PhD thesis

Exploring the contributions of Barnet's Golden Kilometre intervention to primary school pupils' physical literacy development

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Exploring the contributions of Barnet's Golden Kilometre Intervention to Primary School Pupils' Physical Literacy development

A Thesis Submitted to the Faculty of Science and Technology, Middlesex University in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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Abstract

This thesis forms part of a funded research project with Public Health Barnet exploring the impact a primary school run/walk intervention has on developing pupils' physical literacy (PL). The Barnet's Golden Kilometre intervention was developed as a feasible, low-cost initiative, involving primary school children walking, jogging or running one km every day whilst at school. It has been demonstrated that PL is more important than purely physical elements regarding the maintenance of a healthy lifestyle. Identifying initiatives that are likely to encourage progression in the domains of PL (affective, cognitive and physical) from a young age is deemed important to encourage regular physical activity (PA) participation throughout life. The initial study of this thesis determined that no current literature examining school-based run/walk programmes has considered all three domains of PL. Outcomes relating to the physical domain were most commonly explored, and no studies explored the cognitive domain. Based on these initial findings, the thesis examined the PL and PA related effects of participating in Barnet's Golden kilometre over one academic year were. The combined findings revealed that mixed responses were reported following one academic year of participation, and that the intervention may not be universally suitable due to factors such as variation in age, ability and initial PL. However, when implementation is successful, improvements in perceived and actual physical competence (physical domain), improved thoughts and feeling towards exercise (affective domain), improvements in knowledge and understanding of healthy eating and exercise (cognitive domain), as well as health related outcomes (BMI, BF% and waist circumferences) can be observed. In order to encourage positive PL experiences and the benefits reported herein, it is recommended that future research considers the youth promotion model within the Boroughs policy promotion and to help schools understand the valuable role they play in intervention implementation and adaption.

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List of abbreviations

APLF = Australian physical literacy framework
BF% = Body fat percentage
BMI = Body mass index
CAPL= Canadian Assessment for Physical Literacy
CE = Cardiovascular endurance
CF = Cardiovascular Fitness
COREQ = Consolidated criteria for reporting qualitative research
COVID-19 = Coronavirus disease 2019
ED = Estimated difference
FMS = Fundamental movement skills
IG = Intervention group
IG3 = Intervention performed 2.5 times per week
IPG = Intervention-plus group
IPLA = International Physical Literacy Association
LPA = Light physical activity
LMS= Lambda-mu-sigma
MD = Mean difference
MK = Marathon Kids
MVPA = Moderate to vigorous physical activity
NHS = National Health Service
PA = Physical activity
PE = Physical education
PEDro = Physiotherapy Evidence Database
PICO = Population Intervention Control Outcome
PL = Physical literacy
PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SED = Sedentary time
SPA = Self-Paced Activity
SRT = Shuttle run tests
TDM = The Daily Mile
TGDM-3 = Test of gross motor development 3rd edition
TGMD = Test of gross motor development
TGMD-2 = Test of gross motor development 2nd edition
TIDieR = The intervention description and replication checklist
VPA = Vigorous physical activity
WHO = World Health Organisation
UK = United Kingdom

Chapter One: Thesis introduction

1.1 Introduction

The more physically active an individual is, the greater the health benefits associated but even small increases in physical activity (PA) can lead to positive health-related outcomes (Cabinet Office *et al.,* 2017; World Health Organisation, 2022). Encouraging regular PA from a young age is particularly important to develop muscle strength and healthy bones and prevent health implications associated with prolonged sedentary behaviour in adulthood. Reviews of PA in youth (<18 years) have found regular participation can contribute to maintained healthier weight status, improved cognitive function (e.g. Attention and academic performance (de Greeff *et al.,* 2018), improved social and emotional well-being (Rodriguez-Ayllon *et al.,* 2019; Kliziene *et al.,* 2021), reduced depression/depressive symptoms (Biddle *et al.,* 2019; Dale *et al.,* 2019) and reduced risk of other health related outcomes such as diabetes and heart disease in later life (Biddle *et al.,* 2019). However, even with the known benefits of PA, and programmes to encourage activity for children and adults, the levels of inactivity are increasing worldwide with more than 81% of children 11-17 years participating in less than one-hour PA per day (World Health Organisation, 2022). The decline in PA globally is linked to an increase in sedentary behaviours at school and home, limited active recreational and leisure time, and increased modes of transport/ reduced active travel (World Health Organisation, 2022). Today, the United Kingdom (UK) Chief Medical Officer guidelines and World Health Organisation (WHO) recommend that a child aged five - 17 years works towards achieving an average of 60 active minutes per day of moderate to vigorous PA (MVPA) over one week. This time should include a range of activities such as physical education (PE), active transport, school clubs, leisure and recreational sports to help develop motor competency skills (Public Health England, 2021). Within a day, it is also recommended children maintain PA including light physical activities (walking, light skipping etc) to limit sedentary behaviour where possible. In the UK statistics show many children are failing to meet the PA guidelines (55.1% of 5 – 18-year olds) and reap the benefits of maintained participation (Public Health England, 2021). For children and young people, the barriers and facilitators to PA participation have been widely explored (Dobbins *et al.,* 2013; Hesketh, Lakshman and van Sluijs, 2017; Somerset and Hoare, 2018; Messing *et al.,* 2019). As children grow, PA participation declines, more so in adolescent girls than boys (Basterfield *et al.,* 2016; Hesketh, Lakshman and van Sluijs, 2017; Somerset and Hoare, 2018). Whilst difficult to quantify, it is apparent that children are not active enough to achieve the benefits associated with leading a healthy active lifestyle. Given the array of benefits of regular PA participation, finding ways to encourage children to be active and maintain these regular-healthy habits into adolescents and adulthood are paramount (Hesketh, Lakshman and van Sluijs, 2017; Public Health England, 2017; Brown *et al.,*2019).

Schools have been identified as essential environments for contributing to children's daily PA levels (Dobbins *et al.,* 2013; Naylor *et al.,* 2015; Shah *et al.,* 2017; Jones *et al.,* 2020). According to the UK Government Childhood Obesity Plan and PA data tools (Cabinet Office *et al.,* 2017), at least 30 mins of a child's 60 minutes MVPA should be achieved during school time. However, with increasing curricular pressures on schools, PE and the opportunity for active play are often not prioritised (Jones *et al.,* 2020). School-based PA programmes are offered as an opportunity for pupils to be active throughout the school day outside of PE lessons, including during break-time and in active classes (Jones *et al.,* 2020). Existing systematic reviews and meta-analyses of school-based PA programmes have reported the effects of participation, including improved; PA and/or Sedentary behaviours (Dobbins *et al.,* 2001; Kriemler *et al.,* 2011; Hynynen *et al.,* 2016; Owen *et al.,* 2017; Jones *et al.,* 2020), Motivation (Dobbins *et al.,* 2013; Kelso *et al.,* 2020), MVPA (Dobbins *et al.,* 2013), and

academic related outcomes (Watson *et al.,* 2017). Although, the significance of these outcomes has varied, and often only small changes have been observed in PA. For example, Dobbins *et al.* (2013) found some evidence for improvement in MVPA, although with small effect (range from increased five to 45 minutes per day for intervention participating groups). Whilst a more recent review by Jones *et al.* (2020) found no evidence for improvements in MVPA and inconclusive results for sedentary time. In addition, many of these PA interventions that aim to tackle broader determinants of PA are reported to be difficult to implement and are not always implemented as intended, which could affect the PA related outcomes (Okely *et al.,* 2017; Taylor *et al.,* 2018). Research has shown limited time, curriculum pressures for teachers and staff, the need for external bodies, and reliance on continued funding to be just a few of the limiting factors contributing to reduced intervention implementation and sustainability in school PA interventions (Naylor *et al.,* 2015; Gråstén, 2017; Okely *et al.,* 2017; Van den Berg *et al.,* 2017; Weatherson *et al.,* 2017; Larouche *et al.,* 2018; Taylor *et al.,* 2018).

School-based intervention research has consistently made recommendations for the design and completion of PA interventions to combat these limitations and ease the pressures on school schedules, some of these include: being based on evidence and pilot tested in the environments, and identifying and reporting on programme fidelity and adopting theoretical approaches/ comprehensive framework to identify core elements that influence implementation (Smedegaard *et al.*, 2016; Shah *et al.*, 2017; Nathan *et al.,* 2018; Brown *et al.,* 2019; Faghy *et al.,* 2021; Nilsen, 2020). These recommendations fall in line with the WHO Global Activity Plan (2018-2030) which has highlighted the importance of systems-based approaches to prioritise feasibility and speed of implementation schemes. The Global Activity action plan (2018-2030) reports the importance of evidence-based practice to inform and support policy by providing monitoring and evaluation tools that can support the implementation of PA initiatives (World Health Organization, 2018). The recently published UK policy paper 'Get Active' (2023) also outlines the value of evidence to understand successful interventions, and highlights the importance of inclusion in PA and developing lifetime engagement from childhood (Department of Culture Media & Sport, 2023).In terms of intervention designs, having a simple design, require little or no preparation time, require minimal equipment, having minimal or low costs and being time-efficient to complete are all factors that can contribute to successful implementation and continued participation in school-based PA settings (Gråstén, 2017; Van den Berg *et al.,* 2017; Larouche *et al.,* 2018). Many PA interventions have already been developed which have been shown to be successful in meeting many of these factors (Nathan *et al.,* 2018), yet they do not reach many schools across the UK, or children for whom PA/ health continues to be of concern (Cabinet Office *et al.,* 2017).

In recent years, school-based run/walk programmes have gained popularity, and involve children walking, jogging or running a marked route on school grounds for either a set distance or time (Chalkley *et al.*, 2018a; Chalkley *et al.,* 2020b; Sherar *et al.,* 2020). School-based running programmes are often also referred to at a policy level as 'active mile initiatives', which typically entail running for approximately 15 minutes at a self-selected pace until a one-mile distance is covered (Chalkley *et al.,* 2020b; Public Health England, 2020a; Sherar *et al.,* 2020; The Daily Mile 2022). Due to the self-select nature and variation in pace, the programmes are referred to in this thesis as 'run/walk interventions' rather than solely 'running'. Research has found school-based run/walk interventions such as The Daily Mile™ (TDM) (Harris, Milnes and Mountain, 2020; Marchant *et al.,* 2020) and Marathon Kids (MK) (Chalkley *et al.,* 2018b; Chalkley *et al.,* 2020a) offer schools a flexible and straightforward approach to encouraging daily PA without needing additional equipment, staff training or funding to implement, all of which are previously noted as important factors for continued

intervention participation (Naylor *et al.*, 2015). There are now also a number of national and local policies supporting the implementation of this intervention type due to its design and inclusivity for all children as participation does not require any specific sports skill (Public Health England, 2020b; Sherar *et al.*, 2020). The UK Government Childhood obesity: A plan for action report (The Department for Education, 2020), Chapter 2 (The Department of Health and Social Care, GOV. UK, 2019) and the School Sport and Physical Activity Plan 2019 and 2023 (Department for Education, Department for Digital, Culture, Media & Sport, and Department of Health and Social Care, 2019) Department for Education, Department for Digital, Culture, Media & Sport, and Department of Health and Social Care, 2023) all promote the implementation of school-based run/walk interventions like TDM as a method achieving PA targets (Public Health England, 2020a; Public Health England, 2020b; Sherar *et al.*, 2020). Most recently, the UK 'Get Active' strategy encouraged schools to "embrace programmes that help pupils meet the Chief Medical Officers guidelines" (p.30) and referenced TDM as a programme to achieve this (Department of Culture Media & Sport, 2023). The policy backing, public funding rewards and advertisement generated for these initiatives has meant more schools are now taking part each day across the UK and globally (Department of Culture Media & Sport, 2023; Thorburn, 2020). Since its launch in 2012, TDM in particular has grown significantly in popularity in the UK and across the world with approximately 7,666 schools in England alone participating each day (The Daily Mile, 2022).

The rapid uptake in the run/walk initiatives highlights the need for investigation into the outcomes of regular participation and how it contributes to PA habits from a young age. Over the last few years, there has been an increase in studies investigating run/walk interventions like TDM and MK, and results have shown promising findings. The research that exists has provided insight into pupil and parental experiences and, school and teacher perspectives including practicalities, feasibility and delivery as well as process evaluations and implementation science (Chalkley *et al.*, 2018b; Ryde *et al.*, 2018; Malden and Doi, 2019; Chalkley *et al.*, 2020b; Harris, Milnes and Mountain, 2020; Schirmer *et al.*, 2023). The studies have shown the interventions to be simple for schools to conduct and requires minimal additional planning whilst still allowing adaptations for each school's specific context to sustain participation (Chalkley *et al.*, 2018b; Chalkley *et al.*, 2020b; Harris, Milnes and Mountain, 2020). Some studies report improved fitness (means difference 0.437m in shuttle run scores) (Chesham *et al.*, 2018a), muscular endurance (11% improvement in performance) (Mønness and Sjølie, 2009), well-being (Breheny *et al.*, 2020), mental health (Arkesteyn *et al.*, 2022) and pulmonary function (p=.06) (Mainous *et al.*, 2023). However, there is still a lack of robustness within the findings due to small sample sizing, favouring quantitative design with few qualitative and sparse mixed-methods (Breslin *et al.*, 2023). Without these tools there is limited capture of actual intervention experiences from implementation and participation levels, lack of clarity on implementation style, and lack of randomization leading to concerns surrounding study sample bias (Breslin *et al.*, 2023). Chesham *et al.* (2018) is also the only study to consider daily PA at the time of the policy backing and promotion of TDM (increase of 9.1min PA per day) with little research exploring wider contributions such as, motor competencies and qualitative outcomes, some of which are associated with maintained participation in physical activities. Additionally, some studies have raised concerns around initiatives like TDM questioning the long-term impacts and potential negative experiences children could endure from boredom or the idea of 'compulsory exercise' (Fairhurst and Hotham, 2017; Daly-Smith *et al.*, 2019). At the time of the thesis proposal there was limited knowledge on the impacts of participation over an academic year in run/walk interventions and research has called for further analysis on the potential long-term, cognitive and mental health related impacts these interventions have on primary aged children (Breheny *et al.*, 2020; Booth *et al.*, 2022; Breslin *et al.*, 2023).

A concept proposed that considers the physical as well as psychological components that contribute to long-term PA participation is physical literacy (PL). PL is commonly defined as "The motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" (IPLA, 2017). Whitehead (2001) states that the concept covers a variety of movements and physical and psychological skills that go beyond solely competitive sports participation and instead, represents a holistic approach to PA, considering the lifelong processes associated with participation (Edwards *et al.,* 2017; Whitehead, 2001). Although, there are different definitions of PL that encompass different perspectives on the PL concept, many share commonalities through reference to the work of the International Physical Literacy Association (IPLA) or Whiteheadian views of PL (Edwards *et al.,* 2017; Cornish *et al.,* 2020; Liu, Yang and Chen, 2021; Martins *et al.,* 2022). The IPLA definition highlights the core domains of PL that contribute to lifelong PA, namely the affective, cognitive and physical attributes. This was adapted from Whiteheads work and the language has been altered for ease of interpretation and focus on engagement for life (IPLA, 2017). The core principles of PL, which these domains encompass, remain the same and are reflected across different interpretations (Motivation, confidence, physical competence, knowledge and understanding) (Edwards *et al.,* 2017; IPLA, 2017). There is growing interest in the concept of PL as a gateway to life-long PA engagement (Longmuir *et al.,* 2015; Edwards *et al.,* 2017). Developing the core principles of PL (affective, cognitive and physical) is thought to be critical during childhood in order to develop lifelong PA participation which should be developed through PE and PA experiences (Belanger *et al.,* 2018; Shearer *et al.,* 2021). A pragmatic approach to PL seeks to identify progression in these principles to provide evidence to inform PE and PA practise (Hempenstall, 2006; Cook and Odom, 2013; Edwards *et al.,* 2017; Green *et al.,* 2018). Children with greater PL are also more likely to meet daily PA guidelines (Cornish *et al.,* 2020). Schools and school-based PA interventions should enable children to engage in positive experiences across a variety of activities that contribute to PL embodiment and lifelong PA participation (Tremblay, Mark and Lloyd, 2010; Green *et al.,* 2018). Engaging in meaningful PA experiences will provide children with the opportunity to develop and nurture their PL; in doing so, they also then contribute to developing regular PA habits (Whitehead, 2001; Durden-Myers and Whitehead, 2018). However, there are limited studies that consider PL experiences in already developed PA intervention settings so it is unclear if these interventions could contribute to positive experiences which can enable the opportunity for development in confidence, competence, motivation, knowledge and understanding for lifelong PA engagement.

An individual progressing within their PL journey is more likely to enjoy PA participation, understand the importance of engagement, and participate in a range of activities across a variety of environments with others or alone (Whitehead, 2019). In the School Sport and Physical Activity Action Plan (Department for Education, Department for Digital, Culture, Media & Sport, and Department of Health and Social Care, 2019), PL is also included as a core feature of children's school experiences and PA participation. When provided with the opportunity to meaningfully engage in PA, children can begin to refine and develop their PL capabilities allowing meaningful embodiment within the context and environments (Edwards *et al.,* 2017; Cairney *et al.,* 2019a; Whitehead, 2019; Rudd *et al.,* 2020). It is thought that creating positive daily PA habits in schools could contribute to an increased likelihood of developing a lifetime habit of PA (Department for Education, Department for Digital, Culture, Media & Sport, and Department of Health and Social Care, 2019). However, negative experiences can also create reversal in PL development and negatively impact PA experiences (Jurbala, 2015; Whitehead, 2019). Despite the encouragement of these run/walk interventions, some researchers have raised concerns for negative PA experiences associated with continued running or concerns of ‘forced PA’ which could negatively impact a child’s PL (Fairhurst &

Hotham, 2017; Daly-Smith *et al.*, 2019; Thorburn, 2020). It is important for research to identify if and in what way these interventions impact PL for children (both positive and negative) in order to understand lifelong PA engagement and inform Public Health policy. Therefore, identifying how school-based PA interventions contribute to the enhancement of PL would provide valuable insight into the development of lifelong PA related healthy habits. Run/walk interventions are one example of a simple teacher led intervention that many schools already take part in. Understanding the potential contributions these interventions may have on pupils' PL qualities, could provide important insight to policy makers and schools regarding contributions toward lifelong PA engagement, obesity reduction, and policy design for behaviour change. To date, there is no available research exploring PL experiences in relation to school-based run/walk interventions that capture from both children and teacher perspectives. Therefore, the overall aim of this thesis is to explore the effects of Barnet's Golden Kilometre on primary school pupils' PL in order to contribute to the research and policy on lifelong PA engagement and health benefits associated. Specifically, the chapters in this thesis aim to explore which PL components have been examined in school-based run/walk programmes in order to identify gaps in the literature and areas where further research is needed. Then, the thesis turns to explore the PA related health outcomes and PL related effects of participation in Barnet's Golden Kilometre for primary schools' pupils after one school academic year, with insight from teacher and pupil perspectives. The results of this thesis could contribute to policy design where these initiatives currently feature, and guide intervention design that considers life-long PL qualities.

1.2 COVID-19 Impact statement

Due to the Coronavirus (COVID-19) outbreak in winter 2019- 2020 all UK schools were closed from March 20th 2020 and teaching took place remotely. All baseline data collection measures for studies intended to be conducted from March and throughout the remainder of the school academic year and had to be cancelled in line with UK Government Health and Safety guidelines at the time.

During the period of school closure, the thesis project focused on developing the ethical application and intervention design to follow UK Government and WHO social distancing/ COVID-19 guidelines ready for schools reopening. The alterations to the ethics application included updated risk assessment documents, updated data collection measures to adhere to social distancing rules and the introduction of an intervention Health and Safety document for distribution to participating schools. The Health and Safety document was designed in partnership with Public Health Barnet and approved internally by their risk assessment team as well as The London Sports Institute ethics committee at Middlesex University. The document was designed for schools to safely participate in the Barnet's Golden Kilometre once they reopened and included tips on the design and route of the intervention such as participation in classroom bubbles and creating 'overtake zones' for students to pass their classmates whilst maintaining social distancing. This information was shared with the schools already recruited for the project (Pre COVID-19) and across the borough to new schools that requested information on completing the intervention during the pandemic.

Schools first reopened in early June 2020 many with staggered returns for year groups and classes and the project recruitment resumed with baseline measures due to take place in two schools. However, the long period of school closure interrupted the intervention start date and school's participation in the project. For example, many schools that were contacted expressed concerns with losing more learning time for pupils, having limited staff available to facilitate data collection and managing the risk of an outbreak at the school. Following UK Government Guidelines at the time, all schools had also now formed bubble systems in their year groups and/or classes to limit the transmission of COVID-19. The bubble system meant that many

schools were now limited on pupil access to a playground/ outdoor space. In this case, the two initial recruited schools both expressed that they were unable to start the intervention while the bubble system was in place as there was not enough space for each bubble to complete the intervention daily and still maintain social distancing. The UK government guidelines (updated at the end of June 2020) also stated that schools were now unable to allow visitors on site and the bubbling systems would continue for the remainder of the term. In combination, the pressures on schools reopening and new UK Government COVID-19 announcements meant the recruitment of new schools was unlikely and the already recruited schools were unable to begin the project. The intended data collection could not begin if schools did not have the space to complete the intervention daily in their bubbles and the research team could not enter the school ground to complete baseline data collection. The project timeline was therefore altered again and baseline measures and re-recruitment were due to take place in September 2020 when the new school year would begin and bubble system would be lifted. During this time, the project turned to discuss how the intervention could be developed to suit the current guidelines and enable school participation within the limited space.

However, the UK Government guidelines had not eased as initially intended in September 2020 and a second closure of all schools in England was enforced in December 2020. Following this news, the research team which included members of Public Health Barnet, Barnet Council and the 2020 Serving Mayor of Barnet agreed that the initial data collection proposed for the project should be postponed until September 2021 when all restrictions are fully lifted. The data collected in this project is part Public Health Barnet research project and expected to be a crucial element in the development of the Barnet's Golden Kilometre intervention. Therefore, the research (studies two, three and four) was postponed to a more appropriate time to allow rich data collection (when all lockdown and social distancing measures are fully lifted) and a systematic review (study one) was conducted. It is recognised that the COVID-19 pandemic played a key role in the delay of the project and restriction in data collection measures. Once data collection began, many social distancing rules were still in place and strict health and safety guidelines had to be followed throughout. Because of this, many schools were reluctant to participate in research due to concerns with outbreaks and increased curriculum pressures. It is thought that the pandemic has influenced the sample size involved in the project and generalisability of findings, however, has provided additional insight into some of the limitations schools experience when trying to implement interventions and encourage daily PA for pupils. To reflect on this, the research team including Public Health Barnet funders are generating a report summarising the findings of this thesis and considering the influence COVID-19 had not only on data collection but schools current and future participation, in order to aid the borough policy and interventions encouraging PA.

Chapter two: Literature review

Understanding the potential contributions run/walk interventions may have on pupils' PL qualities could be of benefit to policyholders and schools in understanding the contributions participation could have on lifelong PA engagement. This literature review summarises the research into PL including how it is defined across the world, its development as a measurement tool and contributions to health and PA from childhood.

2.1. Development and definitions of PL

PL is thought to of first featured in PE literature dating back to 1930 (Charles McCloy, 1930 cited by Liu, Yang and Chen (2021)). One of the first conceptualisations of PL was Morrison (1969). Adopting a holistic approach Morrison (1969) described PL as an individual carrying out movement efficiently and creatively with enthusiasm (Roetert and Jefferies, 2014; Liu, Yang and Chen, 2021). Margaret Whitehead first introduced the concept of PL in 1993, as an alternative to being 'physically educated' (cited in Whitehead, 2001). Without a definition, Whitehead (2001) instead introduced PL as a concept that enables an individual to enhance their quality of life through PA experiences. The concept evolved through PE settings but now appears more widely as a means to encourage PA across the lifespan (Whitehead, 2001; Whitehead, 2019). In 2013, Whitehead defined PL as "The motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for maintaining purposeful physical pursuits/activities throughout the life course" (Whitehead *et al.,* 2013 p28) her work today has shaped PL research and she is much regarded as the pioneer of PL. Whitehead's definition of PL embodies a holistic premise, underpinned by monism, existentialism and phenomenology (Whitehead, 2001; Whitehead *et al.,* 2013; Durden-Myers *et al.,* 2021; Liu, Yang and Chen, 2021). Monism reflects the three domains of PL: affective (motivation and confidence), cognitive (knowledge and understanding) and physical (physical competencies) capabilities which are in constant collaboration (Whitehead, Durden-Myers and Pot, 2018). Monism is described as the opposite of dualism which sees mind and body as separate entities (Whitehead, Durden-Myers and Pot, 2018). Existentialism refers to an individual's interactions with their environment and how these are of significance to human development (Whitehead, Margaret, 2001; Whitehead, Jean, Telfer and Lambert, 2013; Liu, Yang and Chen, 2021). According to Whitehead *et al.* (2018) existentialists support the monist view in which "existence precedes essence" (Whitehead *et al.,* 2018 p6). Phenomenology is then developed from existentialism in which it highlights the unique individualised experiences of PL and how our own embodiment affects these interactions and in turn PL experiences (Whitehead, 2001; Whitehead, Jean, Telfer and Lambert, 2013; Whitehead, Durden-Myers and Pot, 2018; Liu, Yang and Chen, 2021). Whitehead *et al.* (2018) described that phenomenologists believe an individual's perceptions are founded on their previous experiences and these experiences are different for each individual so therefore, perceptions are unique. The philosophical standpoints of PL are thought to be crucial in understanding its measurement and design of interventions to enhance PL progression (Delaney, Donnelly and News, 2008; Whitehead, 2010; Edwards *et al.,* 2017). Acknowledging philosophical views of PL and within research settings has been encouraged in the understanding of PL adoption and its use in the sports science field (Edwards *et al.,* 2017).

In 2013, Whitehead noted four concerns she'd observed in PE and PA over the years, these were: 1) fewer people are participating in PA post-education, 2) sedentary behaviour is increasing 3) the causes of obesity and stress related conditions are increasing and 4) in many schools and other PA settings there has been a move towards performance focused outcomes (Whitehead, 2013). These concerns raised interest in the literature around the value of PL to improve lifestyles and is thought to have contributed to its embrace in many countries (Roetert and Jefferies, 2014). Today, these concerns are still evident across the world with

inactivity, sedentary lifestyles, obesity rates and poor mental health outcomes all increasing rapidly, something thought to also be heightened since the COVID-19 pandemic (World Health Organization, 2000; World Health Organization, 2016; World Health Organisation, 2021b; World Health Organisation, 2022). Nonetheless, the variety of academics and organisations across different countries adopting the PL concept had led to different interpretations and definitions of PL over the years and is thought to contribute to the restrictions in its measurement within research settings. With this, Whitehead and others have expressed concern for PL discourse in which research has become diverted from the holistic nature of PL and its philosophical underpinnings. Pot, Whitehead and Durden-Myers (2018) listed a series of recommendations for applying the philosophical assumptions of PL in PE. Some of these recommendations include: providing children with choice in activity in order to match their level of motor control and consider the roles of games, goal setting, motivation and cultures. It is important for practitioners to appreciate children's variation in abilities in different activities. Monism in PL, notes that embodied interaction is always occurring and as previously mentioned, these interactions and experiences vary for each individual which can vary the level of embodiment they have (e.g. physical capability or confidence) (Pot, Whitehead and Durden-Myers, 2018). Therefore, activities should be differentiated for children to be inclusive for all. Secondly, for existentialism in PL, practitioners should consider how to provide children with meaningful experiences and according to Pot, Whitehead and Durden-Myers (2018) this could include providing a purpose to the activity but which is relevant to the context. Finally, for phenomenology in practice, there has been reluctance in the design of methods to chart PL and rather the authors suggest how PL can be promoted through individuals' experiences (Pot, Whitehead and Durden-Myers, 2018). When considering PE settings, this should include variety in complexity to cater to children's abilities, their previous experience and perceptions of physical competence. With this though, there should not be an end goal of absolute proficiency and the focus should instead be on individual progression working towards developing the attributes of PL (motivation, confidence, physical competence, knowledge and understanding) in a range of contexts. However, these recommendations refer to the definition and work in PL by Whitehead and only reference philosophies of PL in PE settings which do not consider the wider context of PL. Over the years many definitions for PL have evolved and more recently the concept appears to have become more clearly defined in the literature which can provide clearer guidance for its application in research and wider PA settings today.

There are two recognised approaches to the concept of PL: the idealist (academic) and pragmatic (practical) perspectives (Hylton, 2013; Green *et al.,* 2018; Edwards *et al.,* 2017). An idealist perspective follows the philosophy that PL is a holistic concept, popularised by Morrison (1969), meaning its domains (affective, cognitive and physical) cannot be parted (Edwards *et al.*, 2017; Edwards *et al.,* 2018; Green *et al.,* 2018). Idealists would suggest PL, if explored, should be assessed through qualitative methods that do not divide the concept and can capture the individualised nature of PL (Edwards *et al.,* 2017). The pragmatic approach (Larouche *et al.,* 2011) gives a practical perspective on the concept, including elements such as non-standardised games to assess motor competence within the physical domain (Giblin, Collins and Button, 2014). Pragmatists would seek to measure PL through progress in assessments providing evidence-based practice, which most research is valued on (Hempenstall, 2006; Cook and Odom, 2013; Edwards *et al.,* 2017; Green *et al.,* 2018). The complex nature of PL has meant the different philosophical interpretations influence the methods used to define, measure and quantify the concept and there is not yet a recognised 'gold standard' of assessment nor definition and there remains much variation in the field of PL interpretations (Green *et al.,* 2018; Sherar *et al.,* 2020; Essiet *et al.,* 2022).

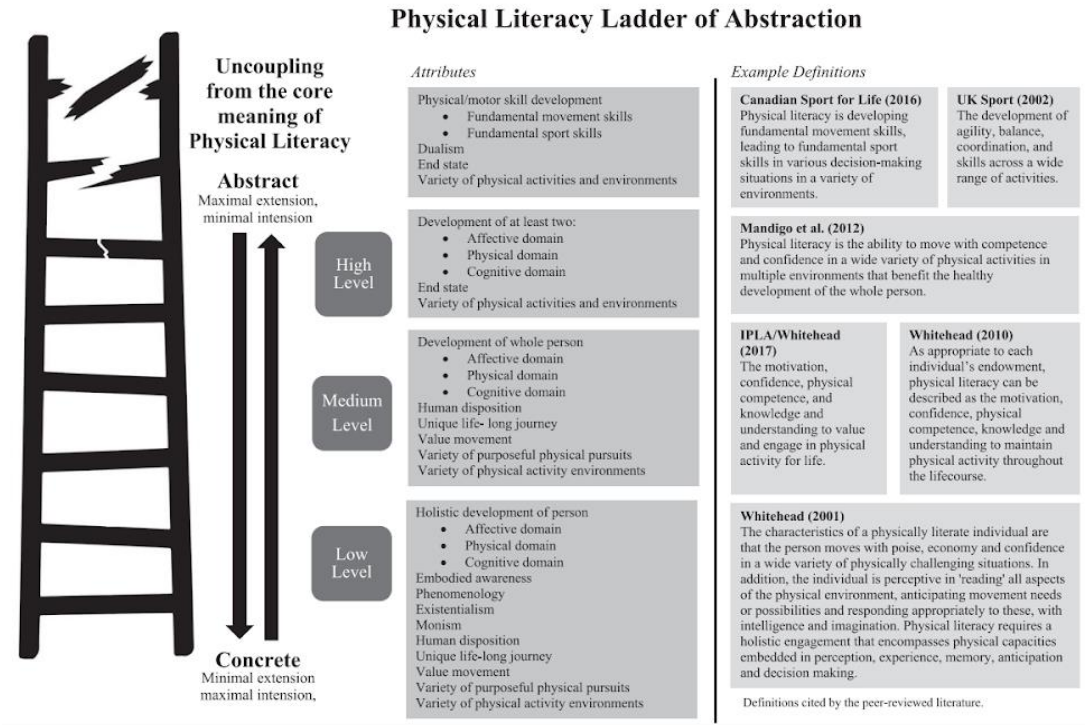

Figure 1: Young, O'Connor and Alfrey (2020) PL ladder of abstraction

A concept analysis by Young, O'Connor and Alfrey (2020) demonstrated that despite the popularity in use of Whiteheads definitions there is still limited consistency in how PL is interpreted in the literature. Since Whiteheads definition in 2013 the use of the philosophical concepts has also had less presents in PL interpretation over the years too (Shearer *et al.,* 2018; Young, O'Connor and Alfrey, 2020). Young, O'Connor and Alfrey (2020) reported that this may have made the concept more concise and definition more appealing to wider populations (researchers, educators, policy makers etc).

In order to account for the variation in interpretations of PL, Young, O'Connor and Alfrey (2020) created a 'ladder of abstraction' drawn on the work of Sartoris (1970) in which there is three levels (low, medium and high) related to the concepts intention (attributes) and extension (cases). Within the ladder, the higher the intention and lower the extension the narrower and more concrete the concept is defined whereas the higher the extension and lower the intention the more flexible the concept but also the broader the definition and interpretation. Figure 1: Young, O'Connor and Alfrey (2020) PL ladder of abstraction shows the PL ladder created by Young, O'Connor and Alfrey (2020) coupled with its representation of the PL attributes and definitions. At the concentre low level, the Whitehead (2001) definition is referenced which pays attention to the intertwining of the philosophical underpinning of the PL and its holistic nature. A challenge of this definition of PL is the grasping of the philosophical underpinnings which have been said to be too complex for interpretation. Young, O'Connor and Alfrey (2020), Edwards *et al.* (2017) and Shearer *et al.* (2018) have all recognised the philosophical concepts have had less prominence over the years. Although, this is thought to have made the concept more concise and allowed more appealing definitions to develop in wider contexts (Shearer *et al.,* 2018; Young, O'Connor and Alfrey, 2020). This development is described by Young, O'Connor and Alfrey (2020) as PL 'moving up the ladder of abstract' to become more flexible for interpretation and utilisation but less foundational to the core attributes of PL.

At medium level, the complexity of the concept is limited with the attributed focusing on the "whole-person" (p948) rather than philosophically rooted focus on holistic development of the person (Young, O'Connor and Alfrey, 2020). This level is said to be the most widely adopted in PL literature as it is more applicable to a variety of contexts and the attributes are recognised to be interconnected but can also be isolated or prioritised depending on the context (Robinson, Randall and Barrett, 2018; Young, O'Connor and Alfrey, 2020). This interpretation is said to also allow measurement of PL outcomes but also the fluidity of the ladder allows research to reference back to the lower-level philosophical embodiment (Young, O'Connor and Alfrey, 2020).

At the higher level of the ladder the attributes have moved further away from the recognition of the philosophical underpinning. Young, O'Connor and Alfrey (2020) described this level to be "more simplistic" (p955) and often PL is referred to having an endpoint (i.e. becoming physically literate) which is contradicting of Whiteheads (2013) concept in which PL has no end and rather should be seen as "Cradle to grave" lifelong journey (Whitehead, 2013, p29). At this stage the definitions of PL also shift to focus more dominantly on individual domains such as physically focused definitions like the UK Sport (2002) demonstrated in Figure 1. Young, O'Connor and Alfrey (2020) and Higgs (2010) have suggested the earlier philosophical approach to PL seen at the lower level of the ladder is seen to be the more academic approach to PL and the medium-higher levels on the ladder where more variation in PL is more appealing in a practical context such as within PE and coaching environments. Young, O'Connor and Alfrey (2020) have suggested that the medium level of interpretation may offer a fresh perspective and flexibility within PL and its assessments. By acknowledging the lower level position within the ladder but applying the attributes specific to context may help to clarify PL interpretations and reduce confusion or miscommunication in the field (Young, O'Connor and Alfrey, 2020; Shearer *et al.*, 2018). The levels of PL approaches created in Young, O'Connor and Alfrey's (2020) ladder has evolved from the varied definitions and interpretations that have existed in the field for many years.

One of the first reviews to conceptualise PL was the work of Edwards *et al.* (2017) which identified seven sub themes of PL within research. These included PL related references to affective, cognitive, physical capabilities, progression/development pathway, target audience, holistic concept and other related constructs (Edwards *et al.*, 2017). The authors concluded ~70% of studies adopted the Whitehead approach to PL which identifies confidence, motivation, knowledge and understanding, and physical competence as important elements of PL which have interrelationships (Edwards *et al.*, 2017; Whitehead, 2010). Other definitions of PL have placed heightened focus on the elements of movement competencies and Fundamental movement skills (FMS) and/or only focused on specific age ranges (Sheehan and Katz, 2011; Almond, 2013; Haughey *et al.*, 2013). PL is gaining worldwide attention including reaching North and South America, Europe, Africa, and Australian/ Oceanian states which is leading to newly developed interpretations and definitions (Carl *et al.*, 2023; Durden-Myers and Whitehead, 2018). Shearer *et al.* (2018) in partnership with IPLA members identified seven prominent groups working to develop PL across the world, these were based within: Australia, Canada, New Zealand, UK and United States of America (USA) all with their own approaches/ definitions to the concept.

Another country who recently completed a PL consensus is China. The Chinese statement refers to PL as "…the integration of physical, perceptual, cognitive, psychological, and behavioural capabilities, echoing with the need for an active, healthy, and fulfilling lifestyle, which involves continuous positive interactions with the environment and embodied engagement in physical activities for life" (Li *et al.*, 2022, p245). The definition embodies five domains of PL relating to physical, psychological, cognitive, behaviours and sensory-

perspectives (Li *et al.*, 2022a; Li, Whitehead *et al.*, 2022). The Greater China statement was also published along with practical and theoretical models to guide PL in the region (Li *et al.*, 2022b). The practical model of PL notes five domains of PL: psychological, cognitive, physical, behavioural and sensory perceptual, and similar to the CAPL model, identifies a domain which encompasses the five which is the dynamic environment which is connected with lifelong PA (Li *et al.*, 2022a). The theoretical model then progresses from this to note philosophical underpinnings of the five domains, these are monism, externalism and phenomenology (Li *et al.*, 2022a; Li *et al.*, 2022b). According to Li *et al.* (2022a) the definition has made specific reference to Chinese culture which is noted to help implications of PL across the world.

According to Shearer *et al.* (2018) The Australian Health and PE curriculum published in 2015 closely aligned with the concept of PL referring to the cognitive aspects of knowledge and understanding to be active for life (The Australian Sports Commission, 2020). Since, the concept has appeared throughout policy and research groups (The Aspen Institute, 2013) have worked to promote the PL of the population. In 2016, the Australia Sports Commission conducted a project aiming to create a PL definition, framework, implementation and assessment guidelines. The project concluded with four statements of PL: "1) **Core** – PL is lifelong holistic learning acquired and applied in movement and PA contexts; 2) **Composition** – PL reflects ongoing changes integrating physical, psychological, cognitive and social capabilities; 3) **Importance** – PL is vital in helping us lead healthy and fulfilling lives through movement and PA; 4) **Aspiration** – A physically literate person is able to draw on their integrated physical, psychological, cognitive, and social capacities to support health promoting and fulfilling movement and PA, relative to their situation and context, throughout the lifespan" (Keegan *et al.*, 2019, p22). These statements highlight that an individual develops their PL through four key domains: physical (skill and fitness), social (interaction based), psychological (attitudes and emotions) and cognitive (understanding) (The Australian Sports Commission, 2020). The additional social aspect which does not feature in Whiteheads as an individual domain, highlights the communication skills in activity including leadership, working with peers and coaching (The Australian Sports Commission, 2020). These are noted within the Whitehead concept but are expressed as important interactions with the environment which are experienced through both physical and affective interaction (Whitehead, 2019). According to the Australian PL Framework (APLF) published in 2019, the definition references 30 elements within these four domains which favour physical components (physical 12 items, psychological seven items, social four items and cognitive seven items). The Australian statement does highlight interconnection of these domains though similar to other definitions by noting that in order to develop PL, progression must be within all domains which are integrated with one another (Shearer *et al.*, 2018; Keegan *et al.*, 2019).

In the earlier years of PL, Canada has arguably been one of the main leaders alongside the UK to adopt the PL concept in PE and PA settings (Roetert and Jefferies, 2014) and continues to be a leading country in PL research and policy application (Carl *et al.*, 2023). The nation has excelled in funded PL programme and research to develop strategies that support sports development over the years and have been one of the first advocates of PL assessments in primary aged children (Jurbala, 2015; Valadi and Cairney, 2023; Francis *et al.*, 2016; Longmuir *et al.*, 2015). According to Shearer *et al.* (2018) Canada has two leading advocates of PL, they are Canadian Sport for Life and Public Health and Education Canada. In 2015, to bring unity and consistency in the definition and practise of the groups Canada released a consensus statement on PL (Shearer *et al.*, 2018; Tremblay *et al.*, 2018). The statement endorsed the IPLA definition noting the elements of motivation, confidence, physical competence and knowledge and understanding within their work. The Canadian Assessment

of PL (CAPL) is based on the Canadian model of PL consisting of four domains (motivation and confidence, knowledge and understanding, physical competence and daily behaviour) the three domains of motivation and confidence, knowledge and understanding and physical competence are noted to overlap one another and intertwine to create positive behaviour change for PA engagement (Jurbala, 2015; Francis *et al.,* 2016; Hurter *et al.,* 2022). The fourth domain is daily behaviour which encompasses these three and notes the value of needing motivation, confidence, knowledge and understanding and physical competence to maintain positive PA behaviour (e.g. participation) (Jurbala, 2015; Francis *et al.,* 2016). The Canadian reference noted additional behavioural attributes seen as a separate domain although these are in line with the IPLA referring to engagement in PA for life (Tremblay, *et al.,* 2018; IPLA, 2017; Shearer *et al.,* 2018).

