)	7.1% (±7.1)	14.8%** (±8.8)	33% (±12.6)	50.5%** (±18.2)
Male	15.6% (±11.8)	12.8% (±15.6)	46.3% (±13.1)	34.4% (±11.7)	29.1% (±7.3)	37.6% (±13.3)	9.1% (±7.7)	15.2% (±9.9)	38.1% (±10.9)	52.8% (±18.5)
Female	24% (±11.7)	14.2% (±12.5)	51.5% (±12.6)	39.3% (±11.9)	20.7% (±8.3)	32.5% (±12.6)	3.8% (±4.5)	14.1% (±6.9)	24.5% (±10.7)	46.5% (±17.7)
KS2	15.3% (±13.2)	8% (±12.2)	53.5% (±11.4)	36% (±12)	25.7% (±9.2)	42.4%* (±13.3)	5.5% (±4)	13.6% (±7.7)	31.2% (±11.5)	56%* (±18.2)
KS3	22.2% (±10.5)	18.6% (±14.7)	43% (±12.5)	36.5% (±12)	26.2% (±8.4)	29%* (±9.1)	8.7% (±9)	15.9% (±9.9)	34.8% (±13.7)	44.9%* (±16.9)
Male KS2	12.1% (±13.4)	9.8% (±14.3)	52.3% (±12.2)	36.4% (±12.2)	29.7% (±8.2)	42.6% (±14.7)	5.9% (±3.2)	11.3% (±8)	35.6% (±10.6)	53.9% (±20.6)
Male KS3	19.8% (±8.2)	16.4% (±17.2)	38.9% (±10.4)	32.1% (±11.2)	28.3% (±6.5)	31.6% (±8.9)	13% (±9.8)	19.9% (±10.4)	41.3% (±11)	51.5% (±16.8)
Female KS2	22.2% (±10.6)	4.1% (±3.8)	26.2% (±10.2)	35.2% (±12.6)	16.9% (±2.8)	42% (±11.1)	4.8% (±5.8)	18.7% (±3.9)	21.6% (±7.1)	60.7% (±12.1)

Female KS3	25.3% (±13)	21.4% (±11.4)	48.2% (±13.8)	42.1% (±11.3)	23.4% (±10.1)	25.7% (±8.9)	3.1% (±3.6)	10.8% (±6.9)	26.5% (±12.8)	36.4% (±13.9)

*Statistically significant difference between non-intervention and intervention days ($p < 0.05$);

**Statistically significant difference between non-intervention and intervention days ($p < 0.01$).

Lunchtime table-tennis activities revealed similar findings to circuit activities. Children engaged in significantly less SB and LPA than non-intervention lunchtimes (SB: $F_{(1,38)} = 6.50$, $p = 0.015$; LPA: $F_{(1,38)} = 8.90$, $p = 0.005$). Additionally, children engaged in significantly more MPA, VPA, and MVPA compared to non-intervention lunchtimes (MPA: $F_{(1,38)} = 11.53$, $p = 0.002$; VPA: $F_{(1,38)} = 16.20$, $p = 0.000$; MVPA: $F_{(1,38)} = 19.10$, $p = 0.000$). PA descriptives for circuit training lunchtimes are provided in Table 6.1.7.

Table 6.1. 7 Mean (±SD) PA intensities (%) according to lunchtime non-intervention day and lunchtime table-tennis intervention.

Lunchtime	Sedentary		Light		Moderate		Vigorous		MVPA	
	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention	Non-intervention	Table-tennis Intervention
Whole cohort	20.5% (±17.2)	14.2%* (±16.6)	44.6% (±12.4)	37.2%* (±13.3)	27.4% (±12)	34.9%** (±15.7)	7.5% (±7.7)	13.8%** (±12.7)	34.9% (±16.1)	48.7%** (±21.7)
Male	17% (±17.5)	8.9% (±9.4)	43.1% (±12.5)	35.4% (±14.5)	29.1% (±10.8)	36% (±13)	10.7% (±8.8)	19.7% (±14)	39.9% (±15.2)	55.7% (±19.5)
Female	24.7% (±16.4)	20.5% (±21)	46.5% (±12.3)	39.4% (±11.7)	25.3% (±13.3)	33.5% (±18.7)	3.6% (±3.1)	6.7% (±5.7)	28.9% (±15.4)	40.2% (±21.6)
KS2	21.3% (±19.9)	13.7% (±19.1)	46.1% (±12.4)	41.1% (±15.3)	27.4% (±14.3)	33.8% (±18.6)	5.2% (±4.1)	11.4% (±12)	32.6% (±16.8)	45.2% (±25.5)
KS3	19.7% (±14.6)	14.6% (±14.1)	43.2% (±12.4)	33.3% (±9.9)	27.4% (±9.53	35.9% (±12.6)	9.8% (±9.6)	16.2% (±13.3)	37.2% (±15.4)	52.2% (±16.9)
Male KS2	21.8% (±23.9)	7.7% (±10.8)	45.9% (±13.8)	40% (±17.2)	26.7% (±12.6)	35.5% (±14.8)	5.7% (±4.7)	16.9% (±14.2)	32.3% (±15.7)	52.4% (±24.1)
Male KS3	12.7% (±7.2)	10.1% (±8.2)	40.5% (±11.1)	31.2% (±10.7)	31.4% (±8.8)	36.4% (±11.8)	15.4% (±9.3)	22.3% (±13.9)	46.8% (±11.5)	58.7% (±14.6)
Female KS2	20.8% (±15.6)	20.4% (±24.2)	46.3% (±11.4)	42.3% (±13.8)	28.2% (±16.6)	31.9% (±22.7)	4.7% (±3.7)	5.3%	32.9% (±18.8)	37.3% (±25.9)

								(±4.6)		
Female KS3	29% (±17)	20.5% (±18.3)	46.6% (±13.9)	36.1% (±8.5)	22.1% (±8.1)	35.3% (±14.2)	2.3% (±1.7)	8.2% (±6.8)	24.4% (±9.4)	43.4% (±16.6)

*Statistically significant difference between non-intervention and intervention days ($p < 0.05$);

**Statistically significant difference between non-intervention and intervention days ($p < 0.01$).

Each PA showed significant increases in lunchtime MVPA compared with non-intervention lunchtimes, with circuits showing the greatest percentage change in MVPA (17.5%). However, other segments of the day were explored to investigate MVPA levels according to intervention PA.

Days which implemented football as a PA showed the greatest MVPA percentage change during lesson time (27.2%). Football intervention PA also revealed the greatest MVPA percentage change when exploring MVPA percentage change over the whole day (3.8%). A similar pattern was revealed when exploring the combined break/lunchtime segment, with football intervention days also showing the greatest percentage change in MVPA (23.9%). In addition to this, football intervention days were the only PA days to show an increase in MVPA percentage change during the break time period (2.78%). Days which implemented dodgeball, circuits and table-tennis all showed negative results in percentage change of MVPA at break times (dodgeball = -2.6%, circuits = -0.7%, table-tennis = -2.6%). Percentage change in MVPA according to segmented day are presented in Figure 6.15.

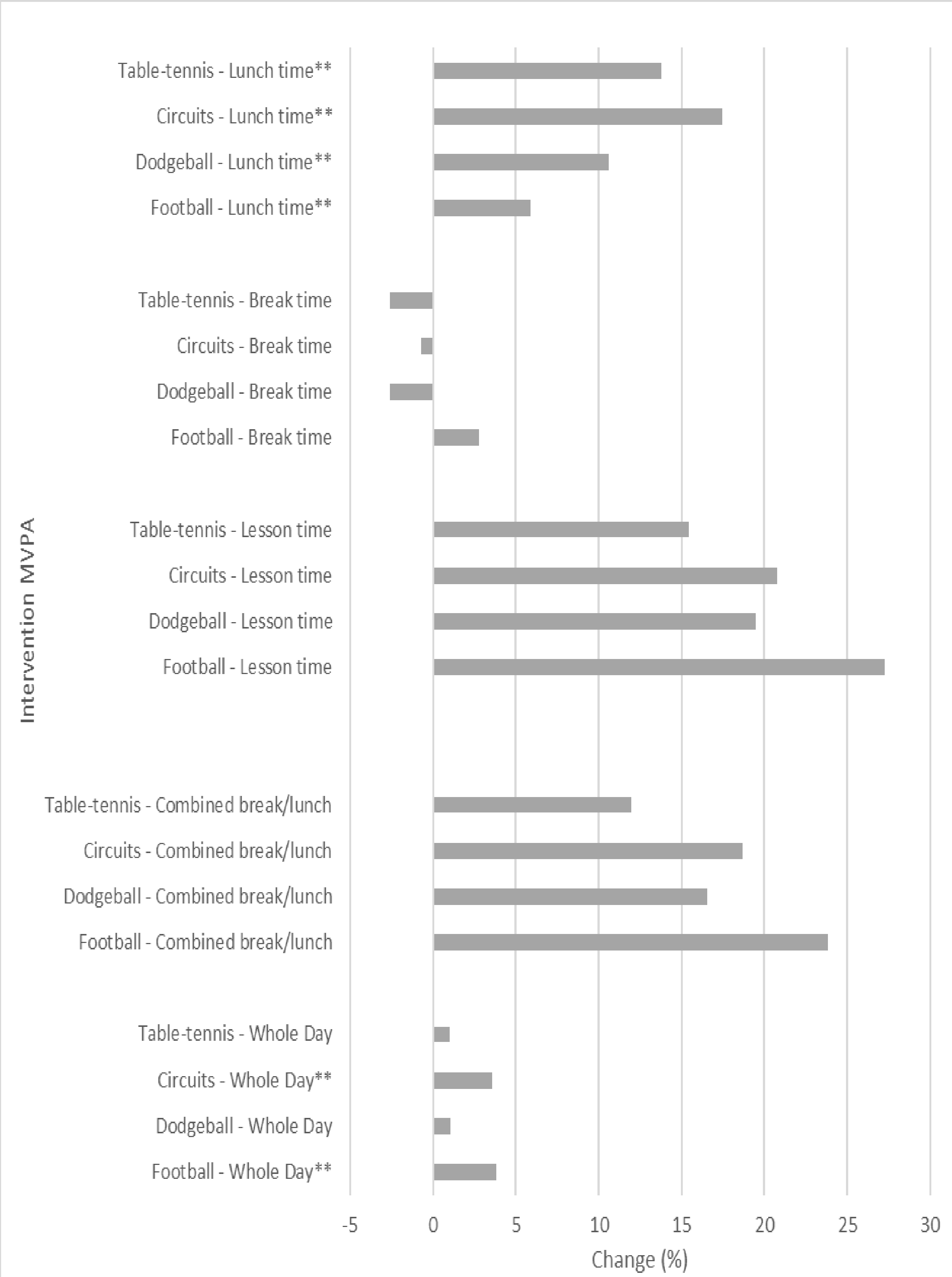


Figure 6. 15 Mean percentage change of MVPA in segment of day according to PA.

A Pearson's correlation was used to explore any relationships between each lunchtime PA club and other times of the segmented day. This would provide an indication as to whether children's PA behaviour changed on days when they attended a lunchtime PA club. Results showed that lower levels of children's SB during football lunchtimes (football = 18.7%), was associated with greater SB during break and lesson time (p = 0.00, break = 22.4%, lesson = 57.9%). However, football lunchtime MVPA (39.9%) was associated with less breaktime SB (p =0.002, 22.4%) and less breaktime MPA (p =0.01, 27.1%). Football lunchtime MVPA (39.9%) and break time MVPA (35.1%) was similar (p =0.016). Football lunchtime MVPA (39.9%) was associated with lesson time LPA (p =0.001, 33.8%). In addition to this, football lunchtime MPA (29.8%) and MVPA (39.9%) was negatively associated with lesson time MPA (p = 0.00, 6.6%). Finally, greater football lunchtime LPA, MPA, and MVPA was associated with lower levels of lesson time MVPA (football lunchtime: LPA: p =0.046, 41.5%, MPA: p =0.00, 29.8%, MVPA: p =0.003, 39.9%; lesson time MVPA: 8.2%).

Reduced dodgeball lunchtime SB (11.7%) was associated with greater breaktime SB (p =0.00, 22.4%) and greater lesson time SB (p =0.00, 57.9%). Furthermore, greater dodgeball lunchtime MPA (36.8%) and MVPA (45.9%) was associated with less breaktime MPA and breaktime MVPA (MPA: p =0.00, 27.1%; MVPA: p =0.00, 35.1%). Dodgeball lunchtime MPA (36.8%) and MVPA (45.9%) was also associated with reduced lesson time MVPA (p =0.02, 8.2%), and greater lesson time SB (p =0.00, 57.9%). Dodgeball lunchtime LPA, MPA, VPA and MVPA were associated with greater break time MPA (dodgeball lunchtime: LPA: p=0.045, 42.3%, MPA: p=0.002, 36.8%, VPA: p=0.044, 9.1%, MVPA: p=0.001, 45.9%; breaktime MPA: 27.1%). In contrast to this, greater dodgeball lunchtime LPA, MPA, VPA and MVPA were associated with reduced breaktime VPA (dodgeball lunchtime: LPA: p=0.04, 42.3%; MPA: p=0.05, 36.8%; VPA: p=0.006, 9.1%; MVPA: p=0.007, 45.9%; breaktime VPA: 8%).

Lower levels of dodgeball lunchtime SB and greater dodgeball lunchtime LPA, MPA, VPA and MVPA were associated with greater break time MVPA (dodgeball lunchtimes: sed = p=0.006, 11.7%, LPA = p=0.031, 42.3%, MPA = p=0.004, 36.8%, VPA = p=0.015, 9.1%, MVPA = p=0.001, 45.9%: breaktime MVPA = 35.1%). This proposes that reduced SB, and higher amounts of all other dodgeball lunchtime PA intensities resulted in greater breaktime MVPA.

Lower levels of dodgeball lunchtime SB, and higher levels of MPA and MVPA during dodgeball lunchtimes were associated with lower levels of children's LPA during lesson time (dodgeball lunchtime sed = p=0.00, 11.7%, MPA = p=0.00, 36.8%, MVPA = p=0.00, 45.9%: lesson LPA = 33.8%). Finally, greater levels of dodgeball lunchtime MPA (36.8%) was associated with lower levels of lesson time MVPA (8.2%, p=0.02).

Low levels of SB at circuits (13.3%) was associated with increased SB during breaktime (p=0.001, 22.4%), and lesson time (p=0.001, 57.9%). Greater levels of circuits MPA, VPA and MVPA was related to lower breaktime SB (circuits: MPA = p=0.003, 35.7%, VPA = p=0.027, 14.8%, MVPA = p=0.001, 50.5%: break sed = 22.4%), and greater breaktime MPA (circuits: MPA = p=0.034, 35.7%, VPA = p=0.018, 14.8%, MVPA = p=0.006, 50.5%: breaktime MPA = 27.1%). This contributed to an association between increased levels of circuits VPA and MVPA, and increased breaktime MVPA (circuits VPA = p=0.006, 14.8%, MVPA = p=0.006, 50.5%: breaktime MVPA = 35.1%). However, VPA and MVPA during circuits was associated with lower breaktime VPA (circuits: VPA = p=0.003, 14.8%, MVPA = p=0.016, 50.5%: breaktime VPA = 8%). Increased levels of circuits MPA and MVPA was also related to greater lesson time SB (circuits: MPA = p=0.005, 35.7%, MVPA = p=0.004, 50.5%: lesson sed = 57.9%) and greater lesson time LPA (circuits: MPA = p=0.002, 35.7%, MVPA = p=0.02, 50.5%: lesson LPA = 33.8%).

Table-tennis SB (14.2%) was associated with breaktime SB (*p*=0.00, 22.4%), and lesson time SB (*p*=0.00, 57.9%). This follows on from previous PA intervention club trends, where lower amounts of sedentary time at table-tennis was associated with greater sedentary time during breaktime, and during lesson time.

Increased table-tennis MPA and MVPA was related to increased SB during breaktime (table-tennis: MPA = *p*=0.00, 34.9%, MVPA = *p*=0.00, 48.7%: breaktime sed = 22.39%), and increased SB during lesson time (MPA = *p*=0.00, 34.9%, MVPA = *p*=0.00, 48.7%: lesson sed = 57.9%). In addition to this, increased table-tennis MPA and MVPA was also associated with reduced breaktime MPA (table-tennis: MPA = *p*=0.019, 34.9%, MVPA = *p*=0.004, 48.7%: breaktime MPA = 27.1%), and reduced lesson time MPA (table-tennis: MPA = *p*=0.001, 34.9%, MVPA = *p*=0.044, 48.7%: lesson MPA = 6.6%).

Increased table-tennis VPA and MVPA was associated with less breaktime VPA (table-tennis: VPA = *p*=0.011, 13.8%, MVPA = *p*=0.004, 48.7%: break VPA = 8%). Furthermore, greater MPA, VPA, and MVPA during table-tennis was associated with increased breaktime MVPA (table-tennis: MPA = *p*=0.021, 34.9%, VPA = *p*=0.021, 13.8%, MVPA = *p*=0.02, 48.7%: breaktime MVPA = 35.1%). Finally, greater MPA and MVPA during table tennis lunchtimes was associated with lower lesson time LPA (table-tennis: MPA = *p*=0.00, 34.9%, MVPA = *p*=0.00, 48.7%: lesson LPA = 33.8%), and lower lesson MVPA (table-tennis: MPA = *p*=0.003, 34.9%, MVPA = *p*=0.03, 48.7%: lesson MVPA = 8.2%).

6.3.3 Evaluating the physical activity intervention – The children's experiences

Following the two focus groups conducted, first order themes which were drawn were: Fun/Enjoyment; Prevents boredom; Location/Environment; Improve fitness/skill/active; Weather; Opportunity; Motivation; Challenge; Teamwork; Range of activities, and Time.

First order themes could be categorised according to the components of the Social-Ecological Model (McLeroy et al., 1988), and these were categorised into either being a ‘strength’ or an ‘area for improvement’ for the PA intervention programme. An outline of children’s quotations, and how these have been analysed and categorised according to the Social-Ecological Model (McLeroy et al., 1988), is provided in Table 6.1.8. Post-intervention focus group transcripts are provided in Appendix 11.

Table 6.1. 8 Lunchtime intervention focus group themes categorised according to the components of the Social-Ecological Model.

	Lunchtime Intervention PA	
	Selected quotes from children	
	Strengths	**Areas for improvement**
Individual		
Time	*"It makes lunchtime more interesting"*	*"a bit longer sessions because there might not be much time"*
Improve fitness/skill/active	*"It teaches you not to be lazy and keep fit as well"* *"They are still encouraging you to be active…"*	
Fun and enjoyment	*"It made it more fun lunchtime"*	*"More support because in dodgeball there seems to be a lot of cheaters"* *"put a limit on how many can come because like dodgeball it's too many"*
Challenge	*"Enjoyed having a challenge"*	

Motivation	*"It makes me want to be more active"*	*"we could do some of the clubs outside of school as well"* *"we can do a mixture of running and high jump, long jump, sprints"*
Interpersonal		
Friends and family	*"I've been more active with my friends…."*	
	"Everyone gets involved as a team"	
Prevents boredom	*"It's something to do, so you don't get bored in classrooms"* *"It stops you from being bored on the playground"*	
Organisational		
Location/Environment	*"It's just a way of staying warm and playing sport instead of going outside and freezing"*	
	"They are still encouraging you to be active, yes because it could be raining but you could still be doing	

	sport, and you don't have to be sat in a classroom"	
Community/Public Policy		
Range of activities	*It's quite good because of the range of different clubs so you don't have to do the one every time, you can do different ones"* *"I've started doing different clubs"*	*"It's all good so far, you just need a rowing club"*
Opportunity	*"It's opened me up to a different range of sports, I've started stuff other than football"*	

The following section will provide further details of children's evaluative responses relating to the lunchtime PA clubs as provided in Table 6.1.8. Extracts provided below are from the mixed-gender KS2 focus group, and the KS3 mixed gender focus group.

Individual component:

When discussing the strengths of the lunchtime PA clubs, children made reference to how they felt encouraged to keep fit, and how PA clubs promoted PA. Children also highlighted how lunchtime PA clubs have influenced their personal lifestyle, as children discussed improved skill level, and the different PA they engage in outside of school. Fun, enjoyment and challenge elements encouraged children to engage in lunchtime PA.

Researcher: *Okay so we've got a range, a small range, a lot of football, of different clubs there which is fine, okay so, what impact have the different lunchtime clubs made? What impact have the different lunch time clubs made?*
Participant 1: *It's quite good because of the range of different clubs so you don't have to do the one every time, you can do different ones*
Participant 2: *It makes me want to be more active*
Participant 3: *Say like, the people have like the different sports, they can do one sport and not do the other*
Participant 4: *It's been alright yes*
Researcher: *Right, and has the start of the lunch time activity clubs affected your sport participation outside of school? Maybe on the weekends, or when you meet your friends? Have you done anything differently?*
Participant 1: *Yes, I've been more active with my friends outside of school*
Participant 2: *Yes I've been playing out with my friends as well, but I do like swimming and taekwondo*
Participant 3: *Yes I've been practicing and trying to get my skills better*
Participant 4: *Yes it sort of has, I've been out with my friends more*
Participant 5: *I've been out with my friends more since doing them*

To further improve the clubs, children identified a range of ideas including more staffing to ensure fair play, reducing numbers and further increasing the range of activities. Children also indicated that they would prefer to see after-school extracurricular activities reflect these lunchtime activities, which would increase the opportunity to engage in these PA at other times of the day. The duration was seen as being too short based on a 40-minute lunch break, where children also had to have lunch either before, or after attending their chosen club.

Researcher: *What is something you think could be improved then?*
Participant 1: *Maybe some more clubs like the days instead of three, a couple more*
Participant 2: *Could be a bit longer the sessions because there might not be much time to play what your favourite activity is*
Participant 3: *I agree with Aaron, a few more clubs probably*
Participant 4: *Like longer sessions, and like put a limit on how many can come because like dodgeball it's too many. It's like you can hardly move around, and it's really irritating, because there's loads of year 5s running everywhere*
Participant 5: *More support because in dodgeball there seems to be loads of cheaters, like Siljan*
Participant 6: *Like teams to be fair like, there could be a whole group of year 5s, against a whole group of year 8s, and that's not fair, they just get out-strengthened'*
Participant 7: *It's not a wrestling match*
Researcher: *Like balanced teams*
Participant 8: *Yes*
Participant 9: *It's all good so far, you just need a rowing club*
Researcher: *A rowing club?*
Participant 10: *No please we need a rowing club, I'm actually begging,*
Participant 11: *Rowing is really bad*
Participant 10: *I love it*
Participant 11: *I hate it*
Researcher: *Anything else?*

Participant 10: *It's fun*

Participant 11: *We need more like longer sessions*

Interpersonal component:

Children referred to how the PA clubs prevented boredom in classrooms, with reference to when children had to stay indoors during wet lunchtimes. However, children also revealed that the playground and being outdoors is also an area which they also feel bored, and therefore lunchtime PA clubs helped alleviate this.

Researcher: *Okay, can you tell me, what were the good points of these clubs?*

Participant 1: *Probably one of the best things was not having to go outside if it's cold or wet, you can actually do something instead of staying in the classroom*

Participant 2: *It teaches you not to be lazy and keep fit as well, but have fun at the same time*

Participant 3: *It's like some people might just stand there like talking to their friends, so it'll keep them active as well*

Participant 4: *It will keep you active and you can stay inside and keep warm, play sport*

Participant 5: *It's something to do, so you don't get bored in classrooms*

Participant 6: *It's just a way of staying warm and playing sport instead of going outside and freezing and that*

Participant 7: *You get to keep warm and you're still getting active*

Participant 8: *You get to keep warm and you get like still hang out with your friends by doing more active rather than just sitting around on the playground*

Participant 9: *Makes you active and keeps you warm at the same time*

Organisational component:

One of the most common themes children highlighted was how lunchtime PA clubs were not affected by poor weather conditions that would normally affect their lunchtimes. From this, it was learnt that school policy indicated that on days of poor weather i.e. rain, snow etc, children were asked to remain in their classrooms throughout break and lunch periods, therefore PA clubs which were staged meant children could engage in PA as opposed to classroom-related SB.

Participant 5: *It's like something to do when it's cold outside, when it's raining, you can just come in and stay and do clubs*
Participant 6: *Anyone can come and like play when it's cold, and have fun*
Participant 7: *They are still encouraging you to be active, yes because it could be raining but you could still be doing sport, and you don't have to be sat in a classroom*
Participant 8: Y*es you just keep warm*
Participant 9: *It makes lunch time more interesting*

<u>Community and Public Policy component:</u>

Children appreciated the variety of clubs on offer, indicating that lunchtimes comprised of different activities as opposed to one club that is repeated continuously.

Researcher*: Okay so we've got a range, a small range, a lot of football, of different clubs there which is fine, okay so, what impact have the different lunchtime clubs made? What impact have the different lunch time clubs made?*
Participant 1*: It's quite good because of the range of different clubs so you don't have to do the one every time, you can do different ones*
Participant 2*: It makes me want to be more active*
Participant 3*: Say like, the people have like the different sports, they can do one sport and not do the other*

However, some children voiced how widening the selection of PA clubs even further may encourage greater participation, which could further improve the lunchtime PA intervention:

Researcher: *Well that leads into my next question, is what other clubs would you like to see? So what other sport clubs would you like to see at lunch times?'*

Participant 1: *I think just a range, more of a range'*

Participant 2: *Just more variety really*

Participant 3: *Swimming club would be nice*

6.4 Discussion

The aim of Study 3 was to implement an intervention that promoted school-based PA in a case study school, using the lunchtime period during Spring term as a specific window of opportunity for intervention during the school day. Findings from qualitative and quantitative data both indicated that the intervention had a positive effect on children's PA, which supports previous literature (Tannehill et al., 2015). There was a 2.4% increase (8.2 minutes) in MVPA on intervention days compared with non-intervention days, which is in line with previous school-based PA intervention literature which has reported an intervention MVPA increase of 8.3 minutes (Fairclough et al., 2016). However, despite this statistically significant finding (p <0.01), there were no significant gender and key stage findings. Results from this intervention reveal both genders, key stages, and genders within each key stage to show reductions in SB and LPA, and greater MPA, VPA and MVPA on intervention days compared with non-intervention days. This follows trends of previous school-based interventions showing when children engaged in PA clubs, a positive impact on MVPA behaviours was evident (Aburto et al., 2011; Fairclough et al., 2016).

Results from this intervention also revealed that more children (n =10 children, 18.2%) met 60-minute daily MVPA guidelines on intervention days demonstrating a 50% increase in the number of children meeting PA guidelines. After analysing data of children meeting PA guidelines (Chief Medical Officers, 2019) further, there was an increase in children meeting guidelines from both genders and key stage on intervention days. This pattern was also revealed when analysing gender within key stage, with the exception of KS2 girls, who had the same number meeting PA guidelines on intervention days, as non-intervention days (meeting = 2, not meeting = 11). This finding for KS2 girls specifically supports previous literature indicating that girls have displayed a smaller intervention effect than boys, and that boys engage in greater levels of PA when compared with baseline measurements (McKenzie et al., 2004; Goldfield et al., 2008; Magnusson et al., 2011; De Craemer et al., 2014). However, girls as a whole cohort within the intervention showed an increase in number meeting PA guidelines (Chief Medical Officers, 2019), so therefore further consideration in future PA investigations should be given to KS2 girls more specifically. Despite this, from the results produced, it could be argued that KS2 girls were consistent with meeting PA guidelines, as opposed to a reverse trend (fewer girls meeting guidelines), and indeed KS2 girls' data (see Table 6.4) indicated that there was a 2.7% increase in MVPA on intervention days compared with non-intervention days (KS2 girls MVPA: non-intervention = 12.2%, intervention = 14.9%).

As the intervention was staged during the lunchtime period, children's PA behaviours were explored specifically in this time period to investigate PA changes. Children engaged in significantly more MVPA (p <0.01) on intervention lunchtimes (45.9%, 22.2 minutes) compared with non-intervention lunchtimes (33.9%, 12.7 minutes). These PA behaviours were supported by children's enjoyment of the different PA clubs, and how these prevented boredom at lunchtime, for example, children stated that the clubs *"Made lunchtime more fun",* prevent boredom, encouraged you to be active and gave children a *"challenge."* In addition to this, improvements in lunchtime MVPA were also discussed in relation to avoiding poor weather conditions and having an opportunity to socialise with friends: *"It's just a way of staying warm whilst doing sports and instead of going outside and freezing and all that."; "You get to keep warm but you get to hang out with your friends and you're doing more active [sic] than sitting around in the playground."* Therefore, it is evident that children were more likely to engage in lunchtime MVPA during colder UK winter months, if an indoor facility was provided (as the children did not like to spend time outside at this time of year), and if there were opportunities to have fun, become active and challenged, whilst also socialising with friends. Previous literature indicates that the lunchtime period is a part of the school day where PA behaviours decline, and this is possibly due to the limited time available, and also some schools having split lunchtimes resulting in less available time for children to engage in PA (Brooke et al., 2016). In Primary schools specifically, the lunchtime period has shown children to engage in the lowest levels of PA when compared with out of school time, and PE lessons (Marks et al., 2015). Furthermore, it is proposed that factors encouraging children's PA are responsible for influencing children's lunchtime PA, such as access to sporting equipment and the surrounding environment (Marks et al., 2015).This further supports calls from previous literature to improve children's school-based lunchtime PA (Hills et al., 2015; Marks et al., 2015; Brooke et al., 2016; van der Niet et al., 2016; Okely et al., 2017).

Current literature advises that strategic planning should help underpin, design and implement a school-based PA programme, and this includes working in partnership with the children to stage PA that is desirable (Morton et al., 2016; Demetriou et al., 2017; McHale et al., 2018), and considering children's feedback to design, develop and implement an extra-curricular programme is promising, accessible, evidence-based, and developmentally beneficial (Halliday et al., 2018). The child-informed school case study approach throughout this thesis allowed for an intervention to be implemented based on prior school research, and children's voice from both Studies 1 and 2.

Following on from looking at the intervention PA clubs generally; the study explored each PA on an individual level to investigate the impact it had on daily MVPA. The children showed a significant increase of 3.8% (13.3 minutes) in daily MPVA on football intervention days (p <0.01) compared with non-intervention days, with a 5.9% MVPA increase specifically during the football lunchtime period (p <0.05). This highlights how football activities specifically within this intervention helped children to achieve more minutes of MVPA which contribute towards the 60 minute guidelines (Chief Medical Officers, 2019). Children made reference to teamwork and how playing football during school lunchtime encouraged them to participate at other times: "*encouraged me to pay football outside of school*"; "*Everyone gets involved as a team*"; "*That's why I like the ones (PA clubs) we have now. Example, football, teamwork, that can be transferred to every other game.*"

The children also showed a significant reduction (5.3%) of SB (p <0.01) on football days compared with non-intervention days, which would suggest a shift in PA behaviour from children's SB towards greater MVPA, and again this was reinforced by the children: *"It's good to get lazy people doing it (football), it might get them like more active."* This demonstrates the children's awareness of the impact the lunchtime PA clubs had on their own PA behaviour. All children showed a reduction in SB during football intervention days, and both genders and key stages engaged in greater MVPA on football days compared with non-intervention days. This is in line with other literature which outlines the positive impact football-related interventions have had on promoting and encouraging children's PA (Friedrich and Mason, 2018), regardless of gender or age (Parker et al., 2019). However, gender by key stage findings revealed KS3 boys engaged in significantly less MVPA (p <0.05, -5%), during football lunchtimes. This indicates that the intensity of the football lunchtime activity was not at a level that would promote MVPA for this cohort and future PA interventions implementing football should consider a greater intensity of HR when working with older boys.

Children's PA behaviour on days which staged dodgeball at lunchtime, showed a 1% (5.3 minutes) increase in daily MVPA, with a 10.6% MVPA increase specifically during the dodgeball lunchtime period (p <0.01), thus supporting patterns of behaviour relating to other dodgeball PA interventions (Bean and Forneris, 2016; Gates et al., 2016). There is an argument suggesting that dodgeball activities fail to differentiate between children of differing abilities, and may not be as inclusive as other PA (Lee, 2017), and children made reference to differences in ability based on age groups where younger children may get *"out strengthened"* by the older children. This is further reflected in KS3 boys MVPA behaviour as this remained similar between dodgeball lunchtimes (44.8%), and non-intervention lunchtimes (43.8%), suggesting the intensity of dodgeball activities needs to be of a higher level in order to positively change KS3 boys PA behaviours. This is explained by KS3 boys being more active on non-intervention lunchtimes than other children, therefore highlighting the need for a greater focus on this particular group of children's MVPA levels.

Children also identified that due to the popularity of dodgeball PA, there needed to be greater focus on managing the number of attendees: *"put a limit on how many can come because dodgeball there's too many."* This then led to children discussing the management of fair play due to the increasing numbers: *"More support because in dodgeball there seems to be loads of cheaters."* Therefore, dodgeball encouraged greater MVPA amongst the children, but it was voiced that further management of numbers and differentiation of ability, would enhance children's experience.

Previous literature indicates that circuit training activities promotes greater MVPA (Brusseau and Burns, 2015). Within this study, there was an increase (p <0.05) of 3.6% (9.4 minutes) in daily MVPA on circuit intervention days compared with non-intervention days, with a 17.5% MVPA increase specifically during the circuit lunchtime period (p <0.01). Children discussed the impact circuits had on their knowledge and general fitness: *"Circuits has made me better at sports and circuits."*; *"circuit training because now I know how to keep like fitter in school and I know what to do and that. And all the fitness and techniques and that."* These findings support previous literature indicating circuit training activities to encourage most improved health-related behaviours in children (Mayorga-Vega et al., 2016), and this encourages children to engage in wider PA as it further reinforces intrinsic goals, and the desire to continue leading physically active lifestyles (Dishman et al., 2015). Further changes in the current study's children's PA support this, as children engaged in less sedentary time (-1.8%) and LPA (-1.7%) on circuit days, and greater levels of MPA (2.7%), indicating a positive shift in daily PA behaviours on circuit training days.

Table-tennis as an activity within interventions has been known to support and improve health-related behaviours (Gråstén et al., 2015; Buchanan and Barrow, 2016; Leonte, 2017). Table-tennis days within this study support these findings as results showed a 1% (2.7 minutes) increase in daily MVPA when compared with non-intervention days with a 13.8% MVPA increase specifically during the table-tennis lunchtime period (p <0.01). Children highlighted how participating in table-tennis activities encouraged participation outside of school: *"It's had an impact as to where I have started to play table tennis because I play at a local park now."* On table-tennis days, children showed a significant reduction (p <0.05) in LPA (-2.9%), which follows the shift and pattern of PA behaviours of other PA lunchtime clubs, promoting greater daily PA, and showed reductions in either (or both) SBs and LPA.

After exploring the individual lunchtime PA clubs, it is evidenced that there was a significant increase in MVPA in every activity during intervention lunchtimes. However, age by gender results revealed KS3 boys engaged in less MVPA in dodgeball and football activities. Previous literature suggests girls demonstrate a greater response to PA interventions based on accessibility, and availability of a wide range of PA on offer (Althoff et al., 2017). Given the current disparities between girls' and boys' PA (Althoff et al., 2017), which schools have a responsibility to address through effective interventions (Dudley et al., 2018), there is a need to inform and design effective gender-related PA interventions (Dudley et al., 2018). Findings from the current study revealed no gender differences, and this can be explained by the use of children's voice to design and shape the PA on offer, and consequently meant that both genders demonstrated increases in MVPA following each PA. However, despite this there are counter arguments which suggest boys engage in consistently more PA than girls following PA intervention (Saint-Maurice et al., 2018). These conflicting arguments suggest that gender-related responses to PA interventions is subject to the context of the staged intervention, and therefore, it is not currently possible to generalise PA related gender responses. In the context of this study, KS3 boys engaged in either similar or less MVPA during football and dodgeball activities, and therefore the effectiveness of the intervention can be enhanced by increasing MVPA within these two activities, particularly for older boys.

When exploring lesson time comparisons on intervention days to non-intervention days, there was a 1.4% increase in children's MVPA on intervention days. Lesson time SB and LPA was relatively similar across both non-intervention and intervention days. However, children's MPA was significantly higher (p <0.05) in lesson time on intervention days (1.1% increase). VPA was relatively similar during lesson time across intervention and non-intervention days, and no significant findings were revealed. Lesson time MVPA according to each PA day also showed greater changes of MVPA compared with non-intervention lesson time (MVPA percentage change: Football = 27.3%, Dodgeball = 19.5%, Circuits = 20.8%, Table-tennis = 15.4%). From this it can be advocated that there was an increase in children's MVPA behaviour during lesson time on intervention days, with MPA displaying the most significant increases. Previous literature identifies that lesson time shows promise for promoting student's MVPA (Weaver et al., 2016b; Taylor et al., 2017a). However, the PA intervention in this study was staged specifically at lunchtime, therefore, this increase in lesson MVPA behaviour may have been a result of academic lessons/other teaching members of staff promoting PA behaviours.

The break time period has been highlighted as an opportunity for schools to promote PA within the school day, however, it is suggested that schools need to consider break time rules and regulations, unsupervised access to equipment and facilities, and how this may relate to an incentive and rewards policy (Morton et al., 2016). Additionally, literature also indicates that physical environment safety influences may hinder the amount of PA children can accumulate at break times (Hyndman and Telford, 2015). Within the current thesis, break time revealed children to engage in lower levels (2.8%) of MVPA during break time on intervention days compared with non-intervention days. This may be explained by PA compensation which suggests children engage in less MVPA during break time due to greater MVPA during lunchtime, or other times of the day (Ridgers et al., 2014).