Similarly, to Canada, Sports New Zealand adopted the work of Whitehead (Shearer *et al.,* 2018). Sports New Zealand first featured PL in 2015-2020 Community Sports Strategy to develop PL for young children in communities within strategy the Whitehead (2013) definition was adopted adopting a holistic view noting physical, social, emotional, cognitive and spiritual requirements for lifelong PA engagement (Sport New Zealand, 2015; Shearer *et al.,* 2018). Most recent reports from Sports New Zealand continue to note the importance of PL progression in children with reference to Whitehead definitions and work of the IPLA but there is still more progression needed to focus on PL at different time points in life-span (IPLA, 2017; Shearer *et al.,* 2018).

In the USA, The Society of Health Physical Educators (SHAPE) America (2014) as part of the outcomes of K-12 PE noted similar components of the Whitehead definition (competence, confidence across a variety of environments) but did not focus on the importance of lifelong experience. SHAPE America explained that to be physically educated an individual is physically literate in which they later replaced the term physically educated with physically literate in K-12 PE (Mandigo, Francis and Lodewyk, 2007; SHAPE America, 2015). In 2015, The Aspen Institute, an educational and policy-based institute, in partnership with SHAPE America developed PL related action plans to encourage PA for life, the 'PL in US' action plan described PL related to skill, confidence and PA for life as noted by Whitehead and was not originally recognised in SHAPE America (The Aspen Institute, 2013; Shearer *et al.,* 2018). Much of the work in the USA has been educational based and there are notes in literature that the use of PE and PL has led to cross-over and blurring in PL interpretations (Hyndman and Pill, 2018; Shearer *et al.,* 2018).

Within the UK, the adoption of PL has been spearheaded by Whitehead and the IPLA. Despite being titled 'International' the work of the IPLA at the time of Shearers *et al.* (2018) publication was largely based within the UK. To date, the IPLA has increased collaboration across the world and now has a number of ambassadors in areas such as Costa Rica, Cyprus, Denmark, Hong Kong, India and more. Much of the work of ambassadors and IPLA members includes collaborating with local groups to provide guidance and training on PL but the research field of IPLA is largely still based within the UK and recently research is progressing within India (IPLA, 2017; Shearer *et al.,* 2018). The IPLA (2017) definition stated on the website is developed by Whitehead defines PL as "The motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life". The IPLA definition identifies PL as 'unique' and a 'lifelong journey' that develops over an individual's lifetime (Whitehead, 2010). Despite its large working group in the UK, the IPLA definition and work of Whitehead is consistently adopted across literature and reviews across the world (Edwards *et al.,* 2017; Shearer *et al.,* 2018; Cornish *et al.,* 2020; Liu, Yang and Chen, 2021; Martins *et al.,* 2021). However, the IPLA definition is not the only one utilised within the UK (England, Ireland, Scotland and Wales).

Within England a working group consisting of public bodies such as Youth Sport Trust, Sport England, Association for PE and Sports Coach UK developed a primary school PL framework for PE and school clubs. The framework refers to the components of Whitehead words including motivation, confidence, physical competence, knowledge and understanding with lifelong reference but also includes additional movement foundation which Shearer *et al.* (2018) noted to sway the definition to be more movement focused and not referring to holistic PL. Sport Wales have recently adopted the IPLA definition within their work. Originally, the equation of PL included "+Lots of opportunities' ' but is now "+ Knowledge + Understanding" on their webpage. The final equation is: "Physical skills + Confidence + Motivation + Knowledge + Understanding = PL" (Sport Wales, 2018). According to Hurter *et al.,* (2022) much of the Sport Wales and Welsh Government websites feature the full IPLA definition today.

There has been movement in the countries across the UK towards developing consensus statements. In 2022, ministers from North and South Ireland joined to launch an All-Island PL consensus statement being the first in Europe to do so. Until this point, Sport Northern Ireland (2008) definition of PL was focused largely on physical related components referring to body management, FMS, competency and confidence to apply the skills in sports setting and Sport Ireland Coaching (2018) had adopted the IPLA definition. The final All-Island consensus statement published in 2022 defined PL in line with IPLA as "the motivation, confidence, physical competence, knowledge and understanding that enables a person to value and participate in PA throughout life" (Sport Ireland, 2022 p1). The definition notes the three interconnected domains of Whiteheads work recognising the cognitive (thinking) denoted from knowledge and understanding, affective (feeling) from the motivation and confidence and physical (doing) from the physical competence (Sport Ireland, 2022). Most recently Sports England have worked in partnership with a number of UK universities (Liverpool John Moores University, Coventry University, the University of Bradford and the University of Gloucestershire) to develop English consensus statements on PL which commenced in March 2022 (Hurter *et al.*, 2022; Morris *et al.*, 2022). So far, the draft consensus statement features on the Liverpool John Moores University web page states "PL is our relationship with movement and PA throughout life" with five further summaries relation to: 1) why PL matters, 2) understanding our PL, 3) Everyone's PL is different, 4) Building PL, 5) How experience affects our PL (Draft Physical Literacy Consensus Statement for England, 2022). The final Sport England definition is not yet published but this is a large step in progress for PL work in England.

A clear similarity in the PL definitions across the world is the inclusivity and individualised nature of the concept (Edwards *et al.*, 2017; Dudley, 2018; Shearer *et al.*, 2018; Hurter *et al.*, 2022). Whilst some adopt additional domains, there is still a clear recognition for the importance of physical, affective and cognitive domains that relate to behavioural outcomes (PA engagement) and how social interactions play a role within this too (Edwards *et al.*, 2017; Dudley, 2018; Shearer *et al.*, 2018; Hurter *et al.*, 2022). Almost all definitions recognise or adopt the work of Whitehead (or IPLA) within their practise or consensus with their own interpretations and adaptions made to suit the context. In the past, lack of evidence surrounding PL outcomes/ benefits across the globe has thought to have been connected to the inconsistency in definitions, leading to challenges in the holistic and individualised nature of PL (Edwards *et al.*, 2017; Edwards *et al.*, 2018; Hurter *et al.*, 2022). However, many of the country specific definitions have recognised the need for PL to be tailored to the population and reflect their PA environments (Barnett *et al.*, 2019; Ke *et al.*, 2022; Li *et al.*, 2022b). Research by Essiet *et al.,* (2022) reported that teachers found PL to be a bit of a 'buzz-word' in education, and in order to be implemented effectively needs to aligned with the school curriculum and be included in development/ training. There is vast research on the definition

of PL but the translation to context, whether that be cultural or educational settings, is challenging. The English Consensus aims to provide a universal definition that is applicable and accessible to all including: teachers, practitioners, policy makers and the general public in education, health sectors and the community (Draft Physical Literacy Consensus Statement for England, 2022; Hurter *et al.,* 2022; Morris *et al.,* 2022). Once the final statement is published, it could provide a definition and approach to PL in England that considers the issues related to adopting existing definitions.

2.1.1 Declaration of philosophical standpoint and PL interpretation in this thesis

In line with the recommendations of PL research, it is important that researchers declare their philosophical stance (Edwards *et al.,* 2017; Durden-Myers and Whitehead, 2018). Accordingly, this research adopts a pragmatic approach to PL by considering the domains which contribute to PA engagement, with reference to the IPLA definition. The definition notes the affective, cognitive and physical domains that contribute to PL. At the start of this research project the PL consensus in England had not launched and whilst the final definition is due to be published soon, this research project continued to reference the popularised IPLA definition but with the pragmatic approaches in the field. The researcher has a background in teaching, coaching and playing sports and wants to know more about PL from a practitioner perspective. The researcher recognises that these experiences have influenced their decision to take a pragmatic approach to design as they value the importance of assessment and evidence to inform future research and policy. Within Young, O'Connor and Alfrey (2020) PL Ladder of Abstraction, this thesis is positioned within the medium level. As previously noted, this stage is where the IPLA definition is positioned and recognises the philosophical underpinnings of PL but rather sits more closely in line with the pragmatic approach to PL by considering measurement methods of PL and its position as a health outcome (Young, O'Connor and Alfrey, 2020).

The thesis refers to the term 'assessment' in PL. In line with existing PL work, assessment is used to recognise the broad approaches to measurement in PL research, similarly, to Edwards *et al.,* (2018) the term includes reference to PL "charting, monitoring, evaluation, characterizing, and/or observation" (p663) which are other conceptualisations used. The approach of 'assessment' is thought to provide a pragmatic perspective of PL and can be used to identify areas of strength and development in PL (Edwards *et al.,* 2018; Green *et al.,* 2018; Shearer *et al.,* 2021; Goss *et al.,* 2022). The term assessment also has value and wide adoption in PE and policy in which the term is said to provide structure in education and evidence in practise (Edwards *et al.,* 2018; Green *et al.,* 2018; Shearer *et al.,* 2021; Goss *et al.,* 2022).

2.1.2 Models of PL

PL is not a pedagogical model but can be promoted through the use of models in different contexts which have been used to shape its interpretations and association with lifelong processes (Whitehead, Jean, Telfer and Lambert, 2013; Dudley *et al.,* 2017). Over the years several frameworks have been developed to guide PL and its position within policy (Dudley *et al.,* 2017), PE (Gleddie and Morgan, 2021) and influencing health outcomes (Cairney *et al.,* 2019a). There are many models that have been applied across the life span and others with focus on younger (Faigenbaum and Rebullido, 2018) and adult years (Jones *et al.,* 2018). This section of the chapter will briefly review some of the models applied in child-PL settings and which also reference lifelong PA, particularly within health and policy context.

The Long-term development framework is a model created by the Canadian Sport for Life society which identifies PL as one of the 10 factors influencing athlete development and sports participation p1-39 (Balyi, Way and Higgs, 2013; Canadian Sport for Life–Long-Term Athlete Development, 2019). The third edition of the framework recognises the individual stages of development in sports performance and life-long engagement in any PA for health benefits (Balyi, Way and Higgs, 2013; Canadian Sport for Life–Long-Term Athlete Development, 2019). The model has been criticised for being performance driven with little consideration for the wider attributes of PL and the holistic nature of the concept, although, the new editions of the framework appear to be more aligned with the wider attributes of PL and PA participation not solely PA performance and considers elements such as confidence and motivation to participate (Balyi, Way and Higgs, 2013; Whitehead, 2013; Canadian Sport for Life–Long-Term Athlete Development, 2019). PL is now embedded within the framework and is thought to provide the foundation for athlete development and PA participation (Balyi, Way and Higgs, 2013; Canadian Sport for Life–Long-Term Athlete Development, 2019).

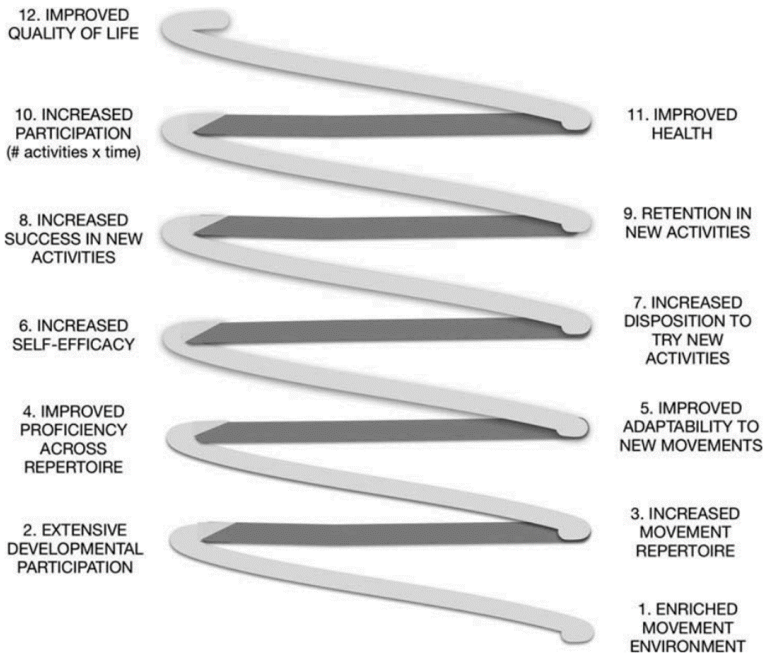

Figure 2: Jurbala (2015) Cycle of PL development

In 2015, Jurbala proposed a cycle of PL development. Using a community-based definition of PL, Jurbala (2015) adopted the definition that PL is "the dynamic communication between the embodied self and the physical environment, which continuously integrates perceptive reading of, and appropriate response to, physical challenges*."* (p377). In which the author notes that PL is a continuous interaction of cognitive, motor, sensory and musculoskeletal systems and with the physical environment which can produce increase in PA, better health and quality of life. The model shown in Figure 2: Jurbala (2015) Cycle of PL development shows PL as a continuous spiral which produces individualised outcomes along the process (Jurbala, 2015). This can be both positive as an individual ascends through the cycle including improving health, increased PA participation and improved quality of life being the top of the cycle. But also negative as an individual can descend such as decreasing PA participation, or loss of self-efficacy. This model supports Whitehead's work that PL is continuous and not stable in which an individual suggests that an individual can progress and regress within their journeys (Jurbala, 2015).

Dudley (2015) proposed a metacognitive model which perceives PL as a construct of learning (Dudley, 2015; Hurter *et al.*, 2022). Unlike other metacognitive models which tend to be concerned with one element of learning (e.g. Bloom (1956) Taxonomy of learning Objectives and the cognitive domain), Dudley (2015) model described PL as being made up of affective, cognitive, psychomotor domains to address the multidimensional process of PL. The observed model of PL defines four core elements: 1) Personal and social attribute of movement, 2) Motivational and behaviour skills of movement, 3) Rules, tactics, strategies of movement and 4) movement competences in multiple environments, all of which are progressed from the three domains of PL (Dudley, 2015; Dudley *et al.*, 2017). The model is defined to be student centred and allow for teachers/ educators and practitioners to observe their pupils behaviour in relation to cognitive, affective and psychomotor development. Dudley *et al.* (2017) proposes four pillars of PL policy developed from his earlier 2015 work but rather this model focuses on the application in wider contexts outside of educational settings. The authors aimed to create commonality in PL research and progression across disciplines by the use of the four pillars and specifically addressed work in public health, education and policy (Dudley *et al.*, 2017).

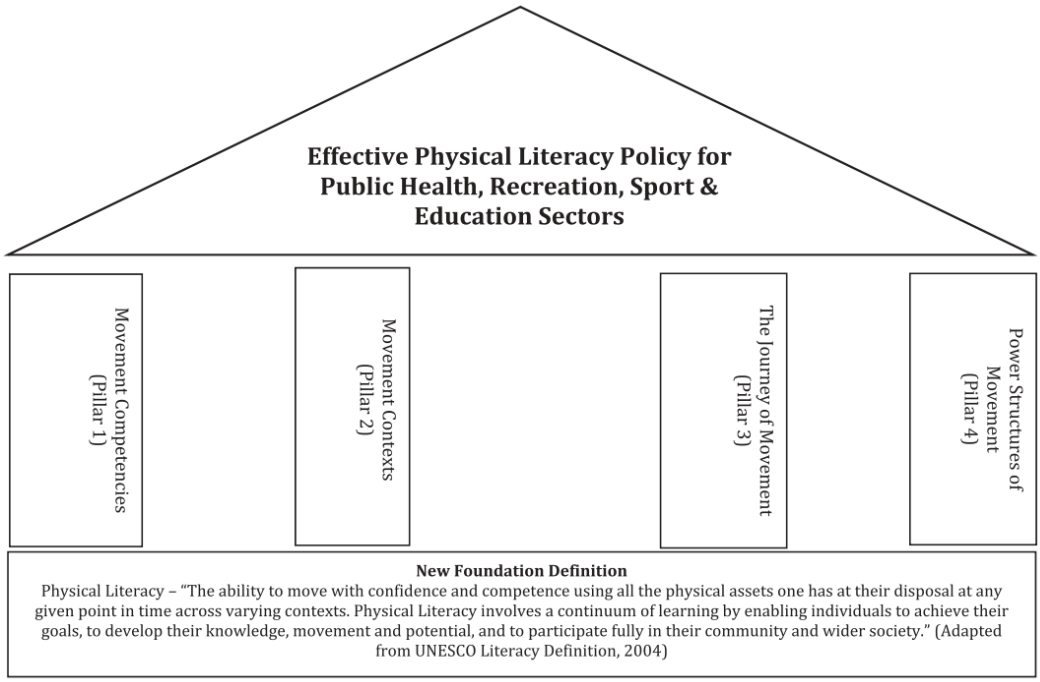

Figure 3: Dudley et al. (2017) Four pillar model of PL

Dudley *et al.* (2017) presented a model of PL for public health, recreation, sport and education which can be used to incorporate PL into policy. There is undoubtedly concerns with the applicability of PL in public health contexts from idealist vies as the underpinning of policy design is driven by data and evidence, which has posed as a challenge for collection in PL context (Dudley *et al.*, 2017; Cairney *et al.*, 2019b; Whitehead, 2019; Dudley and Cairney, 2021; Martins *et al.*, 2021). Dudley's (2017) four pillar model shown in Figure 3**: Dudley et al. (2017) Four pillar model of PL** deconstructs PL by creating a simpler interpretable framework that could guide policy to understand and adopt the concept in practise, Dudley (2017) noted that this approach was to create a common understanding of the research already in PL and create some consistency across the fields.

In pillar one, ‘Movement competencies’ the focus is on FMS development. FMS has been connected with PL (Almond, 2013) however, the sole investigation of FMS has been met with challenge as it does adhere to the monist view of PL and consider the wider components like moving with confidence and poise. Dudley’s (2017) model proposes FMS is interpreted as motor competence in line with Whitehead definition of PL which views competence on a wider spectrum and that motor competence is also interpreted across a variety of environments and skill settings considering land, water and air-based skills. The author's key consideration for this pillar is that policy makers consider promoting wider motor competencies for children but to ensure that this promotion does not come at the expense of other PA opportunities or skill developments. In pillar two, ‘Movement Contexts’ argues that motor competence developed through a variety of physical activities is important to PL (Dudley *et al.*, 2017). The authors recommend that to enrich PA experiences, movement contexts should be considered to meet social and environmental confounders of the populations whilst also providing opportunity to develop tactics and strategies needed to thrive in wider participation settings. In pillar three, ‘The journey of movement’ recognises the non-linear progress an individual has in their PA life course, this may include setbacks like injury, environmental influence (weather) and social influence (change in peer dynamics) and also factors that can excel like access to facilities or mastery development in skills. The recommendation for this pillar notes that policy makers should consider providing flexible and diverse PA in a variety of different contexts (time and setting) in order to consider how movement is developed throughout non-traditional stages in a life course. In pillar four, ‘Power structures of movement’ includes practitioners reflecting on their own experiences and background. The authors recommend efforts to limit inequality in PA by considering social and gender norms that may influence PL (Dudley *et al.*, 2017). This is something that should be a priority in policy to limit disparities in PA engagement. The model promotes a clear focus of PL movement competency promotion and fit within policy. However, the model does not address clearly how the other core elements of PL are considered (affective, cognitive and physical). The authors also noted that policy is often driven by data and evidence, although, there are few recommendations within the model that can be used to inform data collection for policy research and rather the focus is on how policy can develop PL in practice (Dudley *et al.*, 2017). Whilst this is of vital importance for lifelong PA and provides value in the application of PL in wider contexts (not just from PE perspectives) further research is still needed to provide evidence for the importance of PL which can be us used to inform and develop policy through data and evidence.

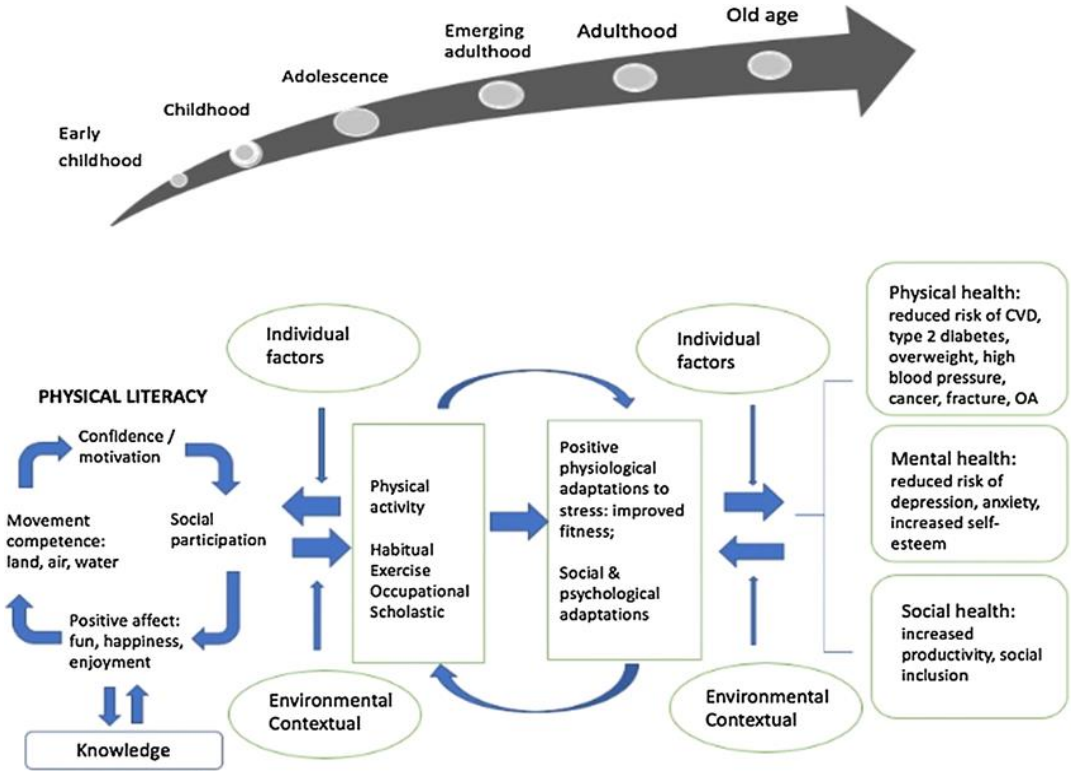

Figure 4: Cairney et al. (2019a) Conceptual model linking PL with PA and health

Cairney *et al.* (2019a) proposed a conceptual model linking PL with PA and health outcomes. The model addresses the cyclical nature of the PL domains and PA positioning knowledge outside the cycle in which the authors proposed that knowledge arises as an outcome but also influences engagement. Similar to Jurbalas (2015) PL cycle the model recognises the progression in PL to not always be a positive linear path, in Figure 4: Cairney et al. (2019a) Conceptual model linking PL with PA and health shows the arrows on the model demonstrate the positive and negative pathways of PL. Unlike models that predict PA, PL emphasises the convergence of the required components to produce the desired outcomes (Cairney *et al.*, 2019a) which is something not previously shown in Jurbalas (2015) cycle model either despite it being recognised in the design and definition. The core outcome of the model demonstrates how regular PA engagement can lead to physical, mental and social benefits positioning the concept as a potential health determinate (Cairney *et al.*, 2019a). The model shows the potential value of adopting PL and its broader impacts, although at the time of publication the authors noted that there is need for further empirical research to support the model (Cairney *et al.*, 2019a).

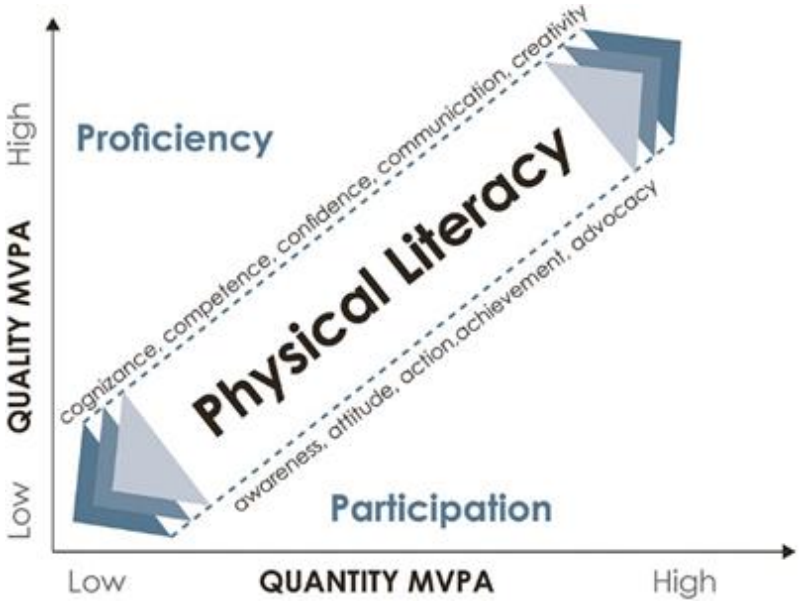

Figure 5: Faigenbaum and Rebullido (2018) Bidirectional continuum

Faigenbaum and Rebullido (2018) proposed a bidirectional continuum of PL in youth populations. The authors expressed that the components of PL are depending on *"...*the quantity and quality of individual MVPA experiences" (p90) and explains that individuals with higher levels of proficiency and time spend in PA have higher levels of PL (Faigenbaum and Rebullido, 2018). The model shown in Figure 5: Faigenbaum and Rebullido (2018) Bidirectional continuum of PL notes that if a child has high levels of PL but does not maintain participation in PA and becomes less active, they regress in the PL continuum. The term of 'proficiency' used within the model is described by the authors as participating in a variety of PA with confidence, competence and enthusiasm (Faigenbaum and Rebullido, 2018). This approach represents a simplified method of PL interpretation and how participation and the interrelationships between the domains of PL (proficiency) may influence a children's PL journey. Although, PL is a complex concept and model does not recognise the wider contributions that may alter one's 'proficiency', for example, an individual may be competent in a PA skill but not confident to participate (Faigenbaum and Rebullido, 2018). This model would therefore pose a challenge for practitioners who are new to the concept and may not understand the wider contributions to developing proficiency and in this case, confidence to participate which would influence overall PA participation and therefore PL profession.

2.2 PL in children

Although PL is a lifelong process, promotion during childhood is important to develop healthy habitual behaviours which can lead into adulthood and later life (Bailey, 2006; Barnett *et al.*, 2018a; Barnett *et al.*, 2018b; Green *et al.*, 2018; Whitehead, 2010; Brown, Dudley and Cairney, 2020). PE and childhood PA are thought to have an important impact on the lifelong embodiment of an individual's PL journey and, as a result, PA engagement in later life making childhood a popular age for PL enhancement (Bailey, 2006; Whitehead, 2010; Green *et al.*, 2018; Brown, Dudley and Cairney, 2020). Early/ primary school years is where the fundamentals of PL are established and developed (Whitehead, Jean, Telfer and Lambert, 2013; Hulteen *et al.*, 2018; Wainwright *et al.*, 2018). These include: developing motivation and confidence (affective), motor competence (physical) and knowledge and understanding of leading a healthy active lifestyle (cognitive) (Whitehead, 2013; Whitehead, 2019). In order to develop these skills, children need the opportunity to practise and refine their performance

in a variety of settings throughout childhood (Jurbala, 2015; Kriellaars *et al.*, 2019). Throughout primary ages (four – 11 years) children develop competence in a range of activities and self-confidence should be formed in PA (Whitehead, 2013; Whitehead, 2019). As children progress through primary school years there should be an increase in ownership of the PA engagement and increase in the value of regular participation (Whitehead, 2013; Whitehead, 2019). At this stage children should receive support from teachers, coaches, family and peers and within a range of environments to support and challenge their PL capabilities (Whitehead, 2013; Whitehead, 2019)

2.2.1 PL Domains in children

Interactions in the domains of PL are associated with PA participants in children (Venetsanou and Kambas, 2017; Whitehead, 2019). This comprises of affective, cognitive and physical interaction which encourage PA engagement and is needed to sustain participation (Venetsanou and Kambas, 2017; Whitehead, 2019). To expand upon the domains of PL, Whitehead (2019) describes the attributes which are symptomatic of PL progression developed from her previous definitions and work in 2010 'PL across a life course' book. Research has shown the definitions and interpretations of PL can vary based on disciples and existing PL knowledge, which can lead to additional domains (e.g. New Zealand spiritual domain), However, Whitehead (2019) remains to confirm the equal importance and interrelationships between the affective, physical and cognitive domains of PL (Whitehead, 2019; Belton *et al.*, 2022). Further research has also confirmed the value of motivation and confidence (affective), knowledge and understanding (cognitive), physical competence (physical) and engagement in PA as characteristics of PL across interpretations (Belton *et al.*, 2022; Hurter *et al.*, 2022).

For the affective domain Whitehead (2019) identified confidence and motivation as important elements which have interrelationships. These psychological elements are essential in the exploration of PL (Whitehead, 2010; Sheehan and Katz, 2011; Edwards *et al.*, 2017). Motivation was defined by Sage (1977) as "The direction and intensity of one's effort" and can be viewed in different forms in sport and exercise psychology (e.g. Intrinsic, extrinsic or achievement motivation) (Cited by Weinberg and Gould, 2018, p53). According to Whitehead (2010) motivation in sport refers to having the desire to be active and having a positive attitude to enjoy new and challenging activities. In her 2019 work, Whitehead's reflections are similar and noted motivation in the affective domain is an individual who is proactive about PA participation in which they apply themselves with enthusiasm and are able to persevere through challenging PA situations (Whitehead, 2019). Confidence is referred to in relation to PA which can be influenced by external experiences and internal belief (Whitehead, Durden-Myers and Pot, 2018; Whitehead, 2019). Whitehead proposed that positive interaction with the physical environment will positively influence confidence and in turn impact on self-esteem and self-confidence. As a PL attribute, an individual would be willing and capable to learn new tasks and create assurance that the activity is rewarding (Whitehead, 2007; Whitehead, 2010; Whitehead, 2013; Edwards *et al.*, 2017; Whitehead, 2019). Whitehead (2018) defined self-confidence specifically in PL context as the development of competence in understanding and performance. Alongside being an attribute of affective progression self-confidence also intertwines with the cognitive domain in which Whitehead (2019) refers to an individual having the self-confidence (in the form of combined self-assurance and self-belief) to plan and execute a physically active lifestyle. These attributes are then said to rise when progress is made in physical competence (Whitehead, Jean, Telfer and Lambert, 2013)

In relation to cognitive domain, knowledge and understanding are vital in its exploration (Edwards *et al.*, 2017; Cale and Harris, 2018). According to Edwards *et al.* (2017) there are three core areas of cognitive domains: 1) having knowledge and understanding of activities,

2) knowledge and understanding of healthy active lifestyles 3) the importance of valuing and taking responsibility for PA. Having the required knowledge and understanding of the importance of health and being active is arguably a fundamental in achieving lifelong PA particularly from a young age (Ennis, 2015; Lundvall, 2015; Cale and Harris, 2018). It is said that knowledge and understanding can enrich the other qualities of PL by developing motivation, confidence and physical competence (Whitehead, 2010). For example, an individual may be able to develop an appreciation of their other physical competency abilities and recognise their development which would in turn enhance motivation and confidence to participate in PA to develop their skills set (Cale and Harris, 2018). According to the attribute of PL progression, having the ability to identify and articulate effective movement patterns is part of the development in the cognitive domain (Whitehead, 2019). This is coupled with also understanding a healthy balanced lifestyle and how PA can contribute towards this is associated with developments in the cognitive domain (Durden-Myers, Whitehead and Pot, 2018; Whitehead, 2019). Although, this knowledge can vary based on age which is not specified in the attributes of PL.

Cale & Harris (2018) proposed how the attributes of the cognitive domain arguably feature in school curricula which could be a reference point for PL progression from a young age. For example, in the English National Curriculum Key Stage Two pupils aged seven – 11 years should understand how to improve in different PA skills and learn to evaluate their own performance including recognising their own successes and reflecting on their past performance (Department for Education, 2014). In Key Stage Three children aged 11-14 years should be able to articular effective performance and how to refine their techniques to improve performance in specific PA as well as be able to analyse their own performance and demonstrate their abilities to improve/ develop (Department for Education, 2014). The National Curriculum also draws on the importance of sustained PA engagement and leading a healthy active lifestyle as well as understanding longer-term benefits of activity (key stage three) and promoting maintained participation for personal health benefits into secondary school (key stage four) (Department for Education, 2014).

Whitehead has also reflected how these components of the cognitive domain clearly note the importance of self-reflection on movement and how to improve/ develop performance which she has recommended is mirrored into PL development through participant evaluations, observations and reflections (Whitehead, 2010). Although much of current knowledge on the cognitive domain in primary children is frequently addressing PE settings rather than border health or PA settings which are required to maintain PA participation for life (Whitehead, 2010; Ennis, 2015; Cale and Harris, 2018; Whitehead, 2019). Cale & Harris (2018) have noted a broader approach which focuses more widely on health and PA promotion could be more beneficial for PL development by allowing a deeper holistic understanding of health and body combined.

Lastly, the physical domain which is arguably often the most favoured in PL research and definitions which has led to many of the challenges surrounding PL misinterpretation (Edwards *et al.,* 2017; Edwards *et al.,* 2018; Whitehead, 2019; Hurter *et al.,* 2022). PL is about providing the opportunity for daily movement which from early years is essential for the development of motor patterns that are needed in later life (Whitehead, Durden-Myers and Pot, 2018; Durden-Myers *et al.,* 2021). Movement more generally is the prerequisite for human proficiency and important for interactions with the environment so its favoured position in PL research is easily understood, nonetheless it should be seen in equal parts to the other domains (Whitehead, Durden-Myers and Pot, 2018). In the past issues have arisen with the physical domain being seen as solely FMS based, however, Whitehead (2019) lists three attributes of PL which extend beyond this. Firstly, Whitehead (2019) notes that progression

includes moving with poise and effectively through a variety of environments including more challenging contexts. Next, the physical domain includes having thought and awareness of movement and meeting the requirements of the physical environment. Lastly, the domain is also about working successfully independently and with others in competitive and social environments (Whitehead, 2019). Whitehead and Murdoch (2006) proposed PL should be underpinned by movement (physical) in school settings but again this is not the sole focus of PL. Rather, from here movement should be explored through developing competence, understanding and positive attitudes in activity (affective and cognitive). This approach could lead to effective interaction in varied PA environments, improve self-confidence and self-esteem, improve understanding and appreciation of the importance to a healthy lifestyle and a high-level of PA participation (Whitehead, 2007).

Whitehead (2001) emphasised that an individual progressing in their PL is more likely to be physically active for life or intrinsically motivated to return to PA at some point in adulthood, therefore understanding where children are in their PL journey and progression is said to be beneficial to educators, coaches, parents and practitioners as it would allow them to support a child in developing areas of their PL (affective, cognitive physical attributes) (Barnett, *et al.*, 2020) and in turn increase the likelihood of a child participating in regular PA (Green *et al.*, 2018).

2.2.2 Measuring PL in children

A review by Shearer *et al.* (2021) investigated the current measures of the PL domains (physical, affective and cognitive) highlighted that there are still only three assessment tools which aim to explicitly measure all elements of PL, those are: The Canadian Assessment of PL (CAPL), the PL Assessment for Youth (PLAY tools) for and Passport for life (PFL). All tools of which are based on the Canadian definitions of PL.

CAPL attempts to assess all components of PL (Larouche *et al.*, 2011; Longmuir *et al.*, 2015; Francis *et al.*, 2016; Edwards *et al.*, 2018; Larouche *et al.*, 2018). The CAPL-2nd edition (CAPL-2) (2017) is one of the most recognised of the tools. It includes assessments of daily behaviour, motivation and confidence, knowledge and understanding, and physical competence for children. The system provides a score for each individual which can be categorised as beginning, progressing, achieving or excelling in their PL journey (Longmuir *et al.*, 2018). The tool includes three physical competency-based tests (Plank, progressive aerobic cardiovascular endurance run, Canadian agility and movement skill assessment), two forms of daily PA behaviour assessments (pedometer test and self-reported PA) and a 22-item questionnaire for motivation, confidence, knowledge and understanding (Longmuir *et al.*, 2018). This tool has been criticised for only recording a specific time point and snapshot of a child's PL journey and the values are focused on normative scores in Canadian populations rather than favouring the individual progression in PL (non-comparative) (Longmuir *et al.*, 2018; Li *et al.*, 2020). Although, the tool has proved widely popular and is used in research across the globe including Chile (Pastor-Cisneros *et al.*, 2021), China (Li *et al.*, 2020), Denmark (Elsborg *et al.*, 2021), Greece (Dania, Kaioglou and Venetsanou, 2020), Iran (Valadi and Cairney, 2023; Mosavi *et al.*, 2023), Indonesia (Wahyuni, Lengkana and Sudirjo, 2023), Pakistan (Liu, Yinghai *et al.*, 2023) and Spain (Mendoza-Muñoz *et al.*, 2021) and more. However, the appropriateness of the tool being applied in different populations outside of Canada has been questioned, for example, Li *et al.* (2022) found significant differences in total PL and distribution scores using CAPL-2. With 8-12-year-old children in Greece scoring higher than Chinese participants (Pillais' trace = 0.260, $F = 53.855$, $p < 0.001$, $\eta 2 = 0.260$) (Li *et al.*, 2020). Research by Elsborg *et al.*, (2021) has found good internal reliability for motivation and confidence measures ($\alpha = .90$; $\Omega = .90$) and high predictive validity for overall CAPL-2 scores ($\beta = 0.560$, $p<.001$) within Danish populations.

The tool was found to be appropriate for use in different populations but areas of the knowledge and understanding domain had recommended adjustments in Chinese and Greek editions (Dania, Kaioglou and Venetsanou, 2020; Elsborg *et al.*, 2021; Li, Kaioglou *et al.*, 2022). Whilst the tool has been translated into several languages, there is still limited knowledge on its suitability in different populations. These findings demonstrate the variance between populations when employing the tool which could be attributed to cultural differences in lifestyle (PA, access to resources, diet etc) which needs to be considered in PL development and PL tool design (Dania, Kaioglou and Venetsanou, 2020; Li *et al.*, 2020).

Sport 4 Life (S4L) developed the PLAY tools for ages 7-12 years. There are six tools with different focus of developments: PLAYfun (for trained professionals to observe physical development and gauge PL level), PLAYbasic (simplified version of play fun designed for trained professionals to be time efficient and provide a short snapshot of PL), PLAYcoach (for coaches), PLAYparent (for parents of children seven years and older), PLAYself (for children to gauge their own PL level). PLAYfun focuses mostly on physical skills including: running, FMS (object control and locomotor), balance and stability where are the PLAYself includes reference to active environments, PL self-reference, ranking of literacy, number and PL and fitness and PLAYparent refers to elements of confidence motivation and active environments. The tools have shown moderate associations with one another and strong inter-reliability but have been criticised for being too skills based, physical competence focused as they are derived through the long-term athlete development framework, being too time consuming and requiring trained assessors or expertise in PL to complete (Caldwell *et al.*, 2021; Jean de Dieu and Zhou, 2021; Liu, Yang and Chen, 2021).

PFL is a PL measure developed for teachers to assess their pupils' PL progress (Lodewyk, 2019). This tool provides a snapshot of pupils' PL journey which enables students to chart their progression and set new goals to encourage their development (Lodewyk, 2019). However, this tool is developed for assessment in PE and for educators to implement and focuses on 4 domains of PL (movement skills, fitness, living skills and active participation) (Edwards *et al.*, 2018) which does not align with the IPLA definition of PL. The CAPL, PLAY tools and PFL are the first to attempt to assess PL in its entirety, although these methods are criticised for their focus on physical elements and separation of the domains does also not adhere to the holistic concept of PL (Edwards *et al.*, 2018). The adherence to the holistic concept and intertwining of domains has been a consistent issue in whole tool assessment approaches. Many researchers have attempted to create domain specific tools to assess the different components of PL which have been inspired by the Canadian models but are suited to wider populations. These methods consider the pragmatic contributions each element can have towards PL development (Edwards *et al.*, 2018).

Krenz *et al.* (2022) developed a German PL assessment in primary age children (6-12 years). The assessment tool based on the work of Wessely *et al.* (2020) and adjusted Canadian model which encompasses motivation & self-efficacy, motor skills, knowledge and understanding and PA participation for PL development. The tool included a questionnaire on participation, motivation, self-efficacy and knowledge with an additional motor skills test using the Dordel-Koch test which is a seven item tests for children (6-16 years) including lateral jumping back and forth, sit and reach, sit-ups, standing long jump, one-legged stand, push-ups and 6-minute running (Jouck, 2009), of which the authors only tested three items (later jumping, standing long jump and 6-minute run). To assess the participation self-efficacy elements in the questionnaire, the authors used pictorial activities which distinguished activities levels (light, moderate and intensive) for participation and confidence in two sporting challenges based on the General Self-efficacy Scale by Schwarzer (Schwarzer *et al.*, 1997) and Bandura's Social-Cognitive Learning theory. Motivation was assessed using a combination of open written

response questions and 6-point Likert scale options to assess enjoyment / happiness which referred to Self-Determination theory (SDT) (Ryan and Deci, 2000). Finally, for knowledge and understanding the questionnaire had two open-ended questionnaires asking participants to describe how PA affected their feelings and what changes were made to their bodies. For final analysis the authors developed a scoring system similar to that of the CAPL in which participants received a score out of 60 (Krenz *et al.,* 2022).. Exploratory factor analysis of the tool receives consistency between motor skill tests (factor loading level greater than .3 threshold). For motivation and self-efficacy, the factors were not exact, but this is in line with IPLA which identified motivation and self-efficacy as separate. However, with child recall and suitability to influence by external factors (social desirability, fluctuations complex questions) it recommended Previous Day PA Recall could be used instead (only recalls the previous day). Introducing objective measures of PA would also be useful, similar to CAPS which could be more suitable for PA assessment however it can be time-consuming and costly (Krenz *et al.,* 2022).

In 2020, Australian PL researcher designed the PL in Children Questionnaire (PL-C) to assess self-perceived PL in children four- 12 years (Barnett *et al.,* 2020; Barnett *et al.,* 2021; Barnett *et al.,* 2022). The PL-C is designed to measure all 30 of the items that feature within the APLF and has been introduced in repose to the limited measurement tools available in PL child research as a method suitable for children who have lower literacy levels, where existing questionnaire tools may not provide appropriate or accurate representations of PL performance (Barnett, 2020). The pictorial questions are designed to represent the 30 elements of the APLF as well as encompass written assessment for children's PL, PA and sports literacy assessments and within a broad range of contexts to reflect the broad nature of PL (e.g. land and water, player and structured activity, classroom and home etc) (Barnett *et al.,* 2020; Barnett *et al.,* 2021; Barnett *et al.,* 2022).The authors have conducted several reliability methods in the development of the questionnaire over the last three years. In 2020, the tool design and content validity were conducted (Barnett *et al.,* 2020). Expert panel group consisting of Australia PE and PL specialists provided feedback on the scale construct and development and 17 children aged four – 12 years participated in interviews (Barnett *et al.,* 2020). Overall, the study found positive responses to the images present including a preference for a 'bunny' character (75%) and some changes were made in relation to the psychological and cognitive domains (Barnett *et al.,* 2020). The study reported children did not understand perceptual awareness (Cognitive), self-regulation - physical and self-perception (Psychological) (Barnett *et al.,* 2020). The authors have since developed these questions based on the feedback collated, however, the complex nature of these concepts may be challenging to capture through pictorial/ questionnaire methods as children may not understand how to respond in a manner which accurately represents their true thoughts (Edwards *et al.,* 2018). These questions were also specific to the definition of the APLF and referenced settings specific to the Australian climate, for example, the location of some of the pictorial questions included areas such as bushland. This would allow a detailed reflection of the population in context (Australia) but limits its applicability to wider locations where children would not experience this type of environment and may not be able to relate to the active setting in the images. Validity results indicated connection between subdomains, mostly psychological domains corresponding with the remaining domains (Barnett *et al.,* 2022). This interconnection is noted as important for the holistic nature of PL in AFPL (Keegan *et al.,* 2019). For the domain-specific test-rest reliability the study reported moderate findings for social and cognitive domains for both boys and girls and for the physical and psychological domains the reliability was good for boys and moderate for girls. The study assessed reliability within a two-week period, however, similar to the points noted by Krenz *et al.* (2022) and combined with the known variation in children's emotions, it may be more appropriate to have

shorter recall periods and limit retest period. Considering the vast development and fluidity of PL, a two-week period also could account for PL development (progression or regression) which may need to be considered in future PL design.

During the early stage of the tool design it was administered in interview format to avoid misinterpretation. As explained by Barnet *et al.* (2020), in the past research has reported that when children are presented with two images side by side children can respond to only one side (such as left) (Marsh *et al.,* 1994) which could be limited through this tool's approach. Therefore, an interview format was designed to allow the statements for each image to be read aloud for the participants to help with understanding in this stage of analysis (Barnett *et al.,* 2020). However, this could influence future understanding and compliance of the tool completion. If these methods were to also be adopted in future practice it could be very time consuming particularly when there are larger sample sizes involved (Edwards *et al.,* 2018).

Young *et al.* (2021) utilised Bernstein's theorising of curriculum and pedagogical relations to analyse PL assessments within health and PE contexts. The authors found six assessment tools which are more than previously identified in an earlier review by Shearer *et al.* (2021). However, Young's paper focused on educational settings whereas Shearer *et al.* (2021) looked more specifically at domains based in 7-12-year olds. The authors identified CAPL, PFL, PLAY tools, IPLA Matrix, Conceptual Model of observed PL and SHAPE America PE standards of assessments. Using Bernstein's theorising the study classified the tools as strong classification and framing, strong classification and weak framing, weak classification and strong framing and weak classification and weak framing, in which the CAPL, PFL and SHAPE America assessments were found to have strong classification and framing for PL. This meant the tools included insulation between the PL domains with clear performance achievement criteria and controlled assessment tasks. The tools also had little variation and clear guidelines of equipment, criteria and purposes (Young *et al.,* 2021). The CAPL and PFL have already been discussed previously but the SHAPE America included five assessment domains relating to movement skills, performance knowledge, PA and fitness, behaviour and value of PA. The PE standard assessment was identified to have a clear distinction from other subject areas and with differentiation between age/ school level with graded fixed outcomes. The assessments are all teacher-led in line with traditional PE metrics including written assessments, fitness testing and formative and summative methods (Young *et al.,* 2021). The three tools were all teacher led with identification on progression and comparison to norms and/or other participants (Young *et al.,* 2021). The PLAY tool was classified as weaker with moderate classification and framing (mainly the PLAYself tool) due to seasonality changes in the performance skill and assessment and the administrators having control as a pose to teachers (education settings). The tools also largely focused on the physical domain of PL with the PLAYfun tool included 18 physical movement related activities. The final two tools IPLA Matric (Whitehead, 2019) and Conceptual Model of Observed PL (Dudley, 2015) were both classified as weak classification and framing. Both tools were found to be focused on the holistic nature of PA and had no end state (Young *et al.,* 2021). Whilst this is more closely aligned to holistic PL, for the context of educational settings an outcome tool is favoured over charting of a journey throughout school environments where the boundaries of assessment are more fluid and interchangeable and progress can be mapped rather than traditional battery assessments (Dudley, 2015; Young *et al.,* 2021; Whitehead, 2019). These tools were not suited within the context but outside of education settings both methods can be applied closely to the holistic monitoring of PL which Idealist views may favour.

In general, there is a lack of comprehensive tools that are able to adhere to all PL domains and which can be applied in a variety of settings (Edwards *et al.,* 2018). Often, one domain is favoured over the others, which, as previously highlighted, does not support the holistic nature

of PL (Edwards *et al.*, 2018). More recently, Shearer *et al.* (2021) reported a number of reliable tools to measure the domains of PL and Young *et al.* (2021) has explored the application in education settings, however, both reviews have highlighted there is still a lack of robust tools that measure all domains and those that do consider broader elements are often not aligned with the more globally used IPLA approach. Often, research has shown that measures tend to focus on motor skills or fundamental sports skills (physical domain) and the cognitive domain is the least explored (Longmuir *et al.*, 2015; Jean de Dieu and Zhou, 2021).

Britton *et al.* (2023) investigated the factor structure of PL in children as proposed by Whitehead. Primary aged children in Ireland between nine -12 years (n=1073) participate in a series of measurements to assess the four attributes of PL that are proposed by Margaret Whitehead and adopted in the IPLA definition (motivation, confidence, knowledge and understanding and physical competence). Firstly, motivation was measured using the Behaviour Regulation in Exercise Questionnaire (Sebire *et al.*, 2013) adapted edition. The questionnaire measures the multidimensional aspects of motivation (intrinsic, identified, introjected and external) in three questions using a five-point Likert scale answer. For confidence, participants completed the modified PA Self-Efficacy Scale, an eight-item single factor scale with three-point Likert scale answers to assess PA related self-efficacy (Bartholomew *et al.*, 2006). Knowledge and understanding were assessed using two adapted questions from the CAPL assessment (Longmuir *et al.*, 2015). Due to the lack of validated measures of knowledge and understanding, two questions were selected based on PA and screen time which were thought to also be applicable in the Irish context. Finally, for physical competence, pupils participated in the TGMD-3 (Ulrich, 2017) which included seven ball-skill related movements (catch, overhand throw, underhand roll, kick, two-hand strike, one-hand strike, and stationary dribble) and six locomotor skills (run, skip, gallop, slide, hop, and horizontal jump). Coupled with Bruininks-Oseretsky Test of Motor Proficiency 2 Short Form (Bruininks and Bruininks, 2005) to test balance skill through two walking trials (scored via walking six steps and balance beam for 10 seconds). To account for health-related fitness elements of the physical domain, four tests were also completed: 20m shuttle run, plank, grip strength and a back-saver sit and reach test. The study assessed goodness of fit to identify a best fitting model of PL within the sample. After adjusting for outcomes that identified negative factor loading (knowledge and understanding) and removing outcomes that demonstrated low and/or non-significant loading (external motivation β=0.04; flexibility and hand grip strength β=0.20) a final model was identified with high goodness of fit indices (indicator loading of >.30) on all elements apart from confidence. The final model included: Motivation consisting of intrinsic, identified and introject. Confidence consists of eight factors: active after school, ask parent/guardian, TV/computer, weather, stay home, skills, busy and friend, and physical competence consisting of balance, object control, locomote skills, VO2 max and plank. The study demonstrated similar findings in line with the work of Cairney *et al.* (2019b) and Gunnell *et al.* (2018) in which both identify a lack of fit for knowledge and understanding within PL. Interestingly, the study also showed strong association with the attributes of the affective domain of PL compared to the physical which has already noted is often seen to be most associated/ underpinning of PL (Edwards *et al.*, 2017; Edwards *et al.*, 2018; Hyndman and Pill, 2018; Hurter *et al.*, 2022). Britton *et al.* (2023) found confidence was most strongly loaded onto the construct followed by motivation and then lastly, physical competence. These findings are in support of holistic PL but also highlight the need for further consideration into the presence of the cognitive domain and its assessment within PL.

Studies that have explored the cognitive domain, often use written methods to explore the knowledge and understanding behind PL and leading a healthy active life (Edwards *et al.*, 2017; Edwards *et al.*, 2018; Shearer *et al.*, 2021). These tools include creative thinking tests,

mock exams, and questionnaires (Edwards *et al.,* 2017; Edwards *et al.,* 2018). Myers *et al.* (2013) Mock exam paper adhered to the cognitive elements by exploring A-level pupils PE knowledge, however, this method did not explore general knowledge and understanding of leading a healthy active lifestyle which is vital in the exploration of the cognitive domain in PL research (Edwards *et al.,* 2018). Santos *et al.* (2017) creative thinking test was developed with specific reference to the physical skills definitions of PL which embodies motor-competence as important to PL progression. This tool is a valid and reliable instrument for measuring creativity and knowledge to interact with the physical environment, however, has also been criticised for not evaluating general knowledge and understanding of healthy active lifestyles, similarly to Myers *et al.* (2013). Francis *et al.* (2016) devised the 'Understandings PL questionnaire' in line with the CAPL model, this tool adopted the whitehead/ IPLA definition and made specific references to the holistic philosophy of PL and explored perceived PL considering physical competence, motivation, knowledge and daily behaviour. This tool has been validated by panel experts within the research area, however, is not yet validated as a tool for clearly assessing the cognitive domain of PL (Francis *et al.,* 2016; Edwards *et al.,* 2018). Llyod (2016) creative writing assessment explores physical experiences which allows participants to write their enquiry experiences, knowledge and understanding. However, this tool is dependent on participants' academic writing ability (Lloyd, 2016). Often the development of knowledge and understanding in PE is through class-room based delivery which allows teachers to educate on the wider benefits of PA beyond solely physical components and address wider health benefits (Cale, 2016). The focus of the approaches on information transmission and not on the development of understanding can be challenging to articulate effectively particularly with younger years (Cale, 2016). Class-room based approaches to cognitive education and testing could also be contradicting PL and the values of leading a healthy active lifestyle as children are sedentary and activity/movement time is limited throughout this time (Cale and Harris, 2018; Goss *et al.,* 2022). In addition, Barnet *et al.* (2020) has also highlighted the importance for research to consider the literacy levels of children particularly when exploring PL. Whilst these tools present more robust measures of cognitive development, they would not be suited to the principles of PL and variety of children, such as primary aged children with lower literacy ability which could influence the findings.

Edwards *et al.* (2018) found qualitative approaches to PL allowed in-depth exploration of both the cognitive and affective domains on PL, but limited measures of the physical domain. For example, Gunnell *et al.,* (2018) have revised a number of questionnaires based on the self-determination theory, PL and the CAPL and produced a much shorter questionnaire of 12 items that address the four subdomains within the affective and cognitive domains of PL (motivation and confidence; knowledge and understanding). The revised questionnaire is aligned with the definition of motivation and confidence within PL and has clearer instructions for completion compared to more comprehensive tools, making it a popular method to explore the affective and cognitive elements of PL in research (Edwards *et al.,* 2018). However, as mentioned, the questionnaire tools like Gunnell *et al.,* (2018) have not considered the physical elements of PL and if altered, questionnaire tools can only capture elements of perceived physical competence and not social or physical interactions with the environment (Edwards *et al.,* 2018; Whitehead, 2019). Due to the unpredictability and daily changes in the behaviour of young children and adolescents, qualitative data can pose a potential challenge for effectively measuring the cognitive and affective domains of PL too as they may not be representative of the child's PL and rather could be reflective of their feelings on the day (Edwards *et al.,* 2018). Quantitative measures on the other hand are a more reliable method of data collection that can undergo more rigorous reliability testing (Edwards *et al.,* 2018).

Although, as shown above in the larger tools of PL assessments, this can lead to the PL domains often favouring one domain (Edwards *et al.,* 2018).

Whilst not all approaches may be able to adequately capture all the broad attributes of PL, Barnett *et al.* (2019) has recommended that research should recognise the aims of their work and acknowledge the limitations in their design and assessment which would help to guide future research and development tools. A mixed-methods approach with both qualitative and quantitative research tools has been suggested as a possible way to embody PL progression through exploring all domains and respect the holistic values of PL by considering the overlapping of tools and a method to combine the strengths or limitations from existing PL approaches (Creswell, 2003; Creswell and Clark, 2017; Edwards *et al.*, 2018). Thus, allowing the adoption of a pragmatic approach to PL recognising the need for practical methods of assessment but still respecting the holistic definition and idealist view that PL domains are interrelated (Edwards *et al.,* 2017; Edwards *et al.,* 2018). Barnet *et al.* (2019) added this approach allows research to align with the core elements of PL (affective, cognitive and physical) and tailor the data collection to suit the sample, which may also allow greater dissemination in findings (e.g. best practise with young populations) (Wright and Majnemer, 2014; Barnett *et al.,* 2019; Arbour-Nicitopoulos *et al.,* 2023).

Wainwright *et al.* (2018) adopted a complementarity mixed-methods pragmatic approach (qualitative + quantitative) to explore the contributions of the Foundation Phase of the Welsh curriculum in its development of PL. The Foundation Phase in Wales is a play-based curriculum for children ages three to seven which considers the holistic areas of learning and is thought to contribute to the development of PL attributes (Department for Children, Education, Lifelong Learning and Skills, 2008; Wainwright *et al.,* 2018). The authors employed the mixed-method design as part of a three-phase study allowing overlapping findings to provide an insight into children's progression and PL related experiences (Wainwright *et al.,* 2018). In stage one, the authors conducted interventions and documentary analysis to understand the relations of the curriculum to PL (Wainwright *et al.,* 2016). In phase two, the authors employed a mixture of methods to determine outcomes of PL and in the final phase three explore the relationship between PL and academic achievement in children aged five – six (Wainwright *et al.,* 2018). Specifically focusing on phase two to monitor PL progress, to assess Physical competence and interaction with the environment the Test of Gross Motor Development (TGMD) second edition was used (TGMD-2). The TGMD-2 is a standardised FMS performance test for children three – 10 years which consists of two subtests to form a criteria norm-referenced score (Objective control and locomotor skills based) (Ulrich, Soppelsa and Albaret 2000). Participant operation field notes were also generated to explore interactions and competencies and allow self-reflection (Wainwright *et al.,* 2018). To explore children's confidence, the Pictorial Scale of Perceived Competence and Social Acceptance was employed (Harter and Pike, 1984). The authors used the six-items of physical competency elements only of the scale at two time points over the year. For motivation, the Leuven Involvement Scale for Young Children video and field notes evaluation instrument was used which is a five-point scale scoring observed behaviour (Laevers, 1994). The study findings indicated significant progression in TGMD-2 overall score and locomotor skills but no improvements in object control, the Leuven scale indicated improvements in motivation for movement (Wainwright *et al.,* 2018). The authors concluded the curriculum lays the foundations for PL in early years apart from the object control elements of the physical domain (Wainwright *et al.,* 2018). The study specifically focused on motivation, confidence and physical competence which adheres to the physical and affective domains on PL and whilst self-confidence and interaction with the environment is noted in the attributed of the cognitive domain this was not reflected on in the study, nor were any elements of the cognitive domain considered (knowledge and understanding). The authors noted the third phase of the study

focused on academic achievement, however, this is not directly in line with the cognitive elements of PL either which as previously noted, should reflect knowledge on activity, interaction with the environment and the value of leading a healthy active lifestyle (Whitehead, 2019).

More recently, Arbour-Nicitopoulos *et al.* (2023) adopted a domain-based approach to PL in youth with and without disability. The domains assessment is a pragmatic approach which adopts the use of domains-specific tools which are suited the context. The authors noted that this approach would provide a 'snapshot' of an individual's PL experiences which may help to overcome issues with addressing PL journeys as this method does not attempt to record overall PL and rather provides a small insight in part of a child journey within a specific context (Arbour-Nicitopoulos *et al.,* 2023). Other research has similarly put forth a domains-based conceptualisation of PL which has been applied in primary children settings (Dudley, and Cairney, 2021; Cairney *et al.*, 2019a; Martins *et al.*, 2021). The approach would also allow research to consider each domain of PL but also still recognise the multi-dimensional constructs by considering how these methods may overlap (Arbour-Nicitopoulos *et al.*, 2023; Britton *et al.*, 2023). This approach would then allow future research to consider the different contributions the domains have when trying to develop PL and PA engagement (Arbour-Nicitopoulos *et al.,* 2023; Britton *et al.,* 2023).

Within Arbour-Nicitopoulos *et al.* (2023) approach the authors conducted measurement tools for movement competence, motivation, confidence, peer relationships and PA behaviour and the changes in these outcomes following a community-based PL programme. For competence the study employed the shortened version of Wright *et al.* (2018) *Challenge* called *Ignite challenge*, a 13-item assessment designed to assess advanced motor skills for children and has been applied in populations with ranges of disabilities. For motivation and cognitive elements of PL the study employed a 24-item behavioural regulation questionnaire-3 (Wilson *et al.*, 2006). The item has six subscales of motivation (amotivation, external motivation, introjected, identified, integrated and intrinsic) consisting of a 5-point Likert scale response system. Secondly for confidence, the 15-point PA self-efficacy scale was used (Foley *et al.,* 2008). The tool assesses confidence in different PA intensity and overcoming barriers to PA (Foley *et al.,* 2008; Arbour-Nicitopoulos *et al.,* 2023). For peer relationships, a third questionnaire on the social-learning domain of PL (AFPL) was employed. The Peer Motivational Climate Youth Sport 21-item Questionnaire was used to assess perception of relationships formed from the programme participation (Ntoumanis and Vazou, 2005; Arbour-Nicitopoulos *et al.,* 2023). Finally, for PA behaviour the authors employed two tools. The authors recorded attendance to the PA programme and daily minutes spent in light, moderate and vigorous intensity PA using GT3X Actigraph accelerometer. Accelerometery was recorded over a seven-day period and parental logbook used to record device wear time. Using these measurement tools, the study was able to independently asses' areas of the PL. The study recorded evidence for improvements in movement competence (6.3% increase), small changes in motivation and confidence following the community-based PL programme. However, reflecting on their methods, Arbour-Niciopoulous *et al.* (2023) noted that further work is needed to reduce the number of measures used that are more optimal for time and context. The total assessment for the tools employed was "upwards of 90 minutes" (p227) which can raise issues with child behaviour responses and availability of time/ resources (Arbour-Nicitopoulos *et al.,* 2023). Future studies may therefore benefit from considering the suitable time efficient methods of assessment as well as those that can still meet the domains of PL.

Considering tools that assess multiple methods of PL would be a time efficient approach and allow research to ensure all domains of PL as covered (Goss *et al.*, 2022; Britton *et al.*, 2023; Barnett *et al.*, 2023). A recent PL review by Barnett *et al.* (2023) has suggested survey tools

coupled with objective assessments of motor competence and/ or cardiovascular outcomes would be more feasible to administer in schools and the findings can complement one another to adhere to holistic PL. The reliability testing within physical competency tools is widely researched and can therefore help to combat concerns of reliability in PL investigation (Barnett *et al.,* 2023). Survey or questionnaire methods have also been proposed as a method of capturing the psychological and cognitive elements on PL that have been previously overlooked in existing research, although would require further work to ensure they suit the literacy levels for children (Edwards *et al.,* 2018; Barnett *et al.,* 2022). Combined mixed methods which capture individualised reflections such as survey tools and quantitative physical competency methods with follow-up or continual data collection may be suitable to allow individual charting and allow self-reflection in line with the domains of PL.

2.3 PL, PA and health outcomes

As the measures of assessing PL have progressed in research, closer attention is being paid to the outcomes of PL engagement and its contributions to children's health. Scholars have suggested a bidirectional relationship between PL and PA which has led to recommendations for further research into health-care settings and practical implications of PL on health-related outcomes (Dudley *et al.,* 2017; Cairney *et al.,* 2019b; Cornish *et al.,* 2020).

2.3.1 Obesity

Public Health policies are often driven by the promotion of healthy lifestyle choice and PA engagement to reduce obesity within communities. Globally, the number of people being classified as obese or overweight has increased significantly in the last 10 years, and almost tripled since 1975 (World Health Organisation, 2021b). The risks associated with obesity include increased risk of coronary heart disease, stroke, diabetes, some cancers, as well as increased mortality rates and poor mental health (World Health Organisation, 2000; World Health Organization, 2021b). In 2014/15 the UK National Health Service (NHS) spent ~£6.1 billion on obesity related illnesses alone, a cost which is expected to increase by over 50% by 2050 making the reduction of obesity a priority in policies today (Public Health England, 2017). Obesity in childhood and adolescence is of particular concern as it can negatively impact participation in recreational and leisure activities, and result in the early onset of the health risks discussed previously (World Health Organization, 2016). In England, a third of children aged 2 to 15 years are reported to be overweight or obese and the most recent national statistics show 37.7% of children in school year 6 are considered overweight (14.35%) or obese (23.4%) (Lifestyles Team, 2022; Public Health England, 2022). The data demonstrates that the number of children classified as obese and severely obese has decreased since 2020/2021 but is still higher than preceding years (Baker, 2023; Lifestyles Team, 2022). Children with obesity are less likely to maintain a healthy weight status into adulthood; therefore, preventing childhood obesity is important to limit adverse health risks later in life and reduce the financial burden on health care systems (World Health Organization, 2000; World Health Organization, 2016; Public Health England, 2017). Although many of the initiatives in place have struggled to maintain a healthy habitual change in participants, often the promotion of initiatives does not consider the wider determinants of lifestyle choices associated with PA participants such as social factors, enjoyment, and perceived competence (Cornish *et al.,* 2020).

The causes of obesity are multifactorial, and research into childhood obesity highlighted low rates of PA, genetics, social cultural factors, poor nutrition and high level of sedentary behaviours as some of the known causes (Ang *et al.,* 2013; Sahoo *et al.,* 2015; Public Health England, 2017). According to Public Health England (PHE) (Public Health England, 2017; Public Health England, 2022) the two leading causes of obesity are poor diet (food and drink) and limited levels of PA. Children in England are failing to maintain active and healthy diets,

which has led to excess weight gain and increases in sedentary behaviour (Public Health England, 2022). The UK Government and PHE have introduced a number of local and national policies to tackle obesity via the promotion of healthy lifestyle behaviours (Public Health England, 2022). The more recent healthy eating related policies include: restricting opening of fast-food takeaways (local), working with schools to encourage health eating in school canteens (local), Soft drinks industry levy (national), and Sugar reduction (national) (UK Chief Medical Officers', 2020). PA related policies include: Developing active environments (local), Moving professionals (Local), OneYou (national) and published PA guidelines from the Chief Medical Officers for under 5s, children and young people, adults and older adults (UK Chief Medical Officers', 2020). Many of these policies have reported positive findings such as significantly reducing sugary-drink consumption in children, and increasing access to green space for PA in local authorities (National Diet and Nutrition Survey, 2020; Public Health England, 2021). Similar early years prevention programmes have also reported strong evidence to support the reduction in obesity (Body mass index (BMI) and adiposity over time (Waters *et al.,* 2011; Brown *et al.,* 2019). More recently, a review by (Brown *et al.,* 2019) found PA focused interventions to be successful in reducing obesity (BMI) in children (6-18 years) but no positive evidence on diet focused interventions and limited evidence for diet and PA combined. Despite the reported success of PA based programmes, UK statistics show many children are still failing to meet the recommended PA guidelines (55.1%, (Public Health England, 2021) and reap the benefits of maintained participation. PA-focused initiatives are often introduced to combat rising childhood obesity and sedentary behaviours in young children by increasing daily PA at school (UK Chief Medical Officers', 2020; Chalkley *et al.,* 2020b; Jones *et al.,* 2020). Existing systematic reviews and meta-analyses of school-based PA programmes have reported the effects of participation, including improved; PA and/or Sedentary behaviours (Dobbins *et al.,* 2001; Kriemler *et al.,* 2011; Hynynen *et al.,* 2016; Owen *et al.,* 2017; Jones, M. *et al.,* 2020), Motivation (Dobbins *et al.,* 2013; Kelso *et al.,* 2020), MVPA (Nathan *et al.,* 2018), and academic outcomes (Watson *et al.,* 2017). However, these findings are often inconsistent across reviews, and many components are inconclusive or only indicate small effects (Dobbins *et al.,* 2013; Jones, *et al.,* 2020). Some suggested limiting factors for these findings is the variation in intervention designs and measurement tools within reviews (Jones, *et al.,* 2020) but also what these policies and interventions often do not consider is the factors associated with long-term engagement.

2.3.2 PL and obesity

The clear focus of PL is the progression in PA (Edwards *et al.,* 2017). Given the vast benefits linked with regular PA, scholars have highlighted the growing importance for research to investigate PL progression, to improve lifetime PA and, in turn produce positive health effects (Green *et al.,* 2018; Brown, Dudley and Cairney, 2020). There has been further growing interest in the concept of PL and its connected positive health outcomes associated with PA (McKean, 2013; Jurbala, 2015; Cairney *et al.,* 2019a; Cairney *et al.,* 2019b; Caldwell, Hilary *et al.,* 2020). As literature now progresses beyond the traditional field of becoming 'physically literature' through PE, pragmatic researchers have suggested that if the outcomes of PL progression are increased PA then it must also be a determinant of health through regular PA benefits (Cairney *et al.,* 2019a; Cairney *et al.,* 2019b). However, much of the research has favoured developing measurement tools whilst scholars have noted the importance for literature to first understand the relationship between PL, PA and heath to support Public Health sectors in their promotion of health active lifestyles (Cairney *et al.,* 2019a; Cornish *et al.,* 2020).

A key focus of Public Health policy noted above is the reduction in obesity through encouraged PA and healthy habits. Literature has suggested PL as a way to promote PA in obese populations by encouraging healthy lifestyle choices (Jurbala, 2015; Paponetti *et al.,* 2023). Paponetti *et al.* (2023) conducted a series of qualitative discussions (interviews, member checks and focus groups) with health care providers in the US and found health care workers valued the idea of PL promotion to encourage PA in obese populations. Particularly, health care practitioners reported the importance of considering the affective and cognitive domains of PL that may influence sustained PA participation (Paponetti *et al.,* 2023). Cornish *et al.* (2020) rapid review on PL and health reported participants with higher BMI, waist circumference, weight and/ or poor cardiovascular fitness (CF) were more likely to have poorer PL than individuals with healthier scores for their ages (Lang *et al.,* 2018; Comeau *et al.,* 2017; Holler *et al.,* 2019; MacDonald *et al.,* 2018). Further PL research has shown that weight related outcomes are reflective of PL in children (Body fat percentage (BF%) (Nezondet *et al.,* 2023); BMI (Comeau *et al.,* 2017); Weight classification (Delisle Nyström *et al.,* 2018; Mendoza-Muñoz *et al.,* 2021). Mendoza-Munoz *et al.* (2021) investigated the difference between obesity and PL (CAPL-2) in Spanish children eight – 12 years of age (n=135 61.5% non-overweight). The study found 42.2% of children classified as healthy weight were excelling in their PL (CAPL-2) compared to only 13.5% of overweight or obese children. The study then also found an inverse relationship between body composition and the CAPL PL domains, apart from knowledge and understanding domain (r from -.223 to .507) (Mendoza-Muñoz *et al.,* 2021). Barnet *et al.,* (2023) has suggested an improvement in health-related outcomes such as daily PA, reduced BF% and optimal BMI to be reflective of PL progression and could be considered to monitor as outcomes of PL development within research. Given the complex nature of obesity within young populations, adopting a PL approach would be beneficial for Public Health policy to consider, particularly in tools that aim to reduce obesity through PA participation.

2.3.3 Public Health and PL

PL is a journey and does not have an end point which means an individual can progress/ regress throughout their life course (Whitehead, Jean, Telfer and Lambert, 2013). In young populations, those with poorer PL are less likely to participate in PA and children with higher PL are more likely to meet daily PA guidelines (Belanger *et al.,* 2018). In order to combat the rising obesity and sedentary behaviours within young populations, PA progression through a PL approach has been suggested as a way to not only increase PA participation but encourage the development of healthy habits that correspond into later life. PL has grown in popularity in policy and practise where it is not being recognised as a way to encourage PA and reduce sedentary behaviour worldwide (Carl *et al.,* 2023).

Global policies to improve health and well-being refer to the values of PL and the importance of generating lifelong health habits to maintain active nations (The Global Action Plan on PA (2018-2030)) (United Nations, 2015; World Health Organization, 2018; World Health Organisation, 2021a). However, a recent review by Carl *et al.* (2023) on PL in policy and practise across Europe identified that PL plays a limited role in political statements. Although, in the UK there were some promising findings for the countries where recognition of PL had been identified in more policies compared to other European countries (Carl *et al.,* 2023).

In 2021, The House of Lords published a call for a national focus on PL (Department for Culture and Department for Digital, Culture, Media & Sport, 2022). In ‘A national plan for sport, health and well-being’ 2021/22 PL is reported a key principle which should be focused towards children through PE and a variety of PA opportunities in order to encourage PA participation for life (Department for Culture and Department for Digital, Culture, Media & Sport, 2022). Association for PE (AfPE) and Youth Sports Trust all welcomed the promotions

of PL in the UK highlighting the value of developing PL from a young age and the work of The Department for Education to prioritise PE with PL valued in similar light to literacy and numeracy skills. The UK government has also backed the plan noting PL as a priority for tackling activity and improving health in schools (Department for Culture and Department for Digital, Culture, Media & Sport, 2022).

In Scotland, at a regional level PL has been used in public health services and recognised within the Scotland Governments four policy areas (Health, sport, education and children and young people) to develop confidence and competence in PA from a young age (Johnstone, 2016; Scottish Government, 2018; Carl *et al.,* 2023). Within the Active Scotland Delivery Plan (2018) outcomes three "We develop physical confidence and competence from the earliest ages" developing PL from birth through NHS programmes and supporting coaches with developing PL through multiple PA is reported (Scottish Government, 2018).

In Wales, the Welsh Government and Sports Wales have highlighted the value of PL with Sport Wales specifically employing National Governing bodies to develop PL strategies in community settings (Gov.Wales, 2012; Carl *et al.,* 2023). In 2012, the Welsh Government published the 'All-wales approach to increase PA for children and young people' in partnership with The Schools and PA Task and Finish Group. The document includes recommendations for delivering quality PE and PA for children noting that PL should be an outcome of these high-quality experiences (Gov.Wales, 2012).

In England, the PL presence is continually growing in policy (Carl *et al.,* 2023). Currently, in addition to the government announcements, the consensus statement is underway with Sports England. The Sports England Active Lives Survey has questions relating to PL, AfPE and Youth Sport Trust have also published PL frameworks for guiding PE experiences and sports provisions in schools (Association for Physical Education, 2013; Youth Sport Trust, 2017; Association for Physical Education, 2021; Carl *et al.*, 2023).

2.3.4 School-based interventions

PL can be applied in a variety of contexts including education, daily activity, fitness and health settings, although it is most commonly featured in PE (Hyndman and Pill, 2018). A review by Carl *et al.* (2022) identified 46 PL interventions across the globe. The review identified 77% adopting whiteheads approach but only 38.6% of interventions considered all three PL domains which has led to questioning surrounding the holistic understanding of PL in practical application. A suggestion for the limited holistic exploration of PL could be the lack of consensus on PL reporting. Carl *et al.* (2022) recommended future research consider using standardised intervention reporting checklists such as Template for Intervention Description and Replication (TIDieR). Carl *et al.* (2023) recently also published the first PL checklist to guide intervention but until this point, there were no other known PL checklists available to guide intervention designs, which has presented a challenge for research aiming to design and implement successful PL programmes (Carl *et al.,* 2022). However, the bidirectional relationship between PA and PL would suggest that interventions designed to improve PA would encourage PL through development in PL attributes (e.g. developing movement efficiency and/or developing confidence when taking part in PA (Whitehead, 2019)).

Schools are key environments for introducing PA interventions to combat obesity and sedentary behaviours which could also correspond with PL development. Children spend a substantial portion of their day in school there so there is opportunity to address health inequalities and introduce programmes to enhance PL through PA such as in PE (Tremblay, Mark and Lloyd, 2010; Green *et al.*, 2018), break time, and in-class activities (Naylor *et al.*, 2015; Shah *et al.*, 2017). Whilst these PA focused interventions may not be development in line with the core domains of PL, Whitehead has noted that no matter an individual's

capability, even small improvements in the attributes of PL would have a positive effect on performance achievement and quality of life suggesting worthwhile contribution to PA engagement (Whitehead, 2007).

School-based run/walk programmes are one example of a PA intervention that has gained popularity in policy over recent years (Public Health England, 2020a; Sherar *et al.,* 2020). The interventions involve children walking, jogging or running a marked route on school grounds for either a set distance or time and can often be referred to in policy 'active mile initiatives', which typically entail running for approximately 15 minutes at a self-selected pace until a one-mile distance is covered (Chalkley *et al.,* 2020b; Public Health England, 2020a; Sherar *et al.,* 2020; The Daily Mile, 2022).

TDM is one example of a popular school-based running/walk intervention designed to improve PA and sedentary behaviours in children (The Daily Mile, 2022). In the early months of 2023, two systematic reviews have been published exploring TDM intervention and health related outcomes in young children (Breslin *et al.,* 2023; Hanna *et al.,* 2023). Both reviews found evidence for improve health outcomes in children and encouraged further rigorous methodological approaches to research are needed (Breslin *et al.,* 2023; Hanna *et al.,* 2023). Some of the research so far has identified factors relating to PA behaviour (Time in MVPA (Chesham *et al.,* 2018a); Movement pattern (Morris, *et al.,* 2019; Harris, Milnes and Mountain, 2020; Hatch *et al.,* 2021), improvements in CE (Chesham *et al.,* 2018; Brustio *et al.,* 2019; Brustio *et al.,* 2020; de Jonge *et al.,* 2020; Marchant *et al.,* 2020), and mixed responses for anthropometric/ body composition (Chesham *et al.,* 2018; Brustio *et al.,* 2019; Breheny *et al.,* 2020; Brustio *et al.,* 2020), cognition (Morris, *et al.,* 2019; Hatch *et al.,* 2021; Booth *et al.,* 2022; Dring *et al.,* 2022a) and self-perceived competence/ self-esteem (Arkesteyn *et al.,* 2022). There have also been a number of studies investigating the process evaluations, facilitators and barrier to participation in this intervention alone (Ryde *et al.,* 2018; Brustio *et al.,* 2019; Hanckel *et al.,* 2019; Ward and Scott, 2019; Malden and Doi, 2019; Marchant *et al.,* 2020b; Harris, Milnes and Mountain, 2020; Hatch *et al.,* 2021; Routen *et al.,* 2021). These findings share connections with the concept of PL (e.g. self-perceived competence = affective domain), although, the concept has only been suggested in qualitative research to be an outcome of participation (Hanna *et al.,* 2023) and it is unclear if any studies have yet considered PL. Despite this, wider run/walk intervention literature has actually suggested that participating in these interventions could contribute to PL development (Sherar *et al.,* 2020). Whilst these interventions may not be developed for progressing PL as a whole (affective, cognitive and physical contributions) but they could contribute to attributes necessary for PL development, such as improved self-perception and movement competencies, which requires further analysis (Sherar *et al.,* 2020; Arkesteyn *et al.,* 2022).

A study by Venkatraman *et al.* (2022) identified that simplified interventions such as TDM which require no equipment, time to implemented and additional training for school staff can also be effective in addressing health inequalities across England. The study found schools based in high-need local authorities were more likely to sign up to the TDM intervention compared to lower-need areas (Venkatraman *et al.,* 2022). Within London, sedentary behaviours and lack of PA engagement are also growing and update of school-based PA interventions has varied (Public Health England, 2020b). One borough in London where child PA engagement and obesity is of concern is the North West borough of Barnet. A key focus of the London Borough of Barnet Health and Well-being Strategy 2015-2020 was to reduce obesity and prevent long term health conditions associated with obesity through the promotion of regular PA and for life. One key promotion in the borough was Barnet's Golden Kilometre', a school-based run/walk intervention designed specifically for primary school children in Barnet due to the lack of uptake in other interventions across the borough. The intervention

(chapter five) is designed with similar characteristics of TDM. The intervention is currently being encouraged across the borough due to the success of run/walk interventions like TDM, however, there is currently no known research exploring this intervention and health related outcomes.

Chapter Three: Thesis table and map

Table 1: Thesis aims

Overall thesis aim: To explore the effects of Barnet's Golden Kilometre in primary school pupil's PL	
Study aims:	
Study One: 'A systematic review exploring the effectiveness of school-based running programmes to develop PA and PL related components '	**Overall:** To investigate the current research on school run/walk interventions and their influence on physical literacy and physical activity related outcome variables (quantitative studies). **1)**To examine the measurement of physical literacy constructs and physical activity-related components in school-based run/walk programmes. **2)** To compare the different intervention methods of school-based run/walk programmes and their impact on encouraging physical activity participation or physical literacy development.
Study Two: 'Are PA and PL related outcomes affected by Barnet's Golden Kilometre intervention?'	**Overall:** To examine the effects of Barnet's Golden Kilometre on physical activity and physical literacy related outcomes **1)** To explore the impacts participating in Barnet's Golden Kilometre has on the domains of physical literacy **2)** To identify the impacts participating in Barnet's Golden Kilometre has physical activity and health outcomes as indicators of physical literacy progression.
Study Three: 'Exploring teachers' perspectives of Barnet's Golden Kilometre and perceived pupil experiences'	**Overall:** To explore teachers' perceived pupils' experiences of participating in Barnet's Golden kilometre and its potential contributions to their physical literacy development. **1)** To discuss teachers' perceptions of pupil's experiences of the intervention. **2)** To examine how the implementation of Barnet's Golden kilometre could influence physical literacy experiences.
Study Four: 'Discussing primary school pupils' experiences of Barnet's Golden Kilometre'	**Overall:** To explore children's perceptions of Barnet's Golden Kilometre over one academic year. **1)** To discuss how Barnet's Golden Kilometre has influenced children's perceived physical activity and physical literacy journey throughout the year. **2)** To explore children's perceptions of Barnet's Golden Kilometre intervention.