SB during break time was similar across non-intervention and intervention days, whereas children's LPA was higher on intervention days (2.8%). MPA was also similar during break time between non-intervention and intervention days, however children engaged in significantly less VPA (p <0.05, -2.4%) on intervention days compared with non-intervention days.

Break time MVPA according to each PA day also showed negative changes of MVPA compared with non-intervention break time with exception to football intervention days (MVPA percentage change: Football = 2.8%, Dodgeball = -2.6%, Circuits = -0.7%, Table-tennis = -2.6%). This supports findings suggesting that interventions including football are likely to encourage children's PA (Friedrich and Mason, 2018), and in the context of this intervention, the break time period on football intervention days shows children to engage in more MVPA compared with other PA days. It can be argued that break time periods on days which children attended dodgeball, circuits and table-tennis support the notion of PA compensation (Ridgers et al., 2014). However in line with further literature, break time MVPA on days when children attended football support findings which suggest that children may not compensate PA (Ridgers et al., 2018a).

Following the analysis of complete segmented day findings, it can be concluded that the intervention increased MVPA and reduced SB and LPA during lunchtime. MPA was significantly higher during lesson time on intervention days ($p < 0.05$), and VPA was significantly lower during break time on intervention days ($p < 0.05$). Therefore, in line with previous research findings, the children did not compensate for increased MVPA at lunch with lower activity at other times during the school day (Ridgers et al., 2018a). This would suggest that there are further discussions to be had surrounding PA compensation and this may vary according to the context of each study (Gomersall et al., 2013; Ridgers et al., 2014).

Focus groups in this study allowed children to express their thoughts and opinions on the lunchtime PA clubs, and children often made reference to how the introduction of the PA clubs helped to reduce boredom at lunchtime, and children found lunchtimes to be more interesting. The PA clubs took place indoors in the school sports hall, which meant that there were no cancelations based on poor weather. Therefore, children felt reassured that the PA clubs would always be staged regardless of weather conditions: *"Keep you active and you can stay inside and keep* *warm and play sport."; "You get to keep warm and you're still getting active."; "Makes you active and keeps you warm at the same time."* This supports previous literature which suggests that the time of year and weather conditions play a major role in encouraging children to engage in PA and therefore, this should be taken into consideration when designing health-related programmes (Lewis et al., 2016; Harrison et al., 2017). These findings were also developed further as the children outlined that school policy on days of severe weather (heavy rain, snow etc), indicated that children were to remain in their form classrooms. Again, this led to boredom and further SB, and highlighted the importance of making use of the school sports hall facility: *"There's something to do so you don't get bored in classrooms"; "you could actually do something instead of staying in the classroom."* The children's voice relating to the school's poor weather policy is supported by the 'Community and Public Policy' component of the Social-Ecological Model (McLeroy et al., 1988). The school's poor weather policy in this study is seen to have a direct impact on the children's opportunity to engage in PA, and therefore it is important to offer lunchtime PA clubs, which incorporate indoor activities, at times of the year when children are kept indoors because of bad weather and health and safety concerns (McLeroy et al., 1988). School policies and accompanying practices, contribute to children's lower levels of PA during UK winter months (Spring term), and thereby, changing policy (offering lunchtime PA clubs) positively impacts children's PA.

Children enjoyed the range of different PA clubs available and didn't feel pressured into attending the clubs: *"It's quite good because of the range of different clubs so you don't have to the one every time, you can do different ones."* The children also appreciated knowing which PA clubs were on through promotion in school assemblies, not having to sign up, and picking and choosing which PA clubs they wished to attend which is supported by previous findings (Tannehill et al., 2015). Children's engagement in the PA clubs relate to Harter's competence motivation theory and self-determination theory (Deci and Ryan, 1985), whereby successful attempts to master a skill increases perceived confidence, leading to increases in motivation (Cairney et al., 2012). Therefore, having the option to choose which PA clubs to attend encouraged greater engagement in the PA, which consequently increased perceived confidence. Previous literature suggests PA interventions designed in this way will enhance children's motivation to engage in PA outside of school (Fairclough et al., 2016).

Children also highlighted that further clubs could be introduced, perhaps seasonal which could take place outdoors or at alternative venues: *"A swimming club would be nice."; "An athletics club like a mixture of running, high jump, long jump, sprints, javelin and maybe like a cross country club. Get yourself in for cross country and get ready."; "It's all good so far, you just need a rowing club."* These points relate to the 'Organisational' component of the Social-Ecological Model (McLeroy et al., 1988), where the surrounding environment, which considers location, facilities and location, are noted to affect PA behaviours.

Children also came up with the idea of staging the same lunchtime PA club after school so they could have more opportunities to engage in these particular clubs. However, as previously discussed in Study 2 (Chapter 5), children highlighted family responsibilities which may restrict engagement in after-school PA. Additionally, children highlighted that a 40-minute lunchtime period was too short to appreciate and enjoy the PA, particularly as children had to use this time to have lunch: *"It could be a bit longer the sessions because there might not be much time to play your favourite activities really."; "I think we need more like longer sessions."* Therefore, it was suggested to increase the duration of PA clubs, which would mean changing school policy on timings of lunchtime. In addition to the point raised when discussing school weather policies, this is another example of how school policy on lunch timings and timetabling relate to the 'Public Policy' component on the Social-Ecological Model (McLeroy et al., 1988). In this example, children propose to allow greater time to the lunchtime period which would need to be discussed with school policy makers.

6.4.1 Strengths and limitations of Study 3

One of the key strengths of this intervention study was using data previously collected (from Studies 1 and 2) to inform the design of the intervention. Additionally, the mixed-methods approach using HR monitors accompanied with focus groups proved to be an effective approach of measuring and understanding children's PA behaviours. Combining a qualitative approach allowed for a deeper evaluation of children's thoughts on the PA offered, which HR monitors were unable to provide, and HR monitors provided a reliable and accurate indication of children's PA behaviours according to each different PA.

Collecting data across the whole school day, and not just during the lunchtime intervention window, enabled for PA behaviours to be analysed according to different segments. This allowed for investigation into the impact of the intervention on children's PA and SB throughout the school day, and allowed investigation into children's PA compensation which has been explored by previous research (Gutin and Owens, 1999). The Social-Ecological Model (McLeroy et al., 1988) underpinned the study allowing for the researcher to gain an insight into the different influencing layers, that affected PA behaviours.

The lead researcher's familiarisation of the school environment, facilities and staffing supported the implementation of the intervention, as the lead researcher had a teaching role within the school. This ensured that the data collection phase of the study could be monitored closely, and the lead researcher was often on hand to resolve any issues relating to equipment issues, or questions children, staff or parents/guardians may have had. Future research may wish to consider the support of school head teachers, and staff to allow for such an intervention to be carried out, and to assist with the implementation of a PA intervention programme, as this can be intensive of time. A school's willingness to adopt a PA intervention programme relates to changes in 'Public Policy' components, and is likely to be influenced by the surrounding 'Organisational' environment as indicated by the Social-Ecological Model (McLeroy et al., 1988), and therefore these factors should be considered during initial planning stages. Consulting the children throughout the study allowed exploration of the 'Individual' component of the Social-Ecological Model (McLeroy et al., 1988). This allowed the researcher to gain a deeper understanding of the individual factors that may influence a child's PA behaviour. This adds to existing knowledge by considering children's thoughts and using their ideas to design, implement and evaluate a PA intervention programme.

Limitations of this study include the sample size (55 children, 9.8% of total school population) engaging in the PA intervention. However, the case study approach of this study was based in a relatively small Middle school and the percent of children population who took part is comparable with other studies (Collins et al., 2012; Collins et al., 2015; Engelen et al., 2018). The design of the intervention meant there was no control group, ruling out the preferred randomised control trial approach. This is explained by the school case study approach which was adopted. Additionally, the design of data collection meant that comparisons of PA behaviour could be made between non-intervention days (control), and intervention days. PA according to non-intervention days may have been affected by poor weather, which consequently may have resulted in children being classroom based for break/lunchtime periods. It is acknowledged that if this was the case, children's SB may have been as a result of this, which may therefore demonstrate a greater intervention effect. This also demonstrates earlier points which children referred to, when poor weather restricts children to classroom activities which were identified as being sedentary. However, the intervention PA programme continued to run regardless of weather conditions, further supporting children's PA behaviours.

The researcher's role as a teacher within the school could be argued to have affected focus group responses, as children may not have felt entirely comfortable in answering honestly or felt obliged to provide answers to try and please the researcher. However, children were reassured that answers provided would not affect their academic performance or teaching. Additionally, planning and organisation of focus groups ensured there was a consistent approach, in order to eliminate researcher bias. 'Mock' focus groups (practice focus groups) allowed the lead researcher to ensure information being collected was done so accurately and impartially. PA was measured across the school day only, excluding time outside of school, however, it could be argued that the children may have compensated for higher levels of PA at school, by lower levels of PA outside of school i.e. at home (Gutin and Owens, 1999). Despite this, the intervention was targeted specifically for the school lunchtime, which was informed by findings from Study 2 (Chapter 5). Additionally, the researcher was mindful of over-researching the children, particularly as the same group of children have participated in Studies 1 and 2. Children remembering to apply/remove HR monitors in their own time (outside of school) is burdensome and can result in non-compliance. Therefore, it was felt that the time outside of the school of environment was not of interest but is acknowledged as potential limitation.

HR monitors were a useful tool in exploring children's PA, however five children's datasets were lost due to file corruption whilst downloading HR data. Additionally, the movement of HR sensors in some children's data resulted in the loss of some HR data, and therefore this is acknowledged as a limitation of the use of HR monitors.

Finally, the PA intervention programme purposely took place during one targeted school term based on findings from Study 2, and the children's PA behaviours reflected this. Therefore, future PA interventions may wish to implement PA intervention programmes which are repeated measures in design, in order to monitor a greater duration of children's PA, which would provide an indication of long-term effects.

6.5 Future recommendations

This intervention was staged specifically during the academic term which reported lowest levels of PA in Study 2 (Chapter 5), however, future research may wish stage a similar intervention using repeated measures design to explore for PA behaviour according to any seasonal variation (Atkin et al., 2016). It is also advised to measure children's PA outside of the school environment to further investigate PA compensation following a staged school-based intervention. This would allow for exploration into whether children's engagement in MVPA during the school day, is compensated with lower levels of PA during other times of the day.

The nature of this intervention programme focused on a sample based at one school, which gives a reflection of PA behaviours within one specific school environment. Future research may choose to stage interventions at multiple school locations so PA behaviours can be compared accordingly. Results produced would provide a more reflective evaluation of an intervention across different populations. However, it is acknowledged that implementing a large-scale intervention may lose school specificity, indicating that the school-tailored approach of the PA intervention, may not necessarily be as applicable in another school.

This intervention was targeted at lunchtime, as data from Study 2 showed children engaged in lowest levels of PA during this time period. Additionally, children's voice from focus groups within Study 2 also highlighted how they felt the lunchtime period during winter months would be best suited for a lunchtime PA intervention programme. However, it may be that other schools find that academic time, break time, or after school, may be more appropriate to stage PA interventions. This could be explored further following PA investigation in multiple schools.

Finally, this study explored and staged a PA intervention in a Middle school environment, with children aged between 9-13 years. First schools, high schools, or schools that follow a two-tier system i.e. Primary and Secondary system, may be worthy of investigation in order to draw PA comparisons.

6.6 Conclusions

This Spring term (winter-based) study found children to engage in significantly more daily MVPA (2.4% increase, 8.2 minutes) following a range of lunchtime interventions activities, which is similar to other PA intervention studies (Fairclough et al., 2016). The mixed-methods nature of the investigation enabled children to express themselves and evaluate the impact of the intervention on their personal lifestyle. The lunchtime period allowed all children to access the PA clubs, and these were not affected by the school's poor weather policy, which indicated children returned to the classrooms on days of poor weather. This therefore still provided access for children to accumulate MVPA regardless of severe weather conditions, and also in an environment which children were already familiar with.

The different types of lunchtime PA clubs revealed differences in children MVPA, with some activities showing children to work at higher intensities (e.g. circuit training), than other activities (e.g. dodgeball). It can therefore be concluded that the nature of each activity influences PA behaviours according to intensity. Despite this, children within this study were not found to compensate for higher levels of PA at lunchtime, by reporting lower levels of PA at other times of the school day.

Chapter 7
Discussion and Conclusion

Chapter 7 - Discussion and Conclusion

7.1 Introduction

This chapter provides an overview of the thesis research, which is followed by a summary of how an ecological model was applied when exploring children's physical activity (PA). Recommendations for school-based PA are provided, followed by a discussion of limitations of the thesis and recommendations for future research. The chapter ends with a conclusion.

This thesis aimed to explore children's PA patterns, weight status and cardiovascular fitness, and implement a PA intervention programme to increase children's moderate-vigorous physical activity (MVPA). A significant contribution is made in response to previous findings which have highlighted the low numbers of children who are meeting the daily recommended levels for PA (Burkhalter and Hillman, 2011; Ekelund et al., 2012; Schoeppe et al., 2014b; Chief Medical Officers, 2019). Findings produced also build upon previous research investigating children's health status and PA behaviours across the school year, and exploring the segmented day for promoting children's PA (Weaver et al., 2016b; Taylor et al., 2017a; Baquet et al., 2018). There is limited research which combines qualitative and quantitative approaches when exploring children's PA behaviours (Gilliland et al., 2015), therefore, the research within this thesis focused on adopting a mixed-methods design to quantitatively measure children's weight status and cardiovascular fitness, and quantitatively and qualitatively explore PA behaviours across the school year. These findings then informed and underpinned a PA intervention to increase children's PA.

In order to achieve this main aim, two exploratory studies were conducted to gain an in depth understanding of children's weight status and PA behaviours, particularly as the designed intervention would be informed by these studies findings (i.e., taking place during the school term with the highest weight status values, and lowest levels of PA and cardiovascular fitness). The targeted intervention took place during the following academic year. Chapter 4 (Study 1) was cross-sectional in design and took place during Autumn term, and explored children's PA, weight status and cardiovascular fitness, and investigated reasons behind PA behaviours through focus groups. Chapter 5 (Study 2) was repeated measures in design and data collection took place across all three school terms (i.e., Autumn, Spring and Summer terms). The study explored PA behaviours and location, and again used focus groups to investigate reasons behind PA at different times of the school year. Gender and age differences were explored throughout both Studies 1 and 2. Findings from these explorative studies helped inform the intervention (Study 3) to increase children's MVPA in the most appropriate school term when PA is at its lowest (i.e., Spring term), and during the most appropriate 'time window' of the day (i.e., lunch time). Intervention activities included football, circuit training, dodgeball, and table-tennis, which represented the activities children identified they like to do in Study 2. Research aims and objectives for each study are provided in Chapter 1.3.

The focus of this investigation was to explore the reality of school children's daily lives. The ontological stance of the thesis is that the reality is seen as a contextual field of information (Jones, 2012), where children's results reflect personal circumstances. A realist perspective was held when carrying out and reporting Study 1, followed by a post-positivist critical realist epistemological stance for Study 2. This was in order to explore the reality independent of the researcher's thoughts, however, literature does suggest that gaining an accurate understanding of the reality can be difficult (Trochim, 2006). The qualitative data collected during Studies 1 and 2 adopted a constructivist approach with a focus on gaining experience of the participants' PA behaviours. Finally, a pragmatic approach was taken for Study 3 (which included an intervention) where the researcher used thoughts as an instrument/tool for prediction, problem solving and action (James et al., 1978; Kennedy and Lingard, 2006; Oliver et al., 2010; Tully et al., 2014). To gain a deeper understanding of the factors influential to children's PA behaviours, the conceptual lens of the Ecological Model for Health Promotion (McLeroy et al., 1988) was used as a supporting model. Specifically, the Social-Ecological Model was used to help design the intervention for Study 3, and this has been a recommended model to adopt and consider when designing PA interventions (McLeroy et al., 1988).

7.2 Application of an ecological model to understand and increase children's physical activity

Previous research has supported the use of ecological models when exploring children's PA behaviours (Mehtala et al., 2014; Porter, 2016; Powell et al., 2016b). This thesis is grounded in the Social-Ecological Model (McLeroy et al., 1988), which offered different layers of influence to better understand children's PA behaviours, and also contribute towards shaping future PA opportunities for children, which in the context of this thesis was by implementing a PA intervention. The layers of the Social-Ecological Model (McLeroy et al., 1988) include: Individual influences, Interpersonal influences, Organisational influences, Community influences and Public Policy influences (see Chapter 3.1, Figure 3.1). The section will discuss how the findings from the thesis relate to the different layers of the Social-Ecological Model (McLeroy et al., 1988), before focusing on each layer in more depth.

Findings from the thesis revealed how components of the Social-Ecological Model (McLeroy et al., 1988) were very much 'inter-related' and should not be treated in isolation, and this has been found in previous PA investigations (Pfeiffer et al., 2013; Shanahan et al., 2016). For example, children's focus groups showed how each child's engagement in PA was affected by interpersonal factors such as family, friends, and the staff-student relationship. Furthermore, the school as an organisation, was the environment which provided children with interpersonal relationships, which contributed towards PA engagement. In Study 3, children discussed in the focus groups how the school-based PA intervention encouraged them to engage in PA in the local community (i.e., local park, sports clubs etc.), which demonstrates how children's school-based PA experience influences their PA in the wider community. Finally, the findings of such school-based PA interventions can be used to inform public policy, which in turn, can support changes to guidelines promoting children's PA. An adapted version of the Social-Ecological Model (McLeroy et al., 1988), informed by findings from the thesis is provided in Figure 7.1.

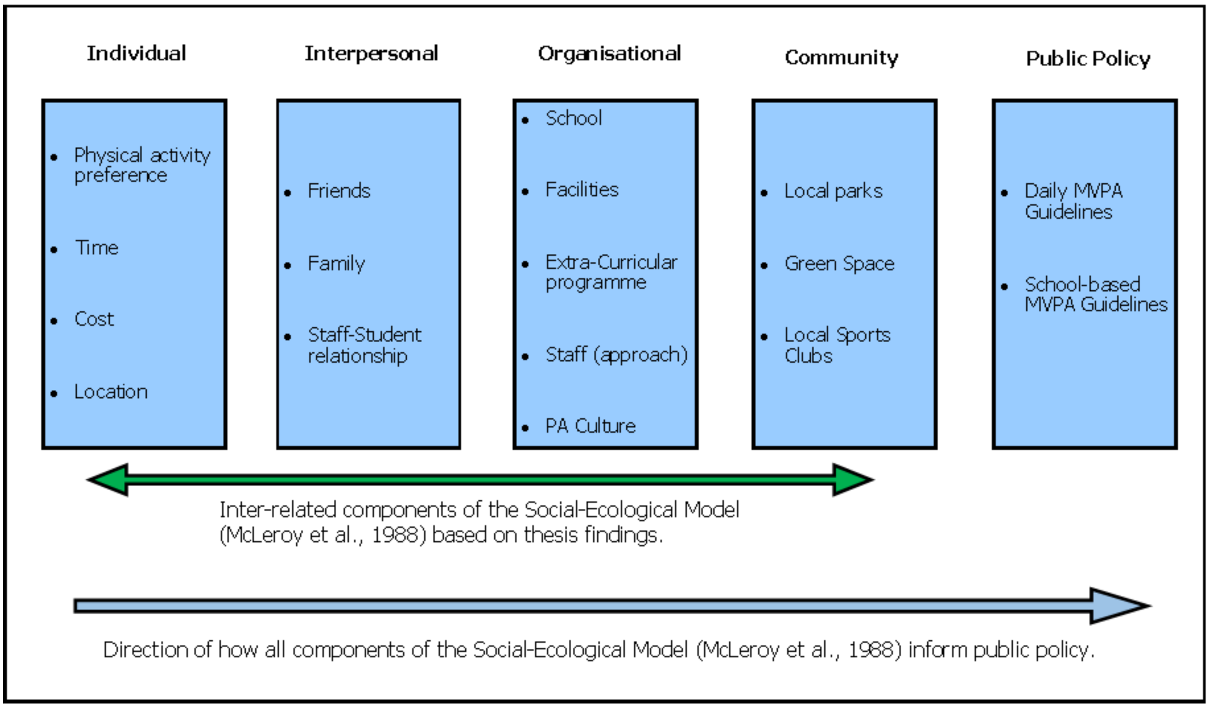


Figure 7. 1 Adapted version of the Social-Ecological Model (McLeroy et al., 1988) for a Middle School case-study of children's physical activity.

7.2.1 Individual level

In the context of this thesis, the individual component of the Social-Ecological Model (McLeroy et al., 1988) is child centred, therefore, in Study 1, the researcher obtained preliminary knowledge of children's PA behaviours and perceptions, weight status and cardiovascular fitness within the participating Middle school. Children highlighted factors such as fun, enjoyment, and wanting to keep fit and healthy as motives for PA participation, and time, poor diet/food intake and the cost of equipment as being barriers which restricted them from PA participation, which is in line with previous literature (Krops et al., 2017; Wan et al., 2017).

Study 2 extended this knowledge of individual influences, as the research monitored the children's PA behaviours during different school terms throughout the academic year and allowed for analysis of any behavioural changes. Findings highlighted how the 'Individual' layer of the Social-Ecological Model (McLeroy et al., 1988) could be seen to influence children's PA behaviour. Each school term, children identified the most common reason for PA engagement as fun and enjoyment, and time available, which was often affected by parents/guardians/carers, and this was often discussed as a potential barrier to PA. Additionally, results from Spring term, which included Winter months, revealed how timetabling PA after school could limit attendance because some children would not have parental permission to attend, potentially due to transport arrangements or safety aspects of allowing children to walk home independently in darker conditions, and similar findings have been supported by previous literature (McMinn et al., 2014; Gray et al., 2015). Furthermore, findings from the study support previous literature, as children highlighted how there was need for equipment costs to be considered when exploring PA engagement, as associated costs would potentially reduce opportunities to engage in PA (Carlin et al., 2015).

As discussed, the findings from Studies 1 and 2 provided knowledge of children's PA behaviours and this provided a rationale for implementing a PA intervention in the Spring term. However, the consultation with children in the design phase contributes new knowledge to existing school-based extra-curricular PA intervention studies (Engelen et al., 2018; González-Cutre et al., 2018; Haddad et al., 2018). Considering children's experiences and preferences from Studies 1 and 2 in the design of the intervention contributed to a large uptake in participation, and this consequently helped shape children's PA behaviours. Focus group data revealed how children valued being listened to and were appreciative of how their ideas had been put into practice. This is supported by the cognitive evaluation theory (Deci and Ryan, 1985), which highlights the importance of participants having critical roles and involvement, which consequently supports PA engagement. Therefore, alongside other contributing factors which positively enhance children's PA, it is suggested that consulting the children's voice is a useful and effective strategy for promoting positive children PA behaviours.

A novelty of the thesis is the child-informed intervention (Study 3). Previously published studies have implemented children's PA interventions, however children have not been involved in the design process (Engelen et al., 2018; González-Cutre et al., 2018; Haddad et al., 2018). The success of the intervention implemented within this thesis is attributed to the progressive nature of Studies 1 and 2, and how the children's preferences were considered in the design stages. This is because the intervention was informed by the findings from the previous two studies, and children were given an opportunity to provide information on their PA barriers and preferences. Learning from research of children's behaviours, experiences and interests resulted in the children having an influence upon the PA culture at the participating school. This relates to acculturation theory (Berry, 2017), where individuals from different cultural backgrounds come into prolonged, continuous, first-hand contact with each other. The first-hand contact results in changes at both individual (i.e., values, attitudes, beliefs and identities) as well as group level (Berry, 2017), and therefore the children's personal attitudes towards PA was 'accultured'.

In addition, focus groups revealed how the children who participated in the intervention continued to take part in similar activities with friends outside of school, as they enjoyed the fun element, and wanted to further improve their individual skill level by playing and practicing in their own time. This finding contributes to existing literature showing the positive effects of school-based PA on children's recreational PA (Haddad et al., 2018; Pearce et al., 2018), and infers that there is a need for PA interventions to consider the types of PA available outside of the school environment, if children's participation is to be encouraged, and skill levels are to be enhanced. Furthermore, this increases children's motivation to engage in PA and supports Harter's competence motivation theory and self-determination theory (Deci and Ryan, 1985) which suggest successful attempts in mastering skills, increases confidence and motivation to continue performing learnt and new skills, and encourages PA engagement (Cairney et al., 2012).

7.2.2 Interpersonal level

Focus group findings from Studies 1 and 2 support previous literature, and revealed how significant others, such as friends and family, encouraged or limited PA engagement (Atkin et al., 2016; Noonan et al., 2016a; Padulo et al., 2019), thus illustrating how the interpersonal component of the Social-Ecological Model (McLeroy et al., 1988) could underpin reasons for children's PA behaviour.

Physical Education (PE), PA and school sport was central to school life at the participating case-study school, and focus group data revealed how relationships between staff and children was often strengthened by staff taking an active role in encouraging and supporting PA clubs. For example, the inter-class competitions were popular, and were promoted by all staff (including teachers and learning support assistants), in school assemblies, and during tutor registration periods. The role of significant others in promoting PA is supported by functional attitude theory (Katz, 1960), whereby persuasive messages targeting the audience will have a positive impact on their functional attitude (Carpenter et al., 2013), and children in the case-study school adopted positive functional attitudes towards PA through their interactions with and observations of school staff. The case-study school had a whole staff community approach which supported children's PA and this may explain the number of children in Studies 1 and 2 meeting 60 minute minimum daily MVPA guidelines (Chief Medical Officers, 2019). For each school term greater numbers of both boys and girls in the current study met current PA guidelines (Chief Medical Officers, 2019) than previously published statistics. Indeed, during Spring term, the term during which children in the current study were least active, 48% of boys and 24% of girls met the guidelines. This is in contrast with 20% of boys and 14% of girls nationally (NHS Digital, 2019), and 14% of boys and 10% girls locally meeting the PA guidelines (British Heart Foundation, 2017).

Study 1 explored how the social environment affected PA behaviours within the Autumn term. Children highlighted PA as providing an opportunity to socialise and have a 'catch up', whilst enjoying the fun element of PA. The basic psychological needs theory (Deci and Ryan, 1985) suggests that psychological well-being and optimal functioning is established from autonomy, competence and relatedness (Deci and Ryan, 1985), and therefore children in the case-study school enjoyed the 'psychological well-being aspect' of PA. The study builds upon existing literature supporting PA through alternative environments (Carlin et al., 2015; Gray et al., 2015), as in the context of this study, the social environment was extended beyond the school environment. Children discussed broader interpersonal factors such as social norms associated with parents valuing and encouraging PA, or alternatively parents prioritising family responsibilities and schoolwork over PA.

Study 2 highlighted how improved weather conditions encouraged greater social engagement with PA, i.e. visiting the park, open spaces with friends, which is in accordance with previously reported findings (Tanaka et al., 2016; Schuttoff and Pawlowski, 2017; Ridgers et al., 2018b). Children identified that during colder and darker winter months, opportunities to socialise with friends at local PA clubs or club fixtures would often get cancelled which led to more sedentary indoor behaviour, particularly at weekends. Consequently, the poorer weather conditions limited children's social interactions and thereby the influence of interpersonal relationships upon PA behaviour. Children described that they 'have to stay inside' in poor weather conditions, and wet weather was specifically indicated as reducing levels of PA motivation. The impact of weather conditions on children's motivation for PA is well documented (Katapally et al., 2016; Lewis et al., 2016; Harrison et al., 2017), and the findings of this thesis support the need for alternative forms of PA during seasons of poor weather, which would encourage children's social interactions with peers, further developing interpersonal relationships and motivation for PA.

Previous studies have considered the social aspects of schools when designing and implementing school-based PA interventions (Engelen et al., 2018; González-Cutre et al., 2018; Haddad et al., 2018; Pearce et al., 2018), and the intervention in Study 3 was informed by these studies. Children in the current study were within an environment which included a range of interpersonal relationships, i.e., child with child, child with staff relationships, and intervention activities were inclusive of all children, thereby encouraging attendance. Attendance at the intervention PA clubs ranged from 20-70 children dependent on the activity, in comparison with the 10-20 (approximately) children who attended pre-intervention PA clubs at the school. As previously mentioned, the school-based peer-supported environment promotes the relationships motivation theory (Deci and Ryan, 1985), as the relatedness through interactions encouraged attendance at the PA clubs.

7.2.3 Organisational level

An individual's PA behaviour may be subject to the organisation which a person is within (McLeroy et al., 1988). The organisational component of the Social-Ecological Model (McLeroy et al., 1988) in this thesis is the school environment, which has been reported to be an effective environment to promote PA amongst children, particularly as the school lunchtime is a designated period of the day which follows a weekly/termly routine (Dudley et al., 2018; González-Cutre et al., 2018; Haddad et al., 2018; McHale et al., 2018; Pearce et al., 2018). Numerous studies have investigated children's PA, and implemented PA interventions to promote children's PA, but these are all specific to each study's individual school environment, ethos and philosophy (Engelen et al., 2018; González-Cutre et al., 2018; Haddad et al., 2018; Pearce et al., 2018; Padulo et al., 2019).

The majority of previous research to report age-related differences in children's PA have been conducted in schools which are part of the dominant two-tier education system in England i.e., Primary and Secondary school (Brooke et al., 2016; Corder et al., 2016; Farooq et al., 2016; Jago et al., 2017; Engelen et al., 2018). This current study was novel in that research was conducted in one of only 102 Middle schools in England (The National Middle Schools' Forum, 2020). The Middle school structure captures the key stage 2 (KS2) and key stage 3 (KS3) transition within the same location, whereas, this transition between key stages normally occurs when children move from Primary to Secondary education in the two-tier system. Age-related findings from both Studies 1 and 2 revealed KS3 children take part in more MVPA, compared with KS2 children which challenge the reported decline in PA behaviours according to age (Ridgers et al., 2012b; Collings et al., 2014; Magoc et al., 2016; Health and Social Care Information Centre, 2019; NHS Digital, 2019). The findings also confirm how the change in environment from Primary to Secondary school may explain reductions in PA behaviour (Farooq et al., 2016; Jago et al., 2017; Engelen et al., 2018), whereas when key stage transitions are taught within the same environment, children's PA behaviours remain consistent, and according to findings of this thesis, older children engage in greater PA than their younger counterparts. Therefore, findings from this thesis contribute that the nature of the schooling environment is worthy of consideration and also reinforce the importance of considering organisational differences when exploring children's PA behaviours (McLeroy et al., 1988).

Focus groups from Studies 1 and 2 revealed how children felt that school policy relating to poor weather conditions reduced PA, as children were to remain in classrooms. These findings are in line with previously published investigations highlighting the negative impact poor weather has on PA engagement (Harrison et al., 2015; Lewis et al., 2016). Additionally, children referred to the current variety of PA clubs on offer as part of an extra-curricular programme as 'not appealing', and the after-school timings did not always suit all children. This adds to existing knowledge on school-based extra-curricular PA (Mears and Jago, 2016; Meier et al., 2018), as it is suggested that schools should offer a wider variety of PA, staged at times which are most accessible to all children, consequently maximising participation. Children also felt that some after-school PA clubs had been more focused towards children representing the school in fixtures as opposed to a more inclusive, participatory and recreational approach, which again supports the need for a more varied extra-curricular PA programme. Focus-group discussion regarding the school as an organisation, included the duration of PE lessons, and length of break time and lunchtime. In accordance with previous findings, these were negatively referred to as it was suggested to limit the amount of time available for PA, (Ridgers et al., 2012b; Harrison et al., 2015; Ridgers et al., 2018b).

The novelty of the intervention in Study 3 was the consideration of the 'children's voice'. This builds on existing school-based PA intervention studies which did not consult children prior to the design and implementation of the respective intervention (Engelen et al., 2018; González-Cutre et al., 2018; Haddad et al., 2018; Pearce et al., 2018), as this intervention incorporated a range of PA clubs which children outlined as most popular and staged at a time which was accessible for all. In addition to this, all PA clubs were inclusive, meaning children who may or may not represent the school for team fixtures were welcome to attend, which consequently increased uptake. This finding is underpinned by the cognitive evaluation theory (Deci and Ryan, 1985), as adopting this inclusive approach meant that more children felt they could engage in PA for their personal intrinsic reasons, which enhanced their future motivation for PA engagement. Additionally, this adapted school extra-curricular programme was not affected by the school's 'wet play' policy, which children often referred to in focus groups, and has been supported by previous studies (Katapally et al., 2016; Lewis et al., 2016; Harrison et al., 2017). The children appreciated that intervention PA clubs took place in the school sports hall and were not cancelled on days of poor weather; cancelation would have resulted in children being engaged in sedentary behaviour in classrooms. Therefore, if facilities allow, schools should aim to ensure that 'wet weather' policies do not hinder children's opportunity to meet the 60 minute daily MVPA guidelines (Chief Medical Officers, 2019), and instead enhance the PA culture within the school.

Organisational aspects of the case-study school may have also contributed to gender-related PA results which challenge previous findings (Ridgers et al., 2012b; Collings et al., 2014; Magoc et al., 2016; Health and Social Care Information Centre, 2019; NHS Digital, 2019). This thesis revealed that girls engaged in greater amounts of MVPA than boys in Autumn and Summer term (Autumn: Girls = 20.9%, Boys = 13.8%; Summer term: Girls = 21%, Boys = 15.7%), which is in direct contrast to previous literature that consistently reports girls to be less active than boys (Ridgers et al., 2012b; Collings et al., 2014; Magoc et al., 2016; Health and Social Care Information Centre, 2019; NHS Digital, 2019). Therefore, the participating Middle school, through its organisation and structure of PA (e.g., separate subject leaders for boys' and girls' PE, a wider staff community promoting PA), may have provided an environment which helped to maintain girls PA. Additionally, the time window in which the school offers PA can maximise uptake for girls. For example, the lunchtime PA intervention meant children could access PA without having to consider any other inter-related factors including interpersonal factors (McLeroy et al., 1988), such as parental permissions or financial considerations, which has previously been reported to reduce children's PA (Carlin et al., 2015; Bermejo-Cantarero et al., 2017).

In addition to this, another organisational aspect were the school facilities at the participating school. The school had a dedicated sports hall where PE lessons and extra-curricular clubs took place. This may have contributed towards the success of the PA intervention in Study 3, where each lunchtime PA club revealed increases in children's lunchtime MVPA. There were also further increases of 8.2 minutes of daily MVPA on intervention days, contributing 13% of the minimum daily guideline of 60 minutes of daily MVPA (Chief Medical Officers, 2019), compared with non-intervention days. These findings reflect the patterns associated with previous school-based PA interventions (Eather et al., 2013; Fairclough et al., 2016). Additionally, the school had two large playgrounds (one for each key stage), extensive playing fields and a 'trim trail' which included a range of different stations to develop agility, balance, and coordination. Other Middle schools may not typically have access to such a diverse range of PA facilities. These facilities were specific to this school and combining these with the wider staff community who encouraged PA, meant that the organisation's environment was conducive and supportive of PA behaviours. Therefore, findings from this thesis support how the organisational component of the Social-Ecological Model (McLeroy et al., 1988), and the context and operation of individual schools should be considered when explaining findings from school-based PA investigations.

7.2.4 Community level

The community component of the Social-Ecological Model (McLeroy et al., 1988), in this thesis relates to the community surrounding the school. Studies 1 and 2 explored children's PA behaviours across four days, including different locations. GPS data from Study 2 revealed children to engage in PA on the street (walking), in local parks and green spaces, in car parks, and local sports clubs. Additionally, focus group findings following the intervention in Study 3 revealed how children continued the intervention activities in the local community (i.e., local parks and local sports clubs), which has been found in previous PA intervention studies (González-Cutre et al., 2018; Haddad et al., 2018; Lau et al., 2018). This demonstrates the positive effect of the PA intervention on children's PA, and shows how these behaviours are continued at a wider community level, including the school-based community and local sports and PA community, and this is in accordance with the Social-Ecological Model (McLeroy et al., 1988). The cultural values and norms of PA within the local community can support children's PA. Acculturation theory highlights how the surrounding environment an individual is immersed in will lead to adoption of those cultural values (Berry, 2017), and the wider community impact of the PA intervention facilitates a culture supporting PA. Therefore, the school-based PA intervention supports the wider community culture for children's PA, and the environment and community surrounding the school and children's home neighbourhoods can support children's PA.

7.2.5 Public Policy level

Despite the thesis not directly integrating public PA policy as a measurable outcome of the investigation, each thesis study compared children's PA against current 60-minute daily MVPA guidelines (Chief Medical Officers, 2019), which in turn enabled comparison with local and national data. In the case of Study 3, the contribution of the school-based intervention to children meeting these guidelines was explored. Data revealed how a greater number of children within the case-study school met recommended PA guidelines (Chief Medical Officers, 2019) compared with local and national data (British Heart Foundation, 2017; NHS Digital, 2019). This is supported by the goal contents theory (Deci and Ryan, 1985), which highlights the importance of engaging in PA to meet goals based on motivation and wellness. Therefore, PA public policy can be used by schools to inform their policies and practices e.g., a wide ranging and inclusive extra-curricular PA programme, and a whole school approach to PA promotion. Finally, the inter-relatedness of the components within the Social-Ecological Model (McLeroy et al., 1988), reveal how public policy can be informed by each component, and it is advised that future research using the Social-Ecological Model (McLeroy et al., 1988) as a framework should not treat each component in isolation, rather an inter-related relationship between each layer (Pfeiffer et al., 2013; Shanahan et al., 2016).

7.3 Recommendations for school-based physical activity

The following section will discuss the key and successful intervention components of this thesis, and how these may be considered, adopted, or adapted for future school-based PA.