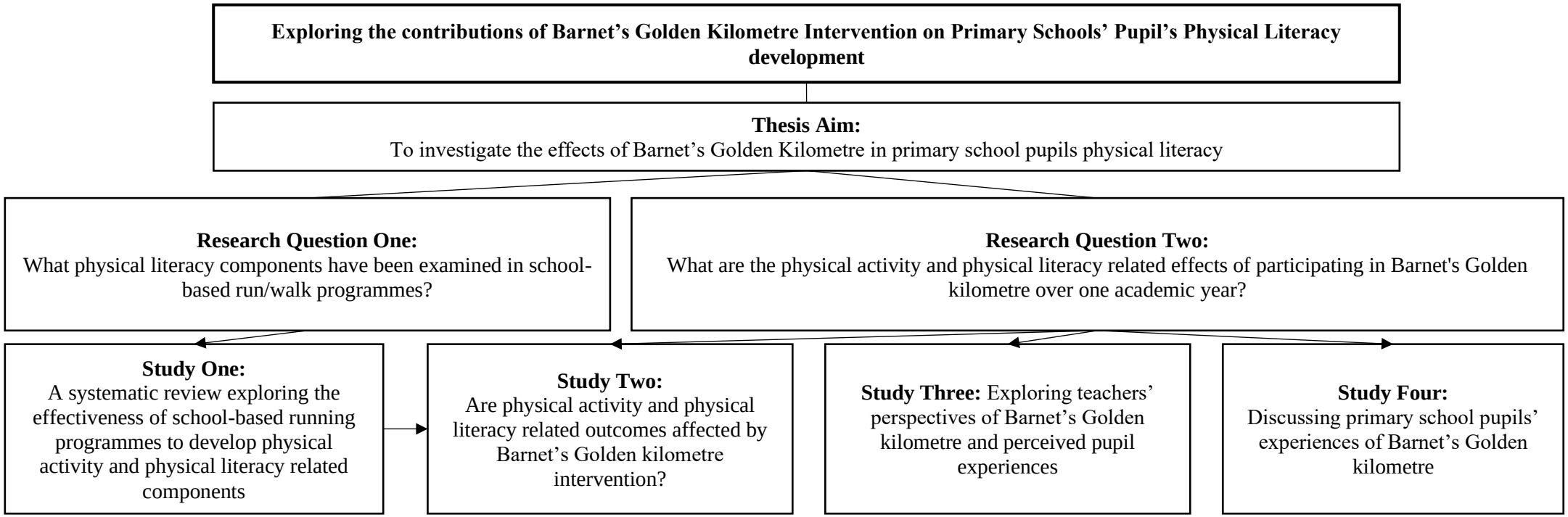

Figure 6: Thesis map

Chapter Four: Study One

4.0 A systematic review exploring the effectiveness of school-based running programmes to develop PA and PL related components

Abstract

Introduction: There is growing interest in the outcomes of school-based run/walk interventions which are now featured in local and national Public Health policies targeting improved childhood physical activity (PA). The concept of physical literacy (PL) is proposed as a method of identifying the potential physiological and psychological contributions participating in run/walk interventions may have towards encouraging life-long PA engagement. *Research aims:* To examine all available research on school-based run/walk interventions and their measurements of PL domains (affective, cognitive and physical) and PA-related components, and to assess the different intervention methods and their impact on encouraging PL and PA in primary school children. *Methods:* The study followed the PRISMA2020 guidelines and was registered with PROSPERO (CRD42021253675). To be included in the review, studies had to satisfy all inclusion criteria. An electronic search was conducted on six databases, the last date search was 25th April 2022. All outcome measures were grouped using the Shearer *et al.* (2021) PL checklist and additional PA related health outcomes. *Results:* Ten studies were included in the final review. Five different run/walk interventions were identified and six studies followed or referred to The Daily Mile protocol. Outcomes relating to the physical domain were most commonly explored, and no studies explored the cognitive domain. Four studies reported significant differences in cardiovascular fitness measures. Positive findings were also reported for outcomes relating to motivation and self-perception/ self-esteem in the affective domain. *Discussion and conclusion:* Overall, run/walk programmes appear to provide promising results in favour of physical and affective developments in PL. However, further research is needed into all domains of PL to contribute towards the research in lifelong PA engagement. It is recommended that future research considers a combination of qualitative and quantitative tools and mixture of participants to provide unique insight as well as reliable data that may contribute to understanding children's PL journeys.

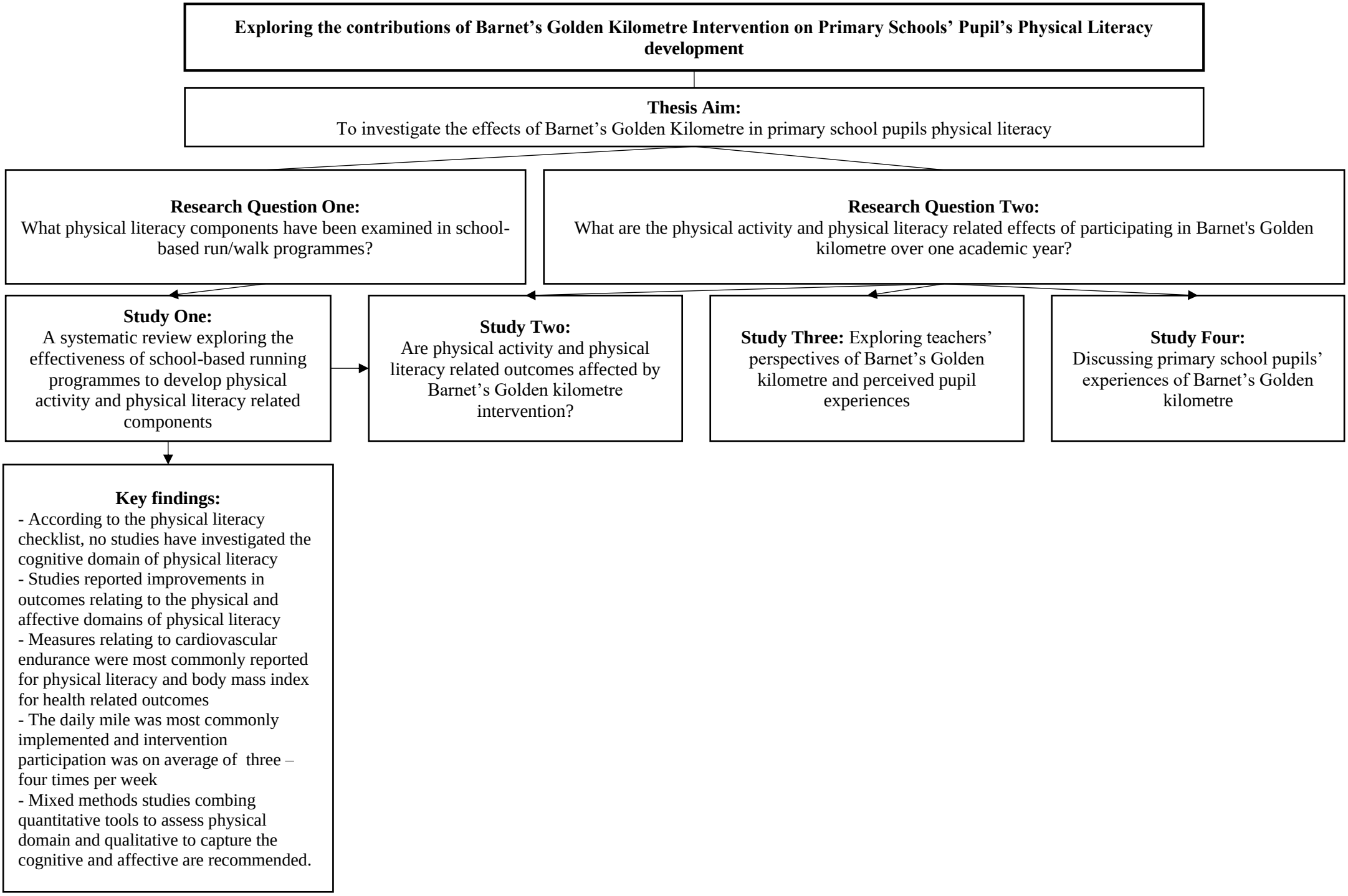

Figure 7: Thesis map and study one key findings

4.1 Introduction

In the last five years, there has been growing discussion surrounding the implementation and outcomes of school-based run/walk interventions (Hanckel *et al.,* 2019; Morris, *et al.*, 2019; Harris, Milnes and Mountain, 2020; Scannell and Murphy, 2023). Specific programmes such as TDM and MK have shown potential to be successful interventions that contribute to improved short-term PA and areas relating to physical fitness, cognitive processes and/or social and emotional well-being (Brooks *et al.,* 2016; Chalkley *et al.,* 2018b; Hanckel *et al.,* 2019; Morris, *et al.,* 2019; Harris, Milnes and Mountain, 2020; Chalkley *et al.,* 2020a; Dring *et al.,* 2022b; Martins, *et al.,* 2022; Scannell and Murphy, 2023). Within Public Health policy these interventions now also feature as tools to combat obesity through increasing daily PA in schools. However, there is still limited knowledge on the long-term impacts of participation and contributions towards obesity related outcomes. Some research has also raised concerns surrounding the limited knowledge on the full range of impacts from participation coupled with the continued national promotion of these interventions (Fairhurst & Hotham, 2017; Daly-Smith *et al.,* 2019; Thorburn, 2020).

The concept of PL could be an approach to addressing these limitations that currently exist in the field. PL is a concept that considers the broad processes (physiological and psychological) that contribute to life-long learning and, when considering its domains, can provide a gateway to PA engagement (Jurbala, 2015; Cairney *et al.,* 2019a). The different definitions of PL share commonalities in that they describe the concept as the intertwining of motor competencies, social environment, affect, motivational factors and cognitive processes, but unlike existing models of PA participation, the concept highlights the cyclical nature of these components (Tristani, 2014; Edwards *et al.,* 2017; IPLA, 2017; Cairney *et al.,* 2019a). It is said that in order to sustain PA engagement, PL progression is needed (Tremblay & Lloyd, 2010; Sum *et al.,* 2018; Whitehead, 2019; Nezondet *et al.,* 2023). Although, this progress is not strictly linear and rather, progression should focus on contributing to the core elements of PL (affective, cognitive and physical progressions) (Dudley, 2015; Dudley *et al.,* 2017). When an individual is seen to be progressing within the domains of PL, it in turn will lead to PA engagement and if maintained, can also increase the likelihood of continued PA participation or returning to PA in adulthood (Tremblay & Lloyd, 2010; Whitehead, 2001; Whitehead, *et al.,* 2013). Alongside other skills, running is one of the movement competencies necessary for PL development (Whitehead, 2019; Sherar *et al.,* 2020). Sherar *et al.* (2020) has highlighted that, whilst the actions of walk, jog and run alone will not develop PL as a whole, the skill could contribute to broader competency development which schools should provide opportunity for in other ways (PE and clubs etc) and requires further analysis. Therefore, if research was to identify how these interventions contribute to the progression within the core elements of PL, it could identify long-term PA engagement and health related benefits associated whilst still also considering psychological impacts which research has raised concerns for (Fairhurst & Hotham, 2017; Daly-Smith *et al.,* 2019; Thorburn, 2020).

If the outcome of PL is PA engagement, the concept is therefore also a determinant of health outcomes experienced through PA participation (Cairney *et al.,* 2019a; Dudley *et al.,* 2017). More recently, research has identified a relationship between PL and health-outcomes (Caldwell *et al.,* 2020; Kanellopoulou *et al.,* 2022; Nezondet *et al.,* 2023). For example, Caldwell *et al.* (2020) found PL level to be associated with health indicators such as BF% and blood pressure in school-aged children. PL could be essential to increasing PA as a strategy to improve health related outcomes in the long-term for young and/or at-risk populations (individuals with high adiposity or low PA levels), and should be valued in research design (Cairney *et al.,* 2019a; Caldwell *et al.,* 2020; Nezondet *et al.,* 2023). Following the inclusion of PL and school-based run/walk intervention in many school and public health policies, it is

important to consider not only PL but also these PA-related health qualities in intervention research in order to inform and guide future Public Health policies and school practice.

The research on run/walk interventions has already highlighted improvements in some PL and PA related outcomes such as CF, waist circumference (Chesham *et al.,* 2018; Brustio *et al.,* 2019; Brustio *et al.,* 2020; de Jonge *et al.,* 2020), self-worth (Arkesteyn *et al.,* 2022), muscular endurance and power (Mønness & Sjølie, 2009). Although, it is unclear if any research has focused on the concept of PL thus far, therefore this opens an opportunity for a review into the current research on school-based run/walk interventions. Identifying gaps in PL and PA-related health research would guide future projects investigating run/walk interventions, and contribute to the policy development where these initiatives currently feature. Adopting a pragmatic approach to PL assessment would also allow research to identify measures that contribute to PL progression and specifically the domains in which these measures fall (affective, cognitive and physical) (Shearer *et al.,* 2021; Goss *et al.,* 2022). Whilst not all tools adequately capture PL, recognising the aims of the study and acknowledging the limitations design is thought to provide worthwhile contribute to the field of PL assessment too (Barnett *et al.,* 2019). Therefore, considering the domains these outcomes cover could be more worthwhile for PL research. This would also still respect the idealist concepts as it considers how these measures in intervention research fit within the PL concept whilst still acknowledging the limitations of the assessments and areas where future investigation is needed (Edwards *et al.,* 2017; Barnett *et al.,* 2019). This would provide useful insight for pragmatic PL investigation and considers the broader processes associated with lifelong engagement (Barnett *et al.,* 2019; Goss *et al.,* 2022), helping to also address the limitations noted in run/walk research. Therefore, the aims of this review were to systematically examine the research on school-based run/walk programmes and the measurements of PL constructs and PA-related health components and secondly, to assess the different intervention methods of school-based run/walk interventions and their impact on encouraging PL and PA development in school aged children.

4.2 Methods

The reporting of this systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Full list reported in appendix A) and was registered with PROSPERO (CRD42021253675) and ethical approval granted by Middlesex university ethics committee (Appendix B).

4.2.1 Search strategy

An electronic search was conducted on six databases: 1) SPORTDiscus, EBSCOhost 2) MEDLINE, EBSCOhost 3) Sage journals, EBSCOhost 4) PubMed 5) ScienceDirect 6) APA Psychinfo, EBSCOhost. The last date of the search for all databases was 25th April 2022. The databases used included areas relevant to PL and PA components. A subject librarian and two researchers (SA and ES) developed the search strategy. The search of databases included a combination of keywords and subject headings for interventions research on children, school-based run/walk programmes and PL or PA components based on the Population Intervention Control Outcome (PICO) framework displayed in *Table 2*.

4.2.1.1 Pilot search strategy

A pilot search was conducted to assess the proposed search strategy and key words, and the clarity and completeness of the items included in the data collection form (Higgins *et al.,* 2019). One reviewer (SA) piloted the search strategies and imported all references into a OneDrive file shared with the review team. The total number of records identified during the pilot search and before screening was 14687 (duplicates removed). The large number of articles produced in the pilot search could have indicated the need to adapt the time restriction

of publications, the use of broad search terms and the inclusion and exclusion criteria of the review (Mengist *et al.*, 2020). The research team agreed to further refine the journal selection in one of the online databases (PubMed) which returned a significantly higher amount of records compared to other databases. Following this, a total of 11268 records were identified before screening. The research team agreed that the total number of records identified were suitable for review and no further changes were made to the search strategy.

The first 200 records were then screened independently by two researchers using the eligibility criteria (ES & SA) and first five studies deemed eligible for review were used to pilot the data collection form (Higgins *et al.,* 2019). There were no disagreements between the researchers for the pilot screening. One researcher (SA) then extracted data from five articles to assess the simplicity of the form and identify any missing data collection elements (Higgins *et al.,* 2019). The accuracy of the data collected was also then checked against the sourced studies to verify the findings by the second researcher (ES) (Higgins *et al.,* 2019). The pilot review team (SA and ES) found using Microsoft OneDrive system a suitable method for storing the review data, compared to free trial software's, such as Covidence, as there were no feature restrictions or time limits on the platform. After piloting, the review team reached consensus on the changes made to search strategy journal selection and no further changes were made to the strategy or screening process (Higgins *et al.,* 2019).

Table 2: PICO Framework and Search Terms

PICO	Application	Code	Search terms
Population	Interventions research on children 4-16 years old	1	Child* OR adolescent OR Youth* OR Teen OR Young people OR Young person OR Juvenile*
Intervention	School-based run/walk programmes (Reception, primary and secondary only)	2	Run OR Walk OR Jog AND intervention OR programme AND school*
Comparison	Control or randomised control groups		
Outcome	Physical literacy or Physical activity components	3A	**Physical literacy – Physical outcomes** AND "physical literacy" OR "Physical activity" OR exercise OR "physical fitness" OR sports OR sedentary OR cardiovascular OR activity OR aerobic OR "motor control" OR coordination OR performance
		3B	**Physical literacy – Affective outcomes** AND "physical literacy" OR "Affective well-being" OR affective OR self-efficacy OR self-confidence OR confidence OR behaviour OR motivation OR Enjoyment OR emotion OR attitude OR belief
		3C	**Physical literacy – Cognitive outcomes** AND "physical literacy" OR "Cognitive function" OR cognitive OR well-being OR Knowledge OR understanding OR value
		3D	**Other outcomes – relation to Physical activity and public health research** OR Obesity OR obese OR weight OR "weight loss" OR "weight reduction" OR "weight management" OR "weight maintenance" OR BMI OR "body mass index" OR "academic achievement" OR "body composition"

Note: Searches were conducted by combining codes (1,2 and 3A, 1,2 and 3B, 1,2 and 3C, 1,2 and 3D)

4.2.2 Inclusion and exclusion criteria

The study characteristics used to determine eligibility for inclusion were based on the PICO framework (Higgins *et al.*, 2019) (*Table 2*). Studies had to satisfy all inclusion criteria to be included in the review, this included assessing at least one outcome in the PL checklist (Shearer *et al.,* 2021) (*Table 3*).

Table 3: Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Peer reviewed, Full-access, Written in English language, Published before 25th April 2022	Conference reports or readings, editorial and forewords
Experimental research design, Mixed-methods or quantitative based	Non-experimental research design, Qualitative methods only, process evaluations or protocols
Interventions must: - Measure at least one outcome in line with the Shearer *et al.* (2021) PL checklist. - Be based in a primary school setting -Adhere to the definition of school-based run/walk programmes as per Chalkley *et al.* (2020). This included: walking, jogging, or running a route on school grounds for either a set distance or time. The intervention should take place in addition to PE and throughout the school week or term. -Include participants aged between 4-16years (pre-adolescents) in primary school	Interventions relating to medical illness and/or physical disability or specific health conditions.

4.2.3 Study selection and extraction

Two researchers conducted the data screening independently (SA and ES). All studies returned from the initial searchers were screened in two stages in accordance with the review's inclusion and exclusion criteria (Higgins *et al.*, 2019). First, all titles and abstracts were reviewed, and duplicates were removed. After stage one, assessors met to discuss any disagreements. At stage two, full texts were screened. Both researchers reviewed the resources twice for the familiarisation process. All studies and records of the selection process took place on a shared standardised Microsoft Excel form to reduce selection and publication bias (Higgins *et al.*, 2019). Studies that did not meet the study criteria were removed. Any disagreements between the researchers were resolved by discussion between the two until consensus was reached.

In order to answer the review objectives and facilitate the risk of bias assessments, the basic characteristics were extracted from each study, as recommended by Higgins *et al.* (2019) and Mengist *et al.* (2020) and recorded in Microsoft Excel. One reviewer (SA) extracted data from the articles and a second verified the data (ES). The extracted data included: year of publication, study type, country, sample size, and intervention characteristics presented in table format throughout. The basic study characteristics are presented *Table 4: Study characteristics and quality score* and detailed findings are presented in the results.

Table 4: Study characteristics and quality score

Author, Year	Control	Sample	Study type	Quality tool	Quality score
Booth *et al.* (2020)	Y+	5463	Cohort study	PEDro	Fair
Brustio *et al.* (2018)	N	276	Cohort study	PEDro	Good
Monness *et al.* (2009)	N	105	Cohort study	PEDro	Fair
Garnett *et al.* (2017)	N	129	Cohort study	PEDro	Fair
Breheny *et al.* (2020)	Y	2280 (IG= 1153, CG= 1127)	Intervention study	PEDro	Good
Brustio *et al.* (2020)	Y	548 (IG= 279, CG= 269)	Intervention study	PEDro	Fair
Chesham *et al.* (2018)	Y	379 (IG-252, CG=127)	Intervention study	PEDro	Fair
Marchant *et al.* (2020)	N	258	Cohort study	PEDro	Poor
Brustio *et al.* (2019)	Y	795 (CG=309, IG= 486)	Intervention study	PEDro	Fair
De Jonge *et al.* (2020)	Y	659 (IG=282, CG=377)	Intervention study	PEDro	Fair

Notes: Y, Control used; N, no control; Y+, Control plus an activity; IG, intervention group; CG, control group; PEDro, Physiotherapy Evidence Database

4.2.4 Quality and reporting

The Physiotherapy Evidence Database (PEDro) Scale was used to assess the risk of bias in each study included in the review. The tool has been validated and used widely in sports and exercise research as a tool for quality assessment (Cashin & McAuley, 2019; Yamato *et al.*, 2017). Three researchers (SA, LW & EE) independently assessed the quality of the studies. The included studies were scored on 11 criteria, and points were awarded when a criterion was satisfied. Studies were scored as "criterion met" (✓) or "criterion not-met" (×). The final quality scores are displayed in *Table 4* and detailed criteria scoring is displayed in *Table 5*. Total scores of between 9 and 11 were considered "excellent", 6 to 8 "good", 4 to 5 "fair" and less than 3 "poor" (Moseley & Pinheiro, 2022). Inter-rater reliability for the PEDro risk of bias indicated strong reliability between assessors (SA, LW k = 0.76) (SA, EE k = 0.92). Any disagreements were resolved via discussion between SA, LW and EE until consensus was reached.

4.2.5 Data synthesis

The outcome measures assessed in the included studies were grouped under the PL domains (physical, affective and cognitive) using the PL checklist developed by Shearer *et al.* (2021). The checklist is a recent tool developed to identify PL qualities in outcome measures. The tool is based on existing PL research and considers the different definitions of PL that have been adopted internationally (Shearer *et al.*, 2021). In line with the study aims, PA outcomes were also grouped. PA-related outcomes were deemed as any outcome measure that related to or connected with participation in PA and exercise, specifically measures that had been used in public health research and did not meet the PL checklist criteria (Biddle *et al.,* 2019; Chaput *et al.,* 2020; Hills, Dengel and Lubans, 2015). The items were scored as 'assessed '(✓), 'not-assessed' (✗) or 'Unclear' (?). Researcher one (SA) categorised each paper and the second researcher (ES) verified the groupings. Meta-analysis was not performed due to the variety in intervention design including: study design, outcome measures, assessment tools and study/ method quality. Therefore, findings were synthesised narratively and results are presented in

Table 5: Quality Score Checklist

Author, Year	1. Eligibility criteria were specified.	2.Subjects were randomly allocated to groups (in a cross-over study, subjects were randomly allocated an order in which treatments were	3.Allocation was concealed.	4.The groups were similar at baseline regarding the most important prognostic	5.There was blinding of all subjects	6.There was blinding of all therapists who administered the therapy	7.There was blinding of all assessors who measured at least one key outcome.	8.Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	9.All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was	10.The results of between-group statistical comparisons are reported for at least one key outcome	11.The study provides both point measures and measures of variability for at least one key outcome
Booth *et al.* (2020)	✗	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓
Breheny *et al.* (2020)	✓	✓	✗	✓	✗	✗	✓	✗	✓	✓	✓
Brustio *et al.* (2018)	✓	✗	✗	✓	✗	✗	✗	✓	✓	✓	✓
Brustio *et al.* (2019)	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Brustio *et al.* (2020)	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Chesham *et al.* (2018)	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
De Jonge *et al.* (2020)	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Garnett *et al.* (2017)	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Marchant *et al.* (2020)	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✓
Monness *et al.* (2009)	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓

Notes: ✗ Criterion not assessed, ✓ Criterion assessed

outcome measure tables. The included studies were then assessed based on their study aims and outcomes and the relation to PL development.

4.3 Results

4.3.1 Study selection

A total of 25780 papers were recorded in the initial search, of which 11268 duplicates were removed, and 3244 were removed for not meeting the journal article inclusion criterion. After screening titles and abstracts of 11268 articles, 59 full article texts were reviewed at screening stage two. Following stage two, ten studies were deemed eligible for inclusion in the review and the remaining 49 were excluded. Figure 8: PRISMA flow diagram displays a full breakdown of the exclusion of studies.

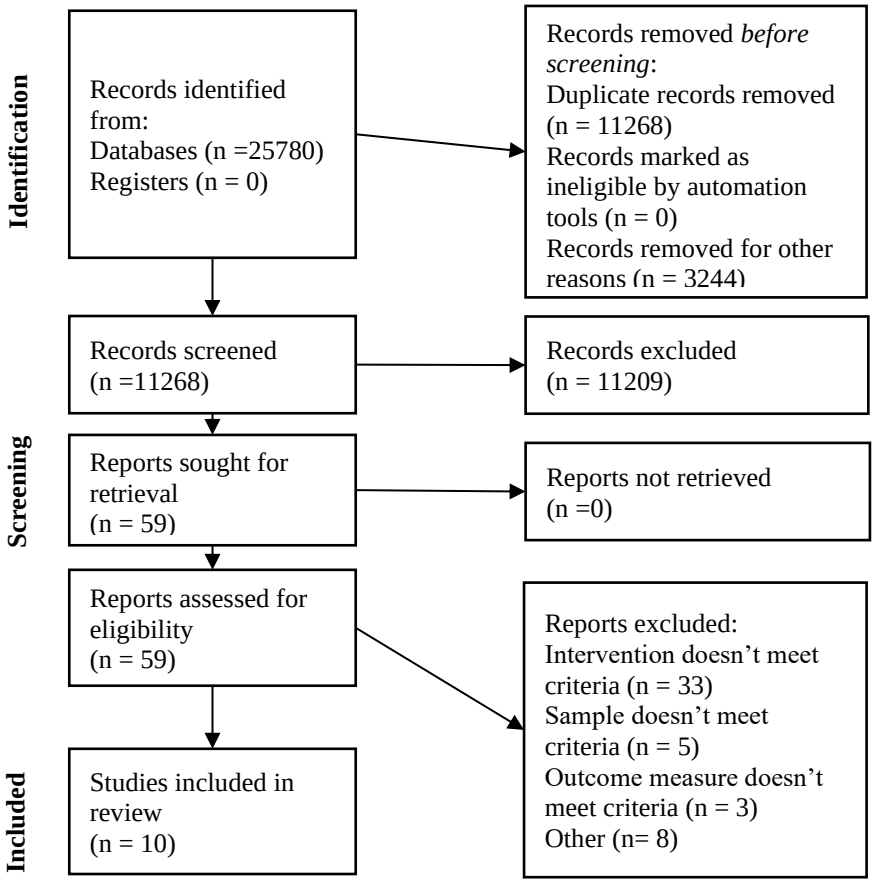

Figure 8: PRISMA flow diagram

4.3.2 Characteristics and quality

For each study the use of control, sample size, study type, quality tool and score are presented previously in *Table 4* and *Table 5*. *Table 6* shows the intervention characteristics extracted from each study including; the study location, intervention type, intervention characteristics (length of study, frequency of completion and duration of intervention).

4.3.3 Intervention characteristics

Table 6: Intervention characteristics

Authors, Year	Location	Intervention type	Intervention characteristics			Intervention delivery	Intervention training
			Length	Frequency	Duration		
Booth *et al.* (2020)	UK	15 min of self-paced activity	Once	Once	15 min	Self-paced run/walk activity similar to TDM. Children ran or walked at self-selected pace for 15 min.	-
Brustio *et al.* (2018)	Italy	1 km walking intervention	4 months	5X/week	10 min	1km walk around a marked path on school grounds at 11am every day. Delivered by class teachers in addition to the usual timetable.	-
Monness *et al.* (2009)	Norway	20 min daily walk	6 months	5 X/ week	20 min	Timed class walks on rugged forest trails. Delivered by class teacher at a time convenient to school timetable. Substituted with indoor PA during bad weather.	-
Garnett *et al.* (2017)	USA	Move it! Move it!	n/a	3 X/ week	25 min	Voluntary morning running and walking programme. Monday, Wednesday and Friday 7:45am-8:10am, students, families and school staff run/walk laps of the school play area. Individual miles are tracked and incentives received at different milestones.	-
Chesham *et al.* (2018)	UK	TDM	6 months	5X/week	~15 min / 1-mile	15 min self-selected pace walk/jog/run around the school play area. Delivered by class teachers as a break from lessons not to replace PE or any PA in the day.	Leaflet
Marchant *et al.* (2020)	UK	TDM	3-6 months	5X/week	~15 min / 1-mile	15 min self-selected pace walk/jog/run around the school play area. Delivered by class teachers as a break from lessons not to replace PE or any PA in the day.	-
Brustio *et al.* (2019)	Italy	TDM	3 months	3X/ week	~ 15 min/ 1-mile	15 min self-selected pace walk/jog/run around the school play area. Delivered by class teachers as a break from lessons not to replace PE or any PA in the day.	Leaflet
Breheny *et al.* (2020)	UK	TDM*	12 months	5X/week	~15 min/ 1-mile	15 min self-selected pace walk/jog/run around the school play area. Delivered by class teachers as a break from lessons not to replace PE or any PA in the day. Teachers were also allowed to adapt the implementation using motivational material.	General TDM information and guidance to official website
De Jonge *et al.* (2020)	Netherlands	TDM*	3 months	3X -4/ week	~15 min / 1-mile	Intervention group: 15 min self-selected pace around school play area. Delivered by class teachers as a break from lessons not to replace PE or any PA in the day. Intervention-plus group: The Daily Mile plus additional teacher support	Welcome pack. Intervention-plus group teachers received personal support
Brustio *et al.* (2020)	Italy	TMD*	6 months	2X or 3 / week	~15 min / 1-mile	2 forms of intervention delivery: 15 min self-selected pace walk/jog/run around school play area. Delivered by class teachers as a break from lessons not to replace PE or any PA in the day. 'Group_2' completed TDM 2 times per week and 'Group_3' completed TDM 3 times per week	Public Meeting. General TDM information and guidance to official website

Note: TDM, The Daily Mile; TDM*, Variation in intervention; IG, intervention group; CG, control group

4.3.3.1 Design

Five different intervention types were included in the review (*Table 6*). Three studies implemented TDM as per TDM website and three implemented TDM with some form of variation from its prescribed protocol. Breheny *et al.* (2020) permitted teachers to adapt TDM as they thought it to be 'motivational' for the pupils. This could include integrating maths classes or using reward tools. Two studies had an intervention group (IG) and an intervention-plus group (IPG) who performed a modified intervention. In de Jonge *et al.* (2020), the IG performed TDM as usual, and IGP performed TDM and received additional teacher support. Teacher support included visits to the school within the first two weeks of implementation, regular contact through WhatsApp such as weather reports and motivational support, and every three weeks teachers would have discussions with support staff on the potential barriers and issues with TDM (de Jonge *et al.,* 2020). Brustio *et al.* (2020) varied the frequency between intervention groups. Subgroups were: the 2_Times subgroup (IG2) which performed TDM less than 2.5 times per week, and the 3_Times subgroup, which performed TDM more than 2.5 times per week (IG3).

One study intervention, reportedly 'Inspired by'' TDM (Brustio *et al.*, 2018), performed a walking intervention in which pupils walked one km along a marked school path for approximately ten minutes. Similarly, Booth *et al.* (2020) assessed the impact of 15-minute bouts of self-paced activity (SPA), such as TDM, compared to more intense running schemes. TDM protocol was not explicitly mentioned nor adhered to in Booth *et al.* (2020), but the interventions shared similar qualities. Mønness & Sjølie (2009) performed 20 min daily walking and was the only study to note the intervention took place across varied terrains, the course involved "varied gradient, steepness, climbing and balancing" (p861). Garnett *et al.* (2017) investigated the intervention 'Move it! Move it!' in which pupils, their families and school teachers voluntarily attended a morning run/walk programme. The programme was completed Monday, Wednesday & Friday 7:45 am – 8:10 am, individual miles were tracked, and incentives were received at different milestones.

4.3.3.2 Length, frequency and duration

Booth *et al.* (2020) was the only study to record immediate pre and post-intervention effects after one performance of the intervention. All other participation varied from three to 12 months. All studies stated the time of year of implementation and data collection; however, no studies investigated the potential seasonal impact on adherence or affect. Two studies conducted pre-, mid and post-assessments (Breheny *et al.,* 2020; Brustio *et al.,* 2020; Marchant *et al.,* 2020).

The frequency of participation ranged from one completion (Booth *et al.,* 2022) up to five times per week, with duration ranging from ten to 25 minutes (Mønness and Sjølie, 2009; Brustio *et al.,* 2018; Chesham *et al.,* 2018; Breheny *et al.,* 2020; Brustio *et al.,* 2020; Marchant *et al.,* 2020). de Jonge *et al.* (2020) performed TDM only on days when schools did not have PE scheduled, this was estimated to be three or four times per week and compliance was reported. Brustio *et al.* (2020) was the only study reported to have compared different intervention frequencies. Mønness & Sjølie (2009) was the only study to report a replacement activity took place on missed intervention days. The intervention did not take place on three school days due to bad weather in which it was replaced with indoor PA.

4.3.3.3 Training

Five studies out of ten provided some form of basic training or introduction to the intervention (Brustio *et al.,* 2018; Chesham *et al.,* 2018; Breheny *et al.,* 2020; Brustio *et al.,* 2020; de Jonge *et al.,* 2020). The training tools used included leaflets (Chesham *et al.,* 2018; Brustio *et al.,* 2019) or guidance to online information (TDM website) (Breheny *et al.,* 2020; Brustio *et al.,*

2020), staff or public meetings (Brustio *et al.*, 2020), and welcome packs (de Jonge *et al.*, 2020). The welcome packs provided in de Jonge *et al.* (2020) included a how-to poster, temporary tattoos, flyers for parents, intervention instruction manuals for teachers and a calendar that can be used to track participation. One study mentioned that no specific intervention training was required due to the simplicity of the intervention design (Brustio *et al.*, 2018). The two remaining studies either did not mention training tools or did not specify intervention-specific training (Garnett *et al.*, 2017), in some cases, general study participation information was provided (Brustio *et al.*, 2018).

4.3.3.4 Delivery

Nine interventions were delivered by class teachers (Mønness and Sjølie, 2009; Brustio *et al.*, 2018; Chesham *et al.*, 2018; Brustio *et al.*, 2019; Breheny *et al.*, 2020; Brustio *et al.*, 2020; de Jonge *et al.*, 2020; Marchant *et al.*, 2020;) or by specialist trained school staff (Garnett *et al.*, 2017). One intervention was led by the research team (Booth *et al.*, 2022).

4.3.4 PL related outcomes

According to the Shearer *et al.* (2021) checklist, no studies explored all three domains of PL (*Table 7*); all studies explored either the physical or affective domains, and no studies explored the cognitive domain. No unified PL method of assessment was identified, all methods of assessment were distinct, and no studies aimed to measure or track PL.

Table 7. PL Outcomes assessed according to the Sherer et al. (2021) checklist

	Affective										**Physical**																	**Cognitive**										
Author, year	Confidence	Motivation	Emotional regulation	Enjoyment	Persistence/ resilience / commitment	Adaptability	Willingness to try new activities	Autonomy	Self-perceptions / self-esteem	Perceived physical competence	Object-control	Stability	Locomotor	Movement skills - Land	Movement skills - Water	Moving using equipment	Cardiovascular endurance	Muscular endurance	Coordination	Flexibility	Agility	Strength	Reaction time	Speed	Power	Rhythmic ability	Aesthetic / Expressive ability	Sequencing	Adapt movement strategies to the situation/ environment	Progression from simple-complex skills	K&U of benefits of PA	K&U of important of PA	K&U of effects of PA on the body	K&U of opportunities to be active	K&U of sedentary behaviour	Ability to identify and describe movement	Creativity and imagination in application of movement	Decision -making	Ability to reflect and improve own performance	K&U of tactics, rules and strategy	K&U of safety considerations and risk
Booth *et al.* (2020)	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Breheny *et al.* (2020)	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Brustio *et al.* (2018)	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Brustio *et al.* (2019)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Brustio *et al.* (2020)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Chesham *et al.* (2018)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
De Jonge *et al.* (2020)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Garnett *et al.* (2017)	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Marchant et al (2020)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Monness *et al.* (2009)	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	✓	✓	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×

Notes: PL, physical literacy; K&U, Knowledge and understanding, × Criterion not assessed, ✓ Criterion assessed

4.3.4.1 Physical

Cardiovascular endurance (CE) was the most frequently explored area in the physical domain (n=7) (*Table 7*). The methods of assessment varied across the majority of studies. However, all focused on the outcome result (e.g. distance run) and not competence scoring (e.g. technique). The tools included a British Athletics Linear track test (Breheny *et al.,* 2020), Step test (Mønness & Sjølie, 2009), six-minute run test (Brustio *et al.*, 2019; Brustio *et al.,* 2020), and shuttle run tests (SRT) (Chesham *et al.,* 2018; de Jonge *et al.,* 2020; Marchant *et al.,* 2020).

There was inconsistency in the magnitude of CE change within the findings, although all studies reported some form of positive difference from baseline, as shown in *Table 8*. In total, four studies found significant improvements in CE (Mønness & Sjølie, 2009; Chesham *et al.,* 2018; Brustio *et al.,* 2020; de Jonge *et al.,* 2020;). Interestingly, three of the studies used control groups (CG) and performed TDM intervention, the third (Mønness & Sjølie, 2009) conducted a 20-minute walking intervention and completed additional control analysis. The duration of intervention participation varied between three (Brustio *et al.,* 2019; de Jonge *et al.,* 2020) and six months (Mønness & Sjølie, 2009; Chesham *et al.*, 2018; Brustio *et al.,* 2020). Three studies that found significant results noted that TDM was completed approximately three times per week. Brustio *et al.,* (2020) observed a significant difference between groups in favour of IG (F=13.932, p-0.008) (correcting for age and BMI) and an overall performance improvement of 7.2%. Findings were also greater in IG3 (Effect size (ES) 0.51) compared to IG2 (ES = 0.29). Similarly, Brustio *et al.* (2019) and de Jonge *et al.* (2020) found IG increased between baseline and 3-month follow-up (Estimated difference (ED) 25.15m, Standard error (SE) 6.39m, p<0.001, Percentage change = 3.1%) compared to CG (ED= 4.44m, SE=6.69m, p=0.911, PC= 0.5%). After adjusting for age and sex, de Jonge *et al.* (2020) found a significant intervention effect on SRT in favour of both IG (IG 1.1 stage, 95% Confidence Interval (CI) 0.8 to 1.5, IGP 0.6, 95% CI 0.5 to 1.0).

Breheny *et al.* (2020) was the only study to conduct mid-follow-up assessments at four months and post-intervention at 12 months and was the longest duration of participation. The study identified small differences (improvements) in CE but in favour of the CG at both time points (four months Mean difference (MD) 5.96, 95% CI 113.81 to 9.94, p=0.436) (12 months MD -65.61, 95% CI 113.81 to 17.21, p=0.048). Overall improvements were observed in CE results in both groups, but these were statistically non-significant. Although, there was a large amount of missing data reported. Marchant *et al.* (2020) reported no differences but there were seasonal differences in data sets.

In addition to CE, Brustio *et al.* (2019) assessed power, and Mønness & Sjølie (2009) stability, flexibility and muscular endurance. Brustio *et al.* (2019) recorded power through standing long jump and no significant difference was observed between groups pre-post TDM participation. Although, an increase in performance was observed in favour of IG (ED 5 ± 0.6cm, p <0.001, +4.7%) compared to CG (ED 3 ± 0.8cm, p <0.001, +3.8%). Mønness & Sjølie (2009) identified significant intervention effects on all measures assessed. For stability, there was a significant intervention effect on balance seconds (Mean (M) = 11.11 ± 2.09, 95% CI 6.95 to 15.27, p = 0.00). Muscular endurance was measured through a back-endurance test in which the study recorded a performance increase of 11% post-intervention (M= 13.89 ± 6.31, 95% CI 1.34 to 26.45, p=0.03). Hamstring flexibility performance also increased by 8% (M= 5.59 ±1.19, 95% CI 3.41 to 7.77, p=0.00).

Table 8: PL related results

Outcome	Affective domain			Physical domain				
	Motivation	Emotional regulation	Self-perception / Self-esteem	Stability	Cardiovascular endurance	Muscular endurance	Flexibility	Power
Increase	1	1	2*	1*	7*	1*	1*	1
No change/ relationship	-	-	-	-	-	-	-	-
Reduction	-	-	-	-	-	-	-	-

Note: X number of studies, * significant results

4.3.4.2 Affective

In total, four studies explored the affective domain of PL (Brustio *et al.*, 2018; Garnett *et al.*, 2017; Breheny *et al.*, 2020; Booth *et al.*, 2022). Small positive effects were found in emotional regulation (*Table 8*). Breheny *et al.* (2020) used Self-Reported Quality of Life and Well-being (Child Health Utility Dimension) and Child Well-Being (Middle Years Development instrument) tools to assess the outcome. The authors found small non-significant differences between groups in favour of the IG for quality of life (MD 0.003, 95% CI -0.05 to 0.05, p=0.894) and well-being (MD 1.90m, 95% CI -3.07 to 6.87, p=0.499) at 12-months.

For motivation, Brustio *et al.* (2018) found a significant positive effect in qualities of the outcome. The authors implemented The Participant Observation Questionnaire. Overall, the study found that participating in the intervention could positively influence motivation orientations towards PA participation. After controlling for age, Brustio *et al.* (2018) observed significant interaction between group and time in social status (F (1237) =4.852, p=0.028), team (F (1273) =6.015, p=0.015) and energy release (F (1273) =8.527, p=0.038). Specifically, significant decreases were observed in social status and an increase in team and energy release in IG. For CG, an increase was observed in social status and a decrease in team and energy release. Booth *et al.* (2020) observed the impact of different classroom break activities on cognition and well-being. The adapted Children's Feeling Scale and Felt Arousal Scale was used to assess self-perception /self-esteem, results for the two measures were recorded as 'affect' and 'alertness'. Statistically significant correlations were observed between change in alertness and affect associated with all physical activities performed. This included 15-minute SPA, CG and bleep test. Specifically, statistically significant differences were identified with SPA and CG for affect and alertness in linear mixed model regression analysis for unadjusted data (affect MD 0.21 ± 0.07, 95% CI 0.05 to 0.37, p=0.006, ES 0.06) (alertness MD 0.32 ± 0.04, 95% CI 0.22 to 0.41, p=0.000, ES 0.15) and fully adjusted models (affect MD 0.21 ± 0.07, 95% CI 0.05 to 0.38, p=0.005, ES 0.06) (alertness MD 0.31 ± 0.04, 95% CI 0.22 to 0.41, p=0.00, ES 0.15), although effect sizes were small. Similarly, statistically significant differences in change scores were also observed in IG for affect and alertness in unadjusted (affect MD 0.28 ± 0.07, 95% CI 0.11 to 0.44, p=0.000, ES 0.07) (alertness MD 0.19 ± 0.04, 95% CI 0.10 to 0.28, p=0.000, ES 0.08) and fully adjusted scores (affect MD 0.27 ± 0.07, 95% CI 0.10 to 0.44, p=0.001, ES 0.07) (alertness MD 0.19 ± 0.04, 95% CI 0.10 to 0.28, p=0.001, ES 0.07). Interestingly, no difference in change scores was observed in affect between the bleep test group and CG. CG alertness scores were significantly lower in alertness than the bleep test group. Garnett *et al.* (2017) also explored self-perception/ self-esteem through the self-regulated learning tool. Although, the study found no statistically positive correlation between self-esteem and miles ran (r=0.6, p=0.46).

4.3.5 PA related outcomes

Table 9: PA Outcomes assessed according to PA checklist

	Anthropometric measures	Cardio metabolic health	Physical fitness	Mental fitness	Cognitive function	PA
Booth *et al.* (2020)	×	×	×	×	✓	×
Breheny *et al.* (2020)	✓	×	×	×	×	×
Brustio *et al.* (2018)	×	×	×	×	×	×
Brustio *et al.* (2019)	✓	×	×	×	×	×
Brustio *et al.* (2020)	✓	×	×	×	×	×
Chesham *et al.* (2018)	✓	×	×	×	×	✓
De Jonge *et al.* (2020)	×	×	×	×	×	×
Garnett *et al.* (2017)	✓	×	×	×	×	×
Marchant *et al.* (2020)	×	×	×	×	×	×
Monness *et al.* (2009)	×	×	×	×	×	×

Notes: × Criterion not assessed, ✓ Criterion assessed

Five studies assessed outcomes relating to the PA checklist (Chesham *et al.*, 2018; Garnett *et al.*, 2017; Brustio *et al.*, 2019; Breheny *et al.*, 2020; Brustio *et al.*, 2020) (*Table 9*). The most commonly explored outcome was BMI assessed in all five studies (Chesham *et al.*, 2018; Garnett *et al.*, 2017; Brustio *et al.*, 2019; Breheny *et al.*, 2020; Brustio *et al.*, 2020).

Table 10: PA related results

	PA related outcomes				
Outcomes	Daily MVPA	Daily sedentary behaviour	Body composition	BMI	Cognitive function
Increase	1*	-	2*	-	1*
No change/ relationship	-	-	-	2	-
Reduction	-	1*	-	2	-

*Notes: MVPA, Moderate to vigorous physical activity; BMI, Body mass index; X number of studies, * significant results at p<0.05*

4.3.5.1 Body composition and PA

Chesham *et al.* (2018) was the only study to assess body composition/ adiposity (*Table 10*). The study calculated composition by the sum of skinfolds at four sites (Triceps, bicep, iliac crest and subscapular). Analysis showed significant improvements in IG body composition compared to CG (M -1.4mm, 95% CI -2.0 to -0.8, p=0.034). The authors were also the only study to measure PA and sedentary time. Follow-up assessments indicated significant improvements in favour of IG for daily MVPA (M +9.1min, 95% CI 5.1 to 13.2, p=0.027) and reduced daily sedentary time (M -18.2min, 95% CI -10.7 to -25.7, p=0.017).

4.3.5.2 BMI

For BMI outcomes, all studies reported non-significant differences between groups following intervention participation. Brustio *et al.* (2019) noted no significant difference between IG and CG in BMI ($p>0.05$) at three months. The authors did note a -0.6% changed between IG baseline (M 17.5 kg.m-2, 95% CI 17.3 to 17.7) and post-test results (M 17.4, 95% CI 17.2 to 17.6). Although the same change was also recorded between CG baseline (M 17.3, 95% CI 17.2 to 17.7) and post-test results (M 17.3, 95% CI 17.0 to 17.6). After correcting for age and gender, no significant group X time interactions were observed between BMI ($F_{1793}= 0.792$, $p=0.374$). At 12 months, Breheny *et al.* (2020) recorded a small increase in favour of IG compared, but this was not statistically significant (MD -0.036, 95% CI -0.085 to 0.013, $p=0.0146$). Brustio *et al.* (2020) observed no difference in BMI and the waist-to-height ratio at any time point, the study recorded baseline, mid (three months) and post (six months). No significant group x gender x time interactions were observed ($F=1.393$, partial $\eta\ 2 = 0.005$, $p=0,234$) and group x time interactions in BMI ($F=1.280$, partial $\eta\ 2= 0.004$, $p=0.275$). Garnett *et al.* (2017) used pre-existing BMI scores from school records. The study reported the relationship between participant BMI and miles run in the interventions. The authors reported a non-significant relationship between miles ran and BMI ($r=-0.07$, $p=0.39$).

4.3.5.3 Waist to height

Brustio *et al.* (2019) and Brustio *et al.* (2020) measured waist-to-height ratio. Brustio *et al.* (2019) recorded a 2.2% change in waist-to-height ratio (cm) between IG baseline (M 0.46, 95% CI 0.47 to 0.48) and post-test (M 0.47, 95% CI 0.46 to 0.48) results. Brustio *et al.* (2020) recorded a small significant reduction at three months in waist-to-height ratio for IG3 (2.7%) but at six months was near the baseline.

4.4 Discussion

This is the first review to examine the current research on school-based run/walk programmes and their potential impact on PL and PA-related health outcomes. Ten articles were identified, and results showed limited exploration of all domains of PL. No studies attempted to chart overall PL progress but using the Shearer *et al.* (2021) checklist, it was possible to investigate individual domains and group the outcomes assessed within these. The results of the review suggest that participating in run/walk interventions for a minimum of three months for an average three/four times per week contributes to improved performance in components of the physical (CE, power, stability and muscular endurance) and affective domains (motivation and emotional regulation) of PL as well as some PA-related outcomes (MVPA and body composition). However, no studies investigated all three PL domains nor was the cognitive domain explored at all. The limited exploration suggests missed opportunities to identify interventions that could optimise all domains and contribute to PL development. This review has made suggestions for future PL investigation in run/walk studies that can complement the findings already published in run/walk studies.

In line with existing research, the outcomes assessed most commonly met the criteria for the physical domain of PL. Cornish *et al.* (2020) and Edwards *et al.* (2018), both found frequent exploration of the physical domain and a lack of investigation within the remaining, particularly the cognitive. There has been some exploration into the impacts of TDM on cognitive function (Hatch *et al.,* 2021; Booth *et al.,* 2022; Morris *et al.,* 2022). Whilst this is a worthwhile measure for contributing to children's development, these studies did not meet the inclusion criteria for the review due to be focused on cognitive development/ cognition rather than knowledge and understanding of participation which is addressed in the Shearer *et al.* (2021) checklist and PL attributed which are reported in the definition adopted in this review (IPLA, 2017). Often this domain in general is under investigated in research as a whole but it is equally important in understanding PA participation through PL and should be considered in future research (Edwards *et al.,* 2018; Cornish *et al.,* 2020).

All outcome measures under the physical domain reported positive results but with varied significance. The physical domain was most commonly assessed around CE (n=7) rather than motor skills such as coordination, locomotor or object control competence, which are listed within the Shearer *et al.* (2021) checklist. Four of these studies reported significant changes in CE following completion of the TDM (Chesham *et al.,* 2018; Brustio *et al.,* 2020; de Jonge *et al.,* 2020) and a walking intervention (Mønness & Sjølie, 2009) and three reported non-significant changes (Brustio *et al.,* 2018; Breheny *et al.,* 2020; Marchant *et al.,* 2020). The studies that reported significant findings were conducted over no longer than six months (three months (Brustio *et al.,* 2019; de Jonge *et al.,* 2020), and six months (Mønness & Sjølie, 2009; Chesham *et al.,* 2018; Brustio *et al.,* 2020), and the only study to track CE over a longer period of 12 months reported non-significant improvements (Breheny *et al.,* 2020). Braaksma *et al.* (2018) recommends PA intervention durations should be a minimum six weeks for CE benefits and performed three or four times per week. All studies that reported significance in CE also reported frequency to be of similar standard each week, although only one study compared intervention frequencies. In which, it was concluded that the group performing TDM more than 2.5 times per week (IG3) was more beneficial on CE than twice per week (Brustio *et al.,* 2020). In general, physical fitness is seen as a stable trait of PA in young children (Raistenskis *et al.,* 2016; Chen *et al.,* 2018), and CE is found to have positive associations with cognitive and academic performance (Ruiz-Ariza *et al.,* 2017; Marques *et al.,* 2018), and strong associations with PL (CAPL) (Lang *et al.,* 2018). Interventions that can improve physical fitness and its components (CE) at a young age are considered crucial in reducing the risks of cardiovascular diseases and other factors like poor mental health and

chronic pain that are associated with low CE into adulthood (Rodrigues *et al.*, 2013). These review findings taken in combination with intervention research are promising in promoting this type of school-based intervention and its potential benefits on health-related outcomes associated with cardiovascular improvements. Although, these findings only represent one outcome of the physical domain for PL. According to Edwards *et al.* (2018) all skills of PL are equally important elements when capturing the domains, which suggests missed opportunity for research to consider the broader contributions to the physical domain as a result of participation (Edwards *et al.*, 2017).

With many school-based run/walk programmes originating as Public Health initiatives, they are often driven by PA and obesity rather than PL, which is a more novel concept. The Public Health driven perspective could explain the lack of exploration of the physical elements like motor skills and instead a more dominant investigation of PA measures like CE and BMI which were two of the most commonly measured outcomes in this review. Similarly, to the work of Edwards *et al.* (2018), no studies assessed the quality of movement and rather the CE outcomes were time-based activities. With the interventions also focusing only on locomotor movements (walk/jog/run), the lack of investigation into other outcome measures like FMS and coordination is not surprising. However, these are equally important components that contribute to PA participation and potential PL progression through their contributions to social, cognitive and affective development, so should not be overlooked (Tsangaridou, 2012; Brusseau *et al.*, 2020). The development of FMS is considered vital in the refinement of more specific motor patterns for young children and run/walk interventions can provide children with the opportunity to freely practise their skills within supportive school environments (Sherar *et al.*, 2020). PL research does address that the concept is not solely motor competence based but that it is an important contribution to its development and PA engagement. Given the design of the run/walk interventions (land based, free moving and not requiring equipment) future research may benefit from investigation movement competencies and build on these findings already discussed in the review to provide additional insight into the quality and fluidity of movement noted in the physical domain aspect of PL (Edwards *et al.*, 2018) and features in the Shearer *et al.* (2021) checklist. Considering broader physical related outcomes like FMS in this setting would create a wider scope of the potential contributions to the physical domain of PL and the contributions to wider skill development in children.

In affective measures, there were significant improvements in components of motivation following a walking intervention (n=1) (Brustio *et al.*, 2018) and self-efficacy/ self-esteem after one performance of SPA (n=1, (Booth *et al.*, 2022). Specifically, motivational benefits in terms of 'social status' and 'team' were identified, which is promising given that existing research demonstrates social support from friends is important in developing autonomous motivation, which is positively associated with PA participation (Owen *et al.*, 2014). Similar qualitative studies such as Chalkley *et al.* (2020b) reported positive pupil experience after participating in the MK programme. The study found autonomy to participate, perceived benefits and supportive school environment facilitated pupil's enjoyment of MK. There was limited evidence available in relation to the affective domain in this review with only four studies measuring affective related outcomes (Motivation (Brustio *et al.*, 2018), Self-efficacy/ self-esteem (Brustio *et al.*, 2018; Garnett *et al.*, 2017; Breheny *et al.*, 2020; Booth *et al.*, 2022) and Emotional regulation (Breheny *et al.*, 2020)). However, these studies findings alongside similar qualitative research do provide positive insights addressing research concerns surrounding run/walk programmes and pupils experiences like potential boredom. Although, this is only of small effect and most often were of non-significance, so larger scale research is needed.

A review by Edwards *et al.,* (2018) has suggested that qualitative methods may be more suitable to the investigation of the affective and cognitive elements of PL than quantitative tools. Qualitative methods such as interviews, focus groups and open-ended questions allow in-depth individualised investigation in which research can be gathered on participant's motivations to exercise (affective) and understanding of a healthy lifestyle (cognitive) (Edwards *et al.,* 2018). Edwards *et al.,* (2018) recommended a mixed methods approach may be more appropriate to capture the domains of PL. Where the qualitative tools adhere to the holistic nature, whilst the quantitative tools can reflect reliability and validity in the data (Edwards *et al.,* 2018; Huang *et al.,* 2020). However, qualitative studies and mixed methods investigations were not included in this review. An initial pilot search of qualitative studies retrieved few studies and none retrieved in line with the specific PL search terms. In addition, there are no known PL checklists for scoring mixed methods PL so the complexity of reviewing and scoring mixed methods studies limits the conclusions that could be drawn. Although, following this review it is recognised that qualitative tools would be useful to capture the missed elements of PL and combined mixed methods may be more suitable to capturing all three domains of PL. Therefore, it is recommended that future research looks to consider a combination of qualitative and quantitative methods, separately to capture physical, affective and cognitive PL progression in young children.

In terms of PA-related health outcomes, the review found there was a focus on weight related measures (Chesham *et al.,* 2018; Garnett *et al.,* 2017; Brustio *et al.,* 2019; Breheny *et al.,* 2020; Brustio *et al.,* 2020)and little or no exploration of other outcomes like daily PA (Chesham *et al.,* 2018) or mental fitness (n=0). All five studies assessed either body composition (Chesham *et al.,* 2018), BMI (z) (Breheny *et al.,* 2020; Brustio *et al.,* 2019; Brustio *et al.,* 2020; Chesham *et al.,* 2018; Garnett *et al.,* 2017) or waist to height ratio (Brustio *et al.,* 2019; Brustio *et al.,* 2020). As previously mentioned, many school-based run/walk programmes have developed as Public Health initiatives where the focus is on reducing obesity and increasing PA participation, this is expected. PA and body composition are also thought to be the outcomes of PL progression (Edwards *et al.,* 2018; Caldwell *et al.,* 2020; Barnett *et al.,* 2023). For example, an individual progressing in their PL would be aware of the importance of leading a healthy active lifestyle, would be engaging in regular PA, and therefore more likely to sustain a healthy body composition as a result of leading a health active lifestyle. Edwards *et al.* (2018) noted that anthropometric measures are not only related to the PL construct but are also a useful comparative measure, which is currently a limitation in research aiming to assess PL (Barnett *et al.,* 2020). PL research that reported the health benefits that would be connected with PL have added that pragmatic evidence is needed to strengthen these findings (Dudley *et al.,* 2017; Cairney *et al.,* 2019b). Therefore, further research into health measures such as body composition and daily PA would be a worthwhile component to explore in PL research in order to identify progression and provide comparable data to inform policy and research.

TDM was the most commonly investigated, three studies performed TDM in accordance with the website (Chesham *et al.,* 2018; Brustio *et al.,* 2019; Marchant *et al.,* 2020), and a further three performed TDM with some variation (Breheny *et al.,* 2020; Brustio *et al.,* 2020; de Jonge *et al.,* 2020). The remaining studies all shared similar characteristics to TDM, including being adaptations of the intervention (Brustio *et al.,* 2018) and having similar qualities, such as frequency (Mønness & Sjølie, 2009), time, distance (Booth *et al.,* 2022) and self-selected pace (Garnett *et al.,* 2017). One reason for the success of TDM could be the pace of the intervention. All studies that used TDM focused on a 'self-selected' pace (n=6) whilst some other remaining interventions (n=2) in this review focused on selected pace, such as walking or just jogging and running. Research shows that PA that provides children with choice can promote autonomy (Roemmich *et al.,* 2012; Teixeira *et al.,* 2012). The choice of self-select pace in

TDM could promote autonomy in children and, in turn, benefit intrinsic motivation and PA participation. As previously noted, MK programme was found to promotes positive pupil experiences, including by autonomy to participate. Although, the MK programme is delivered as an optional lunch time activity for children (Chalkley *et al.*, 2020b). TDM intervention in particular is integrated into the school curriculum which could also influence pupil autonomy. Therefore, specific focus on self-selected pace programmes that are curricular integrated would be beneficial.

The included studies that focused on 'self-selected pace' reported greater findings than other interventions when the same outcomes were assessed. Although, there was inconsistency within findings for TDM intervention which could be due to the quality of the available data. Only one study using TDM scored 'good' (Breheny *et al.,* 2020) and all other studies that reported greater findings in CE scored either 'fair' or 'poor' (Chesham *et al.,* 2018; Brustio *et al.,* 2019; Brustio *et al.*, 2020; de Jonge *et al.,* 2020). Interestingly, the study of higher quality also reported smaller intervention effects on CE compared to studies that performed similar methodology. Most of the studies (n=8) in this review were categorised as 'fair' or lower for quality scoring (scored <5, *Table 4*). Intervention implemented within school settings faces certain challenges that can negatively impact upon quality scoring. Firstly, it is not possible for participants or intervention administrators to be blinded, and allocation is often difficult to conceal. For example, it may not be possible for randomised interventions to take place within the same school due to chances of crossover-effects and contamination as other pupils may observe the intervention and copy it. However, it is possible to blind the assessors to the groupings and limit the risk of bias that can be caused by knowledge of groups during data collection and analysis (Forbes, 2013), yet only one study was noted to have completed this within the review (Breheny *et al.,* 2020). It is recognised that blinding may be a barrier to this type of intervention study. However, it is recommended that future research blinds aspects of study design where possible like study assessors.

Despite teachers being the lead intervention implementers in almost all studies (n=8) (Mønness & Sjølie, 2009; Brustio *et al.,* 2018; Chesham *et al.,* 2018; Brustio *et al.,* 2019; Breheny *et al.,* 2020; Brustio *et al.*, 2020; de Jonge *et al.*, 2020; Marchant *et al.*, 2020), interestingly, almost all outcome measures assessed in the review were administered by research staff and all participants involved in the studies were children. Teachers' and parents/ guardians play a key role in encouraging and supporting a young child's PL journey and PA participation (Lundvall, 2015; Robinson *et al.,* 2018; Whitehead, 2019) and equally teachers are at the forefront for a child's continued participation in many school-based interventions (Nathan *et al.*, 2018). Considering the vital role these adult figures have in shaping children's PA behaviours, involving teachers and parents/guardians in research relating to PL development could increase their understanding and enhance the quality of reflection within the research, enabling future challenges to be negotiated for children's PL journey and intervention implementation (Green *et al.,* 2018; Nathan *et al.,* 2018). It may therefore be worthwhile for future research to also consider the inputs of teachers and parents where possible, such as involving them in the research design or data collection in order to capture a more in-depth understanding of how the run/walk intervention contribute to specific aspects of PL progression which child-based data alone may not provide insight too.

Only one study implemented randomised groups (Breheny *et al.,* 2020), and all other study groupings were predetermined (e.g. schools chose to take part in the intervention or not). Without CG, research is unable to discount the potential effects of confounding variables, and determine the extent to which findings can be attributed to intervention participation (Polgar & Thomas, 2013). Often, within the recruitment for intervention studies, schools either opt to be experimental groups or control, so research teams are unable to randomise the allocations.

There are also potential ethical concerns that need to be considered (Polgar & Thomas, 2013). Specifically, Mønness & Sjølie (2009) noted it would be unethical to split classes from the same school and instead more suitable to control for age effect by using growth curves to estimate natural improvement. Almost all studies in this review were also based within one school so randomisation may not have been appropriate. According to the quality scores in *Table 5*, only three studies reported that groups were similar at baseline regarding important prognostic indicators (Brustio *et al.,* 2018; Breheny *et al.,* 2020; Booth *et al.,* 2022). Without control for variable analysis between group effects, the impact of participation can be misleading. Often participants were treated as one group regardless of initial baseline scores for variables such as fitness or BMI, and reported measures were based on participant mean scores. This could lead to interpretation bias within the findings as the participant response to treatment may vary based on the initial baseline findings.

4.4.1 Study limitations

The findings of the review were limited to the search terms and strategy conducted. The review was restricted to only quantitative studies, therefore, any other types of studies (qualitative, process evaluations etc.) and grey literature exploring PL, PA or this intervention type were not included in the review. Qualitative studies were excluded for not meeting the criteria and/or checklist included in the review. Often the methodologies of qualitative studies were limited and firm conclusions could not be drawn of intervention implementation or outcomes explicitly assessed. Qualitative studies and forms of process evaluations may however, have captured psychological elements, PA and other domains of PL from a holistic perspective and should be considered future. It is recommended that future research reports detailed intervention methodology to prevent exclusion in other PL related reviews. During the time of the review also, a consensus statement on PL in England was started. To date, there is no 'gold-standard' for PL definition or for approaching methods of assessing PL. It is recognised that this may have limited the inclusion of studies in the review.

Intervention adherence was not explicitly reported nor featured in the inclusion criteria of the review. The variance in intervention adherences such as times per week of intervention completion, intensity of participation (walk, jog, run) could impact the variance in results between studies included in this review. It is recommended that future intervention studies report fidelity measures where possible to help with dose response reporting.

4.5 Conclusion

The present study is the first known review to investigate the influence run/walk interventions may have towards developing aspects of children's PL. The results showed promising benefits for the physical and affective domains of PL and particularly the development of CE when interventions are performed three or four times per week for a minimum of three months. This study agrees with existing PL research, in highlighting the need for further investigation into the cognitive domain of PL as no studies considered this aspect within the review nor did any studies consider all three domains. A limitation of this review was found to be the lack of/ exclusion of qualitative studies which is suggested to be important for capturing the individualised nature of the cognitive and affective domains. However, upon pilot investigation it was found limited studies existed in this area initially. Therefore, it is recommended that future research consider a combination of methods including qualitative data collection tools to capture unique experiences coupled with quantitative data to provide results that can complement qualitative experiences and contribute to policy rationale. Future studies investigating PL in children are also recommended to involve a variety of participants (e.g. teachers, parents and guardians) that may contribute to children's PA engagement and can provide useful insight into their PL experience.

Chapter Five: Overview of studies two, three and four

5.1 Study designs

A typology-based approach to mixed methods research design was adopted in the remainder of the thesis investigations. The approach is recommended by Creswell & Plano Clark (2018) for researchers new to conducting mixed methods to anticipate and resolve challenges. The process of selecting this approach followed a combination of emergent and fixed methods design. The thesis began on an emergent mixed method design which was thought to provide a more fruitful capture of PL. For example, initially a quantitative approach was adopted, however, following study one's findings, it appeared this method would not provide an adequate capture of PL alone and rather qualitative components should be added to strengthen the findings by capturing the individualised experiences and psychological elements of PL which cannot be recorded through quantitative approaches. However, following the COVID-19 pandemic, the research design transition to a more fixed mixed methods design due to restrictions with data collection (e.g. social distancing) and time restriction (PhD timeline). Therefore, the data collection for studies two, three and four was pre-determined and planned at the start of the research in accordance with the research aims, time available and COVID-19 restrictions (Chapter one 1.2 for further detail on COVID-19 impact). Creswell and Plano Clarke (2018) reported that many mixed-methods designs consists of both fixed and emergent aspects and rather these two components can be viewed as end points along a continuum. The authors argue that the design approach to mixed methods can be applied to each approach (Creswell and Plano Clark, 2018).

A traditional classification of typology mixed methods design in health sciences was Morgan (1998) whom classified complimentary mixed methods designs (qualitative preliminary, quantitative preliminary, qualitative follow-up and quantitative follow-up). A more recently classification in health science was Plano, Clark and Ivankova (2016) who classified concurrent, sequential qualitative and sequential quantitative designs developed from Creswell and Plano Clarke (2003). In their 2018 work Creswell and Piano Clark reflected on the changing of typologies within research and presented three core designs: explanatory sequential, exploratory sequential and convergent designs which can cross over with one another or be applied to larger frameworks (creating complex mixed methods) (Creswell J.W and Creswell J.D, 2023; Creswell and Plano Clark, 2018). These approaches were considered within this thesis due to their conceptualisation of the 'intent of research design' deemed suited to the pragmatic views but also the initial consideration of timing which needed to be considered within the thesis (Creswell and Plano Clark, 2018; Creswell J.W and Creswell J.D, 2023).

A convergent design was followed in which the quantitative and qualitative findings of studies two, three and four were merged through triangulation in a side-by-side comparison table and in the final discussion to obtain a more detailed understanding of pupils' PL experiences (quantitative + qualitative) (See 5.5) (Morse, 1991; Morse, 2003; Creswell and Plano Clark, 2018; Creswell J.W and Creswell J.D, 2023). The process of triangulation is referred to as 'integration' as recommended by Creswell & Plano Clark (2018) throughout the remainder of this thesis. The studies (two, three and four) were conducted separately at similar times over one academic year but the data was not interacted throughout the collection and analysis. The findings of the separate studies are used to complement one another at the end of the research which is presented in chapters nine and ten. The strengths and limitations were shared across studies to strengthen the quality in the individual methods. The convergent design was thought to also be appropriate for the exploration of PL in which the separate findings could be combined to determine similarities or difference, for example, actual and perceived physical competence are both attribute of PL (affective and physical) which are important for

progression and PA engagement. These two findings combined can provide a more detailed capture of PL experience then on their own. This approach allows detailed reporting of each method employed to ensure the data from each study is not analysed into preconceived categories to fit one another and can also be published independently (Morse, 1991). The method is also often referred to as simultaneous methodological triangulation (Morse, 1991).

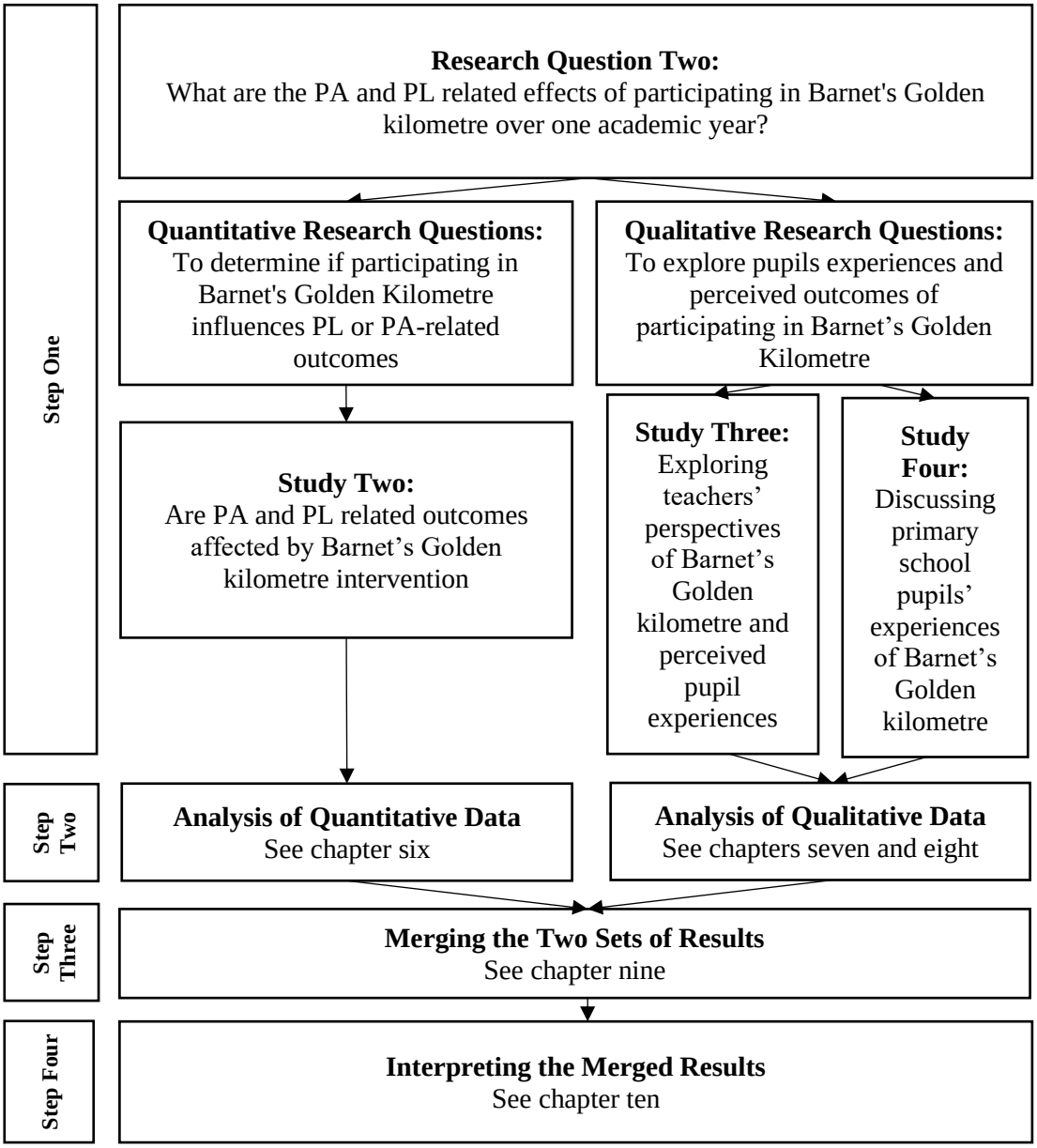

Figure 9: Flow chart of the convergent mixed methods design

This design was thought to be more appropriate in the whole capture of PL at a single time point then the two sequential designs proposed by Creswell and Plano Clark (explanatory and exploratory). These approaches use the initial data collection and analysis to inform the next stage of investigation and is performed in distinct phases (Creswell and Plano Clark, 2018). The exploratory sequential design for example has three stages of data collection in which the initial qualitative findings (phase one) are used to build a quantitative design (phase two) which is then quantitatively tested in phase three (Creswell and Plano Clark, 2018). This approach can be used to develop new instruments, activities for interventions or create a product (such as an app) which may be more suitable to studies trying to design a whole PL assessment tool (Creswell and Plano Clark, 2018). However, these approaches do not align

with the overall thesis aim which is to capture PL changes following intervention participation. Adopting one of these approaches would have led to prioritising one outcome (qualitative or quantitative) at each stage which would limit the capture of PL and its domains. Whereas the convergent design allows broader data collection over a similar time point which could provide a more accurate representation of children's PL experiences following the intervention.

Study two employed a quantitative approach with primary school participants (n=132) and studies three and four adopted a qualitative approach in which primary school teachers (n=5) participated in interviews and children participated in focus groups (n=24) (See chapters seven and eight). The mixed methods research design is intended to combine the strengths and limitations of the two separate methods (quantitative and qualitative) and thus follow the pragmatic recommendations of PL that suggested combining methods to capture the domains (Edwards *et al.*, 2018). Qualitative research allows the recognition of the holistic concept of PL (Idealist) and when combined with quantitative methods respects the necessity for a practical method of assessing PL (pragmatist) (Edwards *et al.*, 2017; Edwards *et al.*, 2018). Figure 9: Flow chart of the convergent mixed methods design presents the mixed methods design adopted in the thesis as suggested by Creswell & Plano Clark (2018) developed from Creswell & Plano Clark (2011). The remainder of the chapter outlines the recruitment for the three studies, intervention implementation and justification of specific methods. The detailed methods of the study protocols are reported in study two (quantitative) and study three (qualitative).

5.1.1 Philosophical view and the selection of methods

When designing research, it is important to acknowledge the philosophical assumption that the researcher (SA) has and how these views interact with the research design and methods employed. It has been highlighted in many fields relative to this thesis the importance for researchers to consider their philosophical perspectives and reflect on their roles in research design and throughout the study processes (PL by Edwards *et al.* (2017); Sport, exercise and health by McNamme (2004), Methodology/ research design by Creswell J.W and Creswell J.D (2023)). This section reflects on the researcher's (SA) philosophical beliefs and how this may have reflected the research conducted in this thesis. The philosophical views and their influence on interpretation of PL and qualitative aspects of design are summarised in chapters two and seven. There is no separate reflection for the quantitative studies as the research position can remain hidden within the statistical analysis however, this section of reflection aims to summarise how the reader may interpret the study aims and design (Creswell J.W and Creswell J.D, 2023). The aims of this section are to provide the reader with guidance on interpreting the results within the thesis by knowing the biases and philosophical stance adopted in research (Creswell J.W and Creswell J.D, 2023).

As already notes in chapter two, the researcher has a pragmatic view on PL and approach to research. Pragmatism in research is centred around the research question and how to understand it (Rossman and Wilson, 1985; Creswell J.W and Creswell J.D, 2023). The pragmatic approach considers the reality and solutions needed to obtain the desired practical outcomes to answer the research questions (Rossman and Wilson, 1985; Creswell J.W and Creswell J.D, 2023). Pragmatism is well suited to mixed methods research in which it is also not committed to one approach or reality and rather allows for integration of views/ data (Morgan, 2013; Rossman and Wilson, 1985; Creswell J.W and Creswell J.D, 2023). The view emphasis freedom of choice in research design which best suits the needs of the study and questions at hand (Morgan, 2013; Creswell J.W and Creswell J.D, 2023).

In addition to the philosophical view, the design and methods, the personal experiences, research question and audience need to be considered in research design as these too can be influenced by researchers predetermined bias (Creswell J.W and Creswell J.D, 2023). Based on the research question and findings in study one, a mixed method had been suggesting as an appropriate approach because one data approach by itself would not provide sufficient data on the phenomenon of interest (PL experiences during Barnet's Golden Kilometre). The mixture of tools can instead be used to compliment the findings of one another (Creswell and Plano Clark, 2018; Creswell J.W and Creswell J.D, 2023). The researchers own training and experience should play a part in determining the choice of approach and specific tools used in design (Creswell J.W and Creswell J.D, 2023). In this case, the researcher had four years of experience in different types of physical domain and health related data collection including FMS, body composition and PA via accelerometery and two in qualitative methods (chapter seven, 7.2.5). It was recognised that mixed methods research requires more time to collect and analyse the different data sets (Creswell and Plano Clark, 2018; Creswell J.W and Creswell J.D , 2023). However, in order to answer the research question, the data collection was to be based within a school environment where the intervention was being ran, which restricts the time available to collect data (e.g. school term is from September to July). The time frame to collect data was also limited to the PhD timeline which had be restricted by the COVID-19 pandemic. Within the timeframe remaining following the pandemic rule beings eased (chapter one, 1.2) there was only one full school academic year to collect data. This meant a convergent method was suited where multiple data collection tools could take place at similar times and also allowed a longer period for data analysis. It was also at this point the research transitioned to a more fixed mixed methods approach. The researcher training and time to pilot methods had also been restricted due to the pandemic so the tools selected were those based on appropriateness to answering the research aims and of which the research time had experience in conducting or training on. The research design was also shaped on the findings of study one and through discussion and recommendation with the supervisory team by considering the approaches they typically support and can provide critique for developing rigour in methods (ES: FMS/PL, EE: Mixed methods/ Qualitative design, LW: Quantitative design). The considerations of audience accepting the research such as supervisory teams, journal editors and colleagues in the field is important to consider especially for dissemination and contributions to future research/ policy (Creswell J.W and Creswell J.D, 2023). The field of PL is divided with the approach to assessment, philosophical considerations and definitions (chapter two, 2.1). However, the view of a pragmatist in PL would consider the value and needs for data to discuss and answer the research questions at hand which could provide promising data for the progression of the concept (Edwards *et al.*, 2017; Creswell J.W and Creswell J.D, 2023).

Following the examples provided in the work of Creswell J.W and Creswell J.D (2023) on the interconnecting of the philosophical view, design and method, this thesis can be summarised as follows: This project adopted a mixed method approach and a pragmatic perspective, with the collection of both quantitative and qualitative data in a convergent design. The researches (SA) assumption is that collection a variety of data types provides a more complete understanding of the research question (PL) than one data tool or method alone. From the approach of a pragmatist, the choice of methods adopted not only considered theory and research evidence in the field but also the practicality of answering the research questions in the environment. The thesis design started with a broad quantitate approach that generalises the results of a larger sample starting with publications in the field (study one) and now turns to a whole school sample (study two). Then, in the second phase and final two studies focus on qualitative methods to capture more detailed individualised view from participants to help

explain the initial quantitative findings. Finally, the findings are integrated through chapters nine and ten.

The integration of studies two, three and four was achieved by 'side-by-side comparison' in a joint displays table (Creswell & Plano Clark, 2018; Creswell J.W and Creswell J.D, 2023). The other form of integration in convergent design is known as data transformation. It was decided that this approach was not applicable to the PL concept which aimed to provide unique experiences through the addition of qualitative data which cannot be counted, rather the use of both methods with statistics and qualitative quotes are to confirm, disconfirm or expand on one another (Creswell & Plano Clark, 2018). A joint table was developed to allow direct comparison of the results from the three studies and determine any similarities and differences between one another (Creswell J.W and Creswell J.D, 2023; Creswell & Plano Clark, 2018). Chapter nine presents the table as developed by Moseholm *et al. (*2017) with the quantitative and qualitative data organised into the domains of PL. To interpret the results SA followed the recommendations of Creswell & Plano Clark (2018) developed from the work of Lee and Greene (2007) and Gutterman *et al.* (2015) in which the research identified how the studies told different stories of pupils' PL journeys and determined whether the quantitative and qualitative findings were more congruent or incongruent. The interpretation of the study integration is presented in chapter ten discussion.

5.1.2 Barnet's Golden Kilometre

The description of the intervention is reported in accordance with the intervention description and replication (TIDieR) checklist (Hoffmann *et al.*, 2016) (Full list is reported in appendix C).

Barnet's Golden Kilometre involves primary school pupils walking, jogging or running for one kilometre everyday whilst at school. The intervention was set up in 2014 with a voluntary steering group consisting of Middlesex University, Barnet Council, Saracens Sport Foundation, Barnet Public Health and Partnership schools for Sport Barnet. This initiative was developed to be simple for teachers to deliver, requiring no financial commitment, training or equipment in order to maximise the potential for a sustainable and habitual change. The intervention can be completed at any time throughout the school day deemed to be a time that would best suit the school/class timetable in addition to all school breaks/lunch and PE that is already taking place. The intervention was made without reference to theory and was a key focus of the London Borough of Barnet Health and Well-being Strategy 2015-2020 to reduce obesity and prevent long term health conditions associated with obesity through the promotion of regular PA. Primary school pupils taking part are told to self-select the pace over 1km distance (walk, jog run) and that the intervention is not a race or competition, rather the focus is on their own individual performance. Participating schools are able to choose where the intervention takes place (i.e. on school ground or local park). For the schools in this project, the intervention was conducted on school grounds around a 1km route which was measured in the playground. The schools in the project chose to complete the intervention one class at a time to prevent overcrowding in the playground. Additional description of the school's facilities and delivery location is described in chapter 5.2.1.

5.1.3 Participant recruitment

Schools located in the London Borough of Barnet were contacted by email and invited to take part in the research project. SA also attended a series of webinars in partnership with Barnet Council and Public Health Barnet to recruit schools for participation. A short presentation was delivered to school Head Teachers in the borough on the research project (studies two, three and four) and attendees received follow-up emails after the webinar (presentations included: Resilient School Barnet, Barnet Partnership for School Sports, Healthy Schools London

program and Change4Life group). To increase recruitment, schools could receive their Healthy Schools London Bronze award when they signed up to the project and silver award when they completed all research (studies two, three and four) at the end of term although this required additional work with Public Barnet Health and was not directly related to the thesis. In addition to this, schools were also offered a launch day to mark the start of the intervention. The launch included an assembly on the project, visit from The Mayor of Barnet and Barnet Public Health team to mark the first day of participation. All pupils were provided with flags and balloons to mark the participation launch day.

Once schools agreed to participate and Head Teachers had provided gatekeeper letters consenting to the protocols of the project, recruitment commenced for each individual study. Two schools located in Barnet consented to participate in the research. In the thesis the schools are referred to as school one (S1) and school two (S2).

A power calculation was conducted to determine an ideal sample size for the research project prior to COVID-19. According to 2019 statistics, Barnet had 93 eligible schools and approximately 31,460 pupils (Barnet Council & Admissions London; Barnet Council, 2021). Within the 93 schools, there were 40 community schools, 33 voluntary aided schools, 10 academies, four free schools, three foundation schools and three all-through schools (Barnet Council & Admissions London, ; Barnet Council, 2021). G*Power (3.1.9) for ANOVA was used to estimate the number of participants required for statistical power of 0.8. The software assumed 95% CI and alpha level of 0.05, as there are no studies with a comparable intervention and sample (Barnet pupils and Barnet's Golden Kilometre), we assumed large effect size of 1.0. The estimated required sample size was 380 participants. This figure was increased by 20% to account for potential missing data (drop out etc) resulting in a final target sample of 456 children (228 participants per group). G*Power software was chosen as it is commonly used within social and behavioural research, is suited to Windows computer platform (compatible with Middlesex University), is free and covers many different statistical tests. Due to changes in timeline and recruitment suitability following the pandemic, and the trial design (randomised and control group), the power calculation could not be applied and voluntary sampling was instead employed for the remainder of the thesis. This is a form of non-probability sampling in which the participants (school leads) are required to respond to the recruitment strategy/ advertisement (Setia, 2016). However, following the pandemic, there was limited responses from schools and those that initially intended to participate had expressed difficulty in continued participate on (starting the project) due to additional pressures caused from school closure/ COVID-19 affecting the trial design and application of the power sample. Therefore, due to the limited responses, voluntary sampling was determined to be the suitable method. Following the recruitment advertised after the pandemic, only two schools out of the possible responded. In which, both were accepted to participate. It is recognised that voluntary sampling can be limiting in research due to the lack of generalisability and may not accurately represent the population of Barnet Primary schools. However, once the schools were recruited a purposive sample strategy was employed.