Previous research has highlighted how the school environment is ideally positioned to promote children's PA behaviours (Engelen et al., 2018; Haddad et al., 2018; Saint-Maurice et al., 2018; Padulo et al., 2019), and further literature indicates how children's PA tracks into adulthood (Telama, 2009; Francis et al., 2013). Therefore, schools have a role to play in providing PA opportunities which may help the children they teach to remain active throughout the life-course.

The design, activities and implementation of this thesis' intervention were to the case-study school being investigated, therefore, it is recommended that schools adopt a 'custom made' design to be successful in improving PA engagement. The success of the PA intervention in this study is a result of a novel approach where the individual component of the Social-Ecological Model (McLeroy et al., 1988) was embedded in the design phase. Children's preferences in PA may differ according to school, and this may be shaped according to current PA opportunities, facilities, staff, and prior experiences. However, the findings from this thesis highlight the importance in exploring children's barriers and facilitators for PA, whilst also considering children's preferences when designing PA interventions. It is therefore recommended that children's preferences should inform the design phase of the intervention, and there is likely to be greater engagement. To implement an intervention that is appealing to both genders and all ages, it is suggested that there is representation and input from boys and girls from each year group which informs the design phase, which further supports the individual and interpersonal components of the Social-Ecological Model (McLeroy et al., 1988). Finally, as this thesis resulted in the design of a lunchtime PA programme based upon the experiences and interests of the participating children, it cannot be assumed that the programme would be attractive to, and effective at increasing PA of all children at the school or children at different schools, therefore, regular consultation with children is recommended. Establishing children's preferences would help to ensure school-based PA opportunities match the children's interests.

In line with the interpersonal and organisational components of the Social-Ecological Model (McLeroy et al., 1988), schools differ according to size, children and staff, and different PA preferences, which consequently influence the ethos of the school in relation to PA. There may be differences in the number of PA-related role models, opportunities for children to engage in PA, and differences in the relationships amongst peers, and between children and staff (i.e., school staff may actively promote PA and encourage children to engage in opportunities contributing to a school-based PA-culture). Therefore, the PA culture of the school should be at the heart of the design of any future PA programmes. Interpersonal relationships between children and staff are influenced according to organisation (McLeroy et al., 1988), which supports acculturation theory (Berry, 2017) as the school provides a range of intercultural encounters. PA opportunities within the school day should also be considered as they have the potential to reach all children, and the intervention design process should involve listening to children, especially those who may not engage in current extra-curricular activity provision. This reinforces the importance of considering the individual component of the Social-Ecological Model, and how there is a need for the children's voice to be considered in the design process (McLeroy et al., 1988). Additionally, different staff members may have varying levels of expertise/experience and different preferences of PA, which may inform the design of PA programmes. This demonstrates further differences according to organisation (McLeroy et al., 1988).

Other organisational considerations in accordance with the Social-Ecological Model (McLeroy et al., 1988), relate to location and facilities. School locations differ locally, regionally, and nationally and this is a consideration for future PA interventions. Although the case-study school in this thesis was based in an urban town within the West Midlands, other schools may be based in more rural or sub-urban areas. Consequently, the surrounding environment will differ according to location, and this should be considered when designing PA interventions as this may affect the facilities and natural resources available for PA (i.e., access to greater green space). More specifically, the on-site facilities each school has is also likely to differ (i.e., not all Middle schools will be fortunate enough to have a purpose-built sports hall, with large playing fields, two playgrounds and a trim trail), and schools' financial budgets are likely to differ, and be spent differently, which may not necessarily be on PA-related equipment. Therefore, it is suggested that PA offered as part of PA programmes are based upon location and facilities available according to each school. The available facilities are likely to shape the nature and scale of the PA programme, for example, the case-study school within this thesis has a wide range of PA facilities, which allowed for a larger scale intervention to compliment the PA ethos, whereas a school with limited facilities may be better suited to a smaller scale PA programme, and may even benefit from offering PA off site at an alternative location.

Finally, the school as an organisation may differ according to educational teaching system. A novelty of this thesis is the case-study school being a Middle school, which was part of a three-tier system, and therefore the differences previously discussed (e.g. staff, facilities etc) are likely to differ from schools which are part of a two-tier system. As a result, the scale and scope of PA programme should be bespoke in design to accommodate the different age of the children, and the school facilities available. Investment from schools into promoting PA behaviours may be considered if schools lack on-site support. This may involve prioritising the use of the school's budget, to invest in new equipment, and to improve facilities and staffing on site, or to take children off-site to provide different PA opportunities.

Two other key layers of the Social-Ecological Model (McLeroy et al., 1988) that should be considered are the community and public policy components. Current PA guidelines state that children should engage in a minimum of 60 minutes of daily MVPA (Chief Medical Officers, 2019), and 30 minutes of MVPA are to be completed within the school environment (HM Government, 2016). Results from previous findings suggest that current PA guidelines and public policy, particularly focusing on the school environment, may need to be addressed to increase the number of MVPA minutes completed at school, as the current 30 minute MVPA school guidelines (HM Government, 2016) could be seen as insufficient (Tudor-Locke et al., 2011; Arundell et al., 2015; Füssenich et al., 2016) in helping children to meet their 60 minute daily MVPA guidelines (Chief Medical Officers, 2019).

As findings from this thesis show children to engage in large amounts of sedentary behaviour and limited PA in home and community environments, it is recommended that children meet the 60 minute minimum daily MVPA guidelines (Chief Medical Officers, 2019) in school, as opposed to the 30 minutes of MVPA currently advised (HM Government, 2016) and therefore, government and school policy should be amended to reflect the need to ensure all children meet the 60 minute requirement. Such a change will require school leaders to explore how school break/lunchtimes, curricular and extra-curricular time periods can contribute to their daily 60 minute MVPA target, and consequently assist in combating children's obesity (Gray et al., 2015), support children's mental and physical health (Ha et al., 2017; Friedrich and Mason, 2018; Ridgers et al., 2018a), whilst encouraging movement competency and physically active lifestyles (Cohen et al., 2014).

7.4 Limitations of the thesis

This section will discuss the limitations associated with the data collection process, data analysis, and results produced from the thesis.

7.4.1 Limitations with measures

It is acknowledged that results from the multi-stage fitness test (MSFT) are dependent on children's effort and engagement with the activity, and that the maximal energy output associated with the test may deter children from fully applying themselves (Mayorga-Vega et al., 2015). Consequently, data gathered using the MSFT method may not be entirely reflective of children's cardiovascular fitness. A more accurate method of gathering accurate maximal oxygen uptake would be in laboratory-based settings, however, the appropriateness of using such laboratory-based testing for measurement with children has previously been questioned (Mayorga-Vega et al., 2015). Therefore, the MSFT was deemed the most appropriate cardiovascular fitness measure to use, supported by the case-study school's facilities, and previous literature indicates this method is a useful alternative for estimating cardiorespiratory fitness (Mayorga-Vega et al., 2015).

The PA diary data used within this thesis were subject to children's recollection of PA and compliance with completing daily PA diaries during the data collection periods. Previous literature questions the use of self-report measures as children may over-estimate or under-estimate amounts of PA which have been completed (Walsh et al., 2004; Tully et al., 2014). However, PA diaries were not the primary method of PA measurement, as these were used alongside HR and GPS monitoring to establish the types of PA participating children were undertaking, especially if satellite signal was lost. Multiple methods of PA measurement has been supported previously (Sylvia et al., 2014), and combining measures supports the reliability of the provided data.

The use of HR equipment has potential limitations. Children received tutorials on how to administer HR equipment, however, there were still instances where HR equipment failed to provide data. HR monitors may have become displaced whilst being worn due to movement, which meant HR sensors were unable to detect children's heartbeat. In order to reduce these issues, the researcher provided additional tutorials focusing on how to tighten HR chest straps, or failing this, changed the HR strap for a smaller size. Additionally, in some instances, HR equipment was removed for some water-based activities or higher risk activities, which has been the case in previous studies (Moore et al., 2014). This meant that children may have engaged in MVPA which may not have been recorded by the equipment. As mentioned previously, the PA diaries captured these events and water-based PA could be noted, however, it is acknowledged that the information provided from PA diaries cannot replace the missing HR data (when equipment may have been removed), which may have consequently affected the accuracy of HR data collected.

Previous literature indicates that GPS data loss may be attributable to problems with the GPS device (e.g. lack of signal, inaccurate positioning or loss of battery power) and/or children's handling i.e. forgetting to wear or switch on the device (Krenn et al., 2011). Within this thesis, there was a lack of GPS signal reported for time spent indoors which was due to inconsistent/interrupted satellite connectivity, consequently leading to missing data. In order to overcome this, the lead researcher manually checked data to confirm the indoor location of children based on their last reported GPS location point (i.e., child approaching an indoor location), before analysing HR data.

7.4.2 Other limitations

As a member of staff at the school in which data was being collected, and as an insider researcher, it is acknowledged that the lead researcher had an intimate knowledge of the context of the school, both present and historical, and was also aware of the two separate lives that the organisation may have: formal and informal (Teusner, 2016). It is acknowledged that this is a limitation as personal bias of the lead researcher may have affected data collection, interpretation of results, and analyses. More specifically, a degree of personal knowledge of the setting and children were naturally inherited by the lead researcher, however a reflexive approach to data collection was adopted to avoid personal bias. Reflexivity is an important aspect of social research where the social scientist is to unmask social reality and its many inflections which are concealed by presumptions (Bourdieu, 1977). Within this thesis, this included consultation with the wider research team when arranging sample recruitment and grouping, and also discussing questions for focus groups amongst the research team to ensure questions were not leading, and were therefore appropriate to gather information related to specific research questions. It was also assured that a child's participation would not have any impact on their academic performance and it was reinforced to children and parents/guardians that children were not obliged to take part in the study or provide information during the data collection process to eliminate coercion.

It is acknowledged that data collected and the intervention implemented within this thesis are based in one Middle school located in the West Midlands, therefore, the findings of each thesis study are reflective of the children at the case-study school, and during one academic year, and are not generalisable to other schools and all children. For example, future academic years within this school, or alternative schools may show children to exhibit different PA behaviours.

The PA intervention in Study 3 (Chapter 6) lasted 8 weeks in duration which does not provide a reflection of children's PA behaviours over the entire school year. It is also acknowledged that follow-up data were not collected to see if the school continued with lunchtime PA clubs, and whether there was a continued positive impact on children's daily PA. Finally, the PA intervention only measured PA within school hours, and not outside of the school day which included other environments. As previous research suggests that after engaging in school-based PA, children compensate with more sedentary behaviour outside of school (Ridgers et al., 2014), it is not known whether children in this study compensated for greater school-based PA (specifically at lunchtime), by reducing PA outside of the school environment (e.g. at home).

7.5 Recommendations for future research

The mixed-methods design to explore PA behaviours throughout the thesis has proven to be an effective approach to gaining greater insight into levels of PA and reasons behind PA participation. Study 1 revealed how combining HR monitors with PA diaries and focus groups provided greater depth and richness to the findings, and previous literature supports a mixed-methods approach (Powell et al., 2016a). This adds to the confidence in which conclusions can be reported, and future research should consider adopting a similar approach. GPS is an effective tool in measuring children's location, and combining this with HR is a useful and accurate approach to gaining an insight into children's PA intensity according to location. This supports previous literature (Chaix et al., 2014; Harrison et al., 2014; Moore et al., 2014; Collins et al., 2015; Pearce et al., 2018), and future research may look to develop this further by exploring PA behaviours according to schools in different geographical locations.

The cross-sectional design of Study 1, was developed into a repeated measures design for Study 2, where PA behaviours were explored over the school year. Findings from Study 2 indicate the importance of considering daylight hours and weather conditions when designing and implementing PA related interventions, which has been proposed when prompting children's PA (Atkin et al., 2016). Future repeated measures research is needed to provide more information about seasonal differences in children's PA behaviour. Furthermore, based on the findings of Study 2 there is a need for more research exploring winter interventions in the UK, when children's PA is reduced due to fewer daylight hours and poorer weather conditions.

The effectiveness of the PA intervention in Study 3 supports previous literature regarding using the school as a setting to promote children's PA (González-Cutre et al., 2018; Haddad et al., 2018; Pearce et al., 2018; Padulo et al., 2019; Wahl-Alexander et al., 2020), and it is advised that future research continues to use the school environment to engage all children in PA, particularly making use of break and lunchtime periods. Arranging PA clubs during school breaktimes as opposed to extending the school day, i.e. before or after school, means PA is accessible to all children, which has been previously supported (Brusseau et al., 2011; Harrison et al., 2015). Findings from Studies 1 and 2 revealed how children felt participation in before or after school PA clubs was dependent on parental consent, home responsibilities and time available, which are in line with previous findings (Bracy et al., 2014; Eyre et al., 2014; Schoeppe et al., 2014a; Lee et al., 2015). This would therefore support the use of current school break periods as effective times for implementing PA clubs based on accessibility for children.

Despite the intervention showing positive changes in children's PA behaviours, there is a need for the organisational, community, and public policy components of the Social-Ecological Model (McLeroy et al., 1988) to be considered. Results presented within this thesis are specific to one particular school, and school policies relating to extra-curricular programmes, location, facilities and teaching staff, will differ according to different schools. Therefore, findings from this thesis may not necessarily be replicable across schools locally, regionally or nationally. More research is needed across a range of schools, both regionally and nationally, to establish a deeper understanding of children's PA behaviours, which can inform community and public PA policy in the UK focusing on improving children's PA.

A wider, research programme focusing on designing PA interventions/extra-curricular programmes in schools is required. As part of schools' organisational policy, the effective findings from Study 3 can be used as a platform to build and develop a more theoretically underpinned PA programme, which considers individual, interpersonal and organisational influences (McLeroy et al., 1988), and is informed by, and informs, a school's PA ethos and culture. Research may wish to explore school-based PA intervention studies of longer duration, to establish whether children sustain engagement with a structured lunchtime programme of activity. Additionally, research may investigate children's PA outside of the school environment, focusing on compensation levels for higher levels of school-based PA. This may warrant further investigation, as it would provide a more holistic picture of children's PA behaviours, particularly following a school-based intervention. Additionally, comparative studies of school PA behaviours across different regions may also be of interest, which would provide a reflection of children's PA behaviours regionally and nationally.

Future research should also draw attention to the segmented day. Within the case-study school, lunchtime data from Studies 1 and 2 revealed children's levels of MVPA to be at their lowest. It may be of interest to explore the segmented day in other schools, and this would then in turn help inform school-specific interventions according to times of their school day which reports lowest MVPA levels. Once again, this area of investigation could be applied on a wider scale so regional and national trends can be monitored. Furthermore, the PA intervention in Study 3 of this thesis offered four activities for children to engage in, whereas other interventions may include greater or fewer activities dependent upon school staffing and facilities, which may consequently increase levels of children's MVPA.

Finally, there is a need for differences in the structure and setting of school organisations to be considered. The case-study school in the thesis studies was a Middle school consisting of children aged between 9-13 years. As previously mentioned within the thesis, the UK typically has a two-tier educational system, comprising of primary and secondary schools, and there are limited plans to develop the three-tier school system. Therefore, PA behaviours of children of older/younger age groups may be worthy of investigation, particularly in schools that follow the dominant two-tier system in the UK. Alternative PA provision for two-tier systems should be explored, which may comprise of a wider range of PA based at larger secondary schools, which tend to have more facilities and increased school staffing. Adopting a specific PA programme according to a two-tier and three-tier based system would therefore allow for comparisons of PA behaviours to be made.

7.6 Conclusion

The thesis has further extended previous work exploring children's weight status, cardiovascular fitness and PA according to location, gender and age differences. Furthermore, the novel approach of adopting a mixed-method repeated measures design across the school year, and incorporating the use of GPS technology proved to be successful in researching the thesis aims which were to explore the PA patterns, weight status and cardiovascular fitness of children, and design, implement and evaluate an intervention to increase children's MVPA. Findings from this thesis highlight how seasonal variation is associated with differences in children's PA; shorter day length and cold and wet weather conditions during the winter months (Spring Term) results in lower PA. Additionally, children's weight status is greatest during the Spring term. The findings indicate that research should target the Winter months to increase children's PA and help maintain weight status. The originality of designing a child-informed PA intervention proved to successfully increase children's MVPA, and this approach should be adopted when designing future children PA interventions to increase MVPA. Moreover, the mixed-methods nature of the investigation enabled children to express themselves and provide valuable information for intervention design. The thesis identifies the lunchtime period as key to staging effective school-based PA interventions, and the school environment is highlighted as providing PA which is inclusive of and accessible to all. The success of the PA intervention was also enhanced due to the indoor location, consequently meaning PA clubs remained unaffected by poor weather conditions, and future research should consider using indoor locations for PA to combat adverse weather conditions.

Findings from the thesis conclude that PA interventions focusing on promoting children's PA should consider the nature of PA being staged. Findings highlighted how different types of lunchtime PA clubs influenced children's PA, with certain clubs encouraging more MVPA. This suggests the nature of each activity influences PA behaviours according to intensity, and therefore consideration should be given to offering popular physical activities which encourage children to work at higher intensities to benefit cardiovascular health.

The Social-Ecological Model (McLeroy et al., 1988) is an effective model to allow researchers to understand the layers of factors that influence children's PA, and this should be used as a foundation for designing PA interventions, particularly in the school environment. In addition to the individual, and interpersonal components of the Social Ecological Model (McLeroy et al., 1988), there is a need for the organisational components to be considered for future PA research, which will inform community and public policy components. Differences in school organisational structure such as school system (two-tier/three-tier), staffing and facilities are likely to influence opportunities for children's PA. Additionally, policy components regarding PA (i.e. extra-curricular programmes) may differ between school organisations. Future research should consider these differences, and further develop more widescale and global strategies that promote children's PA, such as considering the timing of PA opportunities, for example PA within school hours, using break times or extending the school day to provide PA opportunities, which are accessible for more children.

Appendices

Appendices

Appendix 1 Peak height guidelines according to Williams (2009) and Simmons (2000)

These indicate strict protocols in measuring stature standing height and sitting height. When measuring standing height, students were asked to stand erect without shoes, with heels, buttocks and shoulders pressed against the stadiometer. Heels were asked to be placed together with arms hanging freely by students' side. Students were asked to look straight ahead, take a deep breath and stand as tall as possible. The measuring bar was then drawn down to the student's head to take a measurement. When measuring seated height, students sat on a chair which was placed against the stadiometer with their hands rested on their knees. Students were asked to sit back into their chair with their back straight ensuring there was no gap between their back and the stadiometer. Students were once again asked to look straight ahead and the measuring bar was drawn down to the student's head to take a measurement. Height was measured in centimetres using a free standing stadiometer (Seca) and was measured to the nearest 0.5 centimetre. Once both heights were measured, the sitting height measurement was subtracted from the standing height measurement in order to provide the leg length height as an indicator of maturational stage. Weight was measured to the nearest 100 grams using Seca weight scales, and combining both measures of height and weight provided data for BMI calculations.

Appendix 2 International Society for the Advancement of Kinanthropometry (ISAK) guidelines for waist circumference

This involved a tape measure being passed around the waist of the student at the level of the narrowest point between the lower costal border (10^{th} rib) and the iliac crest; students were asked to abduct their arms in order for a more accurate reading to be taken. Once the tape had successfully been passed around the waist, it was clipped back into the tape measure unit, before a tightening button on the unit was pressed which automatically tightened the tape to provide an accurate measure of the waist circumference. This was measured in centimetres to the nearest 0.5 centimetre.

Appendix 3 Multistage fitness test guidelines (Leger and Lambert, 1982).

The multistage fitness test comprises of 23 levels each lasting approximately one minute. Each level includes a series of 20 metre shuttle runs where the starting speed is 8.5km/hr and increases by 0.5km/hr at each level. A single bleep from the pre-recorded audio CD indicates the end of the shuttle and a triple bleep indicates the start of the next level.

Appendix 4 Consent forms - Participant, Parent/Guardian and Head teacher.

Participant and Parent/Guardian consent form

19th September 2014

Dear Parent/Guardian,

RE: PhD level research investigation.

I am writing to ask for your permission for your son/daughter to participate in a research investigation I am completing as part of my PhD qualification which I am completing at Newman University, Birmingham. The aim of the project is to investigate the physical activity levels of children at Woodfield Academy. Within this study I aim to research and identify opportunities, influential factors, such as ethnicity, and barriers to physical activity. The following objectives will be explored:

- What physical activities do students participate in?
- Where do students go to take part in physical activity?
- Why do students visit particular locations for physical activity?
- What are the health outcomes of physical activity behaviours for students?
- Do students participate in different activities?

In order to gather the relevant information I will be conducting the research in the following three phases, once a term for each year group during the 2014-15 academic year:

Phase 1 – Anthropometric and cardiovascular fitness measures including the multistage fitness test, body mass index (BMI), peak height and waist circumference measurements. Measurements will be taken in private, other people may be present in the room but students will have their own privacy. Furthermore, students will be unable to see each other's data.

Phase 2 – An observation, to be agreed, will be completed with the use of Global Positioning System (GPS) devices which will be connected to heart rate monitors. Participants will be asked to wear a chest strap and GPS watch, which they themselves will apply after receiving a demonstration. Participants will be asked to wear the chest strap and GPS watch for four days from Thursday to Sunday. The chest strap and watch will be handed out and collected in by myself at school. These devices will be used to measure frequency, duration, location and intensity of physical activity. Whilst the observation takes place, participants will also be asked to complete an hourly log of their physical activity. GPS data from the GPS watches will be downloaded when students return the equipment back to school.

<u>Phase 3</u> – A focus group discussion session with a sub-sample involving questions related to the frequency, duration and location of physical activity. The discussion will comprise a small group of students which will be audio recorded for analysis. This information will be stored electronically in an mp3 format. This will be stored securely and confidentially, and only I will have access to this information.

All information collected will be kept in strictest confidence and participant names will be replaced with pseudonyms. All participants have the right to access the information during and after the study, and will also have the opportunity to withdraw from the research investigation at any point without reason. The data produced and shared with the school will be anonymous i.e. individual participant information will be kept confidential and will be non-identifiable. Briefings on the progress of the investigation will take place prior, during and post completion of the study. Participation or non-participation in this study will not affect student learning in any way. Any further questions regarding the investigation are welcome; I can be contacted at school by phone.

My research proposal has been accepted by Newman University Ethics Committee. However, if you have any concerns or questions, my Supervising Tutor, Dr Lorayne Woodfield, will be happy to discuss them with you. I can provide you with Dr Woodfield's contact details upon request.

If you give permission for your child to participate, and your child agrees to participate, please complete the Informed Consent Form provided. Many thanks.

Yours sincerely,

Mr I. Khawaja

NEWMAN UNIVERSITY

INFORMED CONSENT FORM

Name of investigator: Mr I. Khawaja

Title of research project:

<u>To investigate the physical activity levels of children</u>

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Research Ethics Committee of Newman University.

I have read and understood the participant information sheet and this consent form.

I have had an opportunity to ask questions about my child's/my participation.

I understand that my child is/I am under no obligation to take part in the study.

I understand that my child/I have the right to withdraw from this study at any stage for any reason, and that my child/I will not be required to explain reasons for withdrawing.

I understand that all the information my child/I provide will be treated in strict confidence.

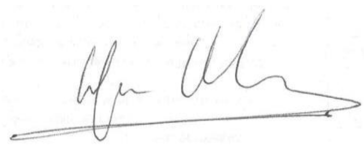
I agree for my child to participate in this study.

Name of participant:

Signature of participant:

Name of parent:

Signature of parent:

Signature of investigator: 

Date: 6th September 2014

NEWMAN UNIVERSITY

INFORMED CONSENT FORM

Name of investigator: Mr I. Khawaja

Title of research project:

To investigate the physical activity levels of children – An Intervention.

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Research Ethics Committee of Newman University.

I have read and understood the participant information sheet and this consent form.

I have had an opportunity to ask questions about my child's/my participation.

I understand that my child is/I am under no obligation to take part in the study.

I understand that my child/I have the right to withdraw from this study at any stage for any reason, and that my child/I will not be required to explain reasons for withdrawing.

I understand that all the information my child/I provide will be treated in strict confidence.

I agree for my child to participate in this study.

Name of participant:

Signature of participant:

Name of parent:

Signature of parent:

Signature of investigator:

Date: 5th January 2016

Head teacher consent form

Newman University,

Genners Lane,

Bartley Green,

Birmingham.

B32 3NT

6th September 2014

Dear Head teacher,

RE: PhD level research investigation.

I am writing to ask for your permission for your school to participate in a research investigation I am completing as part of my PhD qualification which I am completing at Newman University, Birmingham. The title of the project is 'The physical activity of young Britons: a comparative study of British South Asians and White-Europeans.' Within this study I aim to research and identify opportunities, influential factors and barriers to physical activity. The following objectives will be explored:

- What physical activities do British South Asian and White European students participate in?
- Where do British South Asian and White European students go to take part in physical activity?
- Why do British South Asian and White European students visit particular locations for physical activity?
- What are the health outcomes of physical activity behaviours for British South Asian and White European students?
- Do British South Asian students participate in different activities to other students?

In order to gather the relevant information I will be conducting the research in the following three phases, once a term for each year group during the 2014-15 academic year:

Phase 1 – Anthropometric and cardiovascular fitness measures including the multistage fitness test, body mass index (BMI), peak height and waist circumference measurements.

Phase 2 – An observation, to be agreed, will be completed with the use of Global Positioning System (GPS) devices which will be connected to heart rate monitors. Participants will be asked to wear a chest strap and watch, which they themselves will apply after receiving a demonstration. Participants will be asked to wear the chest strap and watch for four days. The chest strap and watch will be handed out and collected in by myself at school. These devices will be used to measure frequency, duration, location and intensity of physical activity. Whilst the observation takes place, participants will also be asked to complete an hourly log of their physical activity.

Phase 3 – A focus group session with a sub-sample involving questions related to the frequency, duration and location of physical activity.

All information collected will be kept in strictest confidence and the school's name and participant's names will be replaced with pseudonyms. The school and participants have the right to access to the information during and after the study, and will also have the opportunity to withdraw from the research investigation at any point without reason. The data produced and shared with the school will be anonymous i.e. individual participant information will be kept confidential and will be non-identifiable. Briefings on the progress of the investigation will take place prior, during and post completion of the study. Participation or non-participation in this study will not affect student learning in any way. Any further questions regarding the investigation are welcome.

My research proposal has been accepted by Newman University Ethics Committee. However, if you have any concerns or questions, please either contact me or alternatively my Supervising Tutor, Dr Lorayne Woodfield, will be happy to discuss them with you.

If willing to participate, please complete the Informed Consent Form provided.

Yours sincerely,

Mr Irfan Khawaja

NEWMAN UNIVERSITY

INFORMED CONSENT FORM

Name of investigator: Mr Irfan Khawaja

Title of research project:
<u>'An investigation to measure physical activity in a large comprehensive school.'</u>

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Research Ethics Committee of Newman University.

I have read and understood the participant information sheet and this consent form.

I have had an opportunity to ask questions about Bishop Walsh Catholic School's participation.

I understand that the school is under no obligation to take part in the study.

I understand that has the right to withdraw from this study at any stage for any reason, and that the school will not be required to explain reasons for withdrawing.

I understand that all the information the school provides will be treated in strict confidence.

I agree for my school to participate in this study.

Name of Head teacher

Signature of Head teacher

Signature of investigator

Date

Appendix 5 Physical Activity Diary, and GPS instructions.

<u>Activity Sheet for Thursday.</u>

Name: ……………………………………………… GPS number: …………………………………………………

Please complete the following activity sheet indicating the type of activities carried out during the day and the time spent on each of the activities. Please state how difficult you found the activity in the 'Intensity of activity' column. You may include more than one activity in each box.

Time	**Type of Activity (e.g. watch television or play football in the park)**	**Intensity of activity (i.e. did you find the activity 'very tiring', 'tiring', 'easy' etc…)**	**Time spent on activity**	**Wear the GPS monitor? (Yes/no)**
6:00am-7:00am				
7:00am-8:00am				
8:00am-9:00am				
9:00am-10:00am				
10:00am-11:00am				
11:00am-12:00pm				

12:00pm-1:00pm				
1:00pm-2:00pm				
2:00pm-3:00pm				
3:00pm-4:00pm				
4:00pm-5:00pm				
5:00pm-6:00pm				
6:00pm-7:00pm				
7:00pm-8:00pm				
8:00pm-9:00pm				
9:00pm-10:00pm				
10:00pm-When you go to sleep				

GPS instructions

Please wear the heart-rate monitor against your skin, around your chest (approximately level with your heart).

The heart-rate monitor should be fitted tightly around the chest, so it does not slip down.

Please turn the GPS monitor on by pressing the on/off button located on the left-hand side of the monitor.

Once the monitor is switched on, it will search for a satellite signal.

Please PRESS THE START BUTTON on the front of the GPS monitor. The watch should then display a running stopwatch. When the stopwatch is running, the data is being collected so please ensure that it is running whenever the watch is worn.

Once the GPS has been started, please wear it on the wrist (like a watch).

GPS charging instructions (just like a mobile phone!)

Place the GPS watch onto the GPS charging device holder.

Plug the charging device into a plug socket and switch the power on.

The GPS device should display the message 'Battery Charging in Progress'.

If this message does not appear, please readjust the GPS watch in the holder until the message is displayed.

Once the device is fully charged (after approximately 2 hours) the GPS watch will display the message 'Battery Charging Complete'.

At this point the device is ready to be worn again for approximately 12 hours.

Appendix 6 Certificate of Research Ethics Approval.

CERTIFICATE OF RESEARCH ETHICS APPROVAL

'The physical activity and health status of British young people: a school year study – an intervention.'

Student Number: 0500334

Module: PhD

Project Number: 2015-12-22-0500334/2395

This is to certify that this project has received approval from the Research Ethics Committee of Newman University

Newman University Birmingham

L. A. Woodfield

Chair of the Research Ethics Committee

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Date: June 2, 2021

Appendix 7 Research Calendar.

◄ Aug 2014	~ September 2014 ~					Oct 2014 ►
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
	1	**2**	**3**	**4**	**5**	**6**
7	**8**	**9**	**10**	**11**	**12**	**13**
14	**15** ASSEMBLY AND CONSENT FORMS DISTRIBUTION	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**	**24** DEADLINE FOR CONSENT FORMS	**25**	**26**	**27**

◄ Aug 2014 ~ **September 2014** ~ Oct 2014 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
28	29 CONSENT FORM ANALYSIS AND GROUPING	30	**Notes:**			

◄ Sep 2014 ~ **October 2014** ~ Nov 2014 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	INFORM SELECTED PARTICIPANTS 3	4
5	6	GROUP 1 MULTI-STAGE FITNESS TEST 7	GROUP 1 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT 8	GROUP 1 GPS 9	10	11

◄ Aug 2014 | ~ September 2014 ~ | Oct 2014 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
12 GROUP 1 GPS	13 GROUP 1 COLLECT GPS	14 GROUP 2 MULTI-STAGE FITNESS TEST	15 GROUP 2 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	16 GROUP 2 GPS	17	18
19 GROUP 2 GPS	20 GROUP 2 COLLECT GPS	21 GROUP 3 MULTI-STAGE FITNESS TEST	22 GROUP 3 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	23 GROUP 3 GPS	24	25
26 GROUP 3 GPS	27 31 HALF TERM	28	29	30		**Notes:** **<u>FRIDAY 24TH TED DAY</u>**

◀ Aug 2014	~ September 2014 ~					Oct 2014 ▶
Sun	Mon	Tue	Wed	Thu	Fri	Sat

◀ Oct 2014	~ November 2014 ~					Dec 2014 ▶
Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	GROUP 3 COLLECT GPS 3	GROUP 4 MULTI-STAGE FITNESS TEST 4	GROUP 4 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT 5	6 GROUP 4 GPS	7	8

◄ Aug 2014 **~ September 2014 ~** Oct 2014 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
GROUP 4 GPS **9**	GROUP 4 COLLECT GPS **10**	GROUP 5 MULTI-STAGE FITNESS TEST **11**	GROUP 5 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT **12**	**13** **15** GROUP 5 GPS	**14**	
GROUP 5 GPS **16**	GROUP 5 COLLECT GPS **17**	**18** GROUP 6 MULTI-STAGE FITNESS TEST	GROUP 6 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT **19**	**20** GROUP 6 GPS	**21**	**22**
23 GROUP 6 GPS	GROUP 6 COLLECT GPS **24**	HIGHER GIRLS FOCUS GROUP **25**	HIGHER BOYS FOCUS GROUP **26**	**27**	**28**	**29**

◀ Aug 2014	~ September 2014 ~					Oct 2014 ▶
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
30	**Notes:**					

◀ Nov 2014	~ December 2014 ~					Jan 2015 ▶
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
	1	**2** MOD GIRLS FOCUS GROUP	**3** MOD BOYS FOCUS GROUP	**4**	**5**	**6**
7	**8**	**9** LOW GIRLS FOCUS GROUP	**10** LOW BOYS FOCUS GROUP	**11**	**12**	**13**

◀ Nov 2014	~ December 2014 ~					Jan 2015 ▶
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
14	**15**	**16**	**17**	**18**	**19**	**20**
21	**22** **23** **24** **25** **26** CHRISTMAS HOLIDAY					**27**
28	**29** **30** **31** CHRISTMAS HOLIDAY			**Notes:**		

◀ Dec 2014 ~ January 2015 ~ Feb 2015 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1 CHRISTMAS HOLIDAY	2	3
4	5 **TED DAY**	6	7	8	9	10
11	12	13 GROUP 1 MULTI-STAGE FITNESS TEST	14 GROUP 1 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	15 17 GROUP 1 GPS	16	

◀ Dec 2014 ~ January 2015 ~ Feb 2015 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
GROUP 1 GPS **18**	GROUP 1 COLLECT GPS **19**	**20** GROUP 2 MULTI-STAGE FITNESS TEST	**21** GROUP 2 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	**22** **24** GROUP 2 GPS	**23**	
GROUP 2 GPS **25**	GROUP 2 COLLECT GPS **26**	**27** GROUP 3 MULTI-STAGE FITNESS TEST	GROUP 3 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT **28**	**29** **31** GROUP 3 GPS	**30**	

◀ Jan 2015 | ~ February 2015 ~ | Mar 2015 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 GROUP 3 GPS	2 GROUP 3 COLLECT GPS	3 GROUP 4 MULTI-STAGE FITNESS TEST	4 GROUP 4 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	5 GROUP 4 GPS	6	7
8 GROUP 4 GPS	9 GROUP 4 COLLECT GPS	10 GROUP 5 MULTI-STAGE FITNESS TEST	11 GROUP 5 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	12 GROUP 5 GPS	13	14
15 GROUP 5 GPS	16 HALF TERM	17	18	19	20	21

◀ Jan 2015	~ February 2015 ~					Mar 2015 ▶
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
22	GROUP 5 COLLECT GPS **23**	GROUP 6 MULTI-STAGE FITNESS TEST **24**	**25** GROUP 6 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	**26** **28** GROUP 6 GPS	**27**	

◀ Feb 2015 ~ March 2015 ~ Apr 2015 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
GROUP 6 GPS 1	GROUP 6 COLLECT GPS 2	3 GROUP 1 FOCUS GROUP	GROUP 2 FOCUS GROUP 4	5	6	7
8	9	10 GROUP 3 FOCUS GROUP	GROUP 4 FOCUS GROUP 11	12	13	14
15	16	17 GROUP 5 FOCUS GROUP	GROUP 6 FOCUS GROUP 18	19	20	21

◄ Feb 2015	~ March 2015 ~					Apr 2015 ►
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
22	**23**	**24**	**25**	**26**	**27**	**28**
29	**30** EASTER HOLIDAYS	**31**	**Notes:**			

◀ Mar 2015	~ April 2015 ~					May 2015 ▶
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
			1 **2** **3** EASTER HOLIDAYS			**4**
5	**6** **7** **8** **9** **10** EASTER HOLIDAYS					**11**
12	**13**	**14**	**15**	**16**	**17**	**18**

◀ Mar 2015 ~ April 2015 ~ May 2015 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
19	20	21 GROUP 1 MULTI-STAGE FITNESS TEST	22 GROUP 1 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	23 GROUP 1 GPS	24 GROUP 1 GPS	25 GROUP 1 GPS
26 GROUP 1 GPS	27 GROUP 1 COLLECT GPS	28 GROUP 2 MULTI-STAGE FITNESS TEST	29 GROUP 2 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	30 GROUP 2 GPS	Notes:	

◄ Apr 2015 ~ May 2015 ~ Jun 2015 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
31					1	2 GROUP 2 GPS
3 GROUP 2 GPS	4 MAY DAY BANK HOLIDAY	5 GROUP 2 COLLECT GPS; GROUP 3 MULTI-STAGE FITNESS TEST	6 GROUP 3 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	7	8 GROUP 3 GPS	9
10 GROUP 3 GPS	11 GROUP 3 COLLECT GPS	12 GROUP 4 MULTI-STAGE FITNESS TEST	13 GROUP 4 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	14	15 GROUP 4 GPS	16

◄ Mar 2015	~ April 2015 ~					May 2015 ►
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
GROUP 4 GPS **17**	GROUP 4 COLLECT GPS **18**	**19** GROUP 5 MULTI-STAGE FITNESS TEST	GROUP 5 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT **20**	**21**	**22** GROUP 5 GPS	**23**
GROUP 5 GPS **24**	**25** **29**	**26**	**27** HALF TERM		**28**	**30**

◄ May 2015	~ June 2015 ~					Jul 2015 ►
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**

◀ Mar 2015 ~ April 2015 ~ May 2015 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1 GROUP 5 COLLECT GPS	2 GROUP 6 MULTI-STAGE FITNESS TEST	3 GROUP 6 BMI, PEAK HEIGHT & WAIST CIRCUMFERENCE MEASUREMENT	4	5	6
				GROUP 6 GPS		
7 GROUP 6 GPS	8 GROUP 6 COLLECT GPS	9 HIGH GIRLS FOCUS GROUP	10 HIGH BOYS FOCUS GROUP	11	12	13
14	15	16 MOD GIRLS FOCUS GROUP	17 MOD BOYS FOCUS GROUP	18	19	20

◄ Mar 2015 ~ April 2015 ~ May 2015 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
21	22	23 LOW GIRLS FOCUS GROUP	24 LOW BOYS FOCUS GROUP	25	26	27
28	29	30	Notes:			

◀ Jun 2015 ~ July 2015 ~ Aug 2015 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20 24	21	22	23		25

SUMMER HOLIDAYS

◀ Jun 2015	~ July 2015 ~					Aug 2015 ▶
Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27 28 29 30 31					Notes:
	SUMMER HOLIDAYS					

Appendix 8 Figures showing the percentages of children according to PA categories.

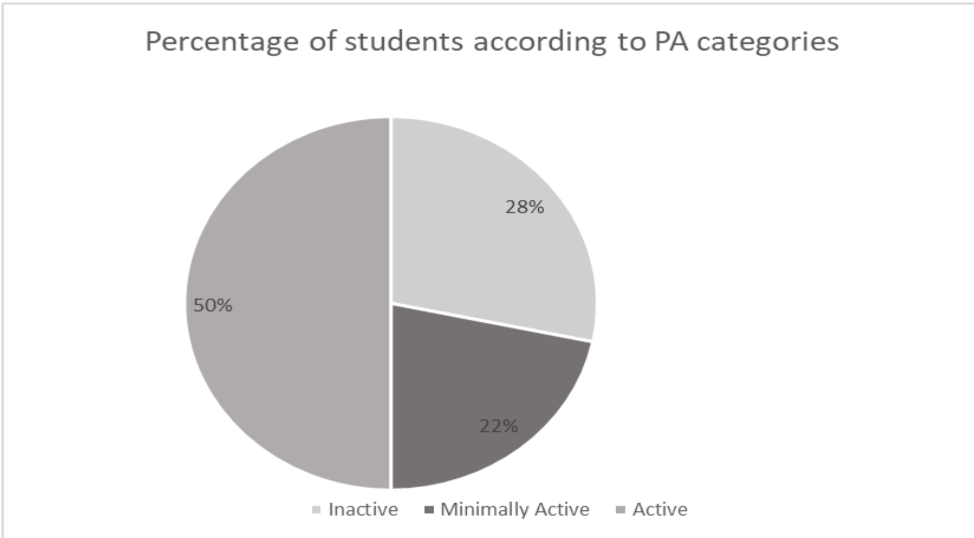

Figure 1. Percentage of children according to PA categories.

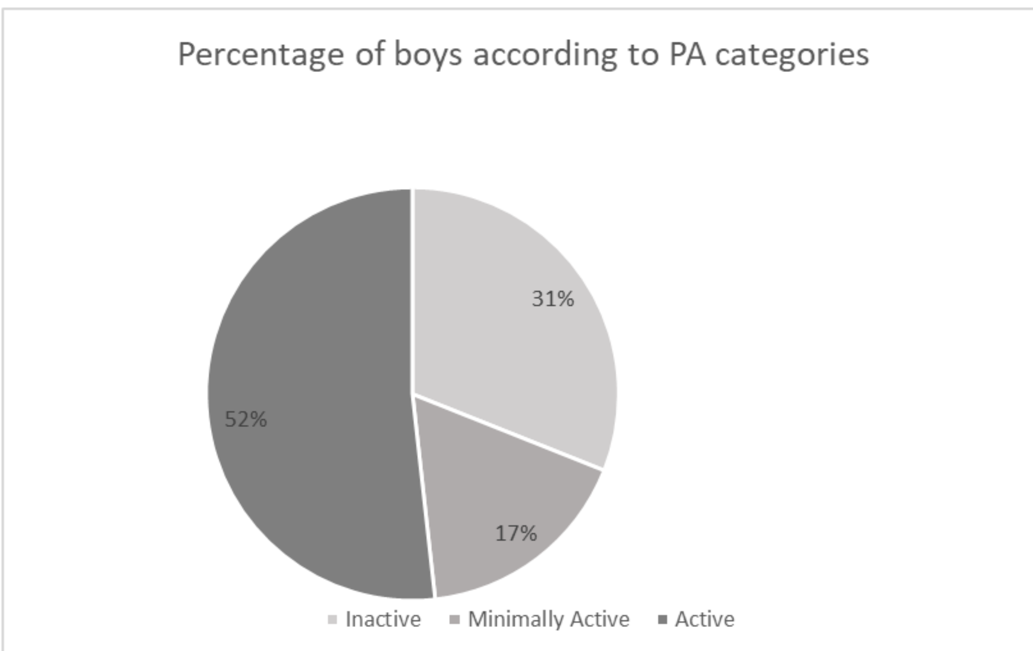

Figure 2. Percentage of boys according to PA categories.

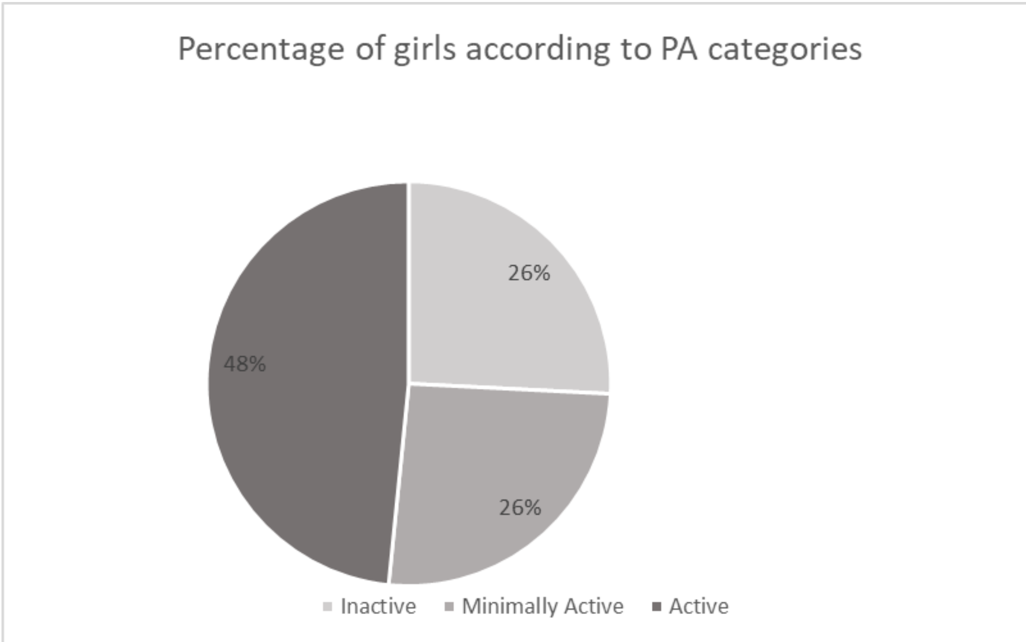

Figure 3. Percentage of girls according to PA categories.

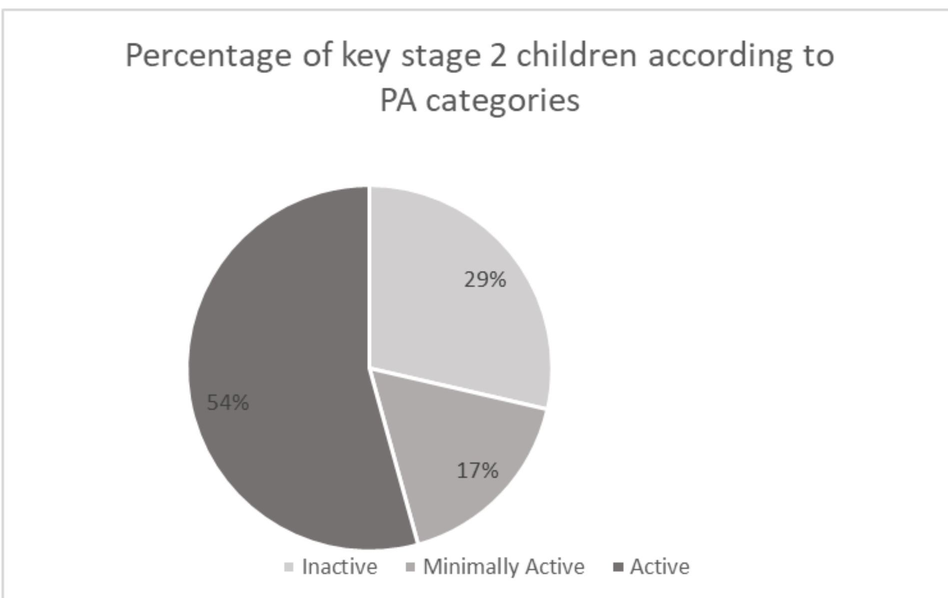

Figure 4. Percentage of KS2 children according to PA categories.

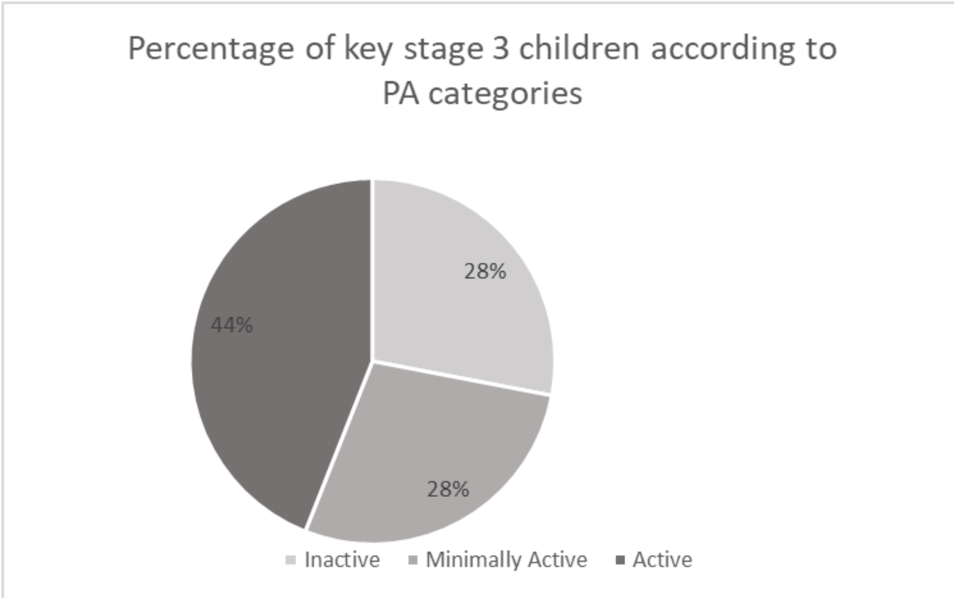

Figure 5. Percentage of KS3 children according to PA categories.

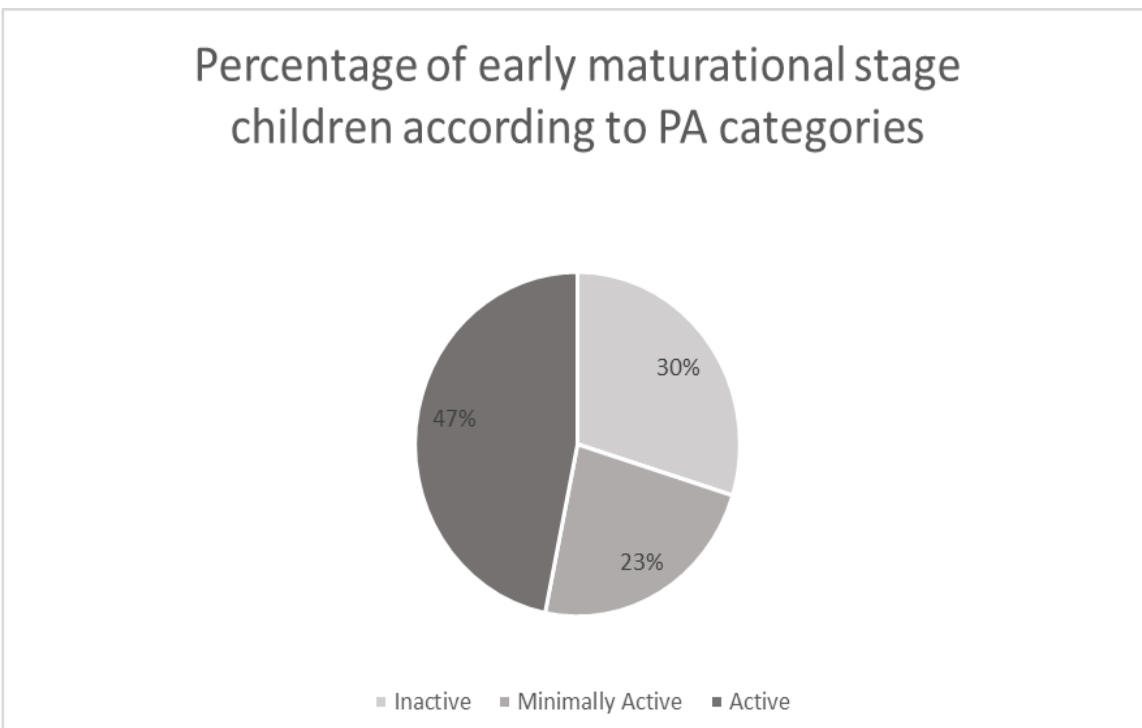

Figure 6. Percentage of early maturational stage children according to PA categories.

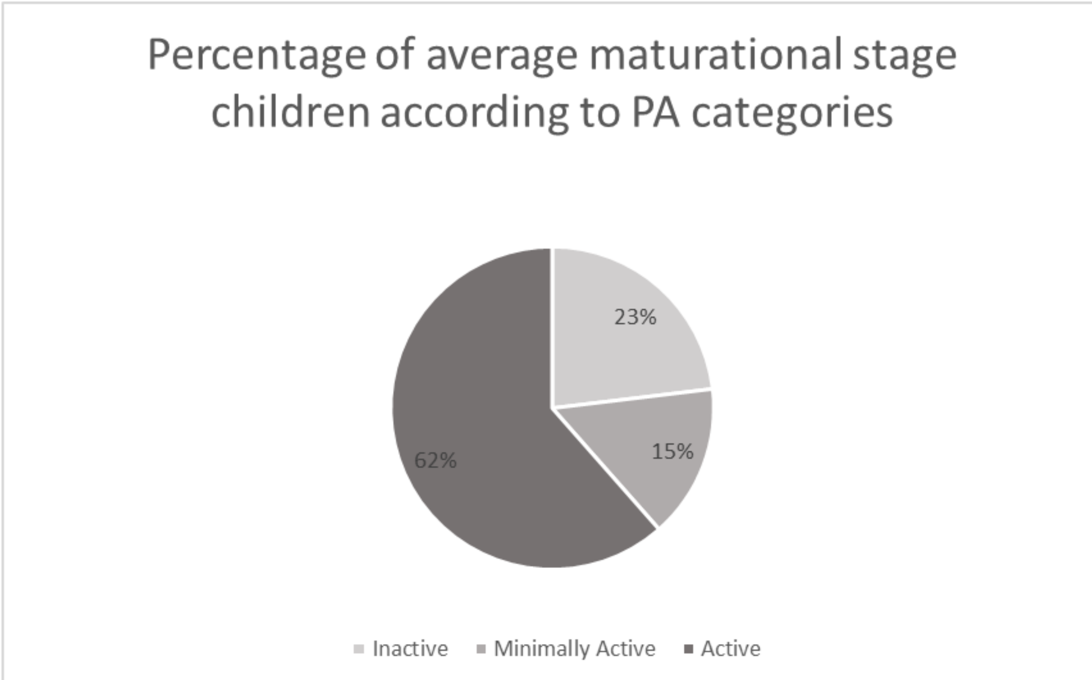

Figure 7. Percentage of average maturational stage children according to PA categories.

Appendix 9 Study 1: Focus groups 1-6 transcripts.

FOCUS GROUP 1

1. RESEARCHER: Focus group one, on the 25th November 2014. First of all, thank you very much everyone for being here. I'm going to start it off by asking why do all of you here take part in physical activity or any exercise?
2. RESPONSE 1: I do it because it's a chance to meet up with friends at the park and go running and all that.
3. RESPONSE 2: I do it for the fun and because I like doing sport
4. RESPONSE 3: I do it for the fun.
5. RESPONSE 4: I do it because I like dancing and it just makes me happy.
6. RESPONSE 5: I do it because I want to get more time to hang out with my friends.
7. RESPONSE 6: I do it because it's fun.
8. RESEARCHER: Right, and where do we tend to go to do our activity? Anyone can talk, where do we tend to like visiting?
9. RESPONSE 1: The park
10. RESPONSE 2: We go to Roman's church and we have our dance teachers there to just teach us dancing, take part in competitions.
11. RESPONSE 3: I go to the Redditch United ground to play football on Saturday and on Monday and on a Friday.
12. RESPONSE 4: I don't really go anywhere, I just like text friends and like meet up anywhere
13. RESPONSE 5: I go to the like park and friends' houses to skate and stuff.
14. RESEARCHER: Right okay, all of you have mentioned a few different venues haven't you, so some have said the church where you do your dance, you go to a local football ground, some of you tend to text your friends and you meet up and socialise together, so, why do you tend to go to these particular places? Is there any reason why you always go to your area? Is there a reason why you always go to your football club?

15. RESPONSE 1: Because you do the grades and you like learn more moves and it just makes me happy and want to do it all the time.

16. RESPONSE 2: We kind of meet up because that's where we all have our talk and mainly have our discussions and have more time there because it's the closest place for us to meet up.

17. RESPONSE 3: We go there because on our football t-shirts we have a badge, and the badge is represented by the club so we play at the club to represent Redditch.

18. RESPONSE 4: Like, it's not out of the way either, like really close so you can get to the places easily.

19. RESPONSE 5: All my friends are at the park and stuff so I can knock for them.

20. RESEARCHER: Right, okay that's interesting. What barriers do you think there are that stop students from exercising? So, is there anything which you think stops other people, perhaps yourself from getting active?

21. RESPONSE 1: Probably technology.

22. RESPONSE 2: Yeah.

23. RESPONSE 3: Yeah.

24. RESPONSE 4: Being too busy.

25. RESEARCHER: Develop your answer by all means.

26. RESPONSE 1: Maybe sometimes some of the people might have other plans and like they might have problems with their family and might have to look after their family and it might stops you having their social time with their friends and going out.

27. RESPONSE 2: If I have too much homework, exams and stuff.

28. RESPONSE 3: Unhealthy eating.

29. RESEARCHER: What did you mean by technology?

30. RESPONSE 1: Like, when you've got a phone or like a console, you don't think as much about getting active, you just want to play on them.

31. RESEARCHER: Okay, what changes would you make to improve students' opportunities to take part in physical activity? So let's pretend that you've been given one chance to get more people active, what would you do and why would you do it?

32. RESPONSE 1: I'd make it into a fun game and so they would like it more because some people don't like exercise.

33. RESPONSE 2: Yeah, I'd make it into like a fun game and whoever did the most exercise in that period of time would get a prize or something like that.

34. RESPONSE 3: I'd make them watch the dancing and if they like the dancing then they could join in.

35. RESPONSE 4: I would probably like do the same, as in like in periods of time when who does the most exercise you win a prize, so your kind of pushing the students to work for the prize.

36. RESPONSE 5: You could like, let them go on trips to like loads of different activities. Like in Malvern you do like loads of sporting activities that loads of people will enjoy.

37. RESEARCHER: Right brilliant, okay thanks very much girls, thanks for taking your time to speak to me. Thank you very much indeed.

FOCUS GROUP 2

1. RESEARCHER: Focus group 2 on 26th November 2014. First of all, thank you very much for taking part in the study guys. And the first question which I've got for everyone is the reasons why do you take part in physical activity or exercise? Anyone can start, so why do you take part?
2. RESPONSE 1: I just do it for fun and I like to be fit.
3. RESPONSE 2: To get fit and healthy.
4. RESPONSE 3: It's better than staying on the PlayStation, it's better to get outside.
5. RESPONSE 4: It's better than sitting down and watching TV.
6. RESPONSE 5: It's better than doing nothing.
7. RESPONSE 6: It's fun.
8. RESPONSE 7: It's more fun than just sitting down because it's boring and then it's why you're lazy, you just sit down. But when you're doing sport, it's just like fun and it's getting you fit.
9. RESEARCHER: Okay, brilliant, okay so where do you go to do your physical activity? Don't worry about your hands, just take it in turns. Yeah, go.
10. RESPONSE 1: My house. Just going up the stairs.
11. RESEARCHER, Okay, do you go into the garden or anything?
12. RESPONSE 1: No I just run up the stairs.
13. RESEARCHER: Right okay, anyone else?
14. RESPONSE 1: I do runs with my dad but I don't do the runs, I go on my bike and I just go sometimes to the gym with him. I do swimming and I go up to the field and play football.
15. RESEARCHER: Who was that with, your brother?
16. RESPONSE 1: No, my dad, I go to the gym with him, he does like 30 mile runs and I go on my bike because I can't keep up with him because he goes too fast.

17. RESPONSE 2: I go to the park, I ride my bike around the block and stuff like that. I go swimming and stuff like that.

18. RESEARCHER: Brilliant, yes.

19. RESPONSE 3: Erm, I go up to Trinity and sometimes Redditch United to do football because I train with them and I also go up to Worcester and I go around to different pubs to play darts as well.

20. RESPONSE 4: I play at the college car park.

21. RESPONSE 5: I go to Rugby at Redditch United on Tuesdays and Sundays.

22. RESPONSE 6: I go to Matchborough astroturf to play football.

23. RESEARCHER: Brilliant.

24. RESPONSE 7: I go to Studley to do football 3 times a week, and I go to gymnastics 3 times a week, sometimes I go swimming, I sometimes play netball with my friends and I play outside with my friends a lot.

25. RESEARCHER: Brilliant, okay so you've all said a few different venues where you go for your exercise and physical activity, why do you choose to be physically active at those venues? So why do you go there?

26. RESPONSE 1: It's something I've always wanted to do to stop staying indoors and not being lazy.

27. RESPONSE 2: It's fun.

28. RESPONSE 3: I don't really go to any specific venue, I just run and just go on my bike and stuff and play football. And I go up to the field by my house and play football sometimes.

29. RESEARCHER: Right okay.

30. RESPONSE 4: I go up to the college car park because it's big and loads of my friends just play there, we play like 60 seconds and stuff like that.

31. RESPONSE 5: I go to Matchborough astroturf because I'm part of the team.

32. RESPONSE 6: I just run up the stairs because it's fun, and tease my sister, that's funny.

33. RESPONSE 7: I go there because they're my hobbies and it's something I do all the time and I have fun at it.

34. RESPONSE 8: I go to them places because that's where the club are, it's what I do and I'm a part of that team and I know people there, so yeah.

35. RESEARCHER: Superb, okay so I want you to think about what potential barriers there are to stop students from being physically active? So what barriers do you think there are that stop yourselves, or your friends from being physically active?

36. RESPONSE 1: Playing on the Xbox, consoles, stuff like that.

37. RESPONSE 2: Home life, like if you've got a family member in hospital or anything like that or funerals and stuff like that, to go to it will stop you from doing other stuff.

38. RESPONSE 3: If you're ill, or PlayStation, Xboxes and TV, and like games consoles.

39. RESPONSE 4: Food.

40. RESEARCHER: Can you develop that answer? What do you mean?

41. RESPONSE 4: I don't know, just like chocolate, sugary food.

42. RESPONSE 5: Like people seem to love consoles and stuff and that's what stops them and they're like "mom when I get home from school can I go on my Xbox or something?" That's the only reason they like getting home. It stops them.

43. RESPONSE 6: The phones and the consoles just stop them from like going outside and just actual meeting their friends other than talking to them over the Xbox or PlayStation.

44. RESPONSE 7: Technology, because the point of technology is to provide ease to someone, and that's usually by doing some form of physical activity so they try and block that out.

45. RESPONSE 8: And the bad thing about technology is people can insult you over that so it's a bad reason.

46. RESPONSE 9: If you're really tired or the weather's bad.

47. RESEARCHER: Okay, last one, so what changes would you make to improve students' opportunities to take part in physical activity? So, if you could make any change, what would it be and why?

48. RESPONSE 1: Not always play on the Xbox because it's not healthy for your eyes and you're not going to get as much fit, you're just going to get lazy and like you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that.

49. RESPONSE 2: There's a time limit for like consoles so you're not always like look at them, because it's like you're being lazy because you're sitting down while you're doing it, not running around.

50. RESPONSE 3: I'd create like clubs or academies that you don't actually have to be good at it to go there and stay there, you can be not terrible but you don't have to be really really good at it just to be there.

51. RESPONSE 4: Destroy technology.

52. RESPONSE 5: The thing is that people need thing like that, like phones and technology and that. The gaming and YouTube would be out of jobs and stuff like that.

53. RESPONSE 6: You get like money for it and fair play to them but you just don't want to sit on there every day, hours and hours on the Xbox. But it's their lives so you can't judge their lives, but you can't make them not play on the Xbox or not play on the PlayStation or whatever you have. You can't stop them but you have glasses and it's going to like stop you seeing far and stop you getting good jobs like the police and stuff because you need good eyes and it wrecks it then.

54. RESPONSE 7: Erm, I think we should like encourage parents to like, every hour you do on physical activity and stuff like that so however long you do on a physical activity, you get half that time on technology or something like that so if you're doing something, you're getting rewarded for it.

55. RESPONSE 8: You only live once and you might as well live it to the fullest and instead of staying inside, you might as well go outside.

56. RESEARCHER: Has anyone got anything else?

57. RESPONSE 1: If you have a limit on how much junk food, like you're only allowed two junk food a week.

58. RESEARCHER: So you'd put a limit on it.

59. RESPONSE 1: You should plan playing your games consoles before you go out, have a limited time and make your parents have a limited time to play it, so you can't have all day, every day on it, and if you do go on it every day, have a certain time and then when you're finished do some exercise and get that weight off.

60. RESEARCHER: Right okay, thank you very much guys for taking part, that's brilliant.

61. RESPONSE 1: Thank you.

FOCUS GROUP 3

1. RESEARCHER: Focus group on the 2nd December 2014, first of all this is focus group 3. Thank you all for taking part in this study. And I've got a few questions and the first one for everybody is why do you take part in physical activity or exercise? Yes go for it.
2. RESPONSE 1: I want to know how I'm doing in exercise and getting fit.
3. RESPONSE 2: To keep your body healthy and strong.
4. RESPONSE 3: Because I don't want to be all weaker when I'm older, I want to stay healthy
5. RESPONSE 4: So I can do more things when I'm older with other people. And I can do races with people when I'm older.
6. RESPONSE 5: Something to do with your heart rate.
7. RESEARCHER: Okay and where do you like to go to do your physical activity or exercise?
8. RESPONSE 1: I like to jog to the park and run round onto the fields.
9. RESPONSE 2: I like to go to Arrow Valley with mum and go round or I like to go to the gym with my mum.
10. RESPONSE 3: I live next to a massive hill and I go up that hill and I race back down again when I'm riding.
11. RESEARCHER: And that's on your bike?
12. RESPONSE 1: (Nods head)
13. RESPONSE 2: I do football and swimming.
14. RESEARCHER: And where do you go?
15. RESPONSE 1: I go to the Abbey Stadium for my swimming and then I do training on a Friday, and then I do a match against another team on a Saturday.

16. RESPONSE 2: I do swimming on a Wednesday, I do tennis with my dad sometimes and then I, in the holidays I go with my dad to ride my bike around any park.
17. RESPONSE 3: I like going to the park and walking my dog around the Arrow Valley Lake.
18. RESPONSE 4: I also go swimming and dancing.
19. RESEARCHER: You've all said a few different venues haven't you, about where you like to go to do your activity, why do you choose to go to those venues. So why do you go to that particular venue?
20. RESPONSE 1: Because they're like big and wide and you've got enough room to race around with your friends and play tag which is a good game for exercise.
21. RESPONSE 2: I was going to say the same about space and it's quiet and you can do like practicing there
22. RESPONSE 3: Because where the hill is, there's like a field at the bottom so if I don't really want to do the hill anymore, I can always ride around the field.
23. RESPONSE 4: Like in the park, it's always like a free place and we can and there's a lot of space, so if you're riding a bike you can ride, maybe some fields or maybe like concrete ground or some bouncy ground you can play tennis and football and stuff.
24. RESPONSE 5: I like a place where it's quiet and not much people like the park around the back of my house.
25. RESPONSE 6: I like Arrow Valley because I can go with my friend Demi, and we go on our bikes around Arrow Valley, it's quiet sometimes and there can be loads of people.
26. RESEARCHER: Right okay, what barriers do you think there are which stop students from being physically active? So what do you think stops people from being active?
27. RESPONSE 1: Too much technology like phones because there's all these YouTube videos and stuff, or new music videos and Christmas stuff that have come in so they're all watching TV to see what they really want for Christmas.

28. RESPONSE 2: They're usually watching TV or on their tablet or at home playing games or something and not getting physically active outside, or riding their bike or something.

29. RESPONSE 3: Like in the summer, most people are on their Xboxes or PlayStations and they're not like enjoying the free weather and like they never go out or anything.

30. RESPONSE 4: Some people just can't be bothered to go out in the environment, they just want to stay in bed late and watch some TV and play with each other.

31. RESPONSE 5: Well, they like watching TV and everyday probably eating treats which can make them fat, like chocolates because it's getting near to Christmas now. People do normally get them in their stockings.

32. RESPONSE 6: It's like when you're in a relationship, you go on your phones and you can't get off it because you're waiting for them to text you back. It's really hard so you don't want to go outside.

33. RESEARCHER: Brilliant, okay, final question. What changes would you make to change students' opportunities to take part in physical activity? So what would you do to get more people active?

34. RESPONSE 1: Erm, maybe have like posters around and like maybe in schools and like outside schools as well. You could have posters to say get fit, but especially in like schools because you did this, like maybe we could have like posters for like games and stuff which we could get to do after school that will get you fit and healthy.

35. RESPONSE 2: Maybe when you're at school and it's a nice day, get some people on the field running around and playing some football or maybe if just at home play some football or some stuff like swimming.

36. RESPONSE 3: Well, say if you went to a park and there's not that many people getting active, you could go on the field and like run around, like the little kids and they could go like, if it's massive places they could do sport and stuff if it's sunny.

37. RESPONSE 4: You could like clubs and you could put posters everywhere saying there's a fair where you can sell bikes and unicycles and scooters and then you can also say new park open so people will know. And if they would like to go there it lets them get active.

38. RESPONSE 5: You could invent new bikes and stuff so make more things that people can get out on, maybe lower the price a little bit so that people don't have to wait loads to save up and then get them before they're all ran out. So just lower the price a bit so people can buy them and then just do it.

39. RESPONSE 6: You could reduce your time down on a tablet or computer so that you're not always on it and you're outside having fun.

40. RESEARCHER: Brilliant, well thank you very much indeed girls, that's all done.

FOCUS GROUP 4

1. RESEARCHER: Focus group 4 on the 3rd December 2014. First of all, thank you for taking part in the study. Going to start off with why do you take part in physical activity or exercise?
2. RESPONSE 1: Because you can keep fit and it will help you have fun whilst staying healthy.
3. RESPONSE 2: To keep fit and some sports keep you fit like football and have fun.
4. RESPONSE 3: I just enjoy doing it and like keep fit.
5. RESPONSE 4: Keep fit and exercise.
6. RESPONSE 5: Keeping myself healthy
7. RESEARCHER: Right, you've all given reasons for taking part in physical activities for example to keep fit, where do you like to go for your physical activity and exercise?
8. RESPONSE 1: Probably out, like out on an actual field, not indoors.
9. RESPONSE 2: Outside.
10. RESPONSE 3: Anywhere outside.
11. RESPONSE 4: Outside.
12. RESPONSE 5: Outside.
13. RESEARCHER: Why would you go outside?
14. RESPONSE 1: It's not just looking at the same things when you're running around.
15. RESPONSE 2: More fun.
16. RESEARCHER: Why would you go outside?
17. RESPONSE 1: You can play more games outside I think.
18. RESPONSE 2: Its better outside and you get fresh air and that a lot.
19. RESPONSE 3: Because you get fresh air outside and it's healthy for you.

20. RESPONSE 4: It's more fun outside because you can do more physical stuff than inside.

21. RESEARCHER: Right okay, I'm assuming a lot of you do different sports outside of school, so I know you mentioned you like playing football, and you play football wherever you tend to play, the different venues you tend to go and play sport at, why do you go to those venues? So for example if you play football at a certain venue, why do you always go there?

22. RESPONSE 1: That's where you play, that's the home ground or your home team. You have to go there.

23. RESPONSE 2: Or if you don't, you miss the next game.

24. RESEARCHER: Anyone else?

25. RESPONSE 1: You might go there because it might be near where you live.

26. RESEARCHER: Okay so it might be closer to home?

27. RESPONSE 1: It might be convenient like to go, it might be like yes a convenient place to go.

28. RESPONSE 2: You might have fun when you're there.

29. RESEARCHER: Yes okay, next question is what barriers are there which stop students from being physically active? So what do you think stops students from being active? Yes anyone.

30. RESPONSE 1: Technology.

31. RESEARCHER: Yes.

32. RESPONSE 1: Phones.

33. RESPONSE 2: Xboxes.

34. RESPONSE 3: TV.

35. RESPONSE 4: Lessons because you're always sitting down not doing much.

36. RESPONSE 5: TV

37. RESEARCHER: Yes develop your answers.

38. RESPONSE 1: Eating fatty foods.

39. RESPONSE 2: They might not like it, so they might not want to do it.

40. RESPONSE 3: Not exercising and getting outside.

41. RESEARCHER: Right okay, if you had an opportunity to make a change, what changes would you make to improve students' opportunities to take part in physical activity? So if you could make one change to make more people active, what would you do?

42. RESPONSE 1: More P.E lessons, like once every day.

43. RESPONSE 2. More clubs as well like at lunchtime and that.

44. RESPONSE 3: I was going to say that, do like a tally vote of their favourite, like physical stuff and then do different some clubs so they're actually be active during the day.

45. RESPONSE 4: You can ask what they like the most, and start clubs and get them to come.

46. RESPONSE 5: Not eating as many fast foods or fat foods.

47. RESEARCHER: So putting a limit?

48. RESPONSE 1: More P.E lessons, more clubs.

49. RESEARCHER: More P.E lessons, more clubs.

50. RESPONSE 1: Every day you could have a different activity to do outside.

51. RESEARCHER: Okay, anything else? Right, okay, thank you very much boys.

FOCUS GROUP 5

1. RESEARCHER: Focus group 5 on the 10th December 2014. First of all, thank you for taking part in the study. And the first question is why do you like to take part in physical activity or exercise?
2. RESPONSE 1: Because it's fun and well, because it's fun.
3. RESPONSE 2: It's fun.
4. RESPONSE 3: Because it makes you feel better.
5. RESPONSE 4: Because it's fun.
6. RESPONSE 5: Because it's fun and it's good for you.
7. RESPONSE 6: It makes you fit; it's good for your health.
8. RESPONSE 7: It's good for fun.
9. RESEARCHER: And where do you like to go to do your physical activity and exercise? So where do you tend to go inside of school or outside of school? Wherever?
10. RESPONSE 1: Abbey Stadium.
11. RESEARCHER: Do you tend to go to any other places other than the Abbey Stadium?
12. RESPONSE 1: The Dolphin Centre.
13. RESEARCHER: Have a think; is there anywhere else you might go? You don't have to whisper girls. Where do you tend to go?
14. RESPONSE 1: I just do school clubs
15. RESEARCHER: So you use school clubs to do it yes?
16. RESEARCHER: Where do you tend to go?
17. RESPONSE 1: The park.
18. RESEARCHER: Oh right okay, so the park. The Abbey Stadium, the Dolphin Centre. Do you tend to go anywhere else to do any exercise?

19. RESPONSE 1: There's like the woods down by mine and I go for a jog with my dad.
20. RESEARCHER: Okay brilliant, does anyone else go anywhere?
21. RESPONSE 1: There's trampolining at, I can't remember the school now but it's a high school.
22. RESEARCHER: Anybody else? Okay, brilliant, so you've all said that you go to different areas to be active, you do different exercises as well to be active, the next question is, why do you choose to be physically active at these venues? So why do you go to those specific places? Is there any particular reason why?
23. RESPONSE 1: Because it's fun and you want to get fit.
24. RESEARCHER: Is there any other reason why you might go there though?
25. RESPONSE 1: Because it does a lot of activities.
26. RESEARCHER: Okay, so they provide more do they? Right, is there any other reason why? What about distance or anything? Is it close?
27. RESPONSE 1: Yes.
28. RESEARCHER: Yes, we've got lots of nodding heads. Right, okay, next one for you to think about is, what barriers are there which you think stop students from being physically active? So what is there that stops people from getting active?
29. RESPONSE 1: Like if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy.
30. RESPONSE 2: People can't get there if they don't have like the right equipment to do it.
31. RESEARCHER: Yes, anything else? What else stops people from getting active?
32. RESPONSE 1: Some people might not like what the variety is.
33. RESPONSE 2: People are lazy.
34. RESEARCHER: Yes, anything else? Okay, final one, what changes would you make to improve students opportunities to take part in physical activity? So if you could make a change, what would you do and why?

35. RESPONSE 1: Like do a survey to see what they would want to do instead of like saying we're going to do hockey today because some people might not like it.

36. RESEARCHER: Anyone else, what would you do? Have a think, so you've got one chance to get people active, what would you do? And it can be anything?