A purposive sampling strategy was used to recruit participants for studies two, three and four. This is a form of non-random sampling in which the target population/group is identified to provide 'information rich' data to answer the research questions and a sample is recruited from this (Jones *et al.*, 2013; Sparkes & Smith, 2014; Judith Green, 2018). For study three, the target group was determined to be primary school teachers from the schools involved in the intervention. Teachers had to have taught pupils in schools' years three – six who were participating in the intervention and/or be involved in implementing the intervention within the school. For the remaining studies, participants had to be pupils from the same year groups years three – six and those taking part in Barnet's Golden Kilometre. In studies two and four,

parents/ guardians and children were recruited through school newsletters, class emails and letter handouts. Two whole school assemblies were hosted in each school to explain the research protocol to pupils and school staff involved in the intervention. The parents/ guardians were provided with the lead research (SA) contact information as well as the class teacher's email if they had any questions regarding the data collection for studies three and four. Further information on participation selection is reported in studies two, three and four.

5.2 Intervention implementation

5.2.1 School facilities

The two schools had varied facilities and class sizes. Both schools were located in Barnet, North West London (4 miles apart) and did not have access to greenspace within the school grounds but did have access to local parks that they would travel to during warmer months. S1 was in a suburban area of the borough and S2 was located in a semi-rural area of Barnet which is mostly residential. At the time of data collection, S1 was a community school with a capacity of 390 with 34.2% of pupils eligible for free school meals (Barnet Council, 2021; Barnet Council & Admissions London, 2022). S2 was an independent school with a smaller school capacity of 120 and 0% of students eligible for free school meals (Barnet Council, 2021; Barnet Council & Admissions London, 2022). Both schools volunteered to participate in the research project, S1 had all pupils from years 3-6 and S2 had only years three and four participate in Barnet's Golden Kilometre every school day. S1 pupils completed the intervention by running laps of the playground and S2 pupils would complete lengths of the playground (back and forth route). There is recognised difference between schools in terms of access to facilities and resources such as playground space, also eligibility for free school meals and capacity which may influence how the intervention is implemented within the setting. S1 has greater facilities on site including a large play round, small, turfed football pitch, adventure playground and indoor swimming pool. The school also had two indoor halls with gymnastics apparatus. Whereas S1 only had one small outdoor playground and adventure playground. The school did not have access to indoor sports hall or space for wet play/ indoor PA.

5.2.2 Intervention adherence

The intervention was designed to be completed five times per week but the average teacher reported completion for the school in this thesis was 3.5 times per week by S1. The schedules varied for each class but schools usually aimed to complete the intervention in the afternoon and would last for ~15 minutes or until all pupils had completed one km distance. There were no reported modifications to the intervention however teachers reported the full distance was not always covered by younger pupils. Following this, class teachers reported that they would deliver the intervention with more emphasis on time (15mins) than distance for their younger classes (years three and four), for example, one teacher reported that they would focus on the 15-minute time outdoors and encourage their class to "build up to one km" each week as this distance may have been too challenging for them at the start (7.3). In May 2022 for National walking month, S1 also completed the intervention in the local park once. All school parents, teaching staff and members of Barnet Council and Public Health were invited to walk the Golden Kilometre around the park with all pupils (year three - six). This event only took place as a one-off completion and was not anticipated to impact the final physiological outcomes of participation.

In PA intervention research, it is important that studies consider and report intervention fidelity to provide insight to the outcomes achieved and describe how the intervention delivered contributed to the behaviour change, allowing for replication in future research (Lambert *et al.,* 2017; Ryde *et al.,* 2018). Conducting a process evaluation or detailed fidelity

assessments was outside the scope of this thesis due to funding restrictions, however, a checklist to account for fidelity, dose and reach was followed to control for intervention adherence and reflect true implementation where possible. The tools used included: for reach and dose delivered, providing each class teacher with a logbook to track their class participation. Each logbook was hung on the display boards outside of the school classroom and included areas for teachers to record the number of pupils eligible to participate that day, the number of pupils that took part and a notes section to record reasons why the school didn't participate, if applicable (See appendix D). Pupil eligibility was determined to be all pupils that were present in class that day with the absence of injury or circumstances that would prevent them from participating. Each week, the school PE lead collated the class logbooks and shared their school participation in a meeting held the first week after every half term for S1. For dose received, in studies three and four interviews and focus groups participants were asked how pupils participated in the intervention each day and the variation of self-select pace they would follow (e.g. walk and jog or jog and run etc). These findings are summarised in studies three (chapter seven) and four (chapter eight) results. Finally, for fidelity, the two schools participating were graded an implementation score adapted from (Wright *et al.*, 2019) implementation scale. According to the scale by Wright *et al. (*2019), a total score of three can be awarded to schools following their reported intervention implementation adherence. A score of 0-2 is available for fidelity to the design of the intervention (0= not implemented at all, 1= implementing the intervention but not adhering to the core principles and 2 = fully implementing the intervention as designed) and a score of 0-2 for the use of intervention enhancement programmes. As the Barnet Golden Kilometre intervention does not offer enhancement programmes, schools were scored based on their engagement with the intervention logbook instead (0= not using the logbook, 1= partially completed logbook 2= school logbook completed).

It was deemed by the research team intervention fidelity measures would be kept minimal to limit additional disruption and burden to schools' busy schedules therefore, using fidelity tools such as behaviour change consortium treatment fidelity framework (Bellg *et al.*, 2004) were not thought to be suitable for the thesis due to the additional data collection required by schools, school staff and pupils. However, the implementation fidelity score by Wright *et al.* (2019) was designed to compare intervention programs to quantify delivery and provide evidence for the outcomes of the study. In relation to this thesis, the implementation fidelity score was used to compare the two-school intervention implementation and explain the possible influences on the primary outcomes.

S1 received an implementation score of 3. The school PE lead co-ordinated with the researcher (SA) throughout and provided the school log books at each meeting. The school did report that they were unable to complete the intervention each school day as designed and rather aimed to complete the intervention 3-4 times per week. S2 received an implementation score of 1. The school had failed to continue to implement the intervention as intended following the initial research visit and launch day but did partially complete the logbook initially. It is thought that a combination of change of school staff in charge of the intervention and limited school facilities contributed to the failed implementation of the intervention. At the time of the scheduled end of term assessments, S2 had not informed the study that they had stopped the intervention instead this was noted during study four qualitative investigation.

Final sample size selection

Due to miscommunication within the schools, on the date the data collection was due to take place for study two (quantitative data), all pupils were away on a school trip which had not been communicated with the research team. Unfortunately, as this was the final week of term, the end of term data collection could not be rescheduled and no follow-up data for study two was collected for S2. The baseline data that had previously been collected for S2 was excluded from any analysis in study two as comparison to end of term could not be made as planned. However, the end of term qualitative data for study four had already been collected as planned and remains in the final thesis sample for study four. This data is reported in study four to provide further insight and evidence for the possible intervention failure in S2. The final sample size and excluded baseline data is reported in study two chapter 6.22.

5.3 Justification of PL tools

Shearer et al., (2021) noted a number of reliable tools to measure the domains of PL however, the authors highlighted the lack of tools that measure all domains, and the limitation of tools exploring the cognitive elements. A mixed-methods approach with both qualitative and quantitative research tools has been suggested as a possible way to embody PL progression (Creswell and Clark 2017; Edwards et al., 2018) and a method to combine the strengths and attenuate the limitations from existing PL approaches (Edwards 2018; Creswell 2003). Thus, allowing the adoption of a holistic definition (Idealist), whilst respecting the necessity for a practical method of assessing PL (pragmatist) (Edward et al., 2017; 2018). The following section outlines the tools used in this thesis and their suitability to the project.

Given that the intervention is designed to create choice and be non-competitive, outcomes that may have created a 'race like' situation were not considered for the remaining studies nor thought to be applicable to the intervention participation (speed, reaction time/ acceleration and agility). As suggested in study one, physical competency assessed through FMS would be a worthwhile measure of exploration and featured within the Shearer et al., (2021) check list (Object-control and locomotor).

As previously noted, there was limited exploration of the affective domain and a complete lack of studies exploring the cognitive domain of PL in relation to run/walk intervention research. Within PL research the assessment of these domains has often been through questionnaires. However, these too have been criticised for not effectively encompassing attributes of PL or not being suited to wider populations (e.g. children with varying literacy skills). The Physical Literacy in Children Questionnaire (PL-C) is a pictorial scale aiming to assess self-perceived PL in young children (Barnet et al., 2020). The tool has been introduced as a method suitable for young children who have lower literacy levels, where questionnaire tools may not provide appropriate or accurate representations of PL performance (Barnet et al., 2020). However, this tool is still in its infancy of development and also informed by the Australian Physical literacy Framework which considers a 4th social domain in addition to the IPLA domains of PL. Gunnell et al., (2018) have revised a number of questionnaires based on the self-determination theory, the definition of PL and the Canadian assessment for PL model (CAPL) and produced a much shorter questionnaire of 12 items that address the four subdomains within the affective and cognitive domains of PL (motivation and confidence; Knowledge and understanding). The revised questionnaire is aligned with the definition of motivation and confidence within PL and has clearer instructions for completion, making it a popular method to explore the affective and cognitive elements of PL in research (Edwards et al., 2017;2018). However the tool has not been validated in English populations nor used to chart intervention progression.

Morgan et al. (2013) measured enjoyment, perceived competence and motivation using subscales of the Intrinsic Motivation Inventory. This is supported by the Self Determination theory (Deci & Ryan, 1985) which has been found to be a valid measure of intrinsic motivation and self-regulation (McAuley et al., 1987). Motivation can be reduced due to social factors according to Corbin (2002), who also suggests that successful interventions include activities driven by student interest. Focus groups have also been used to determine other factors that influence motivation (Whitehead and Biddle, 2008), enabling triangulation and a more holistic approach to PL research. There have been a number of questionnaires that have sought to measure motivation and confidence under the PL umbrella (Tremblay et al., 2010; Morgan et al., 2013; Longmuir et al., 2015). However, many of these methods have also been criticised for either being too long or not accurately measuring confidence and motivation.

Compared to the other domains of PL, there is less research exploring the cognitive domain alone within PL assessments (Edwards et al., 2017; Shearer et al., 2021). Studies that have explored the cognitive domain, often use written methods to explore the knowledge and understanding behind PL and leading a healthy active life (Edwards 2017; 2018; Shearer et al., 2021). These tools include creative thinking tests, mock exams, and questionnaires (Edwards et al., 2017;2018). Myers et al., (2013). Edwards et al. (2018) found Mock exam paper adhered to the cognitive elements by exploring A-level pupils PE knowledge, however, this method did not explore general knowledge and understanding of leading a healthy active lifestyle which is vital in the exploration of the cognitive domain in PL research. Santos et al., (2017) creative thinking test was developed with specific reference to the physical skills definitions of PL which embodies motor-competence as an important characteristic for PL progression. Whilst this tool is a valid and reliable instrument for measuring creativity and knowledge to interact with the physical environment, it has also been criticised for not evaluating general knowledge and understanding of healthy active lifestyles which is crucial in the exploration of PL embodying the IPLA definition. Francis et al., (2016) devised the 'understanding physical literacy questionnaire' in line with the CAPL model, this tool adopted the Whitehead/ IPLA definition and made specific references to the holistic philosophy of PL and explores perceived PL considering physical competence, motivation, knowledge and daily behaviour. This tool has been validated by panel experts within the research area, however, is not yet validated as a tool for clearly assessing the cognitive domain of PL (Edwards et al., 2018; Francis et al., 2017). Lyod (2016) creative writing assessment explores physical experiences which allows participants to write their unique experiences, knowledge and understanding. However, this tool is dependent on participants' academic writing ability (Lyod 2016). Barnet et al., (2020) have also highlighted the importance for research to consider the literacy levels of children particularly when exploring PL. Whilst these tools present a positive step in the direction of monitoring cognitive elements, the do not appear suited to primary aged children with lower literacy ability.

Considering the limited methods for monitoring the cognitive domain and the suitability of existing PL tools to this research setting, in partnership with Barnet Council and Barnet Public Health a child psychiatrist developed a short wellbeing and lifestyle questionnaire specifically for the run/walk intervention. The questionnaire considers the work of Myers et al (2013), Francis et al., (2016), Santos et al., (2017) and Lyod (2016) exploring unique PA experiences but in relation to the MGkm participation. To address the limitations of the existing research in the field, the questionnaire also explores children's general knowledge and understanding of healthy active lifestyles. The questionnaire comprises 11 questions asking about feelings and knowledge towards exercise, the MGkm and healthy eating. Children answered some questions using the smiley face 1-10 Likert scale and other questions required writing or drawings to understand the children's thoughts and feelings and support literacy elements

(Barnet et al., 2020). Further information on intervention development is noted in study two heading 6.2.4.

To support the capture of PL progression Barnet et al., (2019) recommended combining questionnaires with objective measures allowing research to adhere to the domains of PL (physical through objective, affective and cognitive through questionnaire) whilst also limiting the burden on schools. Therefore, study two looked to couple the intervention questionnaire with a movement competency tool. Assessing FMS and performance characteristics are key elements identified within PL research as they reflect physical competence and a prerequisite for being physically active (Stodden et al., 2008; Almond, 2013; Bryant et al., 2014). Children who score higher in motor competence are thought to engage in more PA in and outside of PE and maintain greater fitness levels (Gu et al., 2017; Stodden et al., 2008). There are many different methods of FMS assessment although, no tool has been identified in the literature as being the gold standard (Ward 2019, Wainwright, 2018). It is important to note that biological sex has been found to have a large influence on FMS ability, with many studies reporting sex differences of FMS performance between boys and girls with girls consistently outperforming boys at fine motor skills and boys outperforming in the object control motor skills (Morely et al., 2015; Bryant et al., 2014). Thus, it is important to assess children according to their sex when assessing their FMS.

The Movement Assessment Battery for Children (Movement-ABC) assesses the status of FMS and identification of deficiency in motor pattern. The tool is suitable for children aged 4-12 years, follows four age bands, and includes eight test items made to measure manual dexterity, balance and ball skills, totals scored are then compared to sex-specific normative data (Cools, 2009; Fairbairn et al., 2018). The revised Movement-ABC also includes an optional qualitative observation component, although this does not contribute to the score system (Cools, 2009; Ward 2019). This method of assessment has proved widely advantageous in research particularly for its simple test administration (Ward et al.,2019). The Movement-ABC is specifically aimed at identifying delay in a child's motor skill development, therefore making it a useful method for identifying problems in early preschool and primary school ages but not directly relevant for this particular study that is looking to establish and monitor a child's overall FMS score rather than detect deficiency in motor skill (Cools, 2009).

As previously discussed, Whitehead (2013) deemed a holistic approach to be important when considering the physical domain of PL. Research by Rudd et al., (2016) investigating multiple test batteries for FMS found the Test of Gross Motor Development- 2 (TGMD-2) to be a successful measure of discrete aspects of movement competence, adhering to the holistic approach. Further, a study by Wainwright et al., (2018) applied the TGMD-2 to assess the physical competence under the PL definition, and reported it to be a reliable method. The TGMD-2 has been extensively used in research to assess FMS performance and body co-ordination in children (3-10 years of age) (Rudd et al., 2016), with several authors validating it as a suitable method to be used in pre-school (Aye et al., 2017) and primary school settings (Houwen et al., 2010). The method appears applicable to the physical competence domain of PL and has been proved to be a reliable and valid tool for FMS assessment (O'Brien et al., 2016). Most recently, the Test of Gross Motor Development-3 (TGMD-3) has been used in PL research to consider movement proficiency or referenced as a tool for assessing the physical domain (Houser *et al.,* 2019; Rudd *et al.,* 2020; Stone *et al.,* 2020; Ha & Dauenhauer, 2021; Caldwell *et al.,* 2023; Britton *et al.,* 2023). The test is often used coupled with an additional balance or stability tool, however, due to time restrictions this was not included in

the protocol. Study one identified that stability outcomes have also been considered in run/walk programmes whilst no movement quality has been considered at all. Further information on TGMD-3 is provided in 6.2.4.

Chapter Six: Study Two

6.0 Are PA and PL related outcomes affected by Barnet's Golden Kilometre intervention?

Abstract

Introduction: Study one identified a lack of investigation in movement quality and affective domain of physical literacy (PL) and no run/walk studies had considered cognitive domain. Objective measures of movement competency coupled with a survey tool have been suggested as one approach to capture all domains of PL. PL has also been proposed to lead to health outcomes associated with regular physical activity (PA) and monitoring these outcomes can provide comparable data for research and inform policy. *Research aims:* To explore the impacts participating in Barnet's Golden Kilometre has on the domains of PL and to identify the impacts on PA and health outcomes as indicators of PL progression. *Methods:* One school (n=132) had pupils' year three - six participate in the intervention each school day for one academic year. Baseline, six-month follow-up and end of term assessments of fundamental movement skills (FMS), Body mass index (FMI), body fat (BF%), Waist ratios, and PA were recorded. Baseline and end of term well-being and lifestyle questionnaire was also collected. ANOVAs and t-tests were conducted to determine changes over time. *Results:* Improvements were recorded in FMS, locomotor and ball skill total score and Slide, Skip and two-handed strike mastery at different time points. Questionnaire analysis showed a narrowing in pupils' definitions of exercise and healthy eating. Pupils reported positive feeling towards exercise (before and after) and felt tired after exercise at follow up but reported this with higher positive feelings on the Likert scale. BMI, BF% and waist ratios were reduced at different points and no changes were observed in weekday PA but significant reductions were observed in weekend moderate and vigorous PA. *Discussion and conclusion:* This study identified promising developments for the physical (FMS) affective (feelings) and cognitive (knowledge and understanding) domains of PL. However, this study cannot determine causation between these improvements and intervention participation. To determine how the intervention has impacts these outcomes, it is thought that adopting additional qualitative tools could provide further depth and explore individualised intervention experiences relative to PL.

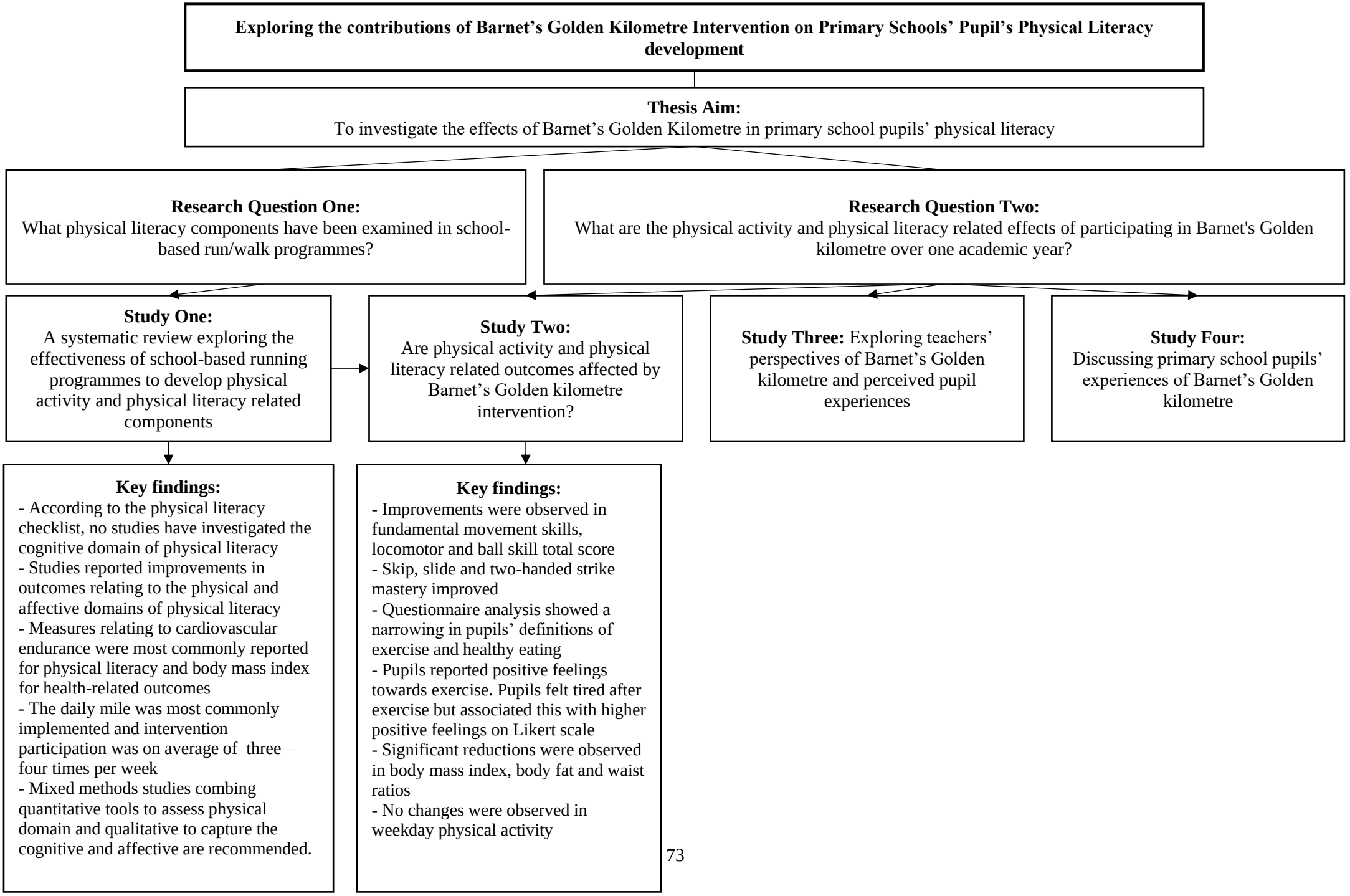

Figure 10: Thesis map and study two key findings

6.1 Introduction

School-based run/walk programmes have been introduced to encourage daily PA in schools. Many of these programmes now feature in a number of local and national policies to improve health in children and have been suggested to contribute to PL development (Public Health England, 2020). Despite the suggested benefits of these interventions, there is no known research considering this intervention and PL in primary school settings. One school-based run/walk programme that has recently grown in popularity in North West London local policies is Barnet's Golden Kilometre. The intervention is one example of a PA experience taking place in many primary schools across Barnet, London that could influence PL in children and in turn contribute to developing lifelong PA habits.

Given the vast benefits linked with regular PA, research has highlighted the growing importance for investigation into PL progression, to improve lifetime PA and, in turn produce positive health effects (Green *et al.,* 2018; Brown *et al.,* 2020). The period of primary years (5-11 years old) is seen to be a pivotal time in PL development (Whitehead 2010; Whitehead, 2019). During primary school years, children are active in a variety of environments and experiences that contribute to their PA into adolescents and adulthood (Whitehead, 2010). Whitehead (2019) describes that throughout primary school, children are developing the pillars of their physical competence in a variety of movement contexts whilst their experiences of new environments will challenge and develop their self-esteem, and cognitive development. Understanding where children are in their PL progression would be beneficial to educators and practitioners as it would allow them to support a child in their development (Green *et al.,* 2018; Barnett *et al.,* 2020) and inform policy designed to improve PA and health (Public Health England, 2020).

However, to date, much of the research surrounding the development of a 'whole-capture' PL assessment tool still remains in its infancy with only recently published tools showing progression in the broader areas of PL (Barnett *et al.,* 2023). Despite there being many studies focused on developing tools for PL assessment and now multiple reviews on PL instruments, there is still limited knowledge on the validity and reliability of these tools in a variety of settings and no 'gold-standard' approach to PL (Edwards *et al.,* 2018; Shearer *et al.,* 2021). One reason for this is the variety of definitions that exist of PL (Edwards *et al.,* 2018). Edwards *et al.,* (2017) review recommended future PL research first identifies its definition and approach to PL as this can influence the evaluation/ choice of study design. As already noted, the IPLA definition of PL has been adopted in this PhD thesis in which PL is defined as "The motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in PA for life" (IPLA, 2017). From the approach of a pragmatist, this study highlights the need for best practice which can help to inform and develop the Public Health and local Government policy where run/walk interventions such as Barnet's Golden Kilometre currently feature and provide comparable data that a whole-concept tool cannot. Identifying how these popular school-based interventions impact the domains of PL and PA engagement may be more beneficial to practise then attempting to identify a comprehensive tool that aligns with all elements of PL respecting the holistic elements too (Green *et al.,* 2018; Barnett *et al.,* 2020).

Sherar *et al.* (2020) has already noted that the nature of run/walk intervention designs (walk, jog run) may not contribute to improving overall PL but rather may contribute to specific areas of development such as further competency progression (physical domain) and PA benefits (health related) in other environments and is therefore worth investigating. Cairney *et al.* (2019b) conceptual model of PL also highlights how regular engagement of PA experienced through PL development could lead to health benefits and highlighted that further evidence is needed to support the model. Much PL has examined the relationship between PL and health

indicators such as CF, BMI, waist circumstance demonstrating relationship between the variables (Comeau *et al.,* 2017; Delisle Nyström *et al.,* 2018; Mendoza-Muñoz *et al.,* 2021; Nezondet *et al.,* 2023). Measuring daily PA, body composition or BF% would be reflective of the outcomes of PL progression which, could allow research to record process (Barnett *et al.,* 2023). With Public Health policies focusing on the reduction of obesity and increased PA these outcomes could also be used to inform policy development. Study one identified exploration of some health outcomes (BMI, body composition) for comparison although this was limited.

In relation to Barnet's Golden Kilometre investigation, the purpose of the overall research project is to assess the impacts intervention participation has on PL in primary school children in the borough to inform the policy and design of the intervention. Following on from study one, the results identified some of the potential gaps in run/walk interventions where future research is needed to identify the PA/ health related outcomes and exploration of PL. Applying the Shearer *et al.,* (2021) PL checklist in study one, identified the need for broader exploration of all domains but specifically a lack on investigation into the cognitive and affective domains. Research in primary settings can however pose a number of practical issues particularly when working with younger populations and must be considered in research design (e.g. time, location, transport and cost (Bird, 2019). PL research has similarly added that feasibility must be considered in the school settings to determine whether the schools have the correct capacity, interest and requirements to conduct a PL assessment (Barnett *et al.,* 2023). A recent PL review by Barnett *et al.* (2023) has suggested survey tools coupled with objective assessments of motor competence and/ or CF outcomes would be more feasible to administer in schools and findings can complement one another. The reliability testing within physical competency tools is widely researched and can therefore help to combat concerns of reliability in PL investigation (Barnett *et al.,* 2023). Survey or questionnaire methods have also been proposed as a method of capturing the affective and cognitive domains of PL that have been previously overlooked in existing research and were also identified to be lacking in study one (Edwards *et al.,* 2018; Barnett *et al.,* 2022). This study aimed to examine the effects of Barnet's Golden Kilometre on PA and PL related outcomes in primary school pupils with a focus on 1) To explore the impacts participating in Barnet's Golden Kilometre has on the domains of PL and 2) To identify the impacts participating in Barnet's Golden Kilometre has PA and health outcomes as indicators of PL progression.

6.2 Methods

This study received ethical approval from the London Sport institute research ethics subcommittee at Middlesex University and was part of a shared ethical application with studies three and four (Appendix E). All data was handled in accordance with Middlesex University data protection and general data protection procedures and gatekeeper letters are presented in appendix F. The participants and their parent/guardian were provided with participant information sheets and consent forms (See appendix G).All data was stored on Middlesex University databases and only shared via Microsoft Office 365 OneDrive server. All data files were password protected which were not shared outside of the research team (SA, LW, ES & EE). The data gathered in all three studies was summarised and presented to Public Health Barnet and each participating school.

In order to match data over the different time points of the intervention for study two and four, the school PE leads kept a list with the children's names and their ID codes which were stored in a secure locked place, SA only had coded data stored on a locked password protected spreadsheet throughout the project. The results of this study and study four consider the influences of age and sex differences. The term 'sex differences' refers to the sex assigned to an individual at birth (Male, female or intersex) whereas gender is how an individual identifies

and is not a binary form (Manclossi, 2023). Data on gender was not collected but ethical approval was granted for schools to provide date of birth and sex (male, female or intersex) of those participants that provided consent to participate in the study data collection.

6.2.1 Research design

This study is the first of three studies investigating PL in children as part of mixed-method investigation (Chapter 5). Schools participated in baseline, follow up (six months) and end of term (ten months) assessments to assess children's PL outcomes over one academic year in primary school.

6.2.2 Participant selection

One school (n=132) (Referred to in this thesis as S1) had pupils' year three - six participate in the intervention each school day for one full academic year. The second school (n=50) (Referred to in this thesis as S2) recruited year 3/4 (n= 31) as intervention. However, as noted in Chapter 5 subheading 5.22, S2's intervention group did not participate in the end of year data collection assessments for study two so the baseline sample was excluded from the final sample in this study.

6.2.3 Intervention

See Chapter Five 5.12.

6.2.4 Protocol

Within primary aged settings, domains-based conceptualisations of PL are thought to be suited as they can tailor to the environment and research settings (Cairney *et al.,* 2019a; Dudley and Cairney, 2021; Martins *et al.,* 2021; Arbour-Nicitopoulos *et al.,* 2023). Considering time to complete the data collection is also crucial at this age due to behaviour response and time available in the curriculum/ school day (Arbour-Nicitopoulos *et al.,* 2023). For the physical domain, FMS test was conducted. For the affective and cognitive a well-being and lifestyle questionnaire. To consider the influence of health outcomes and provide data for policy development BMI, BF%, PA and waist circumstance was assessed. The tool selection and protocol is explained below.

Baseline, follow-up and end of term assessments of FMS, BMI, BF%, Waist ratios, and PA were recorded. At baseline and end of term participants also completed a well-being and lifestyle questionnaire. Participants completed the data collection in their classes during one one-hour PE lesson and one 15-minute reading break. During the PE lesson, the class was split into three groups and completed each station in a circuit as shown in Figure 11: Data collection circuit. During the 15-minute reading break each participant completed the questionnaire or completed any missed data collection stations (such as children that joined the session late). For all anthropometric related measures children were asked to wear shorts, t-shirt (PE kit) and remove shoes and socks. In addition to specific reliability measures noted below, attempts were made to ensure data collection reliability where possible. This included the same research assessors for each data collection station to maintain consistency on data collection instructions and technique for collection such as waist measures and FMS delivery instructions.

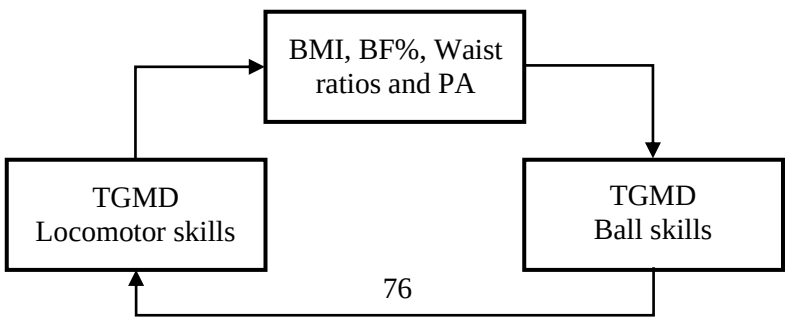

Figure 11: Data collection circuit

FMS

For TGMD-3 each pupil performed six locomotor and seven ball skills twice. The recordings were videoed for later analysis rather than scored via live observation. By videoing each participant's performance, the recordings could be replayed and observed in slow motion to identify each performance criterion (Rintala *et al.,* 2017). Research shows the TGMD-3 to be a reliable tool to analyse gross motor skill and via video evaluations (Rintala *et al.,* 2017; Rey *et al.,* 2020; Carballo-Fazanes *et al.,* 2021).

All trials were conducted on school grounds either in school gymnasium or outdoor PE space that were suitable for administering the TGMD-3 as stated in the manual. The TGMD-3 was administered by the research lead (SA) and undergraduate or master's student researchers and took up to 30mins to complete. The lead researcher (SA) has experience two years experiences using the TGMD-2 and all other students had a one-hour online training on administering the TGMD-3, one-hour in person tutorial and access to all TGMD-3 pre-recorded materials and manual. One student researcher instructed the participants as stated in the TGMD-3 instructions and the second operated the video recordings for each performance.

Scoring

In accordance with the TGMD-3 manual, participants were scored a '1' if the criteria were performed accurately and '0' if the criteria were not performed. At the time of scoring, it was not specified how much training novice assessors would need in order to score the performances for TGMD-3 trials and research had shown differences between novice and experienced assessors scores (Rintala *et al.,* 2017). Therefore, for the purpose of this study, only those in the research team with experience in TGMD scoring were involved in the analysis (SA and LS). The six locomotor skills were totalled for a locomotor sub-skill score, and the seven object control skills for a ball-skill sub-score. Percentage 'Mastery', 'Near mastery' and 'Poor' were then calculated for each FMS skill for comparison. As written by O'Brien *et al.* (2016) and Van Beurden *et al.* (2002), Mastery was defined as a correct performance of all skill components on both trials, near mastery was defined as a correct performance of all components but one on both trials and poor was any score below these two categories (if the performance was incorrect in two or more of the components on both trials) (van Beurden *et al.,* 2002; O'Brien *et al.,* 2016). However, a limitation of mastery calculations is that it can be challenging to determine when a participant is close to achieving mastery. FMS research has employed a binary variable devised of mastery and near mastery total referred to as 'advanced skill proficiency' to consider this potential effect and was added as an additional measure in this study (O' Brien *et al.,* 2016).

Well-being and lifestyle questionnaire

There have been a number of questionnaires that have sought to measure the affective and cognitive domains under the PL umbrella (Morgan, 2013; Tremblay & Lloyd, 2010; Longmuir *et al.,* 2017). However, many of these methods have also been criticised for either being too long or not accurately measuring the PL, such as having a lack of fit with the knowledge and understanding within the cognitive domain (Myers, 2013; Santos *et al.,* 2017; Britton *et al.,* 2023). Considering the limited methods for monitoring the cognitive and affective domains of PL identified in study one and literature, in partnership with members of Barnet Public Health a child psychiatrist developed a well-being and lifestyle questionnaire specifically for Barnet's Golden Kilometre research project. The questionnaire was designed to be a simple short tool that limits sedentary time (time seated during completion) and instruction so that can it be understood by children of varied literacy levels (Cale & Harris, 2018; Barnett *et al.,* 2020). The tool has also been used within the Borough as part of Barnet's Golden Kilometre promotion and was piloted within Public Health Barnet but not in connection with this thesis.

The questionnaire considers the work of Myers *et al.* (2013), Francis *et al.* (2016), Santos *et al.*, (2017), Gunnell *et al.* (2018) and Lyod (2016) exploring unique PA experiences, thoughts and feeling and knowledge of healthy lifestyles with additional reference to Barnet's Golden Kilometre participation. The tool consists of 11 questions focused around feelings (affective), and knowledge and understanding (cognitive) of exercise and healthy eating with an additional 12th question at end of term for pupils to reflect on their participation in the intervention. To enhance face validity the questionnaire answers took different forms to encourage a variety of responses (including: drawings, free text, multiple choice/ Likert scale) (Bird, 2019; Barnett *et al.*, 2020). To assess feelings the questionnaire had five questions structured around perceived energy and attitudes towards exercise. Three questions used a 10-point pictorial Likert scale with three smiley faces to distinguish attitude level, these indicated positive feeling (10) neutral (5) and negative (1) (Krenz *et al.*, 2022). After reporting how they felt before and after exercise, the questionnaire included two open text answers asking pupils to describe how this made them feel in order to provide more depth to the initial responses. The researcher explained to pupils that they can respond to this in any way either by drawing or writing a response. For knowledge and understanding, six open-ended questions asked pupils to describe what they thought exercise and healthy eating was and reflect on their perceptions of these including: self-reported participation, favourite food and if they enjoy healthy eating. The full questionnaire is included in Appendix H. To limit social desirability in responses participants were seated spread out in their classroom and reminded that there are no right or wrong answers and that their answers were anonymous (only ID numbers were written). In agreement with the work of Bird (2019) and Draugalis, Coons and Plaza (2008) only responses with 60% or greater response rate were included in the final sample size. It is said that an acceptable response rate for survey research is between 60-75% and responses <60% would not be reflective of the sample and lead to higher bias (Draugalis, Coons and Plaza, 2008; Bird, 2019).

BMI, BF% and waist ratios

To provide comparable research and evidence for policy health outcomes that have also been considered in PL research were recorded. Study one identified run/walk studies had investigated BMI, BF% and waist ratios (waist to hip or waist to height).

Body Mass Index (BMI) is the principal method for identifying an individual's weight category; underweight, normal weight, overweight, obese or morbidly obese (<18.5, 20-25, 25-30, 30-35 and >35kg/m2 respectively (Jesensen *et al.*, 2016; World Health Organisation 2021). However, BMI does not identify or distinguish BF % and fat-free mass so the method can often be flawed (Nevill *et al.*, 2006). Children are particularly susceptible to having a skewed BMI from factors such as sudden growth spurts and fluctuation in weight, for example, females can often gain more fat tissue during maturation while males lose more fat mass (Castilho *et al.*, 2008; Knowles, 2009), thus highlighting the importance of interpreting BMI with caution. Cole, (1990) developed a reference curve for children's BMI to control for age and sex when determining a child as being normal weight, overweight or obese. If children fall into the 85th or 95th centile then they will be as classed overweight and obese (Cole, 1990), respectively. A z score can also be calculated which can identify how far away a child is from a 'normal' weight for their age and sex (Cole, 1990). By using these techniques, it can help reduce the limitations of BMI.

Body composition has been widely reported in children's studies using a number of different methods. Skinfold thickness from two sites (Medial calf and triceps) which are then applied to Slaughter *et al.*, (1988) equation calculates a prediction of BF% in children (Heyward & Wagner, 2004; Bryant *et al.*, 2014). To accurately access the children's skinfold thickness it

requires an International Society for the Advancement of Kinanthropometry qualified researcher and the equation does not take in to account the height or age of the child and only considers readings from two sites limiting its use in the field. A more popular method in research is to use instead is the Tanita paediatric bioelectrical impedance scales (Kabiri *et al.,* 2015). This works by sending electrical impulses at alternating constant low-level current which results in an impedance to the spread of the current that is frequency dependent (Lukaski & Johnson, 1985). Intra- and extracellular fluids behave as electrical conductors and cell membranes act as electrical condensers. The current passes mainly through the extracellular fluid while at higher frequencies (500- 800 kHz) it passes through the extra- and intracellular fluids (Thomasset, 1962). From this total body water can be determined. Reliability coefficients against skinfolds and hydrostatic weighing range in research between r = 0.957–0.987 demonstrating strong validity (Lukaski *et al.,* 1985; Jackson *et al.,* 1998). The Tanita scales take in to account a child's age, sex, height, mass and activity level from the age of 5 years old (Kabiri *et al.,* 2015).

Alongside BMI, waist ratios are recommended to analyse obesity (Martin-Calvo *et al.,* 2016). Waist circumference is also widely used to compensate for the limitations of BMI measures by reflecting subcutaneous and visceral fat deposits which are linked with health risks for adults and children (10 years+) (Janssen *et al.,* 2004; Gibson, 2005; Nambiar *et al.,* 2010). Waist to hip ratio is assesses central adiposity and if this is reported as ≥0.90 cm (Male); ≥0.85 cm (female) then this is suggested to be dangerous to health (World Health Organisation, 2021). Waist to height ratio considers the size of the participant (height) and uses waist circumference as an indicator of abdominal adiposity (Nambiar *et al.,* 2010). A healthy waist to height ratio should not exceed 0.5 cm (Fredriksen *et al.,* 2018). Waist ratios have been proposing as tools which can aid in the explanation of metabolic consequences associated with obesity/ abdominal obesity specifically which may not be classified in BMI measures (Nambiar *et al.,* 2010). Waist ratios have been used in child research to identify potential health risks in adulthood, if waist circumstance increases with age consistently from childhood then in can indicate future health risks in later life (Fredriksen *et al.,* 2018). These measures are also referenced continually in Public Health and feature in run/walk intervention research (Brustio *et al.,* 2018; Brustio *et al.,* 2019).

Height was recorded to the nearest centimetre using a stadiometer (SECA Instruments Ltd, Germany, Model: SECA213). Children stepped onto the stadiometer with bare feet facing away from the measure and were asked to stand tall. The participants' chin was parallel to the ground with eyes looking forward (as stated in Frankfort horizontal plane; Thompson *et al.* 2009). If children struggled to stand in the correct position then the research team guided the child's head to the correct position with their hands upon the child's consent. Once the child was in the correct position the measurements were recorded.

Mass and BF% were recorded to the nearest 0.1 using Tanita Paediatric Bioelectrical Impedance Scales (Tanita, SC-240MA). Each child's sex (Male or female), age (years), height (cm) was first entered into the scales. Children stepped onto the scales with their head up, looking forward and their weight distributed between both feet touching all four electrodes (ball and heel of each foot). Similar to above, if the child struggled with foot placement, the researcher guided the participants up on their consent. Once the child was stable and the digital display gave a constant reading, mass (nearest 0.1kg) and BF (%) was recorded. This method for collecting height and weight is recommended by Norton *et al.* (1996).

BMI was calculated as kg/m2 and converted to z-scores using the Lambda-mu-sigma (LMS) Growth chart (LMSgrowth.). The Cole (1990) reference curves which control for age and sex were used to classify the data. Each class teacher provided the date of birth for each participant.

Waist circumference was assessed using a non-stretch anthropometric tape measure, placed midway between the 10th rib and superior iliac crest and measured to the nearest cm. Hip circumference was measured around the widest portion of the buttocks and measured to the nearest cm. This protocol is in line with recommended guidelines (Stewart, 2011). Waist to hip ratio was calculated by dividing the waist/hip and waist to height ratio was calculated by dividing waist/height. A member of the research team with experience in recording waist measurements completed the recording (LW).