37. RESPONSE 1: Like a club that's fun and active, and people would like to go to it and it's not too far.

38. RESEARCHER: Anybody else? Right okay, thank you very much indeed girls.

FOCUS GROUP 6

1. RESEARCHER: Focus group 6 on the 10th December 2014. First of all, thank you everyone for taking part. And the first question is why do you take part in physical activity or exercise?
2. RESPONSE 1: To keep ourselves fit.
3. RESPONSE 2: I think it's really fun to go out there and play loads of games.
4. RESPONSE 3: because you're keeping yourself healthy and having fun at the same time.
5. RESPONSE 4: It's a good way to have fun and if will not put on weight and be big.
6. RESEARCHER: Anyone else? Okay, so where do you like to go to do physical activity or exercise? So where do you tend to go?
7. RESPONSE 1: I like to go to this field which is right behind my house to play football, to play tig, to just play loads of games.
8. RESPONSE 2: To go round the lake.
9. RESPONSE 3: To go in the park.
10. RESPONSE 4: In the park a lot, I like playing football.
11. RESPONSE 5: To go round a cricket pitch.
12. RESPONSE 6: Going to play football.
13. RESPONSE 7: Going to a gym, like a sports hall gym.
14. RESPONSE 8: Playing football at Trinity every Wednesday.
15. RESEARCHER: Right okay, so you play every Wednesday at Trinity? Right okay, so you've all mentioned different venues where you tend to go, the park, cricket pitches, Trinity, some of you play or go around the lake to do loads of different sports, why do you tend to go there? Is there any particular reason why you go to those particular venues?
16. RESPONSE 1: Because I play basketball for Redditch.

17. RESEARCHER: Right okay, so it's to do with your sport?
18. RESPONSE 1: It's to do with the team.
19. RESEARCHER: So it's to do with the team?
20. RESPONSE 1: Yes.
21. RESEARCHER: Okay.
22. RESPONSE 2: So I can play for Headless Cross every Sunday.
23. RESEARCHER: So do the team train there?
24. RESPONSE 2: Yes.
25. RESEARCHER: Okay
26. RESPONSE 3: It's the closest open space near my close and it's right by my friends, they live there.
27. RESEARCHER: Brilliant.
28. RESPONSE 4: It's the closest thing to me.
29. RESEARCHER: Okay, yes.
30. RESPONSE 5: It's like the closest thing to me and my friends so we can meet up there.
31. RESEARCHER: Okay, so you've all mentioned where you go, and you've all explained why you go, for example your friends are close, it's close to you in terms of location. Next thing which we want to look at is what barriers are there which stop students from being physically active? So what do you think is out there which stop you or your friends from getting active?
32. RESPONSE 1: Xbox, like we always on a Wednesday, sometimes we don't go out, we just play on the Xbox together. So we normally go out but then, if it's raining and that lot, or if it's just sunny, we don't want to go out, we just play Xbox. If we didn't have an Xbox, we would probably still go out.
33. RESPONSE 2: Consoles are the most distracting thing you can have.
34. RESEACRHER: Okay, why?
35. RESPONSE 2: Because everyone plays them and it drives people wrong.

36. RESPONSE 3: TV because you can watch this programme and not get active.

37. RESEARCHER: Anything else? Okay, last thing which we're going to look at now. What changes would you make to improve students' opportunities to take part in physical activity? So if you could make one change to get more people active, what would you do, what would it be and why would you do it? So if you could get more people active, what would you do?

38. RESPONSE 1: I would try and shorten down the amount of time that people go on electronics.

39. RESPONSE 2: I would try and put a certain time limit on consoles and when they go out and play, not active.

40. RESPONSE 3: I would just unplug all electronics and if they wanted them back, they would have to work for it and do running and all that.

41. RESPONSE 4: You'd like put a word on facebook and tell people what's happening and let everyone know happening and try and bring some people down to it.

42. RESPONSE 5: I would stop people from watching the TV and playing consoles by asking them to stop.

43. RESEARCHER: Has anyone got anything else to say about it? Right, okay, thank you very much indeed boys.

Appendix 10 Study 2: Heart rate intensities according to location for combined terms, and each term.

Table 1. Mean (±SD) duration and percentage time per HR intensity at each location.

Variable	Combined terms			
	KS2		KS3	
	Male	Female	Male	Female
	n=51	*n*=33	*n*=25	*n*=42
House Sedentary (mins)	53.32 ± 71.50	96.26 ± 161.16	126.68 ± 143.53	86.38 ± 110.92
House Sedentary (%)	38.54 ± 31.86	54.36 ± 36.11	59.91 ± 33.20	42.57 ± 34.38
House light (mins)	65.00 ± 73.72	45.63 ± 65.52	68.21 ± 73.10	71.50 ± 113.20
House light (%)	47.74 ± 31.13	35.81 ± 30.38	29.57 ± 23.49	34.82 ± 30.45
House moderate (mins)	17.20 ± 31.43	8.69 ± 13.12	9.03 ± 18.77	39.36 ± 82.55
House moderate (%)	13.02 ± 18.58	8.94 ± 11.42	4.31 ± 9.00*	19.39 ± 29.66*
House vigorous (mins)	0.70 ± 1.69	0.64 ± 2.04	11.16 ± 32.93	2.25 ± 6.88

House vigorous (%)	0.70 ± 1.99	0.89 ± 2.67	6.20 ± 18.89	3.22 ± 15.78
House MVPA (mins)	17.89 ± 31.93	9.33 ± 14.02	20.19 ± 38.22	41.61 ± 86.45
House MVPA (%)	13.72 ± 19.37	9.83 ± 12.35	10.51 ± 21.23	22.61 ± 32.43
On foot sedentary (mins)	8.34 ± 13.14	10.53 ± 20.56	13.97 ± 16.19	12.49 ± 21.78
On foot Sedentary (%)	30.67 ± 31.52	37.75 ± 28.84	38.09 ± 35.68	31.65 ± 33.42
On foot light (mins)	15.29 ± 24.55	9.15 ± 20.44	11.11 ± 15.41	11.01 ± 16.80
On foot light (%)	45.82 ± 30.19	46.72 ± 25.27	32.66 ± 28.41	40.46 ± 31.08
On foot moderate (mins)	4.35 ± 8.66	3.22 ± 6.83	18.52 ± 72.08	10.36 ± 26.95
On foot moderate (%)	20.79 ± 24.42	13.89 ± 12.31	25.25 ± 29.54	23.19 ± 29.62
On foot vigorous (mins)	1.18 ± 4.45	0.58 ± 1.56	1.00 ± 1.76	6.26 ± 37.13
On foot vigorous (%)	2.73 ± 6.63	1.63 ± 2.65	4.00 ± 10.76	4.70 ± 15.87
On foot MVPA (mins)	5.10 ± 9.82	3.66 ± 7.74	19.16 ± 73.24	16.46 ± 47.54
On foot MVPA (%)	23.52 ± 25.87	15.52 ± 13.94	29.24 ± 35.33	27.88 ± 34.45

Motorised transport sed (mins)	19.23	± 52.70	39.93	± 77.89	21.75	± 60.03	21.15	± 38.40
Motorised transport sed (%)	46.18	± 35.66	52.78	± 31.15	52.22	± 35.27	42.35	± 31.98
Motorised transport light (mins)	12.46	± 20.85	15.71	± 22.91	6.49	± 8.82	12.87	± 22.89
Motorised transport light (%)	39.96	± 28.79	33.26	± 26.51	43.86	± 32.39	36.51	± 27.97
Motorised transport mod (mins)	3.43	± 6.63	20.01	± 54.60	0.59	± 1.04	10.10	± 32.05
Motorised transport mod (%)	12.88	± 18.82	13.64	± 21.75	3.59	± 6.04*	18.32	± 24.60*
Motorised transport vig (mins)	0.42	± 1.32	0.61	± 2.31	0.09	± 0.28	0.94	± 2.47
Motorised transport vig (%)	0.99	± 2.26	0.32	± 0.79	0.33	± 1.21	2.81	± 5.89
Motorised transport MVPA (mins)	3.78	± 6.99	20.54	± 56.19	0.64	± 1.13	10.86	± 32.69
Motorised transport MVPA (%)	13.86	± 19.12	13.96	± 22.14	3.92	± 7.01*	21.14	± 27.04*
School sedentary (mins)	62.52	± 71.12	73.43	± 95.88	73.32	± 88.91	48.46	± 60.99
School sedentary (%)	39.37	± 28.28	47.79	± 32.26	38.44	± 28.10	39.43	± 28.00

School light (mins)	81.19 ± 89.57	40.68 ± 70.08	71.66 ± 74.45	58.30 ± 63.67
School light (%)	46.38 ± 25.61*	32.76 ± 25.81*	39.70 ± 21.03	38.24 ± 20.25
School moderate (mins)	17.10 ± 19.27	17.73 ± 26.82	36.96 ± 59.96	32.36 ± 49.11
School moderate (%)	10.88 ± 8.89	16.06 ± 15.56	18.73 ± 18.14	18.90 ± 18.28
School vigorous (mins)	6.54 ± 14.45	2.16 ± 4.31	4.46 ± 7.25	7.71 ± 24.04
School vigorous (%)	3.37 ± 4.76	3.39 ± 9.66	3.12 ± 4.41	3.43 ± 6.12
School MVPA (mins)	22.32 ± 28.26	19.52 ± 29.78	40.41 ± 63.47	39.23 ± 65.26
School MVPA (%)	14.25 ± 11.93	19.45 ± 22.41	21.85 ± 19.94	22.33 ± 21.31
Outdoors sedentary (mins)	18.19 ± 27.02	37.18 ± 46.35	10.81 ± 17.78	22.24 ± 51.78
Outdoors sedentary (%)	35.11 ± 32.40	43.57 ± 33.82	36.31 ± 33.28	28.67 ± 29.05
Outdoors light (mins)	19.66 ± 29.05	28.67 ± 37.89	12.95 ± 21.97	29.29 ± 59.29

Outdoors light (%)	36.16	± 27.05	38.51	± 29.01	32.96	± 23.89	47.22	± 27.53
Outdoors moderate (mins)	9.33	± 16.53	6.18	± 8.71	5.02	± 7.16	6.96	± 10.71
Outdoors moderate (%)	18.59	± 20.31	12.07	± 14.37	22.42	± 21.43	21.11	± 24.52
Outdoors vigorous (mins)	4.34	± 11.87	7.11	± 29.34	3.30	± 14.14	1.03	± 2.32
Outdoors vigorous (%)	10.14	± 19.05	5.85	± 13.15	8.31	± 21.52	3.01	± 4.56
Outdoors MVPA (mins)	12.41	± 21.62	12.91	± 32.20	8.05	± 16.65	7.62	± 11.74
Outdoors MVPA (%)	28.73	± 32.54	17.92	± 22.44	30.73	± 31.47	24.12	± 27.71
Other indoor location sed (mins)	6.14	± 22.96	9.01	± 29.37	2.86	± 7.65	5.59	± 12.00
Other indoor location sed (%)	28.74	± 34.38	32.32	± 31.49	31.89	± 33.18	41.10	± 40.94
Other indoor location light (mins)	9.93	± 41.99	13.99	± 42.26	4.68	± 10.85	4.92	± 11.15
Other indoor location light (%)	49.06	± 28.59	43.81	± 28.51	61.88	± 29.74*	34.80	± 29.15*
Other indoor location mod (mins)	2.40	± 8.01	3.06	± 7.49	0.75	± 2.37	4.63	± 14.12
Other indoor location mod (%)	19.7	± 24.45	18.10	± 21.36	6.24	± 6.81	21.52	± 28.15

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Other indoor location vig (mins)	0.23 ± 0.90	1.23 ± 5.37	0.00 ± 0.00	0.50 ± 2.05
Other indoor location vig (%)	2.45 ± 6.54	5.78 ± 16.25	0.00 ± 0.00	2.59 ± 7.81
Other indoor location MVPA (mins)	2.59 ± 8.69	3.79 ± 9.35	0.75 ± 2.37	5.13 ± 14.84
Other indoor location MVPA (%)	22.21 ± 27.19	23.88 ± 28.44	6.24 ± 6.81	24.11 ± 30.80
Time Outside sedentary (mins)	26.53 ± 29.55	47.72 ± 58.43	24.78 ± 24.67	34.72 ± 60.03
Time Outside sedentary (%)	43.21 ± 34.66	49.33 ± 30.78	34.41 ± 29.83	35.56 ± 31.16
Time Outside light (mins)	26.91 ± 39.78	22.27 ± 31.44	21.13 ± 23.05	16.65 ± 18.64
Time Outside light (%)	29.08 ± 26.13	30.49 ± 25.45	30.72 ± 23.93	32.79 ± 28.43
Time Outside moderate (mins)	13.68 ± 20.48	9.40 ± 11.19	23.55 ± 73.20	17.32 ± 29.20
Time Outside moderate (%)	21.57 ± 22.69	15.12 ± 14.36	29.41 ± 27.62	26.49 ± 29.21
Time Outside vigorous (mins)	5.09 ± 12.11	7.54 ± 29.28	3.93 ± 15.27	7.14 ± 37.39
Time Outside vigorous (%)	6.14 ± 10.42	5.05 ± 11.21	5.46 ± 11.04	5.17 ± 13.33

Time Outside MVPA (mins)	35.88 ± 67.05	26.13 ± 40.09	37.09 ± 88.43	37.35 ± 68.60
Time Outside MVPA (%)	27.70 ± 28.23	20.17 ± 19.43	34.87 ± 34.82	31.65 ± 34.08
	Autumn term			
	KS2		KS3	
	Male	Female	Male	Female
	n=20	*n*=15	*n*=9	*n*=16
Home Sedentary (mins)	53.95 ± 75.29*	114.78 ± 194.79	208.26 ± 180.67*	109.96 ± 141.24
Home Sedentary (%)	38.10 ± 31.78	59.08 ± 36.20	72.96 ± 29.42*	36.49 ± 34.35*
Home light (mins)	70.19 ± 83.09	31.01 ± 32.93	65.74 ± 63.44	113.29 ± 156.06
Home light (%)	49.14 ± 33.83	30.72 ± 26.56	21.36 ± 22.18	40.30 ± 33.96
Home moderate (mins)	15.31 ± 30.92	9.62 ± 11.75	5.67 ± 8.67	47.10 ± 70.51
Home moderate (%)	12.37 ± 19.21	9.55 ± 10.28	1.77 ± 3.27	16.55 ± 26.87

Home vigorous (mins)	0.30 ± 0.90	0.97 ± 2.94	13.33 ± 40.00	1.90 ± 3.08
Home vigorous (%)	0.39 ± 1.23	0.65 ± 1.37	3.90 ± 11.70	6.66 ± 24.90
Home MVPA (mins)	15.61 ± 30.89	10.58 ± 13.56	19.00 ± 40.31	49.00 ± 70.82
Home MVPA (%)	12.76 ± 19.13	10.20 ± 10.70	5.67 ± 11.92	23.21 ± 33.56
On foot sedentary (mins)	6.50 ± 10.13	17.88 ± 28.51	20.22 ± 21.91	13.91 ± 23.74
On foot Sedentary (%)	30.23 ± 32.44	53.90 ± 29.13	33.85 ± 27.96	42.59 ± 40.78
On foot light (mins)	6.51 ± 9.94	6.58 ± 9.19	20.04 ± 20.74	7.50 ± 11.21
On foot light (%)	39.40 ± 35.24	36.90 ± 30.46	40.01 ± 24.10	33.58 ± 27.11
On foot moderate (mins)	2.33 ± 3.81	3.54 ± 8.64	7.15 ± 10.40	2.95 ± 4.04
On foot moderate (%)	25.84 ± 30.76	8.82 ± 10.29	19.62 ± 18.46	21.70 ± 27.18
On foot vigorous (mins)	1.90 ± 6.91	0.33 ± 1.05	1.44 ± 2.01	0.25 ± 0.58
On foot vigorous (%)	4.53 ± 10.25	0.39 ± 0.73	6.53 ± 16.38	2.12 ± 4.60
On foot MVPA (mins)	3.34 ± 5.06	3.70 ± 8.89	7.93 ± 10.95	3.14 ± 4.19
On foot MVPA (%)	30.3 ± 31.23	9.21 ± 10.53	26.15 ± 31.25	23.82 ± 29.77

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Motorised transport sed (mins)	35.65 ± 79.47	73.59 ± 105.08	5.33 ± 7.01	41.60 ± 50.73
Motorised transport sed (%)	44.54 ± 35.46	49.60 ± 32.64	45.24 ± 29.67	50.97 ± 29.51
Motorised transport light (mins)	19.97 ± 27.03	24.68 ± 29.05	6.41 ± 11.12	22.31 ± 33.92
Motorised transport light (%)	36.30 ± 26.61	26.12 ± 25.42	50.79 ± 27.68*	24.20 ± 16.22*
Motorised transport mod (mins)	6.82 ± 8.48*	42.17 ± 76.40	0.52 ± 0.91*	11.94 ± 22.68*
Motorised transport mod (%)	17.66 ± 21.34	23.56 ± 28.94	3.88 ± 5.56	19.13 ± 22.80
Motorised transport vig (mins)	0.83 ± 1.93	1.33 ± 3.35	0.04 ± 0.11*	2.30 ± 3.65*
Motorised transport vig (%)	1.50 ± 2.91	0.72 ± 1.08	0.09 ± 0.23	5.69 ± 7.84
Motorised transport MVPA (mins)	7.50 ± 8.59*	43.34 ± 78.62	0.53 ± 0.95*	13.85 ± 24.39*
Motorised transport MVPA (%)	19.16 ± 21.35	24.28 ± 29.36	3.97 ± 5.59	24.83 ± 27.77
School sedentary (mins)	75.60 ± 83.35	85.30 ± 125.66	119.48 ± 118.56	34.25 ± 41.17
School sedentary (%)	37.1 ± 25.54	56.60 ± 35.59	39.20 ± 28.78	33.78 ± 28.82

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School light (mins)	95.04 ± 84.95	40.23 ± 65.84	121.74 ± 92.72*	52.61 ± 68.23*
School light (%)	46.03 ± 21.33	31.62 ± 30.34	43.72 ± 22.98	33.62 ± 15.14
School moderate (mins)	25.85 ± 21.47	18.42 ± 31.09	33.74 ± 39.28	41.13 ± 60.21
School moderate (%)	13.09 ± 9.20	10.54 ± 10.18	14.43 ± 16.07	27.07 ± 21.95
School vigorous (mins)	7.94 ± 8.68	2.63 ± 6.19	4.89 ± 6.65	11.45 ± 34.46
School vigorous (%)	3.69 ± 3.28	1.25 ± 1.96	2.65 ± 4.55	5.53 ± 8.89
School MVPA (mins)	31.33 ± 24.76	20.68 ± 35.60	37.15 ± 39.33	51.55 ± 85.91
School MVPA (%)	16.78 ± 10.90	11.78 ± 11.51	17.08 ± 17.11	32.60 ± 26.86
Outdoors sedentary (mins)	34.73 ± 34.22	59.91 ± 46.15	13.41 ± 25.88	34.68 ± 46.85
Outdoors sedentary (%)	39.77 ± 31.01	46.90 ± 35.28	55.63 ± 41.45	39.59 ± 28.38
Outdoors light (mins)	30.8 ± 26.02	50.94 ± 44.65	8.33 ± 22.30*	40.21 ± 61.49*

	9			
Outdoors light (%)	38.28 ± 23.00	40.09 ± 31.73	20.14 ± 14.96	43.03 ± 23.50
Outdoors moderate (mins)	15.95 ± 22.52*	9.48 ± 11.04	2.00 ± 4.37*	8.54 ± 11.12
Outdoors moderate (%)	17.27 ± 17.93	7.88 ± 11.76	18.66 ± 32.23	15.14 ± 19.42
Outdoors vigorous (mins)	5.17 ± 10.35	14.67 ± 43.01	0.44 ± 0.90	1.42 ± 3.34
Outdoors vigorous (%)	4.68 ± 6.95	5.13 ± 13.01	5.58 ± 10.20	2.25 ± 4.38
Outdoors MVPA (mins)	18.49 ± 25.98*	23.93 ± 45.77	2.15 ± 4.66*	9.37 ± 12.39
Outdoors MVPA (%)	21.95 ± 23.26	13.01 ± 17.04	24.23 ± 42.41	17.38 ± 22.57
Other indoor location sed (mins)	6.82 ± 20.14	7.37 ± 19.32	3.11 ± 8.12	8.45 ± 16.54
Other indoor location sed (%)	29.44 ± 35.64	27.42 ± 39.93	44.19 ± 36.01	41.82 ± 44.21
Other indoor location light (mins)	4.34 ± 8.09	16.73 ± 49.98	6.48 ± 14.48	5.46 ± 11.31
Other indoor location light (%)	51.26 ± 32.08	47.63 ± 35.81	51.84 ± 29.14	26.73 ± 20.10
Other indoor location mod (mins)	1.66 ± 4.22	2.25 ± 6.44	0.67 ± 2.00	8.59 ± 20.81

Other indoor location mod (%)	19.30 ± 25.73	23.30 ± 31.92	3.97 ± 6.88	27.67 ± 33.67
Other indoor location vig (mins)	0.00 ± 0.00	0.23 ± 0.62	0.00 ± 0.00	0.75 ± 2.49
Other indoor location vig (%)	0.00 ± 0.00	1.66 ± 3.28	0.00 ± 0.00	3.78 ± 10.11
Other indoor location MVPA (mins)	1.66 ± 4.22	2.43 ± 6.97	0.67 ± 2.00	9.34 ± 21.02
Other indoor location MVPA (%)	19.30 ± 25.73	24.96 ± 32.10	3.97 ± 6.88	31.45 ± 34.37
Time Outside sedentary (mins)	41.23 ± 38.09	77.78 ± 65.49	33.63 ± 29.38*	48.58 ± 50.79*
Time Outside sedentary (%)	48.67 ± 31.98	55.74 ± 30.33	37.55 ± 28.96	54.39 ± 28.44
Time Outside light (mins)	25.03 ± 32.23	31.47 ± 34.41	25.74 ± 22.08	15.52 ± 12.63
Time Outside light (%)	21.40 ± 24.14	26.17 ± 28.91	35.75 ± 21.46	21.82 ± 13.22
Time Outside moderate (mins)	18.27 ± 23.53	13.03 ± 13.72	9.15 ± 11.83	11.49 ± 12.99
Time Outside moderate (%)	24.60 ± 25.88	12.33 ± 14.49	20.04 ± 18.23	21.03 ± 23.54
Time Outside vigorous (mins)	6.18 ± 10.68	14.82 ± 42.97	1.22 ± 1.36	1.60 ± 3.39

Time Outside vigorous (%)	5.33	±	8.20	5.76	±	14.05	6.66	±	16.32	2.75	±	4.95
Time Outside MVPA (mins)	60.08	±	97.82	38.82	±	53.52	16.67	±	17.66	24.75	±	38.13
Time Outside MVPA (%)	29.93	±	29.13	18.09	±	18.91	26.70	±	30.98	23.78	±	27.21

	Spring term											
	KS2						KS3					
	Male			Female			Male			Female		
	n=18			*n*=12			*n*=7			*n*=13		
Home Sedentary (mins)	32.10	±	48.34	69.78	±	136.15	80.31	±	74.70	52.77	±	66.18
Home Sedentary (%)	34.12	±	30.95	56.52	±	36.22	52.89	±	35.15	56.58	±	38.37
Home light (mins)	45.71	±	63.95	18.50	±	38.24	67.74	±	80.95	12.10	±	18.01
Home light (%)	47.95	±	25.79	30.79	±	29.19	35.31	±	19.82	19.14	±	22.04
Home moderate (mins)	17.00	±	31.57	3.92	±	6.92	19.81	±	32.68	29.10	±	95.88
Home moderate (%)	16.4	±	19.82	10.93	±	15.25	10.41	±	15.84	24.27	±	38.36

	8			
Home vigorous (mins)	1.18 ± 2.41	0.46 ± 0.89	2.62 ± 4.50	0.00 ± 0.00
Home vigorous (%)	1.45 ± 3.21	1.76 ± 4.38	1.39 ± 2.34	0.00 ± 0.00
Home MVPA (mins)	18.18 ± 33.05	4.38 ± 7.74	22.43 ± 37.16	29.10 ± 95.88
Home MVPA (%)	17.93 ± 22.13	12.69 ± 16.79	11.80 ± 18.17	24.27 ± 38.36
On foot sedentary (mins)	11.00 ± 14.60	3.77 ± 4.66	13.40 ± 12.20	15.97 ± 17.37
On foot Sedentary (%)	28.32 ± 25.16	26.14 ± 21.37	50.53 ± 40.12	30.81 ± 25.55
On foot light (mins)	22.52 ± 31.33	13.81 ± 32.59	4.81 ± 7.08	20.76 ± 24.78
On foot light (%)	51.30 ± 22.12	49.69 ± 19.02	14.27 ± 17.32	40.70 ± 28.09
On foot moderate (mins)	5.41 ± 7.26	3.91 ± 6.04	53.86 ± 136.34	16.79 ± 38.50
On foot moderate (%)	18.72 ± 17.99	20.64 ± 10.40	33.85 ± 40.44	19.84 ± 27.43
On foot vigorous (mins)	0.61 ± 1.14	1.08 ± 2.27	1.14 ± 2.19	19.31 ± 66.63
On foot vigorous (%)	1.65 ± 2.79	3.53 ± 3.40	1.34 ± 2.04	8.65 ± 24.93

On foot MVPA (mins)	5.90 ± 8.03	4.89 ± 8.21	54.83 ± 138.55	35.68 ± 78.62
On foot MVPA (%)	20.38 ± 19.65	24.18 ± 11.98	35.20 ± 41.85	28.49 ± 35.63
Motorised transport sed (mins)	9.62 ± 21.82	5.76 ± 5.73	13.83 ± 24.67	11.28 ± 28.70
Motorised transport sed (%)	43.14 ± 33.67	55.86 ± 27.63	52.66 ± 37.05	47.46 ± 36.28
Motorised transport light (mins)	4.62 ± 6.42	7.12 ± 10.81	7.98 ± 8.83	3.97 ± 4.90
Motorised transport light (%)	47.09 ± 28.38	37.79 ± 24.81	45.06 ± 35.64	34.38 ± 29.54
Motorised transport mod (mins)	0.43 ± 0.89	1.15 ± 2.55	0.52 ± 0.71	1.96 ± 3.70
Motorised transport mod (%)	9.61 ± 18.08	6.35 ± 9.23	2.28 ± 2.68	17.76 ± 26.68
Motorised transport vig (mins)	0.03 ± 0.12	0.00 ± 0.00	0.00 ± 0.00	0.05 ± 0.18
Motorised transport vig (%)	0.16 ± 0.49	0.00 ± 0.00	0.00 ± 0.00	0.40 ± 1.19
Motorised transport MVPA (mins)	0.44 ± 0.93	1.15 ± 2.55	0.52 ± 0.71	1.98 ± 3.71
Motorised transport MVPA (%)	9.77 ± 18.08	6.35 ± 9.23	2.28 ± 2.68	18.16 ± 26.77
School sedentary (mins)	55.81 ± 67.63	66.83 ± 66.07	37.10 ± 60.86	89.00 ± 86.59
School sedentary (%)	39.14 ± 34.11	46.29 ± 25.70	29.58 ± 30.97*	57.24 ± 21.63*

School light (mins)	72.64 ± 92.81	29.81 ± 31.42	42.79 ± 34.55	56.99 ± 63.59
School light (%)	45.32 ± 31.35	30.59 ± 21.13	48.49 ± 22.44	34.05 ± 20.85
School moderate (mins)	14.50 ± 17.37	18.44 ± 28.14	17.98 ± 22.80	11.15 ± 9.35
School moderate (%)	10.79 ± 9.56	17.25 ± 15.41	18.02 ± 14.54*	7.22 ± 4.17*
School vigorous (mins)	9.15 ± 22.23	1.93 ± 1.93	3.55 ± 5.63	1.94 ± 3.26
School vigorous (%)	4.75 ± 6.88	5.87 ± 14.65	3.91 ± 5.14	1.50 ± 2.06
School MVPA (mins)	22.77 ± 35.90	20.19 ± 29.72	20.74 ± 27.60	12.32 ± 10.09
School MVPA (%)	15.54 ± 14.61	23.12 ± 27.89	21.93 ± 17.13*	8.71 ± 5.18*
Outdoors sedentary (mins)	1.50 ± 2.67	25.25 ± 45.17	10.52 ± 13.18	27.21 ± 75.53
Outdoors sedentary (%)	16.51 ± 23.82*	47.61 ± 31.32*	40.18 ± 36.49	31.66 ± 33.49
Outdoors light (mins)	4.03 ± 5.47	12.88 ± 18.81	7.14 ± 8.86	33.15 ± 79.80
Outdoors light (%)	37.53 ± 34.50	36.80 ± 25.06	26.25 ± 23.18	39.48 ± 27.46

Outdoors moderate (mins)	4.51 ± 7.29	3.00 ± 5.14	4.81 ± 4.15	5.85 ± 11.02
Outdoors moderate (%)	28.33 ± 26.22	12.41 ± 13.45	17.77 ± 13.65	26.36 ± 30.21
Outdoors vigorous (mins)	5.47 ± 16.85	0.38 ± 0.78	10.71 ± 26.63	0.74 ± 1.52
Outdoors vigorous (%)	17.64 ± 23.66	3.19 ± 6.16	15.80 ± 35.82	2.51 ± 3.27
Outdoors MVPA (mins)	9.56 ± 20.79	3.15 ± 5.37	15.24 ± 28.88	6.35 ± 11.73
Outdoors MVPA (%)	45.97 ± 40.65	15.60 ± 18.50	33.57 ± 35.09	28.87 ± 32.02
Other indoor location sed (mins)	8.72 ± 32.61	15.20 ± 44.16	6.21 ± 10.99	6.40 ± 10.23
Other indoor location sed (%)	26.99 ± 35.49	50.50 ± 21.01	40.84 ± 34.54	46.29 ± 43.72
Other indoor location light (mins)	19.17 ± 69.12	15.22 ± 44.07	7.05 ± 12.40	4.00 ± 6.95
Other indoor location light (%)	44.52 ± 27.84	33.25 ± 11.72	51.05 ± 29.88	34.54 ± 39.00
Other indoor location mod (mins)	4.31 ± 12.60	4.21 ± 9.68	1.69 ± 3.92	3.31 ± 9.63
Other indoor location mod (%)	23.33 ± 28.17	14.72 ± 15.33	8.11 ± 7.43	16.77 ± 26.06
Other indoor location vig (mins)	0.61 ± 1.46	0.54 ± 1.72	0.00 ± 0.00	0.69 ± 2.50

Other indoor location vig (%)	5.15	±	9.37	1.52	±	2.55	0.00	±	0.00	2.39	±	6.77
Other indoor location MVPA (mins)	4.83	±	13.79	4.73	±	11.17	1.69	±	3.92	4.00	±	12.10
Other indoor location MVPA (%)	28.48	±	32.78	16.25	±	15.08	8.11	±	7.43	19.17	±	32.26
Time Outside sedentary (mins)	12.50	±	14.99	29.02	±	44.82	23.93	±	20.59	43.18	±	86.46
Time Outside sedentary (%)	28.31	±	29.35	48.54	±	33.10	47.53	±	37.05	33.74	±	28.41
Time Outside light (mins)	23.10	±	31.34	18.18	±	33.21	10.00	±	14.22	23.24	±	25.78
Time Outside light (%)	37.98	±	25.45	31.50	±	22.14	16.40	±	17.25	34.88	±	26.55
Time Outside moderate (mins)	9.92	±	10.00*	6.91	±	8.81	58.67	±	138.28*	22.64	±	39.70
Time Outside moderate (%)	25.50	±	21.72	16.78	±	12.98	32.06	±	32.45	22.99	±	26.42
Time Outside vigorous (mins)	5.96	±	17.00	1.35	±	2.31	11.69	±	28.83	19.63	±	67.13
Time Outside vigorous (%)	8.21	±	12.69	3.19	±	4.30	4.01	±	6.21	8.39	±	21.92
Time Outside MVPA (mins)	22.13	±	26.86*	15.33	±	21.61	78.00	±	164.33*	63.54	±	107.65

Time Outside MVPA (%)	33.70 ± 28.72	19.96 ± 16.07	36.07 ± 37.04	31.38 ± 34.09

	Summer term			
	KS2		KS3	
	Male	Female	Male	Female
	n=13	*n*=6	*n*=9	*n*=13
Home Sedentary (mins)	81.74 ± 86.38	102.94 ± 128.24	81.17 ± 115.23	90.96 ± 103.62
Home Sedentary (%)	43.94 ± 34.62	41.67 ± 39.28	49.15 ± 35.13	38.20 ± 29.80
Home light (mins)	83.73 ± 70.28	136.47 ± 94.42	71.04 ± 84.13	79.46 ± 82.45
Home light (%)	45.49 ± 34.47	53.51 ± 37.42	35.21 ± 27.88	41.33 ± 29.25
Home moderate (mins)	20.36 ± 34.24	15.94 ± 22.12	4.02 ± 6.19	40.10 ± 87.65
Home moderate (%)	10.24 ± 17.12	4.75 ± 6.66	2.35 ± 2.96	18.74 ± 26.41
Home vigorous (mins)	0.65 ± 1.33	0.17 ± 0.28	15.63 ± 39.32	4.92 ± 11.68

Home vigorous (%)	0.33 ± 0.64	0.07 ± 0.12	13.29 ± 31.19	1.73 ± 2.58
Home MVPA (mins)	21.01 ± 34.19	16.11 ± 22.19	19.65 ± 41.42	45.02 ± 99.08
Home MVPA (%)	10.57 ± 17.15	4.81 ± 6.69	15.64 ± 32.33	20.47 ± 27.86
On foot sedentary (mins)	7.50 ± 15.43	5.69 ± 9.13	8.16 ± 10.62	7.25 ± 23.86
On foot Sedentary (%)	34.85 ± 40.68	31.73 ± 31.47	34.05 ± 41.44	17.06 ± 28.92
On foot light (mins)	18.79 ± 27.28	6.28 ± 4.31	7.09 ± 10.11	5.60 ± 6.44
On foot light (%)	47.22 ± 33.69	55.87 ± 24.65	37.58 ± 34.80	50.06 ± 40.47
On foot moderate (mins)	6.00 ± 14.26	1.03 ± 1.27	2.42 ± 3.10	13.04 ± 29.21
On foot moderate (%)	16.30 ± 23.18	11.65 ± 14.71	25.14 ± 32.48	30.19 ± 37.60
On foot vigorous (mins)	0.85 ± 1.91	0.17 ± 0.41	0.44 ± 1.01	0.62 ± 2.22
On foot vigorous (%)	1.63 ± 2.52	0.76 ± 1.86	3.23 ± 6.97	2.69 ± 8.08
On foot MVPA (mins)	6.72 ± 16.15	1.08 ± 1.36	2.64 ± 3.39	13.65 ± 29.56
On foot MVPA (%)	17.94 ± 25.55	12.40 ± 16.27	28.37 ± 38.46	32.88 ± 41.90

Motorised transport sed (mins)	7.27 ± 12.49	24.08 ± 36.54	44.31 ± 96.82	5.85 ± 8.94
Motorised transport sed (%)	53.86 ± 41.98	54.24 ± 39.75	58.89 ± 42.75	22.87 ± 25.58
Motorised transport light (mins)	11.77 ± 20.21	10.47 ± 16.92	5.42 ± 6.95	10.15 ± 10.71
Motorised transport light (%)	39.74 ± 36.03	40.83 ± 33.38	36.07 ± 37.50	59.17 ± 30.49
Motorised transport mod (mins)	2.38 ± 5.85	2.33 ± 4.80	0.70 ± 1.41	15.96 ± 52.34
Motorised transport mod (%)	5.60 ± 9.64	4.94 ± 9.45	4.23 ± 8.46	17.53 ± 28.21
Motorised transport vig (mins)	0.35 ± 0.90	0.00 ± 0.00	0.22 ± 0.44	0.15 ± 0.38
Motorised transport vig (%)	0.81 ± 1.52	0.00 ± 0.00	0.80 ± 1.97	0.43 ± 1.12
Motorised transport MVPA (mins)	2.67 ± 6.68	2.33 ± 4.80	0.85 ± 1.57	16.08 ± 52.61
Motorised transport MVPA (%)	6.41 ± 11.14	4.94 ± 9.45	5.03 ± 10.38	17.96 ± 28.50
School sedentary (mins)	51.68 ± 55.80	56.97 ± 64.54	55.32 ± 54.53	25.42 ± 21.63
School sedentary (%)	43.66 ± 25.67	37.35 ± 39.76	45.07 ± 26.99	26.34 ± 25.36
School light (mins)	71.71 ± 96.28	63.53 ± 127.31	44.04 ± 52.22	66.60 ± 62.18

School light (%)	48.59 ± 25.80	38.44 ± 30.23	27.00 ± 11.61	46.28 ± 22.34
School moderate (mins)	7.23 ± 12.14*	14.58 ± 11.93	54.95 ± 90.35*	42.77 ± 53.98
School moderate (%)	7.04 ± 6.38**	22.16 ± 21.61**	24.88 ± 23.64	23.76 ± 18.85
School vigorous (mins)	0.77 ± 0.95	1.44 ± 1.50	4.74 ± 9.41	8.88 ± 20.57
School vigorous (%)	0.72 ± 0.73	2.05 ± 2.68	3.04 ± 4.18	3.62 ± 5.94
School MVPA (mins)	7.85 ± 12.95	15.29 ± 12.61	58.98 ± 96.07	50.97 ± 63.95
School MVPA (%)	7.76 ± 6.75	24.21 ± 24.13	27.93 ± 26.07	27.38 ± 20.47
Outdoors sedentary (mins)	15.85 ± 17.28	4.25 ± 10.17	8.44 ± 11.56	1.96 ± 5.76
Outdoors sedentary (%)	49.46 ± 35.67	18.89 ± 30.73	21.95 ± 21.94	8.13 ± 14.45
Outdoors light (mins)	24.04 ± 42.49	4.58 ± 6.53	22.09 ± 27.29	12.00 ± 20.46
Outdoors light (%)	31.08 ± 25.16	33.99 ± 31.71	46.04 ± 24.66	60.22 ± 32.15
Outdoors moderate (mins)	5.81 ± 11.79	4.31 ± 4.94	8.21 ± 10.00	6.13 ± 10.51
Outdoors moderate (%)	9.24 ± 9.92	32.33 ± 14.41	28.56 ± 21.80	26.98 ± 27.92

Outdoors vigorous (mins)	1.50 ± 1.91	1.67 ± 3.61	0.38 ± 0.61	0.85 ± 1.33
Outdoors vigorous (%)	10.22 ± 24.65	14.79 ± 23.75	3.45 ± 5.05	4.67 ± 5.65
Outdoors MVPA (mins)	7.02 ± 12.67	4.89 ± 5.84	8.36 ± 9.98	6.75 ± 11.61
Outdoors MVPA (%)	19.46 ± 29.62	47.12 ± 37.76	32.01 ± 26.02	31.65 ± 32.42
Other indoor location sed (mins)	1.54 ± 3.84	0.72 ± 1.34	0.00 ± 0.00	1.27 ± 3.65
Other indoor location sed (%)	31.76 ± 42.47	10.17 ± 15.96	0.00 ± 0.00	28.91 ± 33.72
Other indoor location light (mins)	5.73 ± 16.55	4.67 ± 5.82	1.04 ± 2.22	5.19 ± 14.68
Other indoor location light (%)	56.01 ± 31.23	55.04 ± 39.16	93.18 ± 9.64	55.48 ± 19.97
Other indoor location mod (mins)	0.88 ± 2.22	2.78 ± 5.55	0.11 ± 0.33	1.08 ± 3.30
Other indoor location mod (%)	11.31 ± 12.67	15.05 ± 11.01	6.82 ± 9.64	15.62 ± 18.09
Other indoor location vig (mins)	0.04 ± 0.14	5.08 ± 12.45	0.00 ± 0.00	0.00 ± 0.00
Other indoor location vig (%)	0.93 ± 1.60	19.74 ± 34.19	0.00 ± 0.00	0.00 ± 0.00
Other indoor location MVPA (mins)	0.90 ± 2.25	5.32 ± 11.75	0.11 ± 0.33	1.08 ± 3.30
Other indoor location MVPA (%)	12.2 ± 14.18	34.79 ± 44.82	6.82 ± 9.64	15.62 ± 18.09

	3			
Time Outside sedentary (mins)	23.35 ± 18.88	9.94 ± 12.59	16.59 ± 21.93	9.21 ± 23.93
Time Outside sedentary (%)	54.31 ± 40.49	34.64 ± 27.43	22.53 ± 23.73	13.99 ± 23.17
Time Outside light (mins)	35.06 ± 58.79	7.44 ± 5.10	25.18 ± 28.36*	11.44 ± 15.65*
Time Outside light (%)	29.27 ± 28.12	39.64 ± 22.48	35.23 ± 28.18	44.22 ± 39.52
Time Outside moderate (mins)	11.81 ± 25.87	5.33 ± 5.38	10.63 ± 9.53	19.17 ± 32.34
Time Outside moderate (%)	11.76 ± 16.46	19.36 ± 17.19	37.02 ± 32.14	37.10 ± 37.16
Time Outside vigorous (mins)	2.22 ± 3.13	1.72 ± 3.59	0.60 ± 0.74	1.46 ± 3.30
Time Outside vigorous (%)	4.67 ± 10.61	6.36 ± 12.57	5.22 ± 7.52	4.69 ± 7.38
Time Outside MVPA (mins)	17.69 ± 30.64	16.00 ± 18.79	25.70 ± 28.51	26.65 ± 39.91
Time Outside MVPA (%)	16.42 ± 24.80	25.73 ± 27.37	42.24 ± 39.14	41.79 ± 41.38

*Statistically significant (2-tailed) difference between gender within key stage (p <0.05);

**Statistically significant (2-tailed) difference between gender within key stage (p <0.01).

Appendix 11 Study 2: Terms 1-3 - Focus groups 1-6 transcripts.