PA

PA data was obtained using GENEActiv waterproof accelerometer watches which objectively measure PA behaviour (Sedentary, low, moderate and vigorous intensities); a device deemed reliable and valid to measure the health enhancing behaviour that is MVPA (Colley *et al.,* 2017; Corder *et al.,* 2008). The tool is used to assess activity behaviour in PL research and monitor change in activity pattern (Chesham *et al.,* 2018; Edwards *et al.,* 2018; Houser *et al.,* 2019; Arbour-Nicitopoulos *et al.,* 2023). Assessing MVPA with an accelerometer is a more accurate representation of a physically active individual as pedometers cannot record intensity of PA (Corder *et al.,* 2008; Edwards *et al.,* 2018). Accelerometers have been shown to provide accurate representation of MVPA as they can accurately measure acceleration in range of movement for young people and the method has high reliability for the desired monitoring period of 7 days (Rowlands *et al.,* 2006). Miguel's *et al.,* (2017) review and Fairclough (2016) compliance of wear location showed that showed children and adolescents have a higher compliance for the wrist-worn accelerometers compared to the hip-worn devices. Watches were configured for each individual, using anthropometric data, date of birth and handedness, then worn for seven days, on their non-dominant wrist. Children were instructed to wear the watch for the full seven days including during sleep and water-based PA such as swimming. If children did have to remove their watches for a prolonged period of time participants were requested to record this in a PA diary to identify potential differences in actual activity vs recorded. To establish wear time, the non-wear time (at least 60 minutes of zero counts) with no log in the PA dairy was subtracted from 24 hours. Colley *et al.* (2017) defined a valid day for the devices as 10 or more hours of wear time and a valid respondent had to wear it a minimum of four valid days out of the seven days in trial (Including a minimum of two weekdays and weekends). Only eight children returned activity logs which included no recorded removal time so actual activity was assumed. Accelerometer data was considered valid if the participant had worn the watch for four days (to include at least one weekend day) (Barnett *et al.,* 2015). Any data that did not meet these criteria was removed from analysis (n=80 at baseline). To improve PA compliance the study provided children with log books to track PA and reminder letters with the return slips. Participants were provided with the reminder letter the day the watches were calibrated and research staff would visit each class to remind the pupils the day before the watches were due to be returned. Between the first day of watch wear time and last day the PE lead and class teachers were asked to remind pupils about compliance and were provided with lists of the pupils whom had watches to wear/ return on collection day (Howie & Straker, 2016).

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The watches were configured at 100Hz for seven days using GENEACtiv PC software. Phillips *et al.* (2013) cut offs (Left: SED <7 g.s, LIGHT =>7 to <-19 g.s, MOD >19 to <=60, VPA >60g.s; Right: SED <6 g.s, LIGHT =>6 to <=21g.s, MOD >21 to <=56 g.s) and converted 60-s epochs were used to identify the number of minutes per day spent in the four behaviours identified above. For GENEActiv watches, cut points are less widely known than hip-worn ActiGraph tools, some cut points such as (Hildebrand *et al.*, 2014; Schaefer, Van Loan and German, 2014) applied a leave-one-out cross validation approach and lack generalizability from free living scenarios whilst the Philips *et al.* (2013) cut points have been cross validated (van Loo *et al.*, 2018) and within the same sample range as this study (Phillips, Parfitt and Rowlands, 2013; Duncan *et al.*, 2016). Data was analysed based on average wear time per day, weekly, weekday and weekend. PA durations 'during school day' and during 'non-school periods' (Early morning and after school) and weekend morning and day were extracted. The timing for each cut point was based on the returned PA diaries (n=8/ 132 at baseline) in which children reported their wake and sleep time as well as being based on the start and end time of each school day reported by the school Head teacher. Sleep time data was not included in calculations as exact timings of sleep and wake periods were not collected.

Table 11: PA time points assessed

Early Morning	School day	After school	Weekend day	Weekend evening
06:30 – 08:39	08:40 – 15:30	15:31 – 20:00	06:30 - 17:00	17:00 – 20:00

PA accelerometer data was calculated for weekly, weekday and weekend averages across all PA cut point intensities mentioned (Sedentary, light, moderate, vigorous and MVPA). *Table 11* shows the PA analysis, this day assessed for weekly, weekday and weekend, sleep time was not analysed. The PA data is summarised in the results section and full outcomes of SPSS analysis included in appendix I.

6.2.5 Data analysis

6.2.5.1 Reliability

FMS

Reliability testing was conducted throughout the data collection time points for researcher familiarity and allowed their scoring technique to be critiqued and developed throughout the data collection process. To account for the potential differences in the sample size the number of performances scored was determined by calculating the potential margin of error for the sample size at each time point. The formula used for margin of error was $E = z_{\alpha/2}/(2\sqrt{n}) *100$ and the level of confidence was set at 95% (critical value of $z\alpha/2 = 1.96$). The lead researcher (SA) scored all gross motor skills and a second researcher (ES) scored the sample independently for interrater-reliability. To determine intra-rater-reliability, SA coded performances (also based on margin of error) twice at baseline with a two-month time interval between assessment. Both researchers have experience in conducting and scoring TGMD data but were new to the TGMD-3.

Percentage total agreement for each sub skill (Locomotor and ball skills) and Cohens kappa statistic were calculated to determine reliability at all time-points. Kappa statistics were categorised according to Landis and Koch (1977): <0.2 slight, between 0.21 - 0.40 fair, between 0.41 and 0.60 moderate and >0.61 substantial agreement. The kappa statistic has been used in existing TGMD research to assess the reliability for the TGMD edition two (Barnett *et al.,* 2014) and three (Rintala *et al.,* 2017) (*Table 12*).

Table 12: Total margin of error and reliability score

	Baseline (n= 132)	**Follow-up** (n=91)	**End of term** (n=44)
Margin of error (1.96 / (2√ n)) *100) (rounded)	9	10	15
Kappa statistics reliability (Landis and Koch (1977))	0.73	0.69	0.75

Questionnaire

Table 13: Test-retest reliability on well-being and lifestyle questionnaire

Questions *(n=23/ 64)*	**Baseline Mean ± SD**	**Re-test Mean ± SD**	**Cronbach's alpha**	**ICC p value**	**Pearson's correlation coefficient *(r)***
Energy (QU1)	8.88 ± 1.475	8.52 ± 1.675	.037	.465	.020
Feel before Exercise (QU2)	8.38 ± 2.239	7.61 ± 2.675	-.968	.936	-.340
Feel After Exercise (QU5)	8.23 ± 2.193	8.39 ± 1.699	-.391	.777	-.177

The questionnaire is intended to be validated in separate Public Health research (including content and construct) due to time restrictions on data collection it was not possible to run this investigation within the PhD research. Therefore, for the purpose of this thesis, reliability measures were employed where possible. A test-retest reliability was complete one week from baseline for participants to determine internal validity and ensure the measures are representative. The retest took place at the same time (AM) and in the same classroom as done at baseline. ID numbers were used to merge the two survey responses. This time period between testing has been used in test-retest studies with similar age groups and topics (Singh *et al.,* 2011; Barnett *et al.,* 2015; Swelam *et al.,* 2022). It is thought that a longer period

between re-test could also have led to a change in perceptions for pupils (Singh *et al.*, 2011; Barnett *et al.,* 2015; Swelam *et al.*, 2022). A questionnaire with good test-retest reliability will have similar results when administered on a second occasion (Bird, 2019). The study conducted Cronbach's alpha test, Intra-class correlations (ICC) (Two-way mixed, absolute agreement) and Pearson's correlation coefficients were run for retest reliability (Bird, 2019). For Cronbach's alpha, the closer the estimation is to the value of one, the higher the internal consistency (Bird, 2019). A score >.07 and close to .09 is considered good reliability (Bird, 2019). For Pearson's correlation coefficient (*r*) value, scores of <.3 are considered a small correlation, between .3 - .5 medium/ moderate correlation and >.5 large/ strong correlation. The questionnaire was devised to measure participants' knowledge and feelings around exercise and healthy eating. The results of test-retest reliability shown in *Table 13* present poor reliability for all outcomes and inverse relationships between question two and question five on Cronbach's alpha and weak inverse relationships for Pearsons correlation coefficient. After re-test for the questionnaire the researcher (SA) met with the Public Health team who devised the questionnaire to discuss progression and analysis. The research team agreed further reliability and validation would be needed for the questionnaire to be used outside of the research project and development to align with the indent PL aims. For the purpose of the research and the limited time scale, the questionnaire was not changed and rather will only be used as a descriptive tool to support the other outcome variables.

6.2.5.2 Overall Analysis

Data was analysed using IBM SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). Descriptive statistics including means (M), standard deviation (SD) were calculated for each sex and year group (*Table 14* and *Table 15*). One-way repeated measures analysis of variance (ANOVA) were conducted for complete case data to determine changes over time (Baseline, follow-up and end of term). Only participants that had participated in baseline, follow-up and end of term data collection were included in the final sample for each outcome variable (*Table 15*). Participants that participated in only two time points (baseline and follow-up or baseline and end of term) were not included in the final thesis analysis (Baseline n=132). Additional ANOVAs were run with sex (male and female) and year groups (years 3,4,5 & 6) as between group factors to account for any differences between groups. ANCOVAs were also run with BMI and FMS total score as covariates for PA and FMS total school and daily MVPA as covariates for BMI. Mauchly's test of sphericity was conducted to determine the assumption of sphericity. If assumption of sphericity was violated ($p > .05$) the Greenhouse Geisser correction was used (Field, 2018). Post hoc pairwise comparison with Bonferroni correction was used when results were statistically significant in order to explore the significance across the time points (Field, 2018). Partial eta squared is reported to indicate proportion of variance associated with effect as group samples sizes are equal (Brown, 2008). The closer the partial η^2 value is to one indicates a higher proportion of variance.

Descriptive statistics were performed for the total questionnaire well-being and lifestyle answers. Univariate statistical analysis was used to determine the frequency and occurrence in multiple choice questions and paired samples t-test to test for difference in Likert scale items between two time points. Content analysis was performed for the text answers in which predetermined categories were created and sub-themes were developed through thematic analysis and pen profiles are used to represent the data including written text responses and frequency of theme (Mackintosh *et al.,* 2011). Pen profile are considered a flexible form of analysis and can be used in mixed analysis procedures (Mackintosh *et al.,* 2011; Ridgers, Knowles and Sayers, 2012). Similar to the work of Goss *et al.* (2021) the theme had to reach 25% consensus to be included in the pen profile for each question. Findings that featured < 25% is reported within the discussion and total percentage is presented for each theme (Goss *et al.,* 2021) (chapter seven 7.2.7 explains the process of thematic analysis and trustworthiness in detail). The lead researcher (SA) coded the data by organising the written text responses into groups and calculated the frequency of occurrence to determine larger sub-themes (Gillham, 2007). The researcher then presented the findings and raw data to the child psychiatrist whom acted as a critical friend and to confirm dependability of the sample (Ridgers, Knowles and Sayers, 2012). The data was categorised based on the question and responses required. Questions relating to definitions were categorised as 'knowledge and understanding' and questions which required pupils to self-report or reflect on their feelings were categorised as 'self-reflection'. Each category was then placed within a larger group based on the topic of questions, the questions either related to exercise or healthy eating. The themes were then organised into pen profiles and presented to the research team to determine consensus.

6.3 Results

Table 14: Descriptive statistics of sample at baseline (n=132)

	Sample (% female)	Age (years)	Height (cm)	Weight (kg)
Total	132 (54.5%)	8.84 ± 1.1	135.2 ± 9.4	34.7 ± 10.1
Year 3	28 (53.6%)	7.56 ± .6	127.2 ± 6.9	23.1 ± 6.8
Year 4	50 (48%)	8.50 ± .6	132.7 ± 7.3	33.1 ± 8.1
Year 5	36 (63.9%)	9.60 ± .4	138.8 ± 6.9	36.7 ± 8.3
Year 6	18 (55.6%)	10.55 ± .3	147.1 ± 6.4	45.1 ± 12.9

At baseline a total of 132 students (mean age 8.84 ± 1.1, 54.5% female) participated in the intervention. *Table 14* reports the descriptive statistics of participants at baseline. Due to large amounts of missing data only complete cases (all three time points) were included in the final analysis for the outcome measures. The descriptive statistics for this are reported in *Table 15*. Q-Q plot and skewness and kurtosis values for each variable were used to identify the normality distribution of the data. The normality plots indicated that all data was normally distributed allowing for the parametric testing.

Table 15: Descriptive statistics of complete cases

	Complete case sample (% female)	Age (years)	Height (cm)	Weight (kg)
FMS	44 (55%)	8.9 ± 1.3	136.9 ± 10.1	34.6 ± 10.6
Well-being questionnaire	62 (48%)	8.5 ± 1.1	133.4 ± 9.2	33.3 ± 9.6
BMI, BF% and Waist	67 (48%)	8.8 ± 1.1	134.7 ± 8.7	32.8 ± 8.8
PA	12 (42%)	8.5 ± 1.1	133.9 ± 10.4	33.5 ± 7.9

In line with the baseline statistics for all participants table 15 shows that the complete case participants were in year group 4 (age range 8-9 years). The participant sample for FMS testing had the highest range of descriptive statistics with average age, height, weight and % female sample all being higher than the other outcome variables. For example, age was on average 8.9 years ± 1.3 compared to PA which had the lowest average age of 8.5 years ± 1.1. Similarly for weight FMS average was 34.6 kg ± 10.6 compared to BMI, BF% and Waist cohort which had the lowest average score at baseline of 32.8 kg ± 8.8 however, the BMI waist group had more pupils in the obese category (n=2) compared to FMS (n=1).

6.3.1 FMS

6.3.1.1 FMS total score

Mauchly's test of sphericity indicated that the assumption of sphericity had been violated for FMS total score $X^2(2) = 9.98$, $p = .007$. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.84$). There were no significant interactions FMS total score and sex, $F(1.67,76.78) = 0.128$, $p = 0.844$, partial $\eta^2 = 0.03$ and between FMS total score and year groups, $F(6,88)$ $p = .100$, partial $\eta^2 = 0.111$ however, partial eta squared indicates effect size is smaller for gender but medium for year. The intervention resulted in statistically significant changes in FMS total score over time for with FMS total at follow up increasing to 64.58 ± 11.78 (total score) at end of term. Post hoc analysis with a Bonferroni adjustment revealed that FMS total score was statistically significantly increased from mid to end of term assessment (Mean

change = 10.63 (95% CI, -16.12 to -5.13) total score, p = <.001) but not from baseline to follow up (5.58 (95% CI, -2.63 to 13.79) total score, p =.294) and baseline to end of term (-5.042 (95% CI, -11.99 to 1.91) total score, p =.234). Pairwise comparison identified that mid to end of term total scores statistically significant increase for year groups 3,4 and 5 but this was not significant for year 6 or at any other time point.

6.3.1.2 Locomotor and ball skill total scores

Mauchly's test of sphericity indicated that the assumption of sphericity had been violated for FMS total score $X^2(2) = 30.67$, p =<.001. Therefore, a Greenhouse-Geisser correction was applied (ε = 0.666). *Table 16* shows the intervention resulted in statistically significant changes in locomotor total score over time, F (1.33, 59.92) = 16.269, p = <.001 partial η^2 = .266, with locomotor total increase from 25.15 ±11.92 at baseline to 32.47 ± 7.15 at follow up to 33.67 ± 5.73 at end of term. Post hoc analysis with a Bonferroni adjustment revealed that locomotor total score was statistically significantly increased from baseline to follow up assessment (7.326 (95% CI, 12.04 to 2.61) total score, p = .001) and baseline to end of term assessment (8.522 (95% CI, 13.16 to 3.88) total score, p =<.001) but not from follow up to end of term assessment (1.196 (95% CI, 3.37 to 0.78) total score, p = .534).

Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated for FMS total score $X^2(2) = 3.0$, p =.218. The intervention resulted in statistically significant changes in ball skill total score over time, F (2,64) = 9.14, p = <.001 partial η^2 = .222, with ball skill total decrease from 36.06 ±8.85 at baseline to 27.78 ± 9.22 at follow up to increase to 31.21 ± 7.53 at end of term. Post hoc analysis with a Bonferroni adjustment revealed that ball skill total score was statistically significantly decreased from baseline to follow up assessment (8.27(95% CI, 2.67 to 13.88) total score, p = .002 and baseline to end of term assessment (4.85(9 5% CI, 0.44 to 9.26) total score, p =.027) but not from mid to end of term

Table 16: FMS total score ANOVA results

	Baseline vs. Follow up		**Follow up vs. End of term**		**Baseline vs. End of term**	
	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value
FMS total score	5.58 (-2.63 to 13.79)	.294	10.63 (16.11 to 5.13)	<.001*	5.04 (11.99 to 1.91)	.234
Locomotor total score	7.33 (12.10 to 2.556)	.001*	1.20 (3.32 to 0.93)	.507	8.52 (13.21 to -3.83)	<.001*
Ball skill total score	8.273 (2.67 to 13.88)	.002*	3.42 (8.06 to 1.21)	.213	4.848 (0.43 to 9.26)	.027*

assessment (3.424 (95% CI, 8.06 to 1.21) total score, p = .213). There were no significant interactions between total sex and locomotor or ball skill total score and between year group and locomotor total score. There was statistically significant interaction between total ball skill score and year group, F (4,60) = 3.56, p= .011, partial η^2 = .192. In year 4, follow up to end of term total scores significantly increase (-9.300 (95% CI 17.21 to 1.39) p= <.001) but was not statistically significant at any other time points. In year 5, baseline to follow up total scores significantly increase (13.00 (95% CI 4.94 to 21.06) p= <.001) and from baseline to end of term total score (10.14 (95% CI 3.94 to 16.35) p= <.001).

Table 17: TGMD-3 Mastery Frequency (%)

	Year 3			Year 4			Year 5			Year 6		
	Baseline	Follow-up	End-term	Baseline	Follow-up	End-term	Baseline	Follow-up	End-term	Baseline	Follow-up	End-term
Locomotor Skills												
Run	14	33	40	30	49	49	9	47	50	11	27	27
Gallop	4	12	15	9	13	13	13	17	19	6	7	11
Hop	7	15	17	13	22	23	19	22	25	17	20	20
Skip	19	36	40	23	56	57	28	44	58	22	44	56
Horizontal jump	7	8	14	6	13	16	3	7	22	11	13	22
Slide	44	59	79	55	66	70	47	67	72	56	83	89
Ball Skills												
Two-hand strike of a stationary ball	39	41	47	12	16	24	15	31	39	44	50	58
One-hand forehand strike of self-bounced ball	4	4	4	12	30	44	6	13	14	6	22	39
One-hand stationary dribble	14	32	39	40	48	50	31	56	56	50	83	83
Two-hand catch	18	25	43	30	58	96	31	53	58	44	89	94
Kick a stationary ball	7	7	11	8	10	21	42	44	44	44	67	67
Overhand throw	14	14	21	42	56	64	33	36	47	44	69	72
Underhand roll	43	46	46	34	34	34	50	50	60	33.3	50	56

6.3.1.3 FMS Mastery

Locomotor Mastery

Table 18: Locomotor Mastery ANOVA Results

Locomotor skill	Baseline vs. Follow up		Follow up vs. End of term		Baseline vs. End of term	
	Mean difference (95% CI)	p-value	Mean difference (95% CI)	p-value	Mean difference (95% CI)	p-value
Run	22.80 (47.23 to 1.63)	.060	2.38 (9.64 to 4.89)	.632	25.18 (52.02 to 1.67)	.059
Skip	21.98 (39.69 to 4.26)	.027*	7.80 (21.61 to 6.01)	.213	29.78 (43.77 to -15.78)	.027*
Gallop	4.18 (11.54 to 3.19)	.212	2.33 (6.76 to 2.106)	.252	6.50 (14.65 to 1.65)	.091
Slide	18.28 (36.01 to 0.55)	.046*	8.60 (26.01 to 8.81)	.288	26.88 (48.85 to -4.90)	.029*
Hop	5.83 (12.99 to 1.34)	.087	1.53 (4.37 to 1.32)	.240	7.35 (15.29 to 0.59)	.062
Horizontal Jump	3.05 (8.98 to 2.88)	.264	8.63 (20.98 to 3.73)	.128	11.68 (24.41 to 1.06)	.063

Table 17 showed improvements in all locomotor mastery frequency (%) for each year group but ANOVA analysis in *Table 18* shows these improvements were only significant in two skills. Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated for slide mastery $X^2(2) = .212$ p =.900 or skipping $X^2(2) = .25$ p =.882. There were no significant interactions between locomotor mastery and sex or year group. The intervention resulted in statistically significant changes in slide F (2,6) = 24.23, p=.001 and skipping (F 2,6) = 48.175, p=<.001 mastery, *Table 18* displays the ANOVA results for locomotor skills. Pairwise comparison identified significant changes in baseline (50.55 ± 5.75 %) to follow-up (68.83± 10.21 %) (18.28 (36.01 to 0.55) %, p=.046) and baseline to end of term (77.43 ± 8.48%) (-26.88 (48.85 to 4.90) %, p=.029) for slide mastery. There was significant improvement in skipping mastery from baseline (23.05± 3.96 %) to follow-up (45.03 ± 8.16%) (-21.98 (-39.69 to -4.26) % p = .027) and baseline to end of term (52.83 ± 8.62 %) (29.78 (43.77 to 15.78) % p =.006). No significant differences were observed in the remaining locomotor skills at any timepoints. In advanced skill proficiency, significant changes were observed for gallop in baseline to end of term (p=.041) but no changes were observed in any other skills or timepoints.

Ball skill Mastery

Table 19 Ball Skill Mastery ANOVA Results

Ball skill	Baseline vs. Follow up		Follow up vs. End of term		Baseline vs. End of term	
	Mean difference (95% CI)	p-value	Mean difference (95% CI)	p-value	Mean difference (95% CI)	p-value
Two handed catch	25.45 (62.98 to 12.08)	.138	16.53 (53.91 to 20.86)	.363	41.98 (88.78 to 4.83)	.067
Overhand throw	10.40 (37.95 to 17.15)	.492	7.20 (15.44 to 1.04)	.072	17.60 (39.84 to 4.64)	.093
Kick	6.75 (32.08 to 18.58)	.858	3.70 (16.07 to 8.67)	.727	10.45 (32.51 to 11.61)	.315
Two handed strike	12.70 (36.78 to 11.38)	.249	7.68 (10.25 to 5.10)	.002*	20.38 (42.47 to 1.715	.062
One handed strike	10.38 (31.01 to 10.26)	.277	8.03 (28.78 to 12.73)	.471	18.40 (59.22 to 22.42)	.349
Dribble	21.03 (47.12 to 5.07)	.089	2.30 (10.56 to 5.96)	.807	23.33 (46.70 to 0.25)	.051
Underhand roll	5.05 (24.33 to 14.23)	.879	3.90 (15.67 to 7.87)	.618	8.95 (32.79 to 14.89)	.497

Table 17 showed improvements in almost all ball skill mastery frequency (%) for each year group but ANOVA analysis in *Table 19* shows these improvements were only significant in one skill. Mauchly's test of sphericity indicated that the assumption of sphericity had been violated for two handed strike mastery $X^2(2) = 6.21$ p =.045. Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.511$). There were no significant interactions between locomotor mastery and sex or year group. The intervention resulted in statistically significant changes in two-handed strike mastery for year groups over time, F (1.023, 3.069) = 14.67, p=.030, partial $\eta^2 = 0.830$. Pairwise comparison indicated significant changes in follow-up (34.48 ± 14.65) to end of term (42.15 ± 14.47) mastery (7.66(10.25 to 5.11)%, p=.002). No significant difference was observed in the remaining ball skills at any timepoints. In advanced skill proficiency, no significant changes were observed in any skills at any time points.

6.3.2 Well-being and Lifestyle Questionnaire

The well-being and lifestyle questionnaire results are summarised based on question types below.

6.3.2.1 Energy

Results of the paired samples t-test indicated no significant differences between pupils reported energy levels at baseline and end of term assessment, t (61) = 0.66, p=0.51. The average reported energy score was 0.18 less at end of term (8.77 ± 1.51) compared to baseline (8.95 ± 1.48) but this was not statically significant.

6.3.2.2 Exercise

According to the paired samples t-test there were no significant difference between pupils self-reported feelings towards exercise (p>0.05). Pupils reported on average score of 8 on the Likert scale for both baseline (8.26 ± 2.37) and follow up (8.22 ± 2.32) for how they felt before exercise (t (61) = 0.09, p=0.92). After exercise pupils reported more negative feelings at end of term (7.49 ± 2.83) compared to baseline (8 ± 2.46) although this was also not statistically significant (t (61) = 1.05, p=0.29).

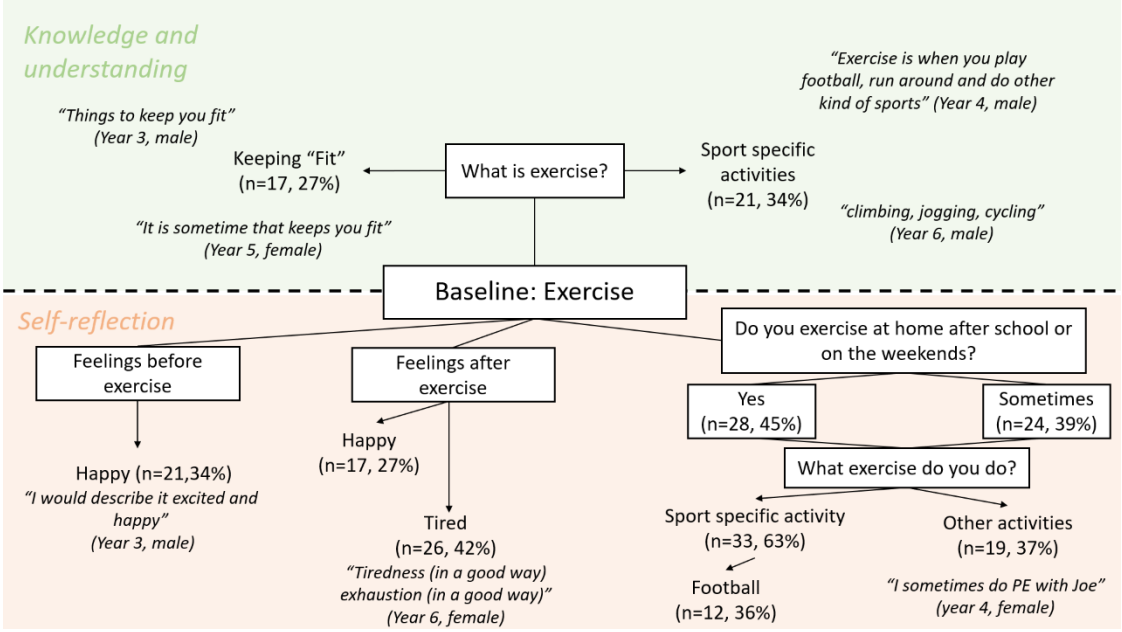

Figure 12: Baseline pen profile on exercise

Baseline knowledge and understanding

Figure 12: Baseline pen profile on exercise presents the participants definition of exercise before the intervention. The definitions most commonly referred to sports specific activities (n=21, 34%) of which pupils mostly included taking part in 'sports' more generally (n=14/21, 66%) and types of sports activities such as football or basketball were mentioned less (n=7, 33%). Second most common responses referred to exercise as a means of 'keeping fit' (n=17/21, 27%), followed by PA related responses (n=8, 12%). Two pupils did not answer the question and remaining responses included references to PE (n=2), weight status (n=2) and 'being healthy'(n=10).

Baseline self-reflection

For self-reflection, Figure 12 shows pupils most commonly reported feeling 'happy' before exercise (n=21, 34%) which was commonly coupled with other positive words such as being 'excited' (n=7, 33%). Pupils also reported feeling 'energised' or 'pumped' before exercise (n=10, 16%). Nine participants reported a positive word such as happy, good and fun before exercise but also coupled this with feelings of being nervous or shy (15%) and four pupils reported feeling bored (6%). After exercise pupils most commonly reported feeling tired (n=26, 42%), within these answers children also coupled the feeling of tired with a positive word such as happy or calm (n=8/26, 31%). Happy featured as the second most common word (n=17, 27%) followed by exhausted (n=6, 10%). On weekends or after school, 45% of participants reported that they did participate in exercise (n=28), 39% reported that they sometimes did (n=24, 39%) and 16% (n=10) said they did no exercise. Of the pupils that said

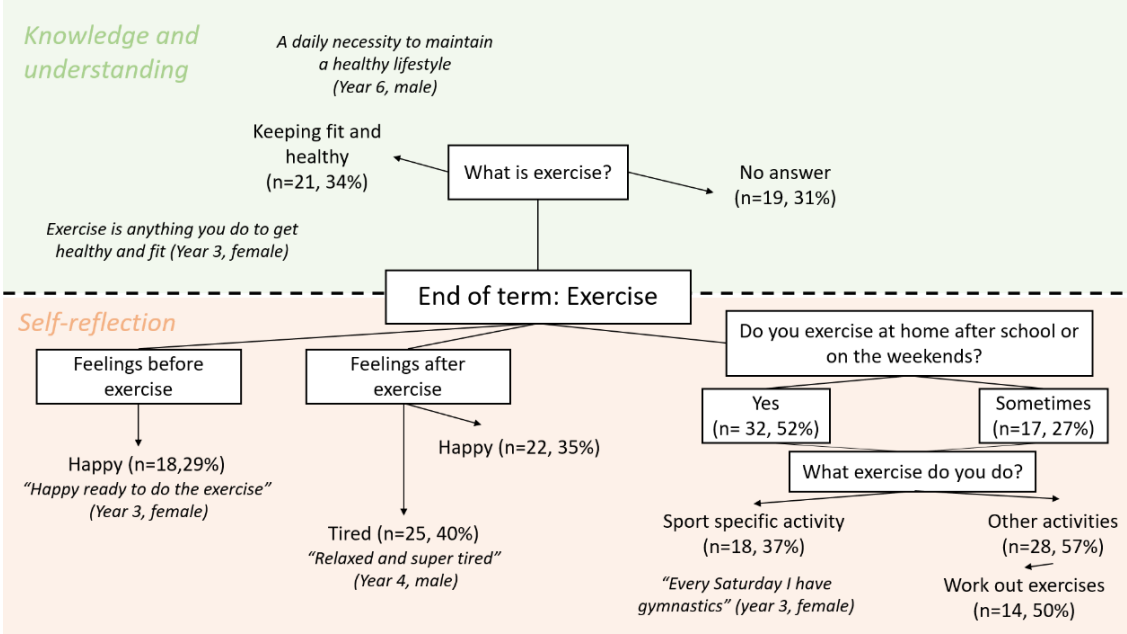

Figure 13: End of term pen profile on exercise

yes or sometimes (n=52) the exercises they most commonly reported to participate in were sport specific (n=33, 63%) such as football (n= 12, 36%), gymnastics (n=5, 15%), swimming (n=3, 9%), basketball (n=2, 6%) and Taekwondo (n=2, 6%).

End of term knowledge and understanding

Figure 13: End of term pen profile on exercise presents pupils' definition of exercise before the intervention. The pupils most commonly referred to keeping 'fit' and 'healthy' (n=21, 34%) and sport specific activities were referred to in 18% of responses (n=11). However, there was a large number of blank/ no answers in the end of term (n=19, 31%) than baseline (n=2) for this question.

End of term self-reflection

According for Figure 13, less children reported feeling happy before exercise compared to Figure 12 (n=18, 29%). Other words pupils used to describe how they felt included feeling excited (n=14, 23%), nervous or worried (n=7, 11%) and tired (n=6, 10%). After exercise, the number of pupils that reported feeling happy increased (n=22, 35%) and one less participant reported feeling tired (n=25, 40%). Tired coupled with a positive word like happy or relaxed appeared in 13% of responses (n=6).

At end of term, there was an increase in pupils who reported participating in exercise at home afterschool or on the weekends (n=32, 52%). Less participants reported that they sometimes participated in exercise (n=17, 27%) and not at all (n=13, 21%). Participants reported most commonly taking part in 'other' non-sport specific activities (n=28, 57%) which commonly included referencing work out exercise like planks, sit ups and jumping jacks (n=14, 50%). Overall, children reported taking part in less sport specific activities (n=18, 37%). The activities reported were commonly reported as football (n=11, 61%) followed by gymnastics (n=3, 17%).

6.3.2.3 Healthy eating

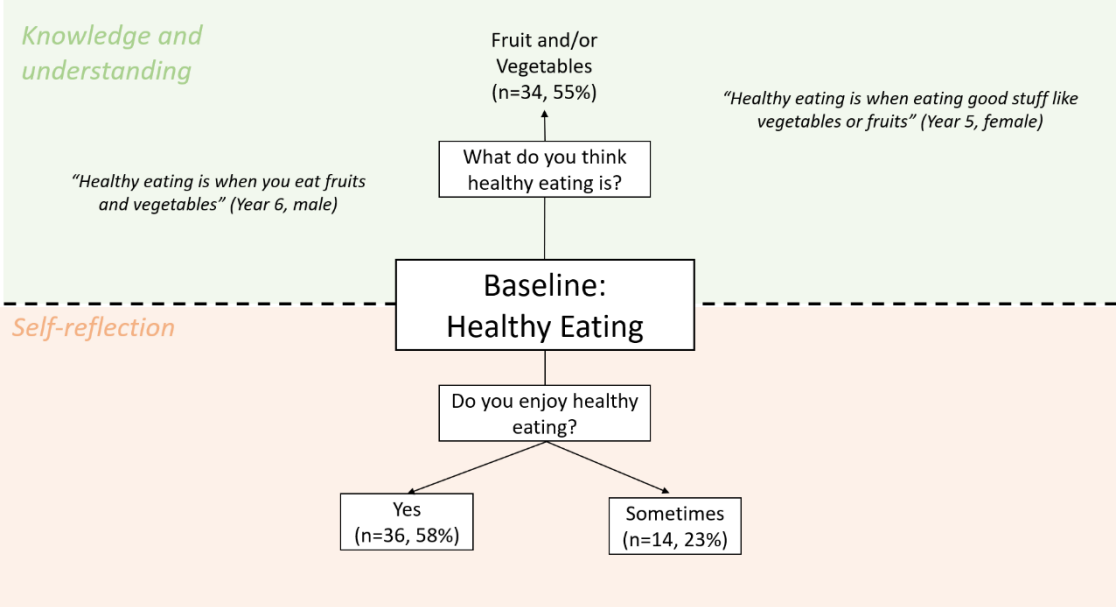

Figure 14: Baseline pen profile on healthy eating

Baseline knowledge and understanding

Figure 14: Baseline pen profile on healthy eating presents pupils' definition of health eating. Fruit and vegetables were most commonly reported (n=34, 55%). Within the theme, 29% of participants referred only to fruit (n=10) and 24% referred only to vegetables (n=8). The next most common theme was food specific references (n=10, 16%) followed by pupils reporting healthy eating should be a restriction or lack of junk foods such as sweets and 'fatty food' (n=7, 11%) and 5% of pupils referred to having a balanced diet.

Baseline self-reflection

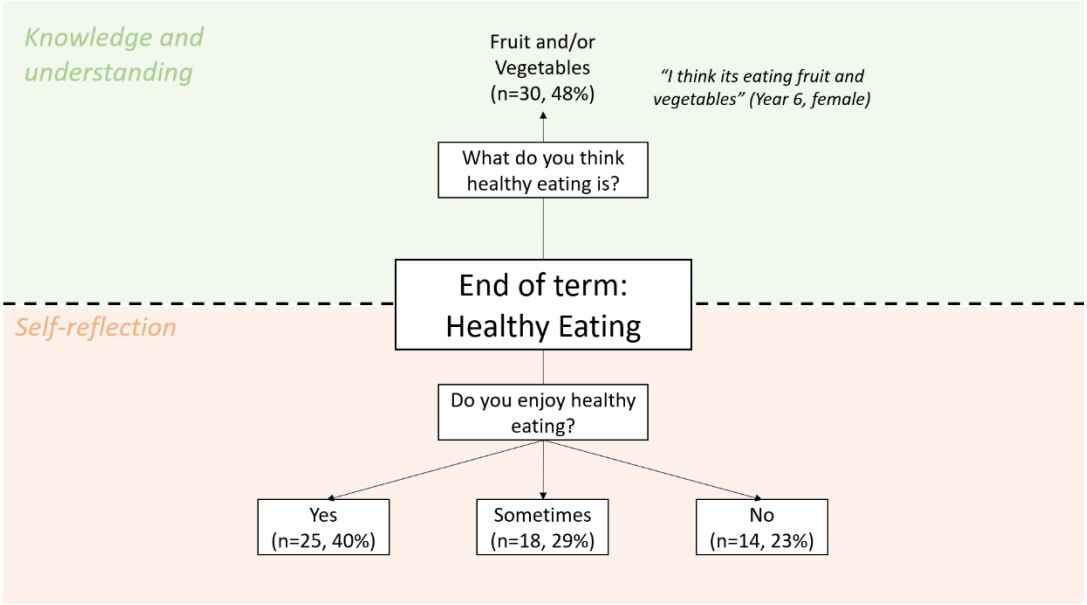

Figure 15: End of term pen profile on healthy eating

When asked if they liked health, pupils most commonly said they did (n=36, 58%) or only sometimes (n=14, 23%). When reporting their food preferences, pupils most commonly said they're favourite was pizza (n=14, 23%), sweets (n=8, 13%), fruit (n=8, 13%) or pasta (n=4, 6%).

End of term knowledge and understanding

Similar to baseline, Figure 15 shows fruit and vegetables were most commonly reported (n=30, 48%) and of which 33% reported only fruit to be healthy eating (n=10) and 17% reported vegetables alone (n=5). Other themes included food specific definitions such as listing 'healthy' foods like cucumber, carrots, peppers and broccoli (n=12, 19%), 10% of responses references not consuming junk or fatty foods (n=6) and 6% referred to having a balanced a diet (n=4).

End of term self-reflection

In total at end of term, there was a decrease in pupils who reported enjoying healthy eating (n=25, 40%) and sometimes (n=18, 29%) with 23% of participants reporting they do not like healthy eating (n=14) (Figure 15). Participants favourite foods where then commonly said to be pizza (n=12, 19%) or pasta (n=7, 11%) and fruit (n=7, 11%).

6.3.2.4 Drawings

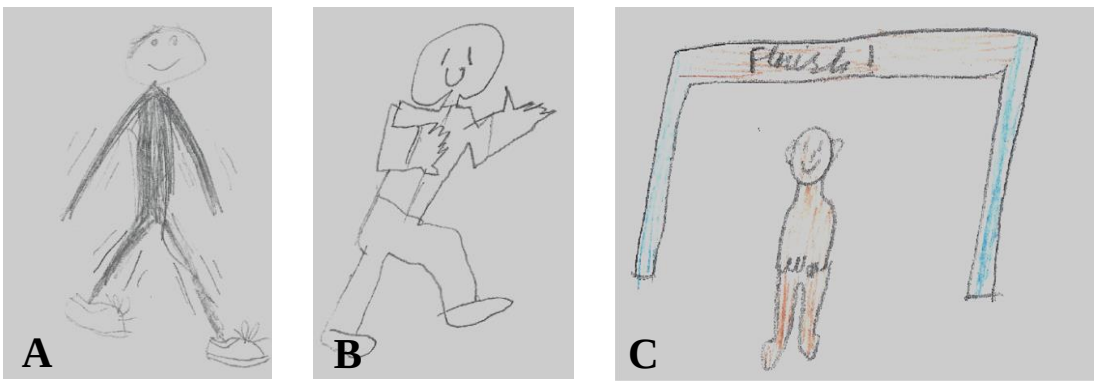

Figure 16: Drawings of positive facial expressions during the intervention

For question 12, pupils were asked to draw themselves taking part in Barnet's Golden Kilometre (Follow-up only). The drawings were summarised and grouped into general positive, negative and n/a drawings categories. Within these groups' subthemes were based on how pupils expressed their emotions and experiences of the intervention; these were: facial expressions, engaging with the environment, texts responses and combinations of these. A total of 84% (n=52) of participants completed the drawings and 16% (n=10) did not drawn an image. Pupils commonly expressed the experiences through facial expressions on drawings of themselves (Positive n=45, 87 % and Negative n=7, 13%) Figure 16: Drawings of positive facial expressions during the intervention shows three pupil drawings of facial expression, these images show pupils smiling as they take part in the intervention. The images show the variation in drawings of themselves with image A showing the participant standing, images B showing the participants in motion and image C showing the participant at a finish line. Within the positive category another subtheme was a combination of facial expression and environment (n= ,%), Figure 17: Drawings of positive facial expressions and environment during the intervention shows an example of a drawing within this category. The participants have expressed they are smiling (positive) but also drawn signs showing start and finish with a 'yay' sign indicating the pupil is pleased to finish.

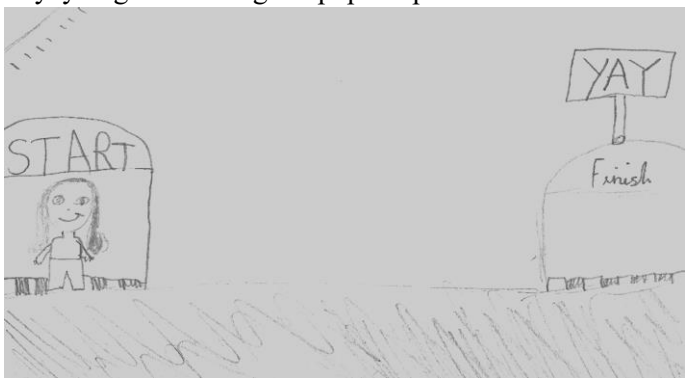

Figure 17: Drawings of positive facial expressions and environment during the intervention

Figure 18: Drawings of negative facial expressions during the intervention coupled with text expressions presents an example of two drawings which were grouped in the negative category. Both drawings present facial expressions coupled with text expressions (such as speech bubble in image A) where the pupils are expressing they are tired during participation. The only text responses written on the drawings that featured in the negative category were related to being 'tired'

Figure 18: Drawings of negative facial expressions during the intervention coupled with text expressions

6.3.3 BMI, BF% and waist circumstances

Table 20: BMI, BF% and Waist Circumstances ANOVA Results

Anthropometric measures	Baseline vs. Follow-up		Follow-up vs. End of term		Baseline vs. End of term	
	Mean difference (95% CI)	p-value	Mean difference (95% CI)	p-value	Mean difference (95% CI)	p-value
BMI (kg/m^2)	1.50 (-2.04 to 5.04)	.904	4.69 (0.83 to 8.54)	.012*	6.19 (3.00 to 9.37)	<.001*
BF%	0.08 (-1.01 to 1.17)	1.000	1.39 (0.46 to 2.32)	.001*	1.47 (0.61 to 2.32)	<.001*
Waist to hip (cm)	0.01 (-0.01 to 0.02)	.872	0.04 (0.00 to 0.07)	.042*	0.04 (0.01 to 0.08)	.013*
Waist to height (cm)	0.08 (0.02 to 0.13)	.002*	-0.04 (-0.09 to 0.01)	.197	0.04 (0.01 to 0.06)	.003*

Notes: *significant difference

Table 20 displayed the results for BMI, BF% and waist outcomes. Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated for BMI ($X^2(2) = 3.103$, p =.212) and BF% violated ($X^2(2) = 5.621$, p =.060.) but was violated for both waist measures (waist to hip ratio $X^2(2) =54.981$, p =<.001 and waist to height ratio $X^2(2) =36.179$, p =<.001). Therefore, a Greenhouse-Geisser correction was applied for both hip ($\varepsilon = 0.623$) and height ($\varepsilon = 0.701$) circumstance.

6.3.3.1 BMI

The results show in *Table 20* that BMI was statistically different at the different time points during the intervention, F (2,130) = 10.060, p= <.001, partial $\eta^2 = 0.134$, with MD 1.51 kg/m^2 BMI decreasing from 63.66 ± 26.87 kg/m^2 at baseline to 62.15 ± 26.99 kg/m^2 at follow up and 57.47 ± 28.85 kg/m^2 at end of term assessments. Post hoc analysis with a Bonferroni adjustment revealed that BMI was statistically significantly decreased from pre-intervention to end of term (6.19 (95% CI, 3.00 to 9.37) kg/m^2, p=<.001) and follow-up to end of term (4.69 (95% CI, 0.83 to 8.54) kg/m^2, p =.012), but not from baseline to follow-up (1.502 (95% CI, -2.04 to 5.04) kg/m^2, p=.904). There were no significant interactions between BMI z-score and sex or year group. BMI decreased from 66.35 ±27.15 kg/m^2 at baseline to 64.28 ± 27.59kg/m^2 at follow up and 59.42 ± 30.43 kg/m^2 end of term for male participants and 60.80 ± 26.700 kg/m^2 for female at baseline, 59.90 ±26.59 kg/m^2 at follow up and 55.39 ± 27.40 kg/m^2 at end of term but this was not statistically significant. BMI decreased at all time points for all year groups 3-6 although pairwise comparison identified only year 3 BMI centiles statistically significant decreased from baseline (55.62 ± 23.77) to end of term (47.00 ± 27.07) (8.62 (95% CI 2.98 to 14.26) kg/m^2, p=.001) and follow-up (54.95 ± 24.243) to end of term (7.95 (95% CI 1.13 TO 14.78) kg/m^2, P=.017)

6.3.3.2 BF%

The results show BF% was statistically different at the different time points during the intervention, F (2,134) = 8.871, p=<.001, partial η^2 = .117 with BF% decrease from 21.03 ± 7.17% at baseline to 20.95 ± 7.01% at follow-up to 19.56 ± 7.56% at end of term. Post hoc analysis with a Bonferroni adjustment revealed that BF% was statistically significantly decrease from baseline to end of term (1.47 (95% CI, 0.61 to 2.32) %, p= <.001) and follow-up to end of term (1.39 (95% CI, 0.46 to 2.32) %, p= .001) but not from baseline to follow-up (0.08 (95% CI, -1.01 to 1.17) %, p= 1.00). There were no significant interactions between BF% and sex, F (2, 132) = .301, p= .741, partial η^2 = .005. There were significant interactions between BF% and year group, F (6, 128) = 0.92, p= .481, partial η^2 = .041. Pairwise comparison showed BF% statistically significant decreased for year 3 pupils from baseline (21.11 ± 6.36) to end of term (18.87 ± 6.85) (2.24 (95% CI 0.73 to 3.75) %, p=.002) and follow-up (21.33 ± 7.06) to end of term (2.46 (95% CI 0.84 to 4.08) %, p=.001).

6.3.3.3 Waist circumstances

The intervention resulted in statistically significant changes in waist circumstance over time for waist to hip, F (1.25,74.11) = 7.14, p = .006, partial η^2 = .106, with ratios decreasing from 0.865 ± 0.05 (cm) at baseline to 0.86 ± 0.05 (cm) at follow-up to 0.82 ± 0.12 (cm) at end of term. For waist to height, F (1.40, 92.512) = 8.67, p = .001, the findings decreased from baseline 0.48 ± 0.08 (cm) to follow-up 0.40 ± 0.18 (cm) and increase to 0.44 ± 0.11 at end of term. There was no significant interactions between waist to hip (cm) or waist to height (cm) and sex or year group.

Post hoc analysis with a Bonferroni adjustment revealed that waist to hip ratio was statistically significantly decreased from baseline to end of term (0.04 (95% CI, 0.01 to 0.08) cm, p = .03) and follow-up to end of term (0.04 (95% CI, 0.00 to 0.07) cm, p = .042) but not from baseline to follow-up (0.01 (95% CI, -0.01 to 0.02) cm, p = .872). Waist to height ratio was statistically significantly decreased from baseline to follow-up (0.08 (95% CI, 0.02 to 0.13) cm, p = .002) and baseline to end of term (0.04 (95% CI, 0.01 to 0.06) cm, p = .003) but increased from follow-up to end of term (-0.04 (95% CI, -0.91 to 0.01) cm, p = .193) although this was not statistically significant.

6.3.4 PA

Full presentation of the PA outputs including weekday weekend with morning, day and evening measures is presented in appendix I. Outcome measures where significant results were recorded are reported in this heading. The intervention did not elicit statistically significant changes in any weekday (Monday-Friday) PA time measures. Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated for daily VPA ($X^2(2)$ =1.42, p =.491) or MVPA ($X^2(2)$ =5.85, p =.054).

6.3.4.1 Daily

MVPA

The results show daily (Monday- Sunday) VPA was statistically different at the different time points during the intervention, F (2,22) = 6.291, p=.007, partial η^2 = .364 with daily VPA decreasing from 17.43 ± 12.3 mins at baseline to 13.03 ± 13.01 mins at follow-up to 10.48 ± 9.64 mins at end of term. There were no significant interactions between daily VPA and sex or year group. Post hoc analysis with a Bonferroni adjustment revealed that daily VPA was statistically significantly decreased from baseline to end of term (6.95 (95% CI, 0.83 to 13.06) mins, p= .025) but not at baseline to follow-up (4.40 (95% CI, -0.06 to 8.88) mins, p = .053) and follow-up to end term (2.55 (95% CI, -3.49 to 8.58) mins, p= .778).

Results from pairwise comparisons show male follow-up (126.14 ± 59.64 mins) to end of term (mean 79.09 ± 48.84 mins) daily MVPA statistically significantly decreased (47.07 (95% CI 3.71 to 90.43) mins p=.032) but not any other time points nor were this significant in females.

6.3.4.2 Evening

MPA

Mauchly's test of sphericity indicated that the assumption of sphericity had been violated $X^2(2) = 8.749$, $p = .013$ Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = .617$) The results show weekend evening MPA was not statistically different at the different time points during the intervention, $F(3.7,12.33) = 1.96$, $p=.166$, partial $\eta^2 = .370$ with evening MPA at weekends increasing at all time points for years 3,4 and 5 but decreasing from baseline 24 to 7 mins at end of term. Post hoc analysis with a Bonferroni adjustment revealed that evening MPA at weekends was statistically significantly increased from baseline to end of term for year 3 (46.00 (95% CI -89.15 to -2.85) mins p=.036) and year 4 (64.17 (95% CI 119.944 to -8.46) mins p=.024) but was not statistically significant at any other time points of year groups.

6.4 Discussion

This is the first study to report on the influences school-based run/walk interventions have on children's PL. The study aimed to examine the effects of Barnet's Golden Kilometre on PL related outcomes in primary school pupils by exploring the effects on FMS development and well-being and lifestyle as indicators of PL progression and BMI, BF%, and daily PA as an outcome of PL progression. The main results of the study suggested some potential progression in pupils' PL journeys in terms of FMS, well-being and significant improvements in BMI, BF% and waist circumstances as outcomes of PL. Although no significant results were identified in weekday PA nor were any significant improvements in PA identified.

In line with the suggestions of Barnet *et al.* (2020) and the findings of study one, this study combined survey data with a motor competence tool in an attempt to capture aspects of the physical (FMS), affective (feelings) and cognitive (knowledge) domains of PL progression that have not been investigated thus far. In existing school-based run/walk studies, improvements have been observed in physical and affective related outcomes over six months but this is the first run/walk study to consider movement quality via FMS, thoughts and feelings towards exercise and knowledge and understanding of exercise and healthy eating following participation over one academic year. To date, studies have focused on physical outcomes related to time-based performance, affective outcomes relating to motivation and self-efficacy and cognitive function based outcomes which were identified in study one.

Firstly, the study observed FMS development via total score, mastery and advanced skill proficiency. Improvements in FMS total score from follow-up to end of term and locomotor and ball skill total from baseline to follow up assessment were identified. The mean difference in improvement from baseline to end of term were less for ball skills (baseline MD 8.3 and end of term 4.85) whereas the improvements in locomotor were greater (baseline MD 7.33 and end of term 8.52). One reason that could explain the variation in these total score findings is number of pupils achieving mastery in the skills and therefore less improved change in total score. This can also be reflected in the mastery skills for locomotor activities. The study findings showed significant improvements in mastery achievement for slide and skip at the same time points but in no other skills and only significant improvement is two handed strike for ball skill mastery. Although, there were no significant changes in advanced proficiency scores overall. The findings of the study showed varied levels of mastery but observed non-significant improvements in almost all skills although non-significant. At baseline all skills apart from slide were equal to or less than 50% mastery for all year groups which shows the potential area for many pupils to mastery each skill. Whilst research has suggested children should achieve mastery by aged 8 years, recent has suggested children in later years of primary school have not yet achieved mastery as expected which is also reflected in baseline findings (O'Brien, Belton and Issartel, 2016; Duncan *et al.,* 2020). The PE curriculum at primary schools is centralised around the refinement and development of FMS so natural progression within these skills is expected throughout the school year (Department for Education, 2014). This can however pose as an additional challenge for determining causation between the FMS developments observed and intervention participation. Interpreting FMS data can be challenging particularly without a control group due to the range of covariates that could influence development (e.g. progression could be from PE, PA clubs, intervention or a combination). None the less, these are important skills that contribute to children's PL and PA engagement which warrants there use in research. The method of assessment in this study did not adopt a constraints-based approach, and only considered the performance of these skills in isolation. This has previously been critiqued as it does not consider the environmental constraints which contribute to skill performance (Newell, 1986; Barnett *et al.,* 2016). The constraints-based approach suggests that development is based the interaction between an

individual, the task, and environment constraints (Newell, 1986). This perspective has been adopted in education settings and interventions to teach FMS by considering individual constraints and manipulating the environment (such as equipment) and task constraints (such as time) to account for participants skill levels (Goodway, Crowe and Ward, 2003; Barnett *et al.,* 2016). Neither Barnet's Golden Kilometre nor any other run/walk interventions adopt this method to promote skill development and therefore, it was not considered in assessment. However, this approach could be used in future intervention development in order to encourage skill progression but individual constraints should first be understood.

FMS are said to be prerequisites for being physically active in childhood (Stodden *et al.,* 2008; Almond, 2013; Bryant *et al.,* 2014; Gu, Thomas and Chen, 2017). Children who score higher in motor competence are thought to engage in more PA in and outside of school and maintain greater fitness levels (Stodden *et al.,* 2008; Almond, 2013; Bryant *et al.,* 2014; Gu, Thomas and Chen, 2017) . Research has shown FMS to also be positively associated with self-belief and executive function which coupled with increased PA, is thought to also increase enjoyment for children (Bremer and Cairney, 2018), all elements of which are noted within PL progression. The development of physical competence is thought to be central to nurturing overall PL development (Hulteen *et al.,* 2018) thus even small observations could be worthwhile contributions by encouraging wider developments in attributes of PL. This is particularly valuable knowing FMS are central to PE at primary age too (Department for Education, 2014). Children with higher physical competence also have higher perceived competence (Duncan *et al.,* 2018) which is said to then lead to the development in affective and cognitive attributes of PL (Whitehead, 2010; Durden-Myers and Whitehead, 2018). For example, improve perceived physical competence can encourage self-confidence to execute different PA skills and overcome challenges in physical environment (Whitehead, 2019). Without a control or analysis of wider PA participation the study is however, unable to determine if the intervention contributed to the progression in the skills observed or if this is natural progression experienced throughout the year (slide, skip, two handed strike). However, with research showing developments in physical competence can lead to wider PL development (self-confidence (Bremer and Cairney, 2018), perceived competence (Duncan *et al.,* 2018)) the progressions identified can still provide worthwhile contributions. For further insight to causation, using additional qualitative research tools such as interviews or focus groups with children may be a suitable additional tool to consider the contributions the intervention has or has not had on the skill developments observed in this study and allow exploration of the wider impacts these improvements may have. With that being said, the progression of physical competence is not the only area of PL nor the focus of this study and other developments were considered which show further potential development in the concept.

Secondly, the study explored elements of the affective and cognitive domain through a well-being a lifestyle questionnaire in which questions were designed to explored pupils' thoughts and feelings and knowledge and understanding towards exercise and healthy eating. The study identified no significant changes in Likert scale questions (feelings and energy) with mean scores slightly decreasing on all questions. Although, before exercise, children generally reported positive emotions such as feeling happy, which was most commonly reported at both time points. Children also reported feeling more excited at end of term (23%) compared to baseline (11%). These findings are promising for PL as children are more likely to participate in PA if they perceived it to be an enjoyable activity and are positive towards participation (Biddle and Mutrie, 2007; Whitehead, 2019). Research shows that some of the self-reported motives for children's participation in PA activity are for fun, an enjoyable experience, an opportunity to learn/ develop physical skills and an opportunity to develop their physical fitness and health (Biddle and Mutrie, 2007; Biddle, *et al.,* 2023). Interestingly, at end of term

more children also reported exercise to be something an individual does to "keep fit and healthy" (34%) whereas at baseline, more sports specific activities (34%) were referenced or children only referred to exercise being an action to "keep fit" (27%). Part of the cognitive domain of PL references the knowledge on how PA can improve well-being and the principles of leading a healthy active and balanced lifestyle. For children, having this basic knowledge on the value of exercise being beneficial to health and fitness would play a key role in the cognitive domain of PL and coupled with the findings of positive feelings towards exercise could motivated pupils to participate in PA (Biddle & Mutrie, 2007; Whitehead, 2019).

Whilst no significant differences were observed, pupils overall still reported high positive feelings towards exercise both before and after on the Likert scale. At end of term, before exercise pupils reported feeling on average 8 out of 10 on the Likert scale and 7 after exercise. According to the symbols on the scale, these scores were both towards the positive end of the scale indicated by a smiley face. The slight decline in pupil scores after exercise could be associated with the increased feeling of tiredness from activity. The questionnaire analysis showed that after exercise children most commonly reported feeling tired (40%) followed by feeling happy (35%). When children reported feeling tired just over ¼ of participations (13%) also reported this coupled this with positive words to describe their feelings such as happy, calm and relaxed. PL literacy notes that development in ones journey is based on PA experiences and perceptions (Whitehead, 2019). Positive feelings after exercise could correspond into further PA engagement in the future. Many studies offer insight into the benefits of PA on affect and cognition but there is less comparison on how affect, and feelings impact children's decision to engage in PA (Liao *et al.*, 2017). Research shows a positive emotional state towards PA can support health-related behaviour such as regular engagement and persistence in challenge. Reviews have also shown PA can increase positive emotions in children (Burns *et al.*, 2017; Li *et al.*, 2022) and Jekauc *et al.* (2017) states if we experience positive feelings during and after activity we would be likely to repeat. Whilst further research is needed to strengthen the quality of findings, research has suggested a bi-directional relationship between feelings and PA engagement (Liao *et al.*, 2015; Liao *et al.*, 2017). Children's reported positive feelings (Likert) after exercise could encourage future PA engagement which would then further enhance PL development through affective (motivation) and cognitive (PA habit) enhancement. Therefore, increasing the likelihood of sustained PA engagement through PL. However, the questionnaire employed in this study asked questions relating to exercise in general and did not ask for specific recall over time or type of activity which limits the findings. Therefore, the study cannot determine the impacts of the intervention on these responses. Further research would be needed to confirm if these responses recorded are relative to Barnet's Golden Kilometre participation and to determine if children would be likely to continue PA participation as a result of the activity.

In terms of the outcomes of PL progression, research has suggested PL could lead to health-related improvements associated with PA (Cairney *et al.*, 2019a). The study investigated several health outcomes often reported in Public Health policy and could be used for comparison to the findings of study one (body composition and PA). The present study found significant decreases in BMI, BF% and waist circumstance. ANOVA results for combined group had a small significant decrease in BMI (MD 6.2 kg/m^2), BF% (MD 1.5%) and waist to hip ratio (MD 0.4cm) from baseline to end of term and follow-up assessments to end of term. These combined results are a good indication of how body composition has changed over time for children. Existing run/walk research that has investigated BMI has observed some improvements although these have been non-significant and over either shorter or similar time periods of three months or six months (Brustio *et al.*, 2019; Brustio *et al.*, 2020), only one study has looked at a longer period of 12 months in which no significant changes were

observed (Breheny *et al.*, 2020). This study similarly did not find any significant changes from baseline to follow up at six months suggesting BMI changes may only be experienced over a longer period of more than six months. Brustio *et al.* (2020) also observed small significant changes in waist to height ratio but only over smaller period of three months and at six months the scores were similar to baseline. These findings could question the suitability of participation and/ or potential reversal in positive health outcomes if behaviours are not sustained. Interestingly, only one study has investigated composition although through skinfold measurements rather than BF%. Chesham *et al.* (2018) found significant improvements compared to control after six months. Similar to this study findings, BF% also only increase over longer assessment periods (baseline to end of term or follow-up to end of term). The study findings coupled with published run/walk studies on similar outcomes suggests that intervention participation may need to occur for a substantial amount of time (e.g. six months plus) to see impact on these health variables. Although, despite seeing improvements in these weight related outcomes, the study observed no significant improvements in any weekday PA measures and identified significant decrease in daily VPA and MVPA which questions the potential PL development proposed in Cairney *et al.* (2019a) health model.

However, these findings contradict that of Chesham *et al.* (2018) who observed significant improvements in daily PA via accelerometers for TDM intervention. The authors identified a significant improvement of 9.1 mins in MVPA and decrease of 18.2 mins in sedentary time per day for primary school pupils compared with the control group (Chesham *et al.*, 2018). Due to the self-select design of these intervention types, it masks the intensity of participation which would influence PA recordings and these health-related outcomes recorded. The findings of this study could suggest potential compensatory effects for the PA participation during the intervention. Whereby children are participating in less moderate or MVPA during the school day due to an increase in light PA from the intervention. Descriptive statistics on daily light PA in this study showed an increase for all year groups at varied time points, but was this all non-significant. Wider PA research has noted light PA to include actions such as standing, walking and playing, all of which have important contributions to health (Bates *et al.*, 2020). The findings of this study could therefore suggest that children participated in lighter PA during the intervention by predominantly walking or lightly jogging the kilometre which could still have health benefits for pupils, such as reduced BF% (Kwon *et al.*, 2011) whilst also reducing MVPA recorded. Further research has suggested light PA could be a good first step for children who are far from meeting PA guidelines (Hubbard *et al.*, 2016) and/or have excess BF% (Kwon *et al.*, 2011). This may also help to encourage PL progression for children by educating pupils on the importance and contributions light PA can still have towards health and also helping to build perceived and actual physical competencies through lighter and/or non-competitive activities like walking through active transport to school (Sasayama *et al.*, 2021). However, the exact intensity of PA completed throughout the intervention was not analyse so limits the confirmation of intensity level and potential benefits participants may have experienced as a result.

The present study used accelerometers to determine accurate readings of PA. Similar to existing run/walk interventions, Chesham *et al.* (2018) and Morris *et al.* (2019) both also used accelerometers to assess PA during TDM intervention. As already noted Chesham *et al.* (2018) observed differences over time whereas Morris *et al.* (2019) observed PA intensity during TDM completion. Morris *et al.* (2019) found children who completed TDM did greater levels of MVPA compared to control group (10.67 ± 2.74mins). Similarly, Hatch *et al.* (2019) observed PA behaviour during TDM via an adapted System for Observation Fitness Instruction Time (SOFIT) tool and also noted higher MVPA during intervention participation.

However, due to the flexibility in completion time throughout the school day the study is unable to confirm the intensity of PA during the intervention and further analysis would be needed into PA pattern throughout completion. The larger epoch length used within the study could have also impacted the accuracy of PA intensity recorded (60sec) so limited the study ability to analyse estimated intensity in raw count analysis. Morris *et al.* (2019) used a shorter epoch length of 15-s epochs to determine a more accurate representation of PA intensity during TDM. However, the authors did not record activity patterns over time so cannot determine if the PA intensity was sustained and could not be used to determine long-term PA benefits or comparison for this study. Research for accelerometers in young children generally recommends short epoch lengths to minimise errors and obtain more 'real' recordings of PA behaviour (e.g. 5-s epochs McClain *et al.,* 2008) (Mcclain *et al.,* 2008; Edwardson & Gorely, 2010). Although, Edwardson *et al.,* (2010) added studies should not compare PA findings across epoch lengths (e.g. 5-s to 60-s) due to the potential variation in intensity readings. Research show that outputs (Raw or counts) from different accelerometery tools (waist or wrist worn) draws different conclusions of PA due to location and technical differences so should not be compared (Fairclough *et al.,* 2016). Study one identified that Chesham *et al.,* (2018) was the only published study to have used accelerometers in continued run/walk intervention participation at the time of this study in which they selected 60-s epochs. However, this study used waist worn ActiGraph accelerometers which could explain the large variation in finding between these studies (Fairclough *et al.,* 2016; Chesham *et al.,* 2018). Since, there has only been one further run/walk intervention study published which reported the use of accelerometers (Ram *et al.,* 2021). However, so far only the protocol has been publishing and findings along with the cut-points or epoch length chosen are not known.

In addition to this, the use of accelerometer tool (wrist worn GeneActiv) and small sample size limits the sample comparability across wider intervention research. Often, when measuring accelerometery waist worn ActiGraph accelerometers are used (Chesham *et al.,* 2018; Morris *et al.,* 2019). Waist worn tools have been found to capture more accurate representations of ambulatory based activities but have been shown to also have worse compliance in children (Fuezeki, Engeroff and Banzer, 2017; Innerd, Azevedo and Batterham, 2019). This study determined wrist worn watches to be a suitable choice given the repetitive use (X3 measures) and access to available resources for data collection. However, despite considering additional compliance methods this study still recorded overall poor levels of compliance at the end of term (9% of baseline sample) which impacted the generalisability and comparability of data.

Overall, there was large amount of missing data throughout all measures and across both time points. Often this can be down to participants leaving schools and not being present on research days, However, large values have also been reported in similar run/walk interventions. Specifically with missingness ranging from 39.5% up to 56% (Breheny *et al.,* 2020). One reason for the large recorded score could be due to poor compliance with the intervention. However, this present study only recorded three pupils drop-outs during the data collection process who were removed from all analysis. For PA accelerometer compliance specifically, there is a recognised novelty of wearing a PA watches at the start of the intervention. During recruitment, pupils were excited for the watch participation and as the year progressed participants could have found less novelty in the use of the watches (Innerd, Azevedo and Batterham, 2019). Seasonal changes could have also impacted overall watch compliance and sample size for overall data collection particularly at the end of term. During the last week of the data collection in July 2022 the UK had a period of extreme hot weather reaching temperatures close to 40ºc. Not only did this lead to a period of closure in schools which limited the time to conduct data collection but also meant that many pupils were still

absent on the 'cooler' days that schools were open. Additional, pupils that received the watches may not have worn them watches due to the heat/ hot weather. The intervention may not have also been completed during periods of extreme weather (summer or winter) and/ or intensity and PA participation may have varied as a result. It is also thought that the COVID-19 pandemic could have influenced participant retention in the data collection overall. For example, since COVID-19 schools now have persistently higher absence rates than ever, overall absence rates pre-pandemic were below 5% which increased to 6.9% in 2021/22 during the data collection season and most recently are 7.5% 2022/23 (United Kingdom Statistics Authority, 2023). Winter 2021/22 illnesses were also unusually high which could be because of the knock-on effects of keeping children separate when possible and resulting in higher school absences (UK Health Security Agency, 2023).

The questionnaire employed in this study may also have represented a limitation in regards to the capture of the affective and cognitive domains of PL. As already noted, the questions related to exercise in general and did not ask for specific recall over time or type of activity which limits the findings and reflections of PL. This also therefore limits the conclusions that can be drawn on the impacts of the intervention on exercise participation and healthy eating. Further research is therefore needed to confirm if the responses recorded are relative to Barnet's Golden Kilometre participation, and to determine if children would be likely to continue PA participation as a result of the activity. In addition to this, children's emotions and feeling are unpredictable and changeable. Therefore relying on quantitative tools may not be a true reflection of children's feelings as these only record one small snapshot into children's experiences rather than recording their progression or change over time, limiting the capture of affective and cognitive domains (Edwards et al., 2017). The unpredictable nature of children's self-report data may also explain the poor reliability findings in this study, however, further research is needed to validate the questionnaire for usein wider intervention research. Therefore, is it recommended that further intervention research prioritise the questionnaire development before employing it in intervention research settings to ensure the reflections are closely aligned with children's experiences.

Collectively, these limitations highlight not only the potential impacts on the quality of data of this study but also the challenges faced with data collection in schools since the pandemic. Previous research has recognised the challenges of data collection in schools and particularly pragmatic PL research has noted the importance of considering data collection tools and efficiency in these settings (Kriellaars *et al.,* 2019; Krenz *et al.,* 2022; Arbour-Nicitopoulos *et al.,* 2023). However, particularly since the pandemic, schools are faced with additional challenges (time, attendance, space, health and safety protocols) which limit the ability to collect quality data and over longer periods of time. Future research should consider data collection on a smaller scale (time, equipment, sample etc) to limit the burden on schools and sample retention which may be more beneficial for the quality of data collected and reflective of real-world intervention experiences.

Further analysis where conversation probes can be used may help to provide more in-depth reflections of these areas recorded in this study and account for deeper PL reflections within these. Determining the wider contributions that Barnet's Golden Kilometre had on PL development was limited in this study to objective measures of FMS and descriptive questionnaire summarise for PL progression and objective measures of anthropometric and PA for PL outcomes. The tool selection and data collection were designed to suit schools' timetables and provide comparable data for future research. However, additional limitations arouse that were not anticipated which has influenced the quality of reflection and conclusions drawn. It is suggested that qualitative methods such as interviews and/or focus groups would allow individual reflection and discussion around these missing elements as well as real world accounts for intervention experiences. These tools also align with the holistic nature of PL and

according to a review by Edwards *et al.* (2018) and combined findings of the thesis so far suggest a greater potential to explore the affective and cognitive elements and perceived competence of PL in run/walk interventions specifically.

Recognising the areas of PL that are not identified through this study investigation allows future research to be conducted into the areas missed whilst also acknowledging the contributions and limitations of these findings towards PL progression, in line with the recommendations of Barnett *et al.* (2020). To date, there is still limited availability of valid and reliable PL questionnaires and other tools that can capture the elements of PL which object tools cannot (Barnett *et al.*, 2023). Through object measurement this study was able to identify actual physical competence improvements and health related outcomes which could be indicators of potential PL development. However, due to study limitations and lack of control, the study has not addressed the potential direct influence intervention participation has had on these outcomes. Therefore, to support these study findings on PL progression qualitative research such as focus groups or interviews would be useful.

6.4.1 Study limitation

The present study had a number of limitations important to consider during final conclusion on the impacts of Barnet's Golden Kilometre. Firstly, there was a large portion of missing data and drop-out in follow-up measures noted in the discussion. The second school recruited for the study (S2) included control and intervention years but due to internal school timetabling and staffing issues was removed from the final study sample as end of term data collection was not conducted (chapters five, 5.1.3). Not only did this limit the final sample size for the intervention group but also meant no control analysis was conducted which limits the validity of the intervention findings. Following previous study reports, a drop-off was expected in data collection participation so additional measures were followed to help improve compliance. Some of these including building relationship with staff and presence in school to create regular contact with class teachers and run data collection at suitable times for each class timetable. Intervention adherence was noted (chapter five, 5.2) and reminders were broadcast within school letters ahead of data collection. For example, S1 had monthly parent/ guardian newsletters shared via email which included reminders on the upcoming data collection and watch return dates for each class. Children were also sent home with information packs on watch care and return after each time point. However, despite these efforts, additional barriers appeared mostly which appeared to be knock-on effects from the pandemic. For example, S1 began running additional educational classes for children to catch up on missed work particularly in older years who were due to sit exams (year six) which clashed with some data collection dates. Whilst efforts were made to run additional data collection sessions where possible to accommodate for all pupils, limited timetable space and school closure during hot weather meant many children were not able to participate in all data collection measures as intended. For the sample recruitment, convenience sampling was also employed which meant schools and class teachers chose to be intervention (none chose control) and no randomization was performed. All classes chose to participate in the intervention but additional consent was sought to participate in the research study.

Given the nature of the included interventions, participants' self-selected pace to complete their distance could also vary the treatment response experienced. The lack of clarity around treatment integrity could lead to bias within the interpretations of the findings. For example, schools could implement the intervention with a focus on running rather than self-selected jog, run or walk, which would influence the extent of impact in outcomes such as PA intensity. Due to restrictions in time and access explicitly treatment response and fidelity dose/response rate were not recorded. However, efforts were made to consider the intervention

implementation and potential influences on PA by employing an intervention checklist to provide a comprehensible description of the intervention content. It is suggested that the intervention intensity (pace and distance covered) may have contributed to light PA however, further analysis would be needed. In order to understand the true extent of the 'self-selected' nature of the intervention and consider how this may change throughout term, further research is needed. It is recommended that future research measures the implementation and intervention frequency. These suggestions are in line with similar reviews where clarity on intervention implementation and integrity are needed before firm conclusions can be drawn on outcomes (Love *et al.*, 2019).

6.5 Conclusion

Following the recommendations of existing PL assessment research coupled with the findings of study one, this study aimed to investigate PL development in primary school pupils through the progression in FMS and a well-being and lifestyle questionnaire. To determine the impacts of PL progression, further data collection was conducted in health outcomes that could contribute to PL research and provide comparable data. This study found improvements in FMS in primary school pupils and increased positive feelings towards exercise. A key finding of the study was that the improvements were identified in all three domains of PL. The study found improvements in FMS (physical), increased positive feelings from pupils towards exercise, and narrowing in pupil understanding of exercise and healthy eating (affective and cognitive). In relation to health outcomes, this study identified improvements in BMI, BF% and waist circumstances over 6 months or more participation. However, further analysis is still needed to determine the associations of these health outcomes with PL and intervention participation. Despite the noted limitations, it is thought that the present study provides a real-world account of intervention participation and reflection of data collection in schools during and post pandemic. To provide accounts for PL experiences and contribute to answering the overall thesis aims, it is thought that adopting additional qualitative tools could provide further depth to the findings identified in the study and explore individualised intervention experiences, specifically with how intervention experiences have influenced perceived competence, health behaviours and feelings towards participation which are relative to PL. Including a variety of participants would help to enhance the quality of intervention reflection and provide detailed accounts of unique PL related experiences.

Chapter Seven: Study Three

7.0 Exploring teachers' perspectives of Barnet's Golden Kilometre and perceived pupil experiences

Abstract

Introduction: Teachers play an important role in supporting children's PL and are at the forefront for continued participation in school-based interventions. School-based run/walk interventions such as Barnet's Golden Kilometre are reliant on teacher's implementation and continued enthusiasm to sustain class engagement in the interventions which can ultimately influence pupils' PL experiences. *Research aims:* The objectives of the study were to explore teachers' perspectives of Barnet's Golden Kilometre and its perceived impact on pupil experiences and PL development and to identify how the implementation of the intervention could influence pupil PL experiences. *Methods:* A purposive sample strategy was employed to recruit participants. Five teachers from two schools in the London Borough of Barnet participated in one off semi-structured interviews. The guides aimed to determine how schools deliver the initiative and how it is perceived by teachers including perceived impacts for pupils and their PL experiences. Inductive thematic analysis was performed using the Braun and Clarke (2006) six phases of analysis. *Results:* Six themes developed relating to perceived experiences, perceived outcomes of participation, teacher attitudes, fidelity/adherence, logistics, and intervention suggestions. *Discussion and conclusion:* Overall, teachers reported the flexibility and simplicity of the design were useful for implementation. However, due to timetable pressure both schools were unable to complete the intervention five times per week and rather both aimed for three to four times each week. In line with similar research, a 'no one size fits all' approach was highlighted as important for pupils' experiences. Teacher highlighted the importance of tailoring the intervention to their class needs to prevent drop-out and increase PL development for all. However, further research is needed to determine the potential influence the intervention can have towards developing pupils PL experiences. It is recommended that future research considers children's reflections of the intervention to provide lived experiences of participation.

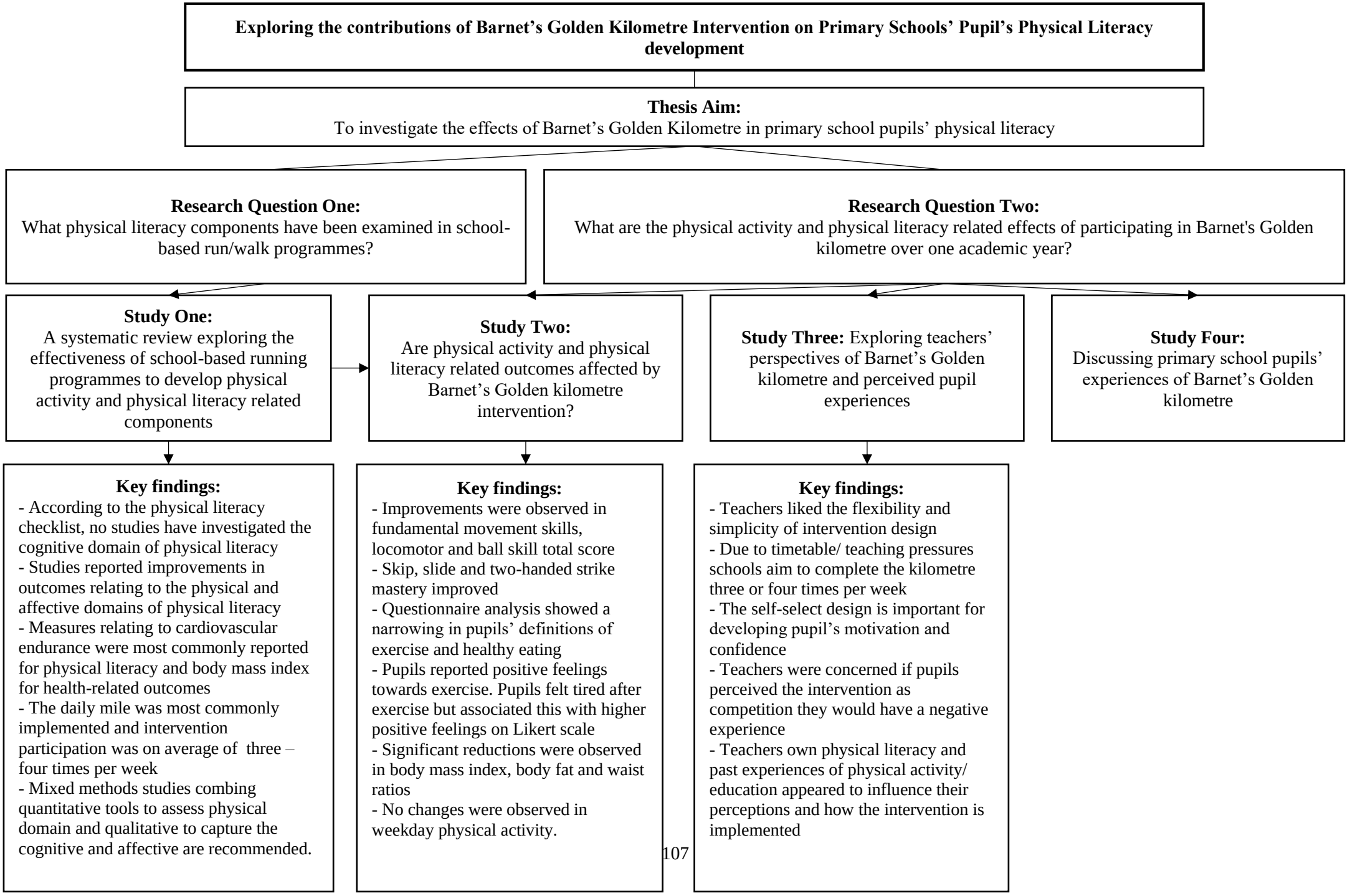

Figure 19: Thesis map and study three key findings

7.1 Introduction

PL considers the broader processes associated with lifelong PA engagement looking beyond solely the physical elements we need to be active (Barnett *et al.,* 2019; Whitehead, 2019; Whitehead, 2010). If research were to explore the influence that school-based interventions have on developing the domains of PL it could identify the environments which help these domains flourish and therefore contribute to developing lifelong PA engagement from a young age. Study one identified limited exploration of all PL domains in run/walk intervention research and particularly limited investigation into the affective and cognitive domains. Existing PL reviews have suggested that qualitative research is more likely to capture the cognitive and affective domains of PL as well as encourage self-reflection on perceived physical competences (Edwards *et al.,* 2018; Shearer *et al.,* 2021). Existing PL research has suggested that qualitative methods could allow deeper understanding of the complex interactions with the environment (and Barnet's Golden Kilometre) that quantitative measures cannot capture (Edwards *et al.,* 2018; Shearer *et al.,* 2021). Research states that combining mixed methods can also demonstrate the practicalities of intervention design and identify the key characteristics of interventions that contribute to successful implementation (Ma *et al.,* 2021) and to PL development (Edwards *et al.,* 2018) which could help to strengthen the findings through mixed methods approach. Therefore, this study is the first of two qualitative investigations into the influences Barnet's Golden Kilometre intervention has on elements of pupils PL experiences.

Much of the qualitative research that exists in run/walk interventions has provided insight into pupil experiences and parental, school and teacher perspectives including practicalities, feasibility and delivery methods (Chalkley *et al.,* 2018; Ryde *et al.,* 2018; Malden and Doi, 2019; Harris *et al.,* 2020b; Marchant *et al.,* 2020). However, these studies have highlighted the importance for future research to understand the unique run/walk intervention deliveries and contextual differences in environments in order to understand pupils' experiences and impacts of PA where little is known (Chalkley *et al.,* 2020; Ma *et al.,* 2021; Malden and Doi, 2019). Study one and similar more recent reviews have showed the quantitative outcomes measured have also focused largely on physical related outcomes like time-based PA and that little is known on the contributions on PA/health related behaviours which could be explored through qualitative investigation of PL (Breslin *et al.,* 2023; Hanna *et al.,* 2023).

Teachers have the opportunity to observe children taking part in PA whether that is in PE, active breaks, intervention participation or school clubs and at many times over the academic year, where they can critique and reflect on the pupil's performance (Lundvall, 2015; Green *et al.,* 2018). Green *et al.* (2018) noted that exploring teachers' opinions enhances the quality of PL reflection and can help feedback for PL development. Children may not also be able to fully recognise their own PL progression nor identify their progress in the attributes associated with the domains of the concept, which teachers can reflect on. Teachers also ultimately play a key role in children's PL development through their support and guidance on developing motor skill in PE settings and their abilities to develop wider skills of PL in school (Whitehead, 2010; Lundvall, 2015; Essiet *et al.,* 2022). Therefore, their perspectives of PL progression could provide valuable insight into the effects of intervention participation that young children cannot reflect on themselves.

Schools are often also reliant on teachers to lead and maintain school participation in PA interventions so children can reap the benefits of taking part (Nathan *et al.,* 2018). Run/ walk interventions such as Barnet's Golden Kilometre are one example of a teacher led intervention that schools are currently taking part in. The intervention relies on each class teacher to take their pupils outside for ~15 mins per day every school day to walk, jog or run one-kilometre distance around the school's grounds anytime in the day that suits their timetable. Research

shows factors such as continued staff and teacher support, access to equipment and environmental contextual factors to be determinants of intervention success or failure in schools (Nathan *et al.,* 2018; Ryde *et al.,* 2018). These interventions rely on teacher's implementation and continued enthusiasm to sustain class engagement which can influence pupils' PL experiences.

However, to date, few studies have discussed teacher experiences on run/walk intervention delivery and its impact on perceived pupil's PL