AUTUMN TERM - FOCUS GROUP 1

1. RESEARCHER: Focus group one, on the 25th November 2014. First of all, thank you very much everyone for being here. I'm going to start it off by asking why do all of you here take part in physical activity or any exercise?
2. RESPONSE 1: I do it because it's a chance to meet up with friends at the park and go running and all that.
3. RESPONSE 2: I do it for the fun and because I like doing sport
4. RESPONSE 3: I do it for the fun.
5. RESPONSE 4: I do it because I like dancing and it just makes me happy.
6. RESPONSE 5: I do it because I want to get more time to hang out with my friends.
7. RESPONSE 6: I do it because it's fun.
8. RESEARCHER: Right, and where do we tend to go to do our activity? Anyone can talk, where do we tend to like visiting?
9. RESPONSE 1: The park
10. RESPONSE 2: We go to Roman's church and we have our dance teachers there to just teach us dancing, take part in competitions.
11. RESPONSE 3: I go to the Redditch United ground to play football on Saturday and on Monday and on a Friday.
12. RESPONSE 4: I don't really go anywhere, I just like text friends and like meet up anywhere
13. RESPONSE 5: I go to the like park and friends' houses to skate and stuff.
14. RESEARCHER: Right okay, all of you have mentioned a few different venues haven't you, so some have said the church where you do your dance, you go to a local football ground, some of you tend to text your friends and you meet up and socialise together, so, why do you tend to go to these particular places? Is there any reason why you always go to your area? Is there a reason why you always go to your football club?

15. RESPONSE 1: Because you do the grades and you like learn more moves and it just makes me happy and want to do it all the time.
16. RESPONSE 2: We kind of meet up because that's where we all have our talk and mainly have our discussions and have more time there because it's the closest place for us to meet up.
17. RESPONSE 3: We go there because on our football t-shirts we have a badge, and the badge is represented by the club so we play at the club to represent Redditch.
18. RESPONSE 4: Like, it's not out of the way either, like really close so you can get to the places easily.
19. RESPONSE 5: All my friends are at the park and stuff so I can knock for them.
20. RESEARCHER: Right, okay that's interesting. What barriers do you think there are that stop students from exercising? So, is there anything which you think stops other people, perhaps yourself from getting active?
21. RESPONSE 1: Probably technology.
22. RESPONSE 2: Yeah.
23. RESPONSE 3: Yeah.
24. RESPONSE 4: Being too busy.
25. RESEARCHER: Develop your answer by all means.
26. RESPONSE 1: Maybe sometimes some of the people might have other plans and like they might have problems with their family and might have to look after their family and it might stops you having their social time with their friends and going out.
27. RESPONSE 2: If I have too much homework, exams and stuff.
28. RESPONSE 3: Unhealthy eating.
29. RESEARCHER: What did you mean by technology?
30. RESPONSE 1: Like, when you've got a phone or like a console, you don't think as much about getting active, you just want to play on them.

31. RESEARCHER: Okay, what changes would you make to improve students' opportunities to take part in physical activity? So let's pretend that you've been given one chance to get more people active, what would you do and why would you do it?

32. RESPONSE 1: I'd make it into a fun game and so they would like it more because some people don't like exercise.

33. RESPONSE 2: Yeah, I'd make it into like a fun game and whoever did the most exercise in that period of time would get a prize or something like that.

34. RESPONSE 3: I'd make them watch the dancing and if they like the dancing then they could join in.

35. RESPONSE 4: I would probably like do the same, as in like in periods of time when who does the most exercise you win a prize, so your kind of pushing the students to work for the prize.

36. RESPONSE 5: You could like, let them go on trips to like loads of different activities. Like in Malvern you do like loads of sporting activities that loads of people will enjoy.

37. RESEARCHER: Right brilliant, okay thanks very much girls, thanks for taking your time to speak to me. Thank you very much indeed.

AUTUMN TERM - FOCUS GROUP 2

1. RESEARCHER: Focus group 2 on 26th November 2014. First of all, thank you very much for taking part in the study guys. And the first question which I've got for everyone is the reasons why do you take part in physical activity or exercise? Anyone can start, so why do you take part?
2. RESPONSE 1: I just do it for fun and I like to be fit.
3. RESPONSE 2: To get fit and healthy.
4. RESPONSE 3: It's better than staying on the PlayStation, it's better to get outside.
5. RESPONSE 4: It's better than sitting down and watching TV.
6. RESPONSE 5: It's better than doing nothing.
7. RESPONSE 6: It's fun.
8. RESPONSE 7: It's more fun than just sitting down because it's boring and then it's why you're lazy, you just sit down. But when you're doing sport, it's just like fun and it's getting you fit.
9. RESEARCHER: Okay, brilliant, okay so where do you go to do your physical activity? Don't worry about your hands, just take it in turns. Yeah, go.
10. RESPONSE 1: My house. Just going up the stairs.
11. RESEARCHER, Okay, do you go into the garden or anything?
12. RESPONSE 1: No I just run up the stairs.
13. RESEARCHER: Right okay, anyone else?
14. RESPONSE 1: I do runs with my dad but I don't do the runs, I go on my bike and I just go sometimes to the gym with him. I do swimming and I go up to the field and play football.
15. RESEARCHER: Who was that with, your brother?
16. RESPONSE 1: No, my dad, I go to the gym with him, he does like 30 mile runs and I go on my bike because I can't keep up with him because he goes too fast.

17. RESPONSE 2: I go to the park, I ride my bike around the block and stuff like that. I go swimming and stuff like that.

18. RESEARCHER: Brilliant, yes.

19. RESPONSE 3: Erm, I go up to Trinity and sometimes Redditch United to do football because I train with them and I also go up to Worcester and I go around to different pubs to play darts as well.

20. RESPONSE 4: I play at the college car park.

21. RESPONSE 5: I go to Rugby at Redditch United on Tuesdays and Sundays.

22. RESPONSE 6: I go to Matchborough astroturf to play football.

23. RESEARCHER: Brilliant.

24. RESPONSE 7: I go to Studley to do football 3 times a week, and I go to gymnastics 3 times a week, sometimes I go swimming, I sometimes play netball with my friends and I play outside with my friends a lot.

25. RESEARCHER: Brilliant, okay so you've all said a few different venues where you go for your exercise and physical activity, why do you choose to be physically active at those venues? So why do you go there?

26. RESPONSE 1: It's something I've always wanted to do to stop staying indoors and not being lazy.

27. RESPONSE 2: It's fun.

28. RESPONSE 3: I don't really go to any specific venue, I just run and just go on my bike and stuff and play football. And I go up to the field by my house and play football sometimes.

29. RESEARCHER: Right okay.

30. RESPONSE 4: I go up to the college car park because it's big and loads of my friends just play there, we play like 60 seconds and stuff like that.

31. RESPONSE 5: I go to Matchborough astroturf because I'm part of the team.

32. RESPONSE 6: I just run up the stairs because it's fun, and tease my sister, that's funny.

33. RESPONSE 7: I go there because they're my hobbies and it's something I do all the time and I have fun at it.

34. RESPONSE 8: I go to them places because that's where the club are, it's what I do and I'm a part of that team and I know people there, so yeah.

35. RESEARCHER: Superb, okay so I want you to think about what potential barriers there are to stop students from being physically active? So what barriers do you think there are that stop yourselves, or your friends from being physically active?

36. RESPONSE 1: Playing on the Xbox, consoles, stuff like that.

37. RESPONSE 2: Home life, like if you've got a family member in hospital or anything like that or funerals and stuff like that, to go to it will stop you from doing other stuff.

38. RESPONSE 3: If you're ill, or PlayStation, Xboxes and TV, and like games consoles.

39. RESPONSE 4: Food.

40. RESEARCHER: Can you develop that answer? What do you mean?

41. RESPONSE 4: I don't know, just like chocolate, sugary food.

42. RESPONSE 5: Like people seem to love consoles and stuff and that's what stops them and they're like "mom when I get home from school can I go on my Xbox or something?" That's the only reason they like getting home. It stops them.

43. RESPONSE 6: The phones and the consoles just stop them from like going outside and just actual meeting their friends other than talking to them over the Xbox or PlayStation.

44. RESPONSE 7: Technology, because the point of technology is to provide ease to someone, and that's usually by doing some form of physical activity so they try and block that out.

45. RESPONSE 8: And the bad thing about technology is people can insult you over that so it's a bad reason.

46. RESPONSE 9: If you're really tired or the weather's bad.

47. RESEARCHER: Okay, last one, so what changes would you make to improve students' opportunities to take part in physical activity? So, if you could make any change, what would it be and why?

48. RESPONSE 1: Not always play on the Xbox because it's not healthy for your eyes and you're not going to get as much fit, you're just going to get lazy and like you need the activity, the exercise and the nice fresh air, instead of being stuck indoors, stuff like that.

49. RESPONSE 2: There's a time limit for like consoles so you're not always like look at them, because it's like you're being lazy because you're sitting down while you're doing it, not running around.

50. RESPONSE 3: I'd create like clubs or academies that you don't actually have to be good at it to go there and stay there, you can be not terrible but you don't have to be really really good at it just to be there.

51. RESPONSE 4: Destroy technology.

52. RESPONSE 5: The thing is that people need thing like that, like phones and technology and that. The gaming and YouTube would be out of jobs and stuff like that.

53. RESPONSE 6: You get like money for it and fair play to them but you just don't want to sit on there every day, hours and hours on the Xbox. But it's their lives so you can't judge their lives, but you can't make them not play on the Xbox or not play on the PlayStation or whatever you have. You can't stop them but you have glasses and it's going to like stop you seeing far and stop you getting good jobs like the police and stuff because you need good eyes and it wrecks it then.

54. RESPONSE 7: Erm, I think we should like encourage parents to like, every hour you do on physical activity and stuff like that so however long you do on a physical activity, you get half that time on technology or something like that so if you're doing something, you're getting rewarded for it.

55. RESPONSE 8: You only live once and you might as well live it to the fullest and instead of staying inside, you might as well go outside.

56. RESEARCHER: Has anyone got anything else?

57. RESPONSE 1: If you have a limit on how much junk food, like you're only allowed two junk food a week.

58. RESEARCHER: So you'd put a limit on it.

59. RESPONSE 1: You should plan playing your games consoles before you go out, have a limited time and make your parents have a limited time to play it, so you can't have all day, every day on it, and if you do go on it every day, have a certain time and then when you're finished do some exercise and get that weight off.

60. RESEARCHER: Right okay, thank you very much guys for taking part, that's brilliant.

61. RESPONSE 1: Thank you.

AUTUMN TERM - FOCUS GROUP 3

1. RESEARCHER: Focus group on the 2nd December 2014, first of all this is focus group 3. Thank you all for taking part in this study. And I've got a few questions and the first one for everybody is why do you take part in physical activity or exercise? Yes go for it.
2. RESPONSE 1: I want to know how I'm doing in exercise and getting fit.
3. RESPONSE 2: To keep your body healthy and strong.
4. RESPONSE 3: Because I don't want to be all weaker when I'm older, I want to stay healthy
5. RESPONSE 4: So I can do more things when I'm older with other people. And I can do races with people when I'm older.
6. RESPONSE 5: Something to do with your heart rate.
7. RESEARCHER: Okay and where do you like to go to do your physical activity or exercise?
8. RESPONSE 1: I like to jog to the park and run round onto the fields.
9. RESPONSE 2: I like to go to Arrow Valley with mum and go round or I like to go to the gym with my mum.
10. RESPONSE 3: I live next to a massive hill and I go up that hill and I race back down again when I'm riding.
11. RESEARCHER: And that's on your bike?
12. RESPONSE 1: (Nods head)
13. RESPONSE 2: I do football and swimming.
14. RESEARCHER: And where do you go?
15. RESPONSE 1: I go to the Abbey Stadium for my swimming and then I do training on a Friday, and then I do a match against another team on a Saturday.

16. RESPONSE 2: I do swimming on a Wednesday, I do tennis with my dad sometimes and then I, in the holidays I go with my dad to ride my bike around any park.

17. RESPONSE 3: I like going to the park and walking my dog around the Arrow Valley Lake.

18. RESPONSE 4: I also go swimming and dancing.

19. RESEARCHER: You've all said a few different venues haven't you, about where you like to go to do your activity, why do you choose to go to those venues. So why do you go to that particular venue?

20. RESPONSE 1: Because they're like big and wide and you've got enough room to race around with your friends and play tag which is a good game for exercise.

21. RESPONSE 2: I was going to say the same about space and it's quiet and you can do like practicing there

22. RESPONSE 3: Because where the hill is, there's like a field at the bottom so if I don't really want to do the hill anymore, I can always ride around the field.

23. RESPONSE 4: Like in the park, it's always like a free place and we can and there's a lot of space, so if you're riding a bike you can ride, maybe some fields or maybe like concrete ground or some bouncy ground you can play tennis and football and stuff.

24. RESPONSE 5: I like a place where it's quiet and not much people like the park around the back of my house.

25. RESPONSE 6: I like Arrow Valley because I can go with my friend Demi, and we go on our bikes around Arrow Valley, it's quiet sometimes and there can be loads of people.

26. RESEARCHER: Right okay, what barriers do you think there are which stop students from being physically active? So what do you think stops people from being active?

27. RESPONSE 1: Too much technology like phones because there's all these YouTube videos and stuff, or new music videos and Christmas stuff that have come in so they're all watching TV to see what they really want for Christmas.

28. RESPONSE 2: They're usually watching TV or on their tablet or at home playing games or something and not getting physically active outside, or riding their bike or something.

29. RESPONSE 3: Like in the summer, most people are on their Xboxes or PlayStations and they're not like enjoying the free weather and like they never go out or anything.

30. RESPONSE 4: Some people just can't be bothered to go out in the environment, they just want to stay in bed late and watch some TV and play with each other.

31. RESPONSE 5: Well, they like watching TV and everyday probably eating treats which can make them fat, like chocolates because it's getting near to Christmas now. People do normally get them in their stockings.

32. RESPONSE 6: It's like when you're in a relationship, you go on your phones and you can't get off it because you're waiting for them to text you back. It's really hard so you don't want to go outside.

33. RESEARCHER: Brilliant, okay, final question. What changes would you make to change students' opportunities to take part in physical activity? So what would you do to get more people active?

34. RESPONSE 1: Erm, maybe have like posters around and like maybe in schools and like outside schools as well. You could have posters to say get fit, but especially in like schools because you did this, like maybe we could have like posters for like games and stuff which we could get to do after school that will get you fit and healthy.

35. RESPONSE 2: Maybe when you're at school and it's a nice day, get some people on the field running around and playing some football or maybe if just at home play some football or some stuff like swimming.

36. RESPONSE 3: Well, say if you went to a park and there's not that many people getting active, you could go on the field and like run around, like the little kids and they could go like, if it's massive places they could do sport and stuff if it's sunny.

37. RESPONSE 4: You could like clubs and you could put posters everywhere saying there's a fair where you can sell bikes and unicycles and scooters and then you can also say new park open so people will know. And if they would like to go there it lets them get active.

38. RESPONSE 5: You could invent new bikes and stuff so make more things that people can get out on, maybe lower the price a little bit so that people don't have to wait loads to save up and then get them before they're all ran out. So just lower the price a bit so people can buy them and then just do it.

39. RESPONSE 6: You could reduce your time down on a tablet or computer so that you're not always on it and you're outside having fun.

40. RESEARCHER: Brilliant, well thank you very much indeed girls, that's all done.

AUTUMN TERM - FOCUS GROUP 4

1. RESEARCHER: Focus group 4 on the 3rd December 2014. First of all, thank you for taking part in the study. Going to start off with why do you take part in physical activity or exercise?
2. RESPONSE 1: Because you can keep fit and it will help you have fun whilst staying healthy.
3. RESPONSE 2: To keep fit and some sports keep you fit like football and have fun.
4. RESPONSE 3: I just enjoy doing it and like keep fit.
5. RESPONSE 4: Keep fit and exercise.
6. RESPONSE 5: Keeping myself healthy
7. RESEARCHER: Right, you've all given reasons for taking part in physical activities for example to keep fit, where do you like to go for your physical activity and exercise?
8. RESPONSE 1: Probably out, like out on an actual field, not indoors.
9. RESPONSE 2: Outside.
10. RESPONSE 3: Anywhere outside.
11. RESPONSE 4: Outside.
12. RESPONSE 5: Outside.
13. RESEARCHER: Why would you go outside?
14. RESPONSE 1: It's not just looking at the same things when you're running around.
15. RESPONSE 2: More fun.
16. RESEARCHER: Why would you go outside?
17. RESPONSE 1: You can play more games outside I think.
18. RESPONSE 2: Its better outside and you get fresh air and that a lot.
19. RESPONSE 3: Because you get fresh air outside and it's healthy for you.

20. RESPONSE 4: It's more fun outside because you can do more physical stuff than inside.

21. RESEARCHER: Right okay, I'm assuming a lot of you do different sports outside of school, so I know you mentioned you like playing football, and you play football wherever you tend to play, the different venues you tend to go and play sport at, why do you go to those venues? So for example if you play football at a certain venue, why do you always go there?

22. RESPONSE 1: That's where you play, that's the home ground or your home team. You have to go there.

23. RESPONSE 2: Or if you don't, you miss the next game.

24. RESEARCHER: Anyone else?

25. RESPONSE 1: You might go there because it might be near where you live.

26. RESEARCHER: Okay so it might be closer to home?

27. RESPONSE 1: It might be convenient like to go, it might be like yes a convenient place to go.

28. RESPONSE 2: You might have fun when you're there.

29. RESEARCHER: Yes okay, next question is what barriers are there which stop students from being physically active? So what do you think stops students from being active? Yes anyone.

30. RESPONSE 1: Technology.

31. RESEARCHER: Yes.

32. RESPONSE 1: Phones.

33. RESPONSE 2: Xboxes.

34. RESPONSE 3: TV.

35. RESPONSE 4: Lessons because you're always sitting down not doing much.

36. RESPONSE 5: TV

37. RESEARCHER: Yes develop your answers.

38. RESPONSE 1: Eating fatty foods.

39. RESPONSE 2: They might not like it, so they might not want to do it.

40. RESPONSE 3: Not exercising and getting outside.

41. RESEARCHER: Right okay, if you had an opportunity to make a change, what changes would you make to improve students' opportunities to take part in physical activity? So if you could make one change to make more people active, what would you do?

42. RESPONSE 1: More P.E lessons, like once every day.

43. RESPONSE 2. More clubs as well like at lunchtime and that.

44. RESPONSE 3: I was going to say that, do like a tally vote of their favourite, like physical stuff and then do different some clubs so they're actually be active during the day.

45. RESPONSE 4: You can ask what they like the most, and start clubs and get them to come.

46. RESPONSE 5: Not eating as many fast foods or fat foods.

47. RESEARCHER: So putting a limit?

48. RESPONSE 1: More P.E lessons, more clubs.

49. RESEARCHER: More P.E lessons, more clubs.

50. RESPONSE 1: Every day you could have a different activity to do outside.

51. RESEARCHER: Okay, anything else? Right, okay, thank you very much boys.

AUTUMN TERM - FOCUS GROUP 5

1. RESEARCHER: Focus group 5 on the 10th December 2014. First of all, thank you for taking part in the study. And the first question is why do you like to take part in physical activity or exercise?
2. RESPONSE 1: Because it's fun and well, because it's fun.
3. RESPONSE 2: It's fun.
4. RESPONSE 3: Because it makes you feel better.
5. RESPONSE 4: Because it's fun.
6. RESPONSE 5: Because it's fun and it's good for you.
7. RESPONSE 6: It makes you fit; it's good for your health.
8. RESPONSE 7: It's good for fun.
9. RESEARCHER: And where do you like to go to do your physical activity and exercise? So where do you tend to go inside of school or outside of school? Wherever?
10. RESPONSE 1: Abbey Stadium.
11. RESEARCHER: Do you tend to go to any other places other than the Abbey Stadium?
12. RESPONSE 1: The Dolphin Centre.
13. RESEARCHER: Have a think; is there anywhere else you might go? You don't have to whisper girls. Where do you tend to go?
14. RESPONSE 1: I just do school clubs
15. RESEARCHER: So you use school clubs to do it yes?
16. RESEARCHER: Where do you tend to go?
17. RESPONSE 1: The park.
18. RESEARCHER: Oh right okay, so the park. The Abbey Stadium, the Dolphin Centre. Do you tend to go anywhere else to do any exercise?

19. RESPONSE 1: There's like the woods down by mine and I go for a jog with my dad.

20. RESEARCHER: Okay brilliant, does anyone else go anywhere?

21. RESPONSE 1: There's trampolining at, I can't remember the school now but it's a high school.

22. RESEARCHER: Anybody else? Okay, brilliant, so you've all said that you go to different areas to be active, you do different exercises as well to be active, the next question is, why do you choose to be physically active at these venues? So why do you go to those specific places? Is there any particular reason why?

23. RESPONSE 1: Because it's fun and you want to get fit.

24. RESEARCHER: Is there any other reason why you might go there though?

25. RESPONSE 1: Because it does a lot of activities.

26. RESEARCHER: Okay, so they provide more do they? Right, is there any other reason why? What about distance or anything? Is it close?

27. RESPONSE 1: Yes.

28. RESEARCHER: Yes, we've got lots of nodding heads. Right, okay, next one for you to think about is, what barriers are there which you think stop students from being physically active? So what is there that stops people from getting active?

29. RESPONSE 1: Like if it's in the winter, some people don't have motivation because it's quite cold and dark, and if it's muddy.

30. RESPONSE 2: People can't get there if they don't have like the right equipment to do it.

31. RESEARCHER: Yes, anything else? What else stops people from getting active?

32. RESPONSE 1: Some people might not like what the variety is.

33. RESPONSE 2: People are lazy.

34. RESEARCHER: Yes, anything else? Okay, final one, what changes would you make to improve students opportunities to take part in physical activity? So if you could make a change, what would you do and why?

35. RESPONSE 1: Like do a survey to see what they would want to do instead of like saying we're going to do hockey today because some people might not like it.

36. RESEARCHER: Anyone else, what would you do? Have a think, so you've got one chance to get people active, what would you do? And it can be anything?

37. RESPONSE 1: Like a club that's fun and active, and people would like to go to it and it's not too far.

38. RESEARCHER: Anybody else? Right okay, thank you very much indeed girls.

AUTUMN TERM - FOCUS GROUP 6

1. RESEARCHER: Focus group 6 on the 10th December 2014. First of all, thank you everyone for taking part. And the first question is why do you take part in physical activity or exercise?
2. RESPONSE 1: To keep ourselves fit.
3. RESPONSE 2: I think it's really fun to go out there and play loads of games.
4. RESPONSE 3: because you're keeping yourself healthy and having fun at the same time.
5. RESPONSE 4: It's a good way to have fun and if will not put on weight and be big.
6. RESEARCHER: Anyone else? Okay, so where do you like to go to do physical activity or exercise? So where do you tend to go?
7. RESPONSE 1: I like to go to this field which is right behind my house to play football, to play tig, to just play loads of games.
8. RESPONSE 2: To go round the lake.
9. RESPONSE 3: To go in the park.
10. RESPONSE 4: In the park a lot, I like playing football.
11. RESPONSE 5: To go round a cricket pitch.
12. RESPONSE 6: Going to play football.
13. RESPONSE 7: Going to a gym, like a sports hall gym.
14. RESPONSE 8: Playing football at Trinity every Wednesday.
15. RESEARCHER: Right okay, so you play every Wednesday at Trinity? Right okay, so you've all mentioned different venues where you tend to go, the park, cricket pitches, Trinity, some of you play or go around the lake to do loads of different sports, why do you tend to go there? Is there any particular reason why you go to those particular venues?
16. RESPONSE 1: Because I play basketball for Redditch.
17. RESEARCHER: Right okay, so it's to do with your sport?

18. RESPONSE 1: It's to do with the team.
19. RESEARCHER: So it's to do with the team?
20. RESPONSE 1: Yes.
21. RESEARCHER: Okay.
22. RESPONSE 2: So I can play for Headless Cross every Sunday.
23. RESEARCHER: So do the team train there?
24. RESPONSE 2: Yes.
25. RESEARCHER: Okay
26. RESPONSE 3: It's the closest open space near my close and it's right by my friends, they live there.
27. RESEARCHER: Brilliant.
28. RESPONSE 4: It's the closest thing to me.
29. RESEARCHER: Okay, yes.
30. RESPONSE 5: It's like the closest thing to me and my friends so we can meet up there.
31. RESEARCHER: Okay, so you've all mentioned where you go, and you've all explained why you go, for example your friends are close, it's close to you in terms of location. Next thing which we want to look at is what barriers are there which stop students from being physically active? So what do you think is out there which stop you or your friends from getting active?
32. RESPONSE 1: Xbox, like we always on a Wednesday, sometimes we don't go out, we just play on the Xbox together. So we normally go out but then, if it's raining and that lot, or if it's just sunny, we don't want to go out, we just play Xbox. If we didn't have an Xbox, we would probably still go out.
33. RESPONSE 2: Consoles are the most distracting thing you can have.
34. RESEACRHER: Okay, why?
35. RESPONSE 2: Because everyone plays them and it drives people wrong.
36. RESPONSE 3: TV because you can watch this programme and not get active.

37. RESEARCHER: Anything else? Okay, last thing which we're going to look at now. What changes would you make to improve students' opportunities to take part in physical activity? So if you could make one change to get more people active, what would you do, what would it be and why would you do it? So if you could get more people active, what would you do?

38. RESPONSE 1: I would try and shorten down the amount of time that people go on electronics.

39. RESPONSE 2: I would try and put a certain time limit on consoles and when they go out and play, not active.

40. RESPONSE 3: I would just unplug all electronics and if they wanted them back, they would have to work for it and do running and all that.

41. RESPONSE 4: You'd like put a word on facebook and tell people what's happening and let everyone know happening and try and bring some people down to it.

42. RESPONSE 5: I would stop people from watching the TV and playing consoles by asking them to stop.

43. RESEARCHER: Has anyone got anything else to say about it? Right, okay, thank you very much indeed boys.

SPRING TERM - FOCUS GROUP 1

1. RESEARCHER: Focus group one, on the third of March 2015. First of all thank you for taking part in the study. Simple question to start off with, so why do you take part in physical activity? And anyone can start that.
2. RESPONSE 1: It's fun.
3. RESPONSE 2: Keep fit and healthy.
4. RESEARCHER: It's fun, keeps you fit and healthy.
5. RESP0ONSE 3: It takes your mind off the food, if you're like obsessed with food.
6. RESEARCHER: Okay.
7. RESPONSE 4: Stay active.
8. RESEACHER: Any other reasons? Why do you do it?
9. RESPONSE 5: It's just fun so for enjoyment.
10. RESPONSE 6: I like getting stuck into the rugby because you get to hurt people.
11. RESPONSE 7: Learning new skills.
12. RESEARCHER: Yes.
13. RESPONSE 8: Working as a team.
14. RESPONSE 9: You have to, because say for example your family is falling off a bridge, you have to run therefore doing physical activity, save them and then run back.
15. RESEARCHER: Okay, alright.
16. RESPONSE 10: Or you could just get a car?
17. RESPONSE 11: But that's the whole point of physical activity isn't it.
18. RESEARCHER: Where do you go to do physical activity?
19. RESPONSE 1: Redditch, Redditch football club.
20. RESPONSE 2: Trinity.

21. RESPONSE 3: The park.

22. RESPONSE 4: School.

23. RESPONSE 5: School.

24. RESPONSE 6: Matchborough astro turf.

25. RESEARCHER: Okay so you go to an astro turf to do your physical activities.

26. RESPONSE 7: I go to Worcester.

27. RESPONSE 8: Studley 3G.

28. RESPONSE 9: Trinity is indoor and their astro.

29. RESEARCHER: Okay, where else will you go?

30. RESPONSE 10: Arrow Valley lake.

31. RESEARCHER: Okay.

32. RESPONSE 11. Sometimes at home, if you run in the house.

33. RESPONSE 12: But what if you break something?

34. RESPONSE 13: Yes but if you let's say, at home you do running or something, in the house.

35. RESPONSE 14: You'd fall over.

36. RESPONSE 15: Not always, you wouldn't fall over always.

37. RESPONSE 16: You'd fall over your settee or gym.

38. RESPONSE 17: Well don't go near the settee then.

39. RESEARCHER: Well some of you said you like to go to a few different venues, who do you go with? Do you go by yourself or do you go with?

40. RESPONSE 1: Mates.

41. RESPONSE 2: Team mates.

42. RESPONSE 3: I go with my dad.

43. RESPONSE 4: Team mates.

44. RESPONSE 5: Team mates.

45. RESPONSE 6: Team mates.

46. RESPONSE 7: Mates and friends.

47. RESPONSE 8: My own friends.

48. RESPONSE 9: Team mates and mates yes.

49. RESEARCHER: Okay so some of you have said that you go to the 3G or you go to the park, some of you like to go around the lake, why do you go to those venues?

50. RESPONSE 1: Because there's a lot of people there and they'll be like "oh do you want to play a round of rugby or something or football, and they'll be like oh yes well I don't really play that much and then you would tackle them like really really really really really cool".

51. RESPONSE 2: Because they're your team and it's the usual place to go and that's where your team plays.

52. RESPONSE 3: They have better facilities.

53. RESEARCHER: Okay, right now, obviously this is the second time you've used the GPS stuff okay, so have you visited any other location for physical activity since the last time you wore the GPS stuff? And if so, if so, what has caused you to go there? So it's the second time you've done this, have you visited a different locations?

54. RESPONSE 1: The motivation.

55. RESPONSE 2: Walking my dogs.

56. RESPONSE 3: I go shopping.

57. RESPONSE 4: I go around Arrow Valley lake and also there's a field by a skate park.

58. RESEARCHER: Now did you visit that before Christmas, before you wore the GPS or have you just visited it like after Christmas?

59. RESPONSE 1: After Christmas.

60. RESEACRHER: And why have you chosen to visit that location after Christmas and not before, what has changed?
61. RESPONSE 2: I'm walking my dog more.
62. RESEARCHER: Okay, so you're walking your dog more. Has anyone else visited different locations?
63. RESPONSE 1: Yes, me.
64. RESEARCHER, Okay and where have you gone?
65. RESPONSE 1: I've went to, it's up in Birmingham and it's sort like a massive massive field, I went there I think a couple of weeks ago, I went there to this football pitch thing, just everywhere basically.
66. RESEARCHER: And you went there after Christmas didn't you? You never went there before Christmas?
67. RESPONSE 1: Yes.
68. RESEARCHER: So what has changed? Why have you gone there now and why did you never go there before?
69. RESPONSE 1: Because the watch motivated me.
70. RESEARCHER: Okay.
71. RESPONSE 2: I've been to Birmingham.
72. RESEACRHER: Okay.
73. RESPONSE 2: To see Aston Villa play.
74. RESEARCHER: Right okay, and did you go before Christmas?
75. RESPONSE 2: Yes.
76. RESEARCHER: You did, you went before Christmas as well. Okay.
77. RESPONSE 3: I went to Birmingham.
78. RESEARCHER: For physical activity?
79. RESPONSE 3: No, because if I didn't go my parents would shout at me.

80. RESEARCHER: Well, we're looking at physical activity, I'm looking at your physical activity so where have we gone to be more physically active? Now you've worn the equipment, you might think, have I been anywhere different to be physically active?
81. RESPONSE 1: My family went around the Lickey Hills.
82. RESEACRHER: Okay and you never went before Christmas? So you've gone just after Christmas?
83. RESPONSE 1: No, we've only just gone.
84. RESEARCHER: Okay. So are there any other changes now that you can think of which would improve your physical activity?
85. RESPONSE 1: That belt thing, I want to get rid of that belt. It's uncomfortable and you know.
86. RESPONSE 2: In the morning when you put it on, it's really cold.
87. RESPONSE 3: It doesn't pick it up as well sometimes.
88. RESPONSE 4: Yes you have got to keep it nice and tight.
89. RESPONSE 5: It all depends on which side you have it on.
90. RESPONSE 6: No you have got to have it directly here and then it starts and you can't breathe, and it hurts when you eat as well because it's so tight on you.
91. RESPONSE 7: I want to go outside more and play for the team more and wear the GPS more.
92. RESEARCHER: Are there any other changes which you'd make, even if it was as a school?
93. RESPONSE 1: Make the watch heavier, no not heavier less heavier because you know trying to write, it's like a cement brick.
94. RESPONSE 2: Get the school more active and more sporty and more sports clubs after school because there's more like art, DT and we need some more sports ones.
95. RESPONSE 3: Not just like one sports club, when you have rugby for P.E, have like other clubs like football club and rugby club.

96. RESPONSE 3: Even though football has finished, still have it on.

97. RESPONSE 4: How the school has just the one team that goes away, like good athletes, they should do less.

98. RESEARCHER: Like another team you mean?

99. RESPONSE 4: Like less skills.

100. RESEARCHER: Right okay.

101. RESPONSE 4: For people who aren't that good.

102. RESEARCHER: Oh I see.

103. RESPONSE 5: There's like a lot of people that don't want to do the physical activity like the football and the rugby, and a lot of people like prisoner and dodgeball which having an after school club which will be better because it will get more people involved, where you can do the boys and girls separately and year separately then. And if there's a dodgeball club, it may get a few more people to be active.

104. RESEARCHER: Okay, has anyone got anything else which they'd like to say about getting more people active? Okay, well thank you very much indeed.

SPRING TERM - FOCUS GROUP 2

1. RESEARCHER: Focus group two, on the fourth of March 2015, first of all, thank you for taking part in the study. First question, why do you take part in physical activity and exercise?
2. RESPONSE 1: Because I like feeling the thrill of like, the pain of when I'm doing really hard stuff like running big distances and stuff like that.
3. RESPONSE 2: I like to get fitter than I already am.
4. RESPONSE 3: To stay fit and instead of say sitting inside all day and not getting any fresh air.
5. RESPONSE 4: So that you're doing something all day instead of just like on your computer.
6. RESPONSE 5: Because I want to stay fit and healthy.
7. RESPONSE 6: Same, I really want to stay fit and healthy to be honest.
8. RESEARCHER: Where do you like going to do physical activity and exercise?
9. RESPONSE 1: Well at the front of my house there's this like field area and I normally ride my bike up there and there's a big hill, and I go down and there's two like field bits and I play football there and sometimes I race my brother on my bike.
10. RESPONSE 2: College, shorter.
11. RESPONSE 3: I go down to the park with Reece and Rio and I like play around my house.
12. RESPONSE 4: I play for Redditch football team and I play at the park with Rio and Wes.
13. RESPONSE 5: I play on a field right near my house.
14. RESPONSE 6: I do a taekwondo club.
15. RESEARCHER: Who do you go with to take part in physical activity and exercise? I know you've mentioned a few names so are they family or friends?

16. RESPONSE 1: I normally go with my brother on bike rides but I go with my dad because my dad is going to the London marathon so he runs and I go on my bike, and we do about ten miles.
17. RESPONSE 2: I go with my friends.
18. RESPONSE 3: I go with my friends.
19. RESPONSE 4: Mainly friends.
20. RESPONSE 5: I go with my brother but sometimes I go with my sister.
21. RESPONSE 6: It's either my mum or my dad.
22. RESEARCHER: And why do you choose to be physically active at those particular venues?
23. RESPONSE 1: I don't understand the question.
24. RESEARCHER: So, you said you like going with your dad, why do you like going with your dad to those areas? Is there any reason why?
25. RESPONSE 1: Not only is it helping my dad get prepared for the marathon, it's also helping me with my legs so that I can run faster as well.
26. RESPONSE 2: It's a big space so that's it really, like got a big space to play.
27. RESPONSE 3: There's a big space to play and it's just a bit of fun really.
28. RESPONSE 4: It keeps me active and it builds up like my stamina and it helps me to be a better footballer.
29. RESPONSE 5: I just go there like if I've had a row with my brother to get friends again.
30. RESPONSE 6: I go to stay fit.
31. RESEARCHER: Okay, obviously this is the second time you've worn the GPS stuff, so this question is have you visited any other location for physical activity since the last time you wore the GPS equipment, and if you have visited a different location, why have you visited that location now and not before Christmas? So it's the second time you've worn the GPS stuff, the first time was before Christmas, now you've worn it after Christmas. So have you visited any different places?

32. RESPONSE 1: Well, before I used to go by my other house because I moved house and it was bigger and it had like football pitches and stuff like that but now because I've moved house I go on the field outside and also my dad has started preparing for the marathon so I've decided to go along with him since he's been preparing, so yeah.

33. RESPONSE 2: I used to go to Matchborough astro-turf because it was good weather but now it's kind of cold so I just kind of stay in the car park where it's near my house.

34. RESPONSE 3: a few days ago at Redditch United we've started going to an astro-turf and cricket field by Redditch.

35. RESPONSE 4: I've just started football.

36. RESPONSE 5: I've been going to the lake.

37. RESEARCHER: Has that been after Christmas?

38. RESPONSE 1: Yes.

39. RESEARCHER: And did you not go there before Christmas?

40. RESPONSE 2: No because our dog is getting a bit fat and he's been so we're going to have to take him longer distances now so we've been going to the lake with him.

41. RESPONSE 3: I haven't.

42. RESEARCHER: So it's been the same for you?

43. RESPONSE 3: Yes.

44. RESEARCHER: Are there any other changes you can think of which would improve student's physical activity and would help us to break down any barriers to physical activity? Perhaps at school? How can we get you more active?

45. RESPONSE 1: Like, I'm not saying this is what you have to do, but you could like as rewards, like if you, you know at lunchtimes, you don't have to do this but if you choose to like run like, every one hundred metres you run round the field, like if it's obviously dry, you get like a reward or something. And like the longer you run, and the longer the distance, you get a better reward or something like that.

46. RESPONSE 2: I think you could like on a certain day say for example Wednesday like one class goes onto the field and has a run and then the next day the other class goes. Or, you could have like in P.E when someone doesn't do it properly, the thing that they have to do, they can just do it for a forfeit.

47. RESPONSE 3: I think it's fine how it is.

48. RESPONSE 4: At lunchtime people should join in to more physical activities like football or basketball because it keeps you fit and plus then you can get in trouble like for fighting but you can instead of like losing your anger you can play football or something.

49. RESPONSE 5: I think you should like have a few competitions with like some of the things like on a special day maybe Wednesday, like Abdullah said we can have a team of football trying to have who wins the match like every Wednesday.

50. RESPONSE 6: How about have a lunchtime fitness club, how about that?

51. RESPONSE 7: One more point, you could have more physical activity clubs and less like, I'm not saying don't have homework cubs or I.T clubs but like less of them and more physical activity ones like football and stuff, and ones for girls as well.

52. RESPONSE 8: Start letting us on the field so we can run around the field and everything.

53. RESPONSE 9: Instead of just like doing certain like year groups, you should be able to do like on Wednesday, like every Wednesday instead of like stopping the year sixes, let year five and year six do football, because then you're improving your own stamina and then you're improving the year five football as well. And then on Thursday have like a year seven and eight football club or rugby.

54. RESEARCHER: And what are the barriers to physical activity, what stops us from getting active?

55. RESPONSE 1: Like normally, kids, computers or what they do is the moment they're just out of breath, not out of breath but when they're like "oh no I've got a stich or something," they just get like really weak and they don't push themselves they're like "I'm stopping,". They could have only done a few metres and then they'd stop because they're out of energy, not pushing themselves.

56. RESPONSE 2: I push myself.

57. RESPONSE 3: I didn't said you didn't.

58. RESPONSE 4: Like not being allowed to go outside or anything like, like being set rules like you can't go very far or anything.

59. RESPONSE 5: And instead of like at home, try and improve behaviour because I get banned on sunny days in the holidays if I've been naughty, so instead of being naughty just be good yes and if it's like a wet day, you can go out on a sunny day.

60. RESPONSE 6: I think it's mainly most of the computer clubs and like all the Xboxes and all that at home, it's stopping them from getting out and getting active.

61. RESEARCHER: Has anyone else got anything else they want to say about getting people active?

62. RESPONSE 1: Not having enough sleep.

63. RESPONSE 2: Not eating enough carbohydrates, and you've got to eat at least some chocolate not loads because it's a good energy source.

64. RESEARCHER: Right, thank you very much boys, that's great.

SPRING TERM - FOCUS GROUP 3

1. RESEARCHER: Focus group three, on the tenth of March 2015, first of all, thanks for taking part in the study. Simple question to start off with, why do you take part in physical activity and exercise?
2. RESPONSE 1: Because I enjoy it.
3. RESPONSE 2: I take part in physical activity because I think it's fun and it gets you out of mischief.
4. RESPONSE 3: To keep fit and I enjoy it.
5. RESPONSE 4: I take part in physical activity because it keeps me interested and I have fun taking part.
6. RESPONSE 5: It keeps us fit.
7. RESEARCHER: Okay, so where do you like to go to do your physical activity and exercise?
8. RESPONSE 1: To a football ground or a field.
9. RESPONSE 2: I go to a football ground or a field.
10. RESPONSE 3: I got the field or the Abbey Stadium.
11. RESPONSE 4: I go to a field or I go to a hall and do stuff with other people.
12. RESPONSE 5: In P.E or up town.
13. RESEARCHER: And who do you go with to do your physical activity and exercise?
14. RESPONSE 1: I either go with my sister, friends or football team.
15. RESPONSE 2: I got with my mum and my football team.
16. RESPONSE 3: I usually go with my mum or my cousins.
17. RESPONSE 4: I go with my friends and my dog on some occasions.
18. RESPONSE 5: I go with my friends and my awesome family.
19. RESEARCHER: You've mentioned a few different venues which you go to, why do you choose to be physically active at those venues? So, for example if you go to

a park or a field or into town, why do you go to those particular venues to be physically active?

20. RESPONSE 1: Because it's just a calm place to go to do it.

21. RESPONSE 2: Because there's nothing else, not much else that I enjoy other than football and running.

22. RESPONSE 3: There's more variety to do stuff rather than just one activity.

23. RESPONSE 4: Because it's a bigger area to do stuff and I can interact with other people whilst I'm doing it.

24. RESPONSE 5: It's an easy place with, and easy to walk to, and it's big and you can walk and walk and walk and walk.

25. RESEARCHER: Right, now obviously this is the second time you've worn the GPS equipment. You wore it once before Christmas and you've worn it after Christmas so you've had two different occasions where you've worn the equipment. Have you visited any other location for physical activity since the last time you wore the GPS equipment? And if you have been somewhere different, what has caused you to visit this new location?

26. RESPONSE 1: I haven't gone anywhere else.

27. RESPONSE 2: I haven't gone anywhere else.

28. RESEARCHER: So you've stayed at the same?

29. RESPONSE 1: Yes.

30. RESPONSE 3: Neither have I.

31. RESPONSE 4: I stayed the same.

32. RESPONSE 5: I've been up town instead of the park because it's been raining a lot, so it's been wet so I can't do anything.

33. RESEARCHER: So that's quite a big factor isn't it? The weather, it affects you as to whether you're going to go indoors or outdoors, doesn't it. Is there anywhere else where you may have been? Possibly with weather influences? Has the weather influenced any of you in what you do?

34. RESPONSE 1: Yes.

35. RESEARCHER: How?

36. RESPONSE 1: Because when it's raining you mostly tend to do it inside, when it's sunny I tend to do it outside where there's more room.

37. RESPONSE 2: Yes because when it's raining we can't like have our football matches and they get called off.

38. RESPONSE 3: Yes that's the same as me.

39. RESEARCHER: Right okay, are there any other changes that you can think of which would improve students' physical activity?

40. RESPONSE 1: I don't know.

41. RESEARCHER: How can we get you more active?

42. RESPONSE 1: Have more lessons in P.E and longer lessons.

43. RESPONSE 2: Double P.E.

44. RESPONSE 3: Double P.E like they do in high school, like my sister does.

45. RESPONSE 4: Yes because high school do double P.E and then.

46. RESPONSE 5: Go to different clubs.

47. RESPONSE 6: Yes more clubs that other people like to do.

48. RESPONSE 7: They should start taking people swimming.

49. RESPONSE 8: We've already been swimming in year five and year six.

50. RESPONSE 9: Yes but year seven and eight?

51. RESPONSE 10: Yes we don't.

52. RESPONSE 11: I think we should do double P.E or something like that.

53. RESPONSE 12: Anything else?

54. RESPONSE 13: Like having a certain time or place where you can do a P.E challenge in school time, like after school or somewhere, don't laugh at me.

55. RESEARCHER: Okay, what barriers are there to P.E or physical activity? What stops you from getting physically active?

56. RESPONSE 1: Raining.

57. RESPONSE 2: Asthma.

58. RESPONSE 3: Illness.

59. RESPONSE 4: Weather.

60. RESPONSE 5: Hunger.

61. RESPONSE 6: Not being able to run a long distance.

62. RESPONSE 7: People that stop you, like you have to be motivated to do it or something like that.

63. RESPONSE 8: In P.E lessons, people just mess about and they just waste your time if you actually do like P.E.

64. RESPONSE 9: If we were to do more P.E I would say we would need time to get changed like extra time to get changed, say if you had it like after registration, then I'd say get changed in registration and then you'd have the whole hour of P.E instead of cutting fifteen, twenty minutes out and only have a forty five minutes lesson.

65. RESPONSE 10: Everybody just messes around in the changing rooms so that's less time.

66. RESEARCHER: Okay has anyone else got anything else which they'd like to add on anything to do with GPOS equipment or physical activity?

67. RESPONSE 1: No.

68. RESPONSE 2: No.

69. RESPONSE 3: No.

70. RESEARCHER: Okay thank you very much.

SPRING TERM - FOCUS GROUP 4

1. RESEARCHER: Focus group four, on the eleventh of March 2015, first of all, thanks for taking part in the study. First question, why do you take part in physical activity or exercise?
2. RESPONSE 1: Because I find it fun.
3. RESPONSE 2: It's interesting.
4. RESPONSE 3: I've never tried it before.
5. RESPONSE 4: Because it's good for you and you make more friends.
6. RESPONSE 5: Because it's good fun.
7. RESPONSE 6: I just do it for fun and just meet new people and make friends.
8. RESPONSE 7: Exercise.
9. RESEARCHER: And where do you like to go to do your physical activity or exercise?
10. RESPONSE 1: Normally taekwondo because I have all of my family and that there so.
11. RESPONSE 2: I like going roller blading.
12. RESPONSE 3: I go roller blading at the abbey as well.
13. RESPONSE 4: I go to the Abbey Stadium and I do roller skating.
14. RESPONSE 5: Abbey Stadium.
15. RESPONSE 6: I do Greenlands Church and sometimes the Abbey Stadium.
16. RESPONSE 7: I do gymnastics and skating at the Abbey Stadium.
17. RESEARCHER: Right, and who do you go with to do your physical activity or exercise? So who do you go with?
18. RESPONSE 1: Mainly my dad or my sisters or brothers.
19. RESPONSE 2: I go with my friends and my brother.

20. RESPONSE 3: I normally go with my friends and family.
21. RESPONSE 4: Aimee
22. RESPONSE 5: Friends.
23. RESPONSE 6: Friends and people from my dance.
24. RESPONSE 7: Izzy.
25. RESEARCHER: Right and you've all mentioned a few different areas where you go to do your activities, why do you choose to be physically active at those venues?
26. RESPONSE 1: My dad makes me.
27. RESPONSE 2: I don't really choose, it's just because I know that people who roller blade there and it's fun to do it there.
28. RESPONSE 3: I don't really know but I sometimes go with a couple of people from dance or I just wanted to try it.
29. RESPONSE 4: Because there's lots of different things there and there's loads of different variety.
30. RESPONSE 5: Don't know really, it's fun, I don't know.
31. RESPONSE 6: It's because it's where my dance is based and it's close to me and it's just where I know they go roller skating, and it's close to me.
32. RESPONSE 7: It's fun.
33. RESEARCHER: Okay, now obviously this is the second time where you've worn the GPS equipment. You wore it once before Christmas and you've worn the equipment once after Christmas. So you've had two attempts or two goes at wearing the GPS equipment each, have you visited any other location for physical activity since the last time you wore the GPS equipment? And if you have been somewhere new, or you have been somewhere different, what has caused you to visit this new location?
34. RESPONSE 1: I haven't been anywhere new.
35. RESPONSE 2: Well, when I started at Christmas, I didn't really go anywhere, then I went skating.

36. RESPONSE 3: No, nowhere new.

37. RESPONSE 4: I started gymnastics because a lot of my friends of there and then they got me into it.

38. RESEARCHER: Was that before Christmas or after Christmas?

39. RESPONSE 4: After.

40. RESEARCHER: That's after Christmas okay and you didn't do gymnastics before Christmas?

41. RESPONSE 4: No.

42. RESPONSE 5: I've been to new horse riding stables.

43. RESEARCHER: Right okay and that's after Christmas. Why did you not go there before Christmas?

44. RESPONSE 5: Because it was further away and it's closer.

45. RESEARCHER: Right okay, so the location.

46. RESPONSE 6: Haven't been anywhere new but I did go somewhere when I had it on to Manchester for my little brother's birthday.

47. RESPONSE 7: I went to gymnastics after Christmas because I've always wanted to do it.

48. RESEARCHER: Are there any other changes that you can think of which would improve students' physical activity? Perhaps here, how could we get you more physically active?

49. RESPONSE 1: I don't know really.

50. RESPONSE 2: You could do some more clubs that people want to do because like for each sport we do in P.E there's not all the clubs.

51. RESPONSE 3: Don't really know.

52. RESPONSE 4: Just do like more clubs that people want to do.

53. RESPONSE 5: Like let people choose what clubs and what they want to do in P.E lessons.

54. RESPONSE 6: To see what physical activities they do outside of school and see if we can make that part of the P.E routine.

55. RESPONSE 7: Like what Courtney said, see what pupils want to do.

56. RESEARCHER: And what barriers do you think there are to stopping us from getting active?

57. RESPONSE 1: Safety, because some things might not be safe in school areas.

58. RESEARCHER: Any example?

59. RESPONSE 1: Like with gymnastics when you have bars and vaults and everything and springboards, they can be dangerous.

60. RESEARCHER: Is there anything else that stops us from getting active?

61. RESPONSE 2: Some people just can't be bothered sometimes.

62. RESPONSE 3: The weather as well, if it's an outside sport.

63. RESPONSE 4: If it's sunny then I think more people like to go outside but if it's raining I don't think people will have the motivation.

64. RESPONSE 5: And sometimes it's the days that they're on.

65. RESEARCHER: Right, what do you mean by that?

66. RESPONSE 5: Well, because with some clubs, like another club is on at the same time, that one is quite popular so no-one actually goes to the other club even though they might want to.

67. RESPONSE 6: It might be affecting them by their home routine, say there's something wrong going on in the family and they've got to go and help, it's fitting into their routine.

68. RESEARCHER: Has anyone else got anything else which they'd like to add? Okay, thank you very much.

SPRING TERM - FOCUS GROUP 5

1. RESEARCHER: Focus group five, on Tuesday the seventeenth of March 2015, first of all, thanks for taking part in the study. And got a nice easy question to start off with, why do you take part in physical activity or exercise?
2. RESPONSE 1: To get fit and make your bones much stronger and you can get stronger and if you get a better heartbeat it means that you're working harder and you can achieve higher goals.
3. RESPONSE 2: To stay healthy and fit and keep you strong and keep your bones strong.
4. RESPONSE 3: To try and achieve your goal.
5. RESEARCHER: Yes.
6. RESPONSE 4: Because it's fun.
7. RESPONSE 5: To make you stronger.
8. RESEARCHER: Excellent, and where do you like going to do your physical activity and exercise?
9. RESPONSE 1: Well sometimes me and my carer don't plan things and then we turn out to be going down the park or normally I walk around my house a lot like watching TV and doing all that sort.
10. RESPONSE 2: I go to, I run around the house and then me and my mum go listen to music while we run around our street.
11. RESPONSE 3: Normally I go swimming because that's my favourite sport but we only go on Fridays in the afternoon in school weeks but normally I just go to some gyms on, well me and my mum call it fitness Friday, so after school on a Friday after I've been swimming we go, we get changed and we go to the gym that's like, my granddad has to drive us there because it's a bit long way, but it's really fun and it's good for our strength.
12. RESPONSE 4: Arrow Valley lake with my uncles because I go climbing and that lot and rocks and we have ice cream after and play on the park and we run around the lake.

13. RESPONSE 5: Mine would be Arrow Valley lake as well because in the summer me and my mum go bike riding.

14. RESEARCHER: Okay, now all of you have mentioned a few different areas where you go and some of you have mentioned people who you go with and that's my next question, is who do you go with to take part in physical activity and exercise?

15. RESPONSE 1: My carer and my brother.

16. RESPONSE 2: My big sister and my big brother and my big cousin.

17. RESPONSE 3: Normally I go with my mum and sometimes I try to force my dad to go because he's got a big tummy.

18. RESPONSE 4: Most of the time I go with my uncles and then and then I go with either my auntie, my mum and my nan. My granddad's got a walking stick so.

19. RESPONSE 5: Sometimes I go with my sister and my mum but most times I go with just my mum.

20. RESEARCHER: Okay and you've all mentioned a few different venues you like to go to, to do your physical activities, why do you choose to visit those venues to do your activities? So why do you like going to that particular place?

21. RESPONSE 1: I like going there because it's just a lot of fun and it doesn't matter whether you're wearing the watch or not it's just still you can have a load of fun.

22. RESPONSE 2: Because you have some fresh air, and you've got energy to let it all out.

23. RESPONSE 3: Sometimes places that are small, you can't go to because they don't have a lot of opportunity or what to go on, but if you go a big gym and it's just full of one thing then I think you should go to another one because there's not a lot of fun and if it's that one sport that you don't do, then you shouldn't go there but if you find like a gym which has loads of different areas of different sports, then swimming, climbing, exercise then I think you'll get you strength and bones good to the maximum strength.

24. RESPONSE 4: Because that's the only place we normally walk our dog to do exercise with us and it's the only place my nan really likes going with my brothers and that lot so.

25. RESPONSE 5: Well, I go there because the lake's fairly big so we do five laps around the lake to try and build our strength.

26. RESEARCHER: Brilliant, now obviously this is the second time you've worn the GPS watches and heart rate straps isn't it, you wore it once before Christmas and you've worn it once after Christmas so this is your second go wearing the equipment. This question is looking at whether you have visited any other location for your physical activity since before Christmas when you wore the watch and the heart rate strap? And if so, what caused you to visit this new location? So have you been somewhere new after Christmas when you've worn the watch? And if you have been somewhere new, then where have you gone? And why have you gone there?

27. RESPONSE 1: I've been to a different park and it was somewhere around Birmingham. We went there on a Saturday because my great granddad who has died walked my nan there after her Sunday dinner and he took her to the park so we decided to that we'll have a walk down there and we find it fun because my nan hasn't been in a long time and I've never been there before.

28. RESPONSE 2: Before Christmas like about three weeks ago before Christmas I was wearing the watch and on that one fitness Friday and my mum took me to a special new park. And it had loads of swings wo I could exercise my legs, it had a special well you know those running ones, and she took me to a new gym for that one but I had loads of fun at the park and it was a great surprise.

29. RESEARCHER: And this was after Christmas?

30. RESPONSE 2: No this was before Christmas.

31. RESEARCHER: Have you been anywhere new after Christmas?

32. RESPONSE 2: Yes I have been to this new even bigger gym that had just opened. It was very good and it even had a new exercise.

33. RESPONSE 3: I actually went to Evesham park because there's like tight ropes and everything there.

34. RESEARCHER: And that was after Christmas?

35. RESPONSE 3: Yes.

36. RESEARCHER: And why do you think you never went there before Christmas?

37. RESPONSE 3: Because it's quite far away from my house.
38. RESEARCHER: Girls? No, okay, that's brilliant, are there any other changes you can think of which would improve students' physical activity? So how can we get you more active?
39. RESPONSE 1: More P.E, and we could have a running machine to get our energy going and some skipping ropes.
40. RESPONSE 2: Well, you know how they have those obstacle courses outside, well we went to Oakhill and they had those, they had like those running things like from Arrow Valley, I think we should have some of those on the playground and all that. And when you're doing P.E and you've got that one activity like gymnastics or something like that, I think you should do it longer.
41. RESPONSE 3: I think that we should have longer P.E sessions and more things to do.
42. RESPONSE 4: At break time and lunchtime and after school, you should do running club or some club where you get active and that like the GPS thing.
43. RESPONSE 5: I agree that we should have longer P.E sessions but I also agree that we should have longer swimming because some people want to improve even more on like a special swimming route or position or swimming backwards. Because if you've got like the length perfect, and you know you want to try but it's time to get out, then you just want that extra time so you can improve and it would be great if we had on Wednesday's or random days, children could go to the nearest gym and maybe have a mini P.E session there so they could go like on the runners and you know the cyclers that don't go anywhere, we could do that and if they had a new swimming pool then that would be great because if people wanted to improve still, then they could go in there.
44. RESEARCHER: Brilliant, has anyone got anything else that they'd like to add? Okay, right thank you very much.

SPRING TERM - FOCUS GROUP 6

1. RESEARCHER: Focus group six, on the eighteenth of March 2015, first of all, thank you for taking part in the study. First question is why do you take part in physical activity and exercise?
2. RESPONSE 1: Because I want to play football when I'm older.
3. RESPONSE 2: Because it's fun.
4. RESPONSE 3: I like doing sports.
5. RESPONSE 4: I like playing cricket.
6. RESPONSE 5: To stay healthy.
7. RESPONSE 6: To stay fit.
8. RESPONSE 7: To be a footballer.
9. RESEARCHER: Right and where do you like going to do your physical activity and exercise?
10. RESPONSE 1: To clubs.
11. RESPONSE 2: To a park.
12. RESPONSE 3: Football pitch by my house.
13. RESPONSE 4: Football pitch.
14. RESPONSE 5: New college.
15. RESPONSE 6: Outside on the green.
16. RESEARCHER: Right okay, and who do you go with to take part in physical activity and exercise? So who do you tend to go with?
17. RESPONSE 1: My friends.
18. RESPONSE 2: Myself.
19. RESPONSE 3: My friends.
20. RESPONSE 4: My brother and my mates.

21. RESPONSE 5: My little brother.

22. RESPONSE 6: My dad and my brother.

23. RESPONSE 7: My dad.

24. RESPONSE 8: My cousin and my brother.

25. RESEARCHER: And you've all mentioned different venues where you tend to go to do your sport and do your activities, why do you choose to be physically active at these venues? So what makes these venues so special for you to go to? So why do you go there and not anywhere else?

26. RESPONSE 1: It's because at clubs you can like be red carded and it's fair and I think it's like sometimes out of the areas at the park, they hand ball it and don't get a yellow card, or they tackle somebody or slide tackle, and they kick somebody and they don't get a yellow card for it so it's not fair.

27. RESPONSE 2: Because it's near my house.

28. RESPONSE 3: Because everyone plays fairly and plays in their position.

29. RESPONSE 4: Because when you play you have like more space, and you get to try new skills out and stuff.

30. RESPONSE 5: People make it fair that we each have turns to play it in cricket, so one person bowls then when someone hits it then we change places.

31. RESPONSE 6: It's fair.

32. RESEARCHER: Right and obviously this is the second time where you guys have had the chance to wear the GPS equipment isn't it? You wore it once before Christmas and you've worn it once after Christmas. So have you visited any other locations for physical activity since the last time you wore the GPS equipment before Christmas? And if so, what has caused you to visit this new location? So have you been anywhere different this time round, and if you have, why have you gone there now and not before Christmas?

33. RESPONSE 1: I've gone to the park because now the weather is starting to get better and I think I've made new friends there.

34. RESPONSE 2: A football pitch because there's lots more room there.

35. RESPONSE 3: Before Christmas I had lots to do, but after Christmas I went to the astro-turf to play football.

36. RESPONSE 4: I took my dog for a walk round this massive field.

37. RESEARCHER: Right okay, are there any other changes that you can think of which would improve students' physical activity? So how can we get you more active? What can we do?

38. RESPONSE 1: I think you should put like more clubs because like I don't think we have benchball or like somebody might want to play benchball, or some people they're not allowed to go to clubs after school, but they're allowed to go to clubs at break and lunchtime, so I think you should have more clubs at lunchtime as well because then more people will go to those instead of after school clubs.

39. RESPONSE 2: Have more P.E lessons.

40. RESPONSE 3: In P.E make the game times longer and the training time shorter.

41. RESPONSE 4: To encourage the students like so, if you encourage students they might start doing more physical activities.

42. RESPONSE 5: I was going to say what Josh said and encourage them.

43. RESPONSE 6: Have more P.E lessons.

44. RESEARCHER: Right and what barriers do you think there are which stop us from getting active?

45. RESPONSE 1: Like if you've got a problem with your leg and you really can't walk.

46. RESPONSE 2: When you've got asthma.

47. RESPONSE 3: If you need to take your dog to the vets and like you want to play football but it will stop you from going.

48. RESPONSE 4: If you've got asthma.

49. RESPONSE 5: If you have loads of homework to do and all that, and you can't really be active and you can't really go outside, you just need to stay inside and do work which is kind of a pain.

50. RESEARCHER: Right, has anyone got anything else which they'd like to add about physical activity? Okay yes.

51. RESPONSE 1: That we should do more football.

52. RESPONSE 2: That you should like do a mix of different sports, like benchball, football, cricket and other sports.

53. RESEARCHER: Right okay, thank you very much boys.

<u>SUMMER TERM - FOCUS GROUP 1</u>

1. RESEARCHER: Focus group one, on the ninth of June 2015. First of all thank you for taking part in the study. First question is why do you take part in physical activity and exercise?
2. RESPONSE 1: To keep fit and it's enjoyable, it's fun.
3. RESPONSE 2: It's something to do so you don't get bored.
4. RESPONSE 3: Enjoyment.
5. RESEARCHER: Okay and where do you like to go to do your physical activity, sports and exercise?
6. RESPONSE 1: Fields, football fields, school, the gym hall and also maybe the astro or 3G.
7. RESPONSE 2: Fields, abbey stadium.
8. RESPONSE 3: Anywhere as long as I want to do the sport just anywhere.
9. RESPONSE 4: Fields.
10. RESPONSE 5: Anywhere that is available.
11. RESEARCHER: Can you provide an example?
12. RESPONSE 5: Like a car park.
13. RESEARCHER: And why do you choose to be physically active at these venues? So what is the reason behind it?
14. RESPONSE 1: I have football training there.
15. RESPONSE 2: Because it's a big space you can do what you want and you don't have to do it with certain boundaries.
16. RESPONSE 3: Sometimes it's the nearest place to do certain sports, and then for competitions you go all around the country to play them.
17. RESPONSE 3: So you want to have fun and all that.
18. RESEARCHER: And who do you go with to do your physical activity? Is there anyone in particular or does it change?

19. RESPONSE 1: I either go with friends or when its football training I go with my football team mates who I train with.

20. RESPONSE 2: Friends and family.

21. RESPONSE 3: Usually friends or family.

22. RESPONSE 4: Friends.

23. RESPONSE 5: Same, mates.

24. RESEARCHER: Who is more influential because you've said friends and family, but who influences you more, is it your friends or is it your family who encourage you to get active?

25. RESPONSE 1: Family but friends do encourage you as well but family encourages you more.

26. RESEACRHER: So you think your family encourages you more?

27. RESPONSE 1: Yes.

28. RESEARCHER: Okay.

29. RESPONSE 2: Friends because they've got the same life as what you do, so you can do the same thing.

30. RESPONSE 3: It's usually my dad that pushes it a lot, because he would take me anywhere to do anything I wanted to.

31. RESPONSE 3: Family.

32. RESEARCHER: Right okay. Right, this is the third which you've worn and it's the final time which you've worn the GPS equipment and the heart rate monitors, now have you visited any new locations since the last time and also since the first time. If not, maybe you've just visited the same ones.

33. RESPONSE 1: Yes I've just visited the same ones, mainly just Redditch football fields and Abbey stadium.

34. RESPONSE 2: I think once we went around this path in the fields because we were out on a friends day out, and there was this place which we went through and we had to go through all the forests to get to it.

35. RESPONSE 3: Just mainly a couple of different places, fields and that. That's about it.

36. RESPONSE 4: Like theme parks and all that.

37. RESEARCHER: Yes.

38. RESPONSE 5: I can't remember.

39. RESEARCHER: Are there any changes you can think of which would improve students physical activity? So what can we do to get you more active?

40. RESPONSE 1: See what they like the most and start things to do with them.

41. RESPONSE 2: See what they like and see what sport, and name like different sports to see if anyone would enjoy playing or not and also offer more opportunities for clubs, so maybe rather than having football just at one point in the year, have it all round because some people prefer that.

42. RESPONSE 3: Parents to like push it and take them anywhere they wanted to, and do whatever they wanted to, rather than judging them on what they want to do, because you don't think it's something a good thing for them to do.

43. RESPONSE 4: I'm not sure if this would work or not, but make them feel guilty, like say they aren't doing enough, or something like that, obviously it's not best for like year 5 and stud like that because they might get depressed, but sometimes that's the best way to get messages across.

44. RESEARCHER: Okay, final question then, what barriers are there that stop you guys from getting active? So what stops you from getting active?

45. RESPONSE 1: The availability of places that you go to do it, like for example car parks, if its full up or if there's one car straight in the middle, it's a bit difficult to play around it, and yeah, stuff like that.

46. RESPONSE 2: Availability of sometimes sports aren't like promoted in different areas and sometimes your family can get in the way of because they make plans and something you wanted to do, even if you're physically active, sometimes the times you do want to do something, there's already plans going on and they won't either let you or, certain members in your family if you have little sisters you have to look after, or little brothers and you sometimes struggle with going out with mates and that.

47. RESPONSE 3: Family events, events like when you have to go with your friends and family. Also if like training gets cancelled and you stay indoors.

48. RESPONSE 4: And like the weather, because you can't really run on a track, if the track is covered in puddles because you'll probably like slip over.

49. RESEARCHER: Okay, has anyone got anything else which they'd like to add?

50. RESEARCHER: Okay, thank you very much guys.

SUMMER TERM - FOCUS GROUP 2

1. RESEARCHER: Focus group two, on Wednesday the 10^{th} June 2015. First of all thank you for taking part in the study. Why do you take part in physical activity and exercise?
2. RESPONSE 1: Because I enjoy it and I find it fun.
3. RESPONSE 2: I enjoy it and it just keeps me active and I have fun.
4. RESPONSE 3: It keeps me fit and healthy.
5. RESPONSE 4: Because it gives me something to do and its fun.
6. RESPONSE 5: I pass my time when I'm doing sports.
7. RESEARCHER: Okay, and where do you like going to do physical activity, exercise or any sport?
8. RESPONSE 1: Anywhere quiet.
9. RESPONSE 2: I go to a field behind me and I go to a hall when I'm with my friends.
10. RESPONSE 3: I sometimes go in the park to play football or anything.
11. RESPONSE 4: Here.
12. RESEARCHER: At school?
13. RESPONSE 4: Yes.
14. RESPONSE 5: I go to a football ground.
15. RESPONSE 6: I just go to places where there aren't anyone, because I don't like being watched.
16. RESEARCHER; And why do you choose to be physically active at these different venues? So, why do you choose to go there?
17. RESPONSE 1: Because it's fun and it gets rid of times that you don't want to waste.
18. RESPONSE 2: So I can socialise with my friends and I can do more stuff with them.

19. RESPONSE 3: To keep myself fit and healthy.

20. RESEARCHER: Yes.

21. RESPONSE 4: To keep myself healthy and I go to quiet places so people aren't just watching me and know what I'm doing.

22. RESEARCHER: Okay, you've all mentioned different venues, different places, and different reasons why you go there. Who do you tend to go to these places with?

23. RESPONSE 1: My football team and sometimes friends, and parents.

24. RESEARCHER: Yes.

25. RESPONSE 2: Sometimes alone or sometimes family.

26. RESEARCHER: Yes.

27. RESPONSE 3: Either alone or with my friends.

28. RESPONSE 4: My friends most of the time but I also do it with my dad as well.

29. RESPONSE 5: I go on my own or I take my dog with me.

30. RESEARCHER: Right okay, obviously this is the third and final time which you've worn the GPS equipment and the heart rate equipment, so I want you to think about the locations which you've been to. Have you visited any other location for physical activity, so maybe somewhere new this time since the last time you wore the GPS equipment and if you have been somewhere new, what has been the cause of you to go here?

31. RESPONSE 1: My dad runs for this charity and they've got their own little gym in Dudley and we always go there and because it's got a massive swimming pool we go there. And it's only basically to keep ourselves healthy; anyone can go there so it's good.

32. RESEARCHER: Has anyone else been somewhere new?

33. RESPONSE 2: Parks and fields in Stockton on Tees, because my dad lives up there so I have a lot of chance to go out there walking my dog and riding my bike.

34. RESEARCHER: And what stopped you from doing that before?

35. RESPONSE 2: I didn't really have much time to go outside because my dad was always working.
36. RESEARCHER: Right okay, interesting. Anyone else been anywhere new since the last time you wore the equipment?
37. RESEARCHER: Okay, are there any other changes you can think of that could improve student's physical activity? So what would you do to try and get more people active if you could?
38. RESPONSE 1: Give them a choice of what they want to do for like P.E or something, so what they want to do for P.E.
39. RESPONSE 2: Challenge them, like really push it. Get them to their limits.
40. RESPONSE 3: Persuade them like how good sport is and everything so they can take part in sports.
41. RESPONSE 4: Make it fun for them.
42. RESEARCHER: Okay.
43. RESPONSE 5: Make it more often because we only have two lessons of it, we should have more.
44. RESEARCHER: Anything else?
45. RESPONSE 6: More clubs on offer where you choose what to do with like the P.E lessons because at some clubs you're restricted to what you do. More clubs where you can choose what to do.
46. RESEARCHER: Okay, right, final question then, what barriers are there which stop students from becoming physically active?
47. RESPONSE 1: I think maybe outside of school, you could be really busy or just, they could have things going on which stops them from having the time doing physical activities.
48. RESPONSE 2: Caring for people at home like baby sisters and parents and cooking and cleaning like a young carer.
49. RESEARCHER: Yes. Anything else?

50. RESPONSE 3: Technology. Because a lot of people just sit at home and play on a computer or on an ipad or a phone and they don't really go out and do anything else.

51. RESEARCHER: Anything else? Okay has anyone else got anything else they would like to add regarding any of the questions? Okay, right, thank you very much girls.

SUMMER TERM - FOCUS GROUP 3

1. RESEARCHER: Focus group three on Tuesday 16th June. First of all thank you for taking part in the study. First question, why do you take part in physical activity or exercise?
2. RESPONSE 1: Because it's fun and I don't have to sit around and be bored and it's just fun.
3. RESPONSE 2: To get myself fit and healthy.
4. RESPONSE 3: Because it's fun and instead of watching TV, like when you've got all that sweet stuff around you, you just like pick at it. When you go out, you want more of the healthy stuff to keep you fit.
5. RESPONSE 4: It's fun, it's enjoyable, it like uses your spare time.
6. RESPONSE 5: Because it's fun and there's different things to do and you don't get bored.
7. RESPONSE 6: It's fun and it gives you something to do.
8. RESPONSE 7: It's fun and you stay fit and healthy.
9. RESEARCHER: And where do you like going to do your physical activity or exercise?
10. RESPONSE 1: Swimming or just like going on my bike or running around the school with my mate.
11. RESPONSE 2: Mostly the Abbey Stadium.
12. RESPONSE 3: The Abbey Stadium, the Greenlands church where I do my dance and then just swimming and going outside and the park.
13. RESPONSE 4: The park, the like Abbey Stadium and the Kingsley Sports centre.
14. RESPONSE 5: Abbey Stadium and the park sometimes.
15. RESPONSE 6: When I'm playing out with my mates at the park and wherever I do taekwondo.
16. RESPONSE 7: I go roller skating which is at the Abbey Stadium and to the park with my friends.

17. RESEARCHER: Okay now all of you have mentioned completely different venues to some of the other people here, why do you choose to be physically active at these venues? So why are you active at your venues?

18. RESPONSE 1: First of all, I go around, the school I mentioned before is, it isn't this school it's my old first school and it's like a circle and you run around and it's really fun. And the reason why I go round there is because it's easy and I know my whole way round and I know all the closes and the ways around.

19. RESPONSE 2: Because I know a lot of people there and it's fun.

20. RESPONSE 3: It's because where my activities are based and where it's just closest to me.

21. RESPONSE4: The activities are based there and it's like a close place to go.

22. RESPONSE 5: Well, I go roller skating and it's really, there's not many places where it does it so, and it's fun so.

23. RESPONSE 6: I know a lot of people there and it's just a place where me and my family can get to easily.

24. RESPONSE 7: It's really fun and I just get to hang out with my friends.

25. RESEARCHER: You all do a range of different sports and exercises, who do you do them with and who do you go with?

26. RESPONSE 1: I go with my best mate Lauren but she goes to Ipsley so you probably don't know her, but yes I always do them with her or I either go with Chloe, or Abbie, she's close to it as well.

27. RESPONSE 2: Friends and family.

28. RESPONSE 3: Well I don't really know some of them but some of them are in year five at this school and then like some of them go to different schools and like, it's just a way of making new friends as well.

29. RESPONSE 4: Family and friends.

30. RESPONSE 5: Friends and family.

31. RESPONSE 6: Sometimes my friends but mainly my family.

32. RESPONSE 7: I go with my friends.

33. RESEARCHER: Now obviously this is the third and final time where you have worn the equipment and you've gone on this project, have you visited any other location for physical activity since the last time you wore the GPS equipment? And if you have been somewhere new, what has caused you to visit the new location? So have you been anywhere new?

34. RESPONSE 1: Yes, I went to this like, because when I wore them, I went to a theme park at Drayton Manor, but I was really scared they were going to fall off when I was on the rides so what I did was, I took the watch off and kept the heart monitor on and gave the watch to my mum to stand and watch and the only reason I went is one, it gets your adrenaline pumping and two, it's really fun.

35. RESPONSE 2: I went to like this dolphin centre and you had to learn to train dolphins and it was fun.

36. RESPONSE 3: I didn't go anywhere new but I was doing more stuff getting ready for my exams that I did last week.

37. RESPONSE 4: I went to this place called Lickey Hills and you go walking up mountains and stuff.

38. RESPONSE 5: I haven't really been anywhere new.

39. RESPONSE 6: I haven't been anywhere new either.

40. RESPONSE 7: I haven't been anywhere new.

41. RESEARCHER: Okay, are there any other changes that you can think of which would improve student's physical activity? Is there anything we could do to help get you active?

42. RESPONSE 1: Yes, either like more time doing sport stuff or better, not better but like more variety of equipment to use, because sometimes it just doesn't vary that much its very limited what you can do.

43. RESPONSE 2: More P.E lessons because no-one really wants to waste their time on after school clubs or anything. Then lessons, everyone's got to go.

44. RESPONSE 3: Like do the more modern stuff that everybody's into because if more people are into it, they'll do it more often. So it would be better to have the more modern stuff than like the basic stuff that you've like done in the past, yes it's nice and all that but do more modern stuff so more people do it.

45. RESPONSE 4: More P.E lessons and like new stuff like Chloe said, like roller skating, trampolining, and probably other new sports.

46. RESPONSE 5: Adding more P.E lessons and more like after school clubs, but some people can't always make it after school so lunchtime clubs.

47. RESPONSE 6: Some more clubs like inside of school time because people can't get sometimes to the clubs that they want to after school.

48. RESPONSE 7: More P.E lessons and maybe like a few trampolines.

49. RESEARCHER: Okay, final question, what barriers are there which stop students from being physically active?

50. RESPONSE 1: Not having the time to do it or not having the space to do it, or knowing a safe place to do it or having equipment or anything like that, because sometimes most students can't get them

51. RESPONSE 2: It helps to be somewhere local to most people and then it's got to be somewhere where they know other people because otherwise they won't go because they don't know anyone else.

52. RESPONSE 3: What's stopping them might be the weather outside because say they go to run and they couldn't really run in the rain unless they wanted to, and then just their health sometimes like, if they've got asthma, what effects them, trying to have that physical activity. So it's like yes they can do it, but they can't go past a barrier sort of thing, which stops them from having more of that variety of doing it.

53. RESPONSE 4: Health would be one and like if and the weather, and if someone said you were bad at that sport, you would think yes I'm really bad at sport and they probably won't even give it more of a go and there would be more like not enjoying it and doing it.

54. RESPONSE 5: Could be health and the weather but sometimes people don't have the time as well so that could stop them and they might not think it's safe or something.

55. RESPONSE 6: The place that it's at and the weather, and also the time, the times that it's on.

56. RESPONSE 7: The time, the venue, the weather and not being healthy enough to do it.

57. RESEARCHER: Right, brilliant, has anyone got anything else which they would like to add regarding any of the questions?

58. RESPONSE 1: I think instead of just having the plain areas to do P.E to do like say the playground or the field. I think they should get, like the bottom bit of the field that we don't actually use that much unless we're doing shot put, I think the back part of it we should set up obstacles and stuff and should put on and then it's more fun and people will be like more happier to like do it.

59. RESEARCHER: Thank you, anymore?

60. RESEARCHER: Right, okay, thank you very much.

SUMMER TERM - FOCUS GROUP 4

1. RESEARCHER: Focus group four on Wednesday 17th June. First of all thank you for taking part in the study. First question, is why do you take part in physical activity or exercise?
2. RESPONSE 1: Because I like to be a sporty person.
3. RESPONSE 2: Because I like it.
4. RESPONSE 3: Because I like doing sports and then I want to keep fit.
5. RESPONSE 4: Because I like playing football.
6. RESPONSE 5: I want to keep fit.
7. RESPONSE 6: Because like I want to keep fit and I really like football and other stuff and like if I like more sports then I have more options of jobs, like footballer and all that.
8. RESPONSE 7: I like sports because they keep me fit and I like playing and enjoying it.
9. RESEARCHER: Where do you like going to do your physical activity or exercise?
10. RESPONSE 1: On fields and stuff when I play football and I sometimes and I sometimes go to my training group when I do my martial arts.
11. RESPONSE 2: Like grassy areas.
12. RESPONSE 3: Anywhere.
13. RESPONSE 4: To a park.
14. RESPONSE 5: To a lake.
15. RESPONSE 6: I like to go Lakeside and to the park as well.
16. RESPONSE 7: I like to go up on a green grass field next to my house.
17. RESEARCHER: Okay, why do you choose to be physically active at these venues? You've all mentioned different venues, why do you go there?

18. RESPONSE 1: Because I want to learn new things and hopefully succeed in what I'm doing.
19. RESPONSE 2: Because it's easy to do when I want to do it.
20. RESPONSE 3: So I get active.
21. RESPONSE 4: Because there's room to play football and you can play football with other people.
22. RESPONSE 5: To get more active.
23. RESPONSE 6: So I can play with my friends and I can play with my cousins because they are always at the park at like 8'oclock which is kind of late.
24. RESPONSE 7: to learn new sports.
25. RESEARCHER: Okay, and who do you go with to take part in physical activity and exercise?
26. RESPONSE 1: I go with my dad and when I go to my training group I go with my trainer called Liam.
27. RESPONSE 2: Family and friends.
28. RESPONSE 3: My family.
29. RESPONSE 4: My brother and my friends.
30. RESPONSE 5: My friends.
31. RESPONSE 6: Mr Ashton because he like organises across and Mr Thornewill sometimes, and I like to go alone sometimes and with my friends.
32. RESPONSE 7: My friends and my brother.
33. RESEARCHER: Now obviously this is the third and the final time when you have worn the equipment and I want to find out whether you have visited any other location for physical activity since the last time you wore the GPS equipment. And if so, what has caused you to visit this new location? So have you been anywhere new this time? And if you have, why have you visited this new location?

34. RESPONSE 1: Because when I go running with my dad sometimes, we went around this really long like road and I thought that it would be good to go there because it's got a long track to go on.

35. RESPONSE 2: Yes because better weather and that.

36. RESPONSE 3: Yes because I went on a bike ride with my dad and it was like, I think it was half a mile.

37. RESPONSE 4: I haven't been anywhere new.

38. RESPONSE 5: I haven't been anywhere new.

39. RESPONSE 6: Astroturf and another park.

40. RESPONSE 7: I go to the shopping centre which has a really big field next to it and when they finish shopping I will go there and play.

41. RESEARCHER: Brilliant, are there any other changes you can think of, excuse me, which would improve students physical activity? So how can we get you more active?

42. RESPONSE 1: By like organising groups to do it.

43. RESPONSE 2: If you put them into little groups, they can do it for longer.

44. RESPONSE 3: More P.E lessons.

45. RESPONSE 4: Longer P.E lessons and if we had more teachers, we could have an option of sports and each person from every year group could go to one of them.

46. RESPONSE 5: More teachers to like have around, and we could use that little green bit down the slope, we could use that little bit.

47. RESPONSE 6: More teaching assistants helping with P.E lessons.

48. RESEARCHER: Okay, final question, what barriers are there which stop students from being physically active? So what stops you from getting active?

49. RESPONSE 1: Probably some fences that stop you from going like if say you're going for a long sprint or a run and there's a fence, you're going to have to stop and go the other way.

50. RESPONSE 2: Nothing really because where I go, it's where there's nothing around me.

51. RESPONSE 3: Gates and fences blocking us from fields.

52. RESPONSE 4: Like fences with gates on it so you can't go on trim trails in public.

53. RESPONSE 5: Like sometimes school work, and homework, and getting organised for the next year and next term.

54. RESPONSE 6: We should have some more school trips to help make us more and get more active and go somewhere.

55. RESEARCHER: Okay brilliant, does anyone else have anything which they'd like to add.

56. RESEARCHER: Right okay, thank you very much indeed.

SUMMER TERM - FOCUS GROUP 5

1. RESEARCHER: Focus group five on Monday the 22nd June 2015. First of all thank you for taking part in the study. First question is why do you take part in physical activity or exercise?
2. RESPONSE 1: I just take part in it because I like doing stuff like cycling and that is classed as physical exercises, so I thought why not do the Woodfield gets active because that's physical activity, you do running for the bleep test, and you get to wear it at home so you get to do your daily life with it. So yes, I like it.
3. RESPONSE 2: I like doing physical activity because it gets me out of the house and I like staying fit.
4. RESPONSE 3: I like doing the physical activity because you don't have to do it on your own. You can just like play out and like football or with your friends and you can be physical doing that.
5. RESPONSE 4: I joined up because I want to keep fit and I like to help you get the data of if the children are healthy or physically active.
6. RESPONSE 5: I like physical activity because I like getting my heart pulse up and staying fit and healthy and I like doing lots of sports and running around so.
7. RESPONSE 6: I like staying fit and healthy.
8. RESPONSE 7: It's fun.
9. RESEARCHER: Okay, where do you like going to do your physical activity or exercise?
10. RESPONSE 1: Well I go pretty much around England, if it's in the holidays I will go down to Cornwall or something, if it's during school days I will be here in Redditch which isn't very sunny but still you can get out and I go round the field which has a park and that outside my garden and in Cornwall and that they have parks there and beaches there so I just tend to pop in and out of them two places.
11. RESPONSE 2: I go to south Redditch, the field at south Redditch and I play games at my close and I'll pretty much play anywhere. I play anywhere there's no cars.

12. RESPONSE 3: I normally go to sports centres because I do taekwondo, and if I'm not there I'm outside in my garden playing football or riding my bike around town.

13. RESPONSE 4: I play near a field near my house, but if any of my friends are coming out I just come round and my play with them and go there and just play football with my brother.

14. RESPONSE 5: I normally go and do a few jogs around Arrow Valley lake, that's about it.

15. RESPONSE 6: I go out the front because I live in a cul-de-sac, and out my back and sometimes on a field. Maybe around Arrow Valley.

16. RESPONSE 7: I mainly go to taekwondo to do it.

17. RESEARCHER: Okay, why do you choose to be physically active at these particular venues? So you've mentioned lots of different venues, why do you choose to go there?

18. RESPONSE 1: Well, usually around my park out the back, it's usually quite quiet there and yes there's the occasional dog and bicycle that goes past but usually there's nothing there to hurt you and it's quite quiet and in Cornwall and that, you've got holiday parks, you've got just regular parks, you've got the beach as I mentioned earlier, you can go surfing and all that kind of stuff so yes.

19. RESPONSE 2: I go there because it's like public and other people know where it is so I can play with them so yes.

20. RESPONSE 3: I go there because other people are there to help me, push me on to get more fit.

21. RESPONSE 4: I go there mainly because it's quite close and I know the area fairly well. There's my friend's house if I get lost, and yes.

22. RESPONSE 5: I go there because it's a big open place and you have public people to like stay alongside you and like do stuff with you.

23. RESPONSE 6: I like to go where I go because it's quiet sometimes and there's like really loud places like Arrow Valley and it's quite quiet sometimes, but it can get quite loud when boats are going past and stuff like that.

24. RESPONSE 7: It just challenges me.

25. RESEARCHER: Who do you go with to take part in physical activity or exercise?

26. RESPONSE 1: Well if I'm on holiday in Cornwall or Somerset or Devon, wherever, usually I'll have my parents, my brother and my sister with me, and if I'm going to the park outside, I'll usually have my sister who comes out with my brother and I'll usually go out alone just going around and that.

27. RESPONSE 2: I go with any of my friends who will come along, so you know, and sometimes I play with my brother.

28. RESPONSE 3: When I'm at the park and stuff, I'll be with my friends playing out. But when I go to the sports centre to do taekwondo I go with my family, and there will be my friends who support me there.

29. RESPONSE 4: When I go to the lake I go with my family but when I am just playing on the field I normally bring my brother, just me and him, sometimes my sister if she is walking home.

30. RESPONSE 5: Normally when I go to the park, normally I play out with my friends but sometimes I go to the park with my older brother and hang out, do a couple of jogs or something.

31. RESPONSE 6: There's this one friend who comes round sometimes and we go out into the back and play out there, and if I'm going to the lake, I'll go with my parents.

32. RESPONSE 7: I normally just bring my mum.

33. RESEARCHER: Okay now this is obviously the third and final time where you have worn the GPS equipment, have you visited any other location for physical activity since the last time you wore the GPS equipment? And if so, what has caused you to visit this location? So have you been anywhere new this time? And if you have, what caused you to come to this new place?

34. RESPONSE 1: No I haven't been anywhere new with it.

35. RESPONSE 2: No.

36. RESPONSE 3: I haven't been anywhere new with it.

37. RESPONSE 4: I've gone to a like, gone on holiday a bit, round to different houses yes just gone around.

38. RESPONSE 5: I haven't been anywhere new.

39. RESPONSE 6: I went on holiday but I didn't take it in case I lost.

40. RESPONSE 7: No.

41. RESEARCHER: Okay, are there any other changes you can think of which would improve students physical activity? So, how can we get you more active?

42. RESPONSE 1: Is it okay if I don't answer?

43. RESEARCHER: Yes of course.

44. RESPONSE 2: Well I suppose some people think that some games are gender specific, like prisoner or something, most people think that's a boy's game. If you did more, I don't mean stop doing those games, I mean some people don't like them so do different games.

45. RESPONSE 3: Well I think you do a lesson in school, or after school, in school at lunch or after school for people who wear the GPS watches to get them a bit more active.

46. RESPONSE 4: I think we could have a little more P.E clubs and have certain people join like instead of having a few people that you see who are really good, you could go over to them and ask them to join.

47. RESPONSE 5: You could have a club after school so then you could get more fit and active even if you're not wearing the GPS watch or anything.

48. RESPONSE 6: I think we could have more P.E lessons and bring some more equipment for people to play with at break and lunchtime.

49. RESPONSE 7: I have no idea.

50. RESEARCHER: Final question, what barriers are there which stop students from getting physically active? So what stops you from getting active?

51. RESPONSE 1: Well in the olden days when my dad was around there wasn't as many cars on the road and health and safety wasn't as good, and he could go pretty much anywhere he liked, and play maybe football or maybe basketball with his friends or, he used to do this thing, they had a sign and nobody obeyed it, no ball games, and he used to do this with his friend, kick the ball straight at the sign, see how hard you could hit it.

52. RESPONSE 2: Well I suppose obesity and more people are becoming obese so that might be stopping them.

53. RESPONSE 3: Like if there's your favourite TV show on and you don't want to miss it or sweets and chocolate.
54. RESPONSE 4: Unhealthy food because if you're full, you don't really want to go out and play like a game of football so yes a lot more healthy food really.
55. RESPONSE 5: I've forgotten what I was going to say.
56. RESEARCHER: I'll come back.
57. RESPONSE 6: They might not have anyone to encourage them to do it.
58. RESPONSE 7: I don't know.
59. RESEARCHER: Does anyone have anything else which they'd like to add?
60. RESPONSE 1: I enjoyed it.
61. RESEARCHER: Right, thank you very much boys.

SUMMER TERM - FOCUS GROUP 6

1. RESEARCHER: Focus group six on Monday the 22nd June 2015. First question, why do you take part in physical activity and exercise?
2. RESPONSE 1: Because I want to stay healthy and fit.
3. RESPONSE 2: Because I want to be more healthy and stay fit.
4. RESPONSE 3: Because I don't want to go fat or anything or obese.
5. RESPONSE 4: So I can keep on doing activities and not get like get fat.
6. RESPONSE 5: I chose to do it so when I'm well more old and wrinkly, I can do more things.
7. RESEARCHER: And where do you like going to do your physical activity and exercise?
8. RESPONSE 1: We have a gym at home and behind my house there's these massive fields so me and my dad go running there.
9. RESPONSE 2: I like to go to the park or the field by my house.
10. RESPONSE 3: I go bike riding with my dad, I go swimming on a Wednesday and I go running with my mum.
11. RESPONSE 4: I go to football and I go to Redditch lifesavers.
12. RESPONSE 5: I just go crazy on my bike until I run out of breath and can't get up.
13. RESEARCHER: Okay, all of you have mentioned a range of different venues where you go, why do you choose to visit those particular venues?
14. RESPONSE 1: The field behind my house is like really really really big, and there's football poles there so when I get tired I just like to sit on the poles and eat food.
15. RESPONSE 2: Because there's lots to do there.
16. RESPONSE 3: I like going swimming because I like going in the water, and I like going on my bike because well I like pushing my bike pedals and I go running with my mum so I can race her.

17. RESPONSE 4: I like going swimming and football because you don't stop, it's just like you're always active.

18. RESPONSE 5: I forgot what the question was.

19. RESEARCHER: Why do you choose to be physically active at those venues?

20. RESPONSE 5: Oh it's just because I don't want to get fat, because if you're fat then no-one likes you and I want to be liked.

21. RESEARCHER: Okay, who do you go with to do your physical activity and exercise?

22. RESPONSE 1: Sometimes I go with my dad, and sometimes I go with my mate who lives across the street from me.

23. RESPONSE 2: I go with my dad and my friends and my little brother.

24. RESPONSE 3: I go with my dad bike riding and I go with my mum to have races, and then I go with my dad or mum swimming.

25. RESPONSE 4: I go with my dad to football because he is one of the coaches there, and then I go with my mum to swimming so she watches me and stuff.

26. RESPONSE 5: I go with my friends when I ride my bike.

27. RESEARCHER: Okay, obviously this is the third and final time when you've worn the GPS equipment, have you visited any other location for physical activity since the last time you wore the equipment? And if you have, what caused you to visit this new location? So have you been anywhere new? And if so, what has caused you to visit the new area?

28. RESPONSE 1: I went to Malvern, I think it was a couple of days ago I think with my mum, my dad and my brother, because the last time we went was last year and we wanted to go again this year.

29. RESPONSE 2: I didn't really go anywhere new.

30. RESPONSE 3: I've been to the park. I don't think I've been anywhere else.

31. RESPONSE 4: I went to Lickey Hills and walked the dogs and stuff.

32. RESPONSE 5: We often do stuff at this club called Brownies, so we places and do there.

33. RESEARCHER: Are there any other changes you can think of which would improve student's physical activity? So how can we get you more active?

34. RESPONSE 1: I think we could encourage people to do more by like say that if they really like their bed, then we could put their bed at the end of a racing track so there's something like they're getting somewhere to work hard or something.

35. RESPONSE 2: Probably ask them what they would like to do, like what sports they like. RESPONSE 3: To encourage them to keep fit.

36. RESPONSE 4: To get them more active and like more sports.

37. RESPONSE 5: There was this time when we were on the field and in topic when we were looking around through all these books and we ran around looking for them which got us a bit of exercise.

38. RESEARCHER: Okay, final question, what barriers are there which stops students from being physically active? So what stops you from getting active?

39. RESPONSE 1: Friends, say that you want to do something active and they just want to like sit around and do something, that stops them from doing what they want.

40. RESPONSE 2: Maybe their parents being busy so they can't really take them anywhere.

41. RESPONSE 3: Classrooms really, because sometimes you just have to sit and down and you won't get to keep active much.

42. RESPONSE 3: I've got asthma so it like stops you from, like sometimes it damages your lungs.

43. RESPONSE 4: Technology.

44. RESEARCHER: Has anyone else got anything which they'd like to add?

45. RESEARCHER: Okay, thank you very much girls.

Appendix 12 Study 3: Focus groups transcripts.

POST INTERVENTION FOCUS GROUP 1

1. RESEARCHER: Focus group post intervention on the fifteenth of March 2016. First of all thank you for taking part in the study. And the first question is what was your favourite lunchtime activity club?
2. RESPONSE 1: Prisoner.
3. RESPONSE 2: I like prisoner too.
4. RESPONSE 3: Prisoner.
5. RESPONSE 4: Prisoner.
6. RESPONSE 5: Table tennis.
7. RESPONSE 6: Football.
8. RESPONSE 7: Football.
9. RESPONSE 8: Prisoner.
10. RESPONSE 9: Football.
11. RESEARCHER: Okay, so you've all come to a different club there, you've all given different answers, what impact has those clubs and the other clubs, what impact have they had on you? So for example, do you play that sport outside of school? Have you been encouraged to play it on the playground before school with your friends? What impact has it had? Anyone?
12. RESPONSE 1: Not really anything to me.
13. RESEARCHER: Because it's prisoner and dodgeball isn't it?
14. RESPONSE 2: It's had an impact as to where I have started to play table tennis because I play at a local park now.
15. RESEARCHER: Oh right.
16. RESPONSE 3: Just encouraged me to pay football outside of school.
17. RESEARCHER: And where do you play?

18. RESPONSE 3: Studley.
19. RESEARCHER: So you play for a club outside of school?
20. RESPONSE 3: Yes.
21. RESEARCHER: Okay brilliant. Anyone else? That leads us into the third question really, has the start of these clubs affected your participation outside of school? So did you start playing table tennis outside of school because of the table tennis club in school or did you play before?
22. RESPONSE 1: Yes.
23. RESEARCHER: So it was actually the start.
24. RESPONSE 1: We did play before I actually came to this school, because Mr Barnes let me.
25. RESEARCHER: Right okay, and then because you've started playing here now, now you play outside of school as well?
26. RESPONSE 1: Yes.
27. RESEARCHER: Right and has anyone else had that? Has anyone else gone to a club here and thought I play.
28. RESPONSE 2: Yes I play dodgeball outside of school.
29. RESEARCHER: And where do you play that?
30. RESPONSE 2: On some grass.
31. RESEARCHER: Yes and how about some of the other sports because there's quite a range there. There was football, circuit training, dodgeball, table tennis.
32. RESPONSE 3: Circuits has made me better at sports and circuits.
33. RESEARCHER: So it's improved you? What do you think
34. RESPONSE 4: A bit of the circuit training because now I know how to keep like fitter in school and I know what to do and that. And all the fitness and techniques and that.
35. RESEARCHER: So has that had an impact on your main sport?
36. RESPONSE 4: Yes it's helped me get more fitter, and other stuff.

37. RESEARCHER: Okay, what was a good point about the lunchtime activity clubs? What was a good point, what did you love about them?
38. RESPONSE 1: It made it more fun lunchtime.
39. RESEARCHER: Made lunchtime more fun.
40. RESPONSE 2: You get to throw balls at the year 8's.
41. RESEARCHER: So you enjoyed playing with different year groups?
42. RESPONSE 3: You were active.
43. RESPONSE 4: I enjoyed having a challenge.
44. RESEARCHER: What was your favourite thing about having lunchtime activity clubs?
45. RESPONSE 5: It's fun.
46. RESPONSE 6: It stops you from being bored on the playground.
47. RESPONSE 7: Everyone gets involved as a team.
48. RESPONSE 8: You start doing more P.E and more fitness and getting more fit.
49. RESPONSE 9: It's different from stopping outside every day.
50. RESPONSE 10: You've got something to do instead of just being bored.
51. RESEARCHER: Yes okay, thank you for those answers, what then is something which could have been improved? Can you think of anything which you think may have improved the lunchtime clubs?
52. RESPONSE 1: That we could do two of the clubs outside of school as well.
53. RESEARCHER: Right okay, like after school as well?
54. RESPONSE 1: Yes.
55. RESEARCHER: Right anything else, anything else which you can think of which we could do to improve?
56. RESPONSE 2: Put different kinds of clubs on as well instead of other clubs.
57. RESEARCHER: So for example?

58. RESPONSE 2: Like basketball because I like basketball.

59. RESEARCHER: Okay, anybody else, anything we could do to improve? No, okay, are there any other clubs which you'd like to see?

60. RESPONSE 1: Basketball.

61. RESPONSE 2: Hockey.

62. RESEARCHER: Hockey at lunchtime? Yes.

63. RESPONSE 3: Fencing. I've always wanted to do that.

64. RESPONSE 4: Rounders.

65. RESEARCHER: Rounders. Go on then.

66. RESPONSE 5: Ice hockey.

67. RESEARCHER: Ice hockey, any other clubs that you'd like to see?

68. RESPONSE 6: Cricket.

69. RESEARCHER: A cricket club.

70. RESPONSE 7: Softball.

71. RESPONSE 8: Netball.

72. RESPONSE 9: Ballet.

73. RESPONSE 10: Tennis.

74. RESPONSE 11: Benchball, badminton.

75. RESPONSE 12: Baseball.

76. RESEARCHER: So quite a few, you'd like to see a range of clubs I think. Right okay, so this is the start of the clubs and in January this was the start of these clubs. Would you like to see these clubs continued? Would you like to see them carry on in the future?

77. RESPONSE AS A WHOLE: Yes.

78. RESEARCHER: And why would you like to see thee clubs continued in the future? Can you tell me why?

79. RESPONSE 1: Because if you do it more you could improve yourself at it.

80. RESPONSE 2: And it’s fun.

81. RESPONSE 3: It improves like your skills.

82. RESPONSE 4: Other kids get to have the chance to do some of these clubs.

83. RESEARCHER: Any other reasons why?

84. RESPONSE 5: Other kids coming up get to have a taste of the stuff we do.

85. RESEARCHER: Yes. Anything else folks? Any other reasons why you’d like to see them carry on? So you’d all like to see them carry on though?

86. RESPONSE AS A WHOLE: Yes.

87. RESEARCHER: Right okay, that’s brilliant. Thank you very much indeed folks, that’s brilliant.

POST INTERVENTION FOCUS GROUP 2

1. RESEARCHER: Focus group post intervention two on the sixteenth of March 2016. First of all thank you for taking part in the study folks. Question one is what was your favourite lunchtime activity club?
2. RESPONSE 1: Mine was probably the football.
3. RESPONSE 2: Mine was the football as well.
4. RESPONSE 3: Yes same football.
5. RESPONSE 4: Footy.
6. RESPONSE 5: Football.
7. RESPONSE 6: Football.
8. RESPONSE 7: Football.
9. RESPONSE 8: Prisoner.
10. RESPONSE 9: Football.
11. RESEARCHER: Okay, so we've got a range, a small range, a lot of football of different clubs which is fine. Okay, so what impact have the different lunchtime clubs made? What impact have the different lunchtime clubs made?
12. RESPONSE 1: It's quite good because of the range of different clubs so you don't have to the one every time, you can do different ones.
13. RESPONSE 2: It makes me want to be more active.
14. RESPONSE 3: Say people like to do different sports so like do one club and not the other.
15. RESPONSE 4: It's been alright yes.
16. RESPONSE 5: It's like something to do when it's cold outside or it's raining and you can come in and stay warm and do clubs.
17. RESPONSE 6: Like anyone can come and play when it's cold and have fun.
18. RESPONSE 7: They're still like encouraging you to be active, yes it could be raining but you could still be doing sport. You don't have to be sat in a classroom.

19. RESPONSE 8: Yes you can just keep warm.

20. RESPONSE 9: It makes lunchtimes more interesting.

21. RESEARCHER: Right, and has the start of these lunchtime activity clubs affected your sport participation outside of school? Maybe on the weekends, or when you meet your friends? Have you done anything differently?

22. RESPONSE 1: Yes, I've been more active with my friends outside of school.

23. RESPONSE 2: Yes, I've been playing out with my friends as well, but I do like swimming and taekwondo.

24. RESPONSE 3: Yes, I've just been practicing, trying to get my skills better.

25. RESPONSE 4: Yes, sort of has, because I've been out with my friends more.

26. RESPONSE 5: I've been out with my friends more since doing them.

27. RESEARCHER: Okay.

28. RESPONSE 6: Yes, it's opened me up to a different range of sports so I've started doing stuff other than football.

29. RESPONSE 7: I've started doing other stuff, like I've started doing different clubs.

30. RESPONSE 8: I've started playing out a bit more.

31. RESEARCHER: I think it's funny some of you have said that and one of the things last year some of you were saying were to do with circuit training as a physical activity and an intense activity which I know some of you have been attending, so that's a different activity which I know some of you went to as well isn't it. Okay, can you tell me, what were the good points about these clubs?

32. RESPONSE 1: Probably one of the best things was not having to go outside if it was cold or wet, you could actually do something instead of staying in the classroom.

33. RESPONSE 2: It teaches you how not to be lazy and how to keep fit as well but have fun at the same time.

34. RESPONSE 3: Some people might just stand there talking to their friends so it keeps them active as well.

35. RESPONSE 4: Keep you active and you can stay inside and keep warm and play sport.

36. RESPONSE 5: There's something to do so you don't get bored in classrooms.

37. RESPONSE 6: It's just a way of staying warm whilst doing sports and instead of going outside and freezing and all that.

38. RESPONSE 7: You get to keep warm and you're still getting active.

39. RESPONSE 8: You get to keep warm but you get to hang out with your friends and you're doing more active than sitting around in the playground.

40. RESPONSE 9: Makes you active and keeps you warm at the same time.

41. RESEARCHER: Okay, what is something which you think could be improved then?

42. RESPONSE 1: Maybe some more clubs on the days instead of the three. A couple more?

43. RESPONSE 2: It could be a bit longer the sessions because there might not be much time to play your favourite activities really.

44. RESPONSE 3: I agree with Aaron, just a few more clubs probably.

45. RESPONSE 4: Longer sessions and put a limit on how many can come because dodgeball there's too many. It's like you can't hardly move around. It's really irritating, because you've got year 5's running everywhere.

46. RESPONSE 5: More support because in dodgeball there seems to be loads of cheaters.

47. RESPONSE 6: Teams to be fair, there could be a whole group of year 5's against a whole group of year 8's, and they'll just get out strengthened.

48. RESPONSE 7: It's not a wrestling match!

49. RESEARCHER: Like balanced teams?

50. RESPONSE: 8 Yes.

51. RESPONSE 9: It's all good so far, you just need a rowing club.

52. RESEARCHER: A rowing club.

53. RESPONSE 10: No please we need a rowing club, I'm actually begging.
54. RESPONSE 11: Rowing's really bad, I hate it.
55. RESPONSE 12: It's fun.
56. RESEARCHER: Anything else?
57. RESPONSE 13: I think we need more like longer sessions.
58. RESPONSE 14: I think we should add more clubs and make them better.
59. RESPONSE 15: I want a running club.
60. RESEARCHER: A running club?
61. RESPONSE 16: Yes that would be quite good. We used to have one.
62. RESEARCHER: Well that leads into my next question which is what other clubs would you like to see? So what other sports clubs would you like to see at lunchtimes?
63. RESPONSE 1: I think just more of a range.
64. RESPONSE 2: Just more variety really.
65. RESPONSE 3: A swimming club would be nice.
66. RESPONSE 4: I can't think of any.
67. RESPONSE 5: More of a variety like hockey and stuff like that.
68. RESPONSE 6: Four way.
69. RESEARCHER: Any other clubs you'd like to see guys?
70. RESPONSE 7: Basketball.
71. RESPONSE 8: Running.
72. RESPONSE 9: Hockey, athletics, rounders.
73. RESPONSE 10: Four way club.
74. RESPONSE 11: That's actually a good idea.

75. RESPONSE 12: An athletics club like a mixture of running, high jump, long jump, sprints, javelin and maybe like a cross country club. Get yourself in for cross country and get ready.
76. RESEARCHER: Okay, final question, would you like to see these clubs continued in the future?
77. RESPONSE AS A WHOLE: Yes.
78. RESEARCHER: And if you would, why do you want to see them continued in the future?
79. RESPONSE 1: Lunchtime is boring and you have fun there.
80. RESPONSE 2: It's fun there.
81. RESPONSE 3: Teachers are nice there.
82. RESPONSE 4: It's like if football is banned, you can just go and play football.
83. RESPONSE 5: It's good to get lazy people doing it, it might get them like more active.
84. RESPONSE 6: Some of the clubs are really good and need to be continued because mixed abilities, you can transfer that ability to a different game. That's why I like the ones we have now. Example, football, teamwork, that can be transferred to every other game.
85. RESEARCHER: Has anyone else got anything they want to add before we finish? Right, okay, thank you very much folks.

Appendix 13 Study 3: Intervention Calendar.

January 2016						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	**4** **TED DAY**	**5** **ADVERTISE CLUBS**	**6** **DODGEBALL** **HAND OUT**	**7** **COLLECT CONSENT FORMS**	**8** **COLLECT CONSENT FORMS**	9
10 **GROUP 1**	**11** **KS2 FOOTBALL**	**12** **BASELINE** **TEST**	**13** **DODGEBALL**	**14** **BASELINE** **TEST**	**15** **TABLE TENNIS**	16
17 **GROUP 2**	**18** **KS2 FOOTBALL**	**19** **KS3 FOOTBALL**	**20** **DODGEBALL**	**21** **CIRCUIT TRAINING**	**22** **TABLE TENNIS**	23
24 **GROUP 3**	**25** **KS2 FOOTBALL**	**26** **KS3 FOOTBALL**	**27** **DODGEBALL**	**28** **CIRCUIT TRAINING**	**29** **TABLE TENNIS**	30

31						

February 2016

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<u>GROUP 4</u>	**1** **KS2 FOOTBALL**	**2** **KS3 FOOTBALL**	**3** **DODGEBALL**	**4** **CIRCUIT TRAINING**	**5** **TABLE TENNIS**	6
7 **<u>GROUP 1</u>**	**8** **KS2 FOOTBALL**	**9** **KS3 FOOTBALL**	**10** **DODGEBALL**	**11** **CIRCUIT TRAINING**	**12** **TABLE TENNIS**	13
14	**15** **Half Term**	**16** **Half Term**	**17** **Half Term**	**18** **Half Term**	**19** **Half Term**	20
21 **<u>GROUP 2</u>**	**22** **KS2 FOOTBALL**	**23** **KS3 FOOTBALL**	**24** **DODGEBALL**	**25** **CIRCUIT TRAINING**	**26** **TABLE TENNIS**	27

28 **GROUP 3**	**29** **KS2 FOOTBALL**					

March 2016

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
GROUP 3		**1** **KS3 FOOTBALL**	**2** **DODGEBALL**	**3** **CIRCUIT TRAINING**	**4** **TABLE TENNIS**	5
6 **GROUP 4**	**7** **KS2 FOOTBALL**	**8** **KS3 FOOTBALL**	**9** **DODGEBALL**	**10** **CIRCUIT TRAINING**	**11** **TABLE TENNIS**	12
13	**14** **FOCUS GROUP 1**	**15** **FOCUS GROUP 2**	**16**	**17**	**18**	19

20	**21**	**22**	**23**	**24**	**25** **Easter Holiday**	26
27	**28** **Easter Holiday**	**29** **Easter Holiday**	**30** **Easter Holiday**	**31** **Easter Holiday**		

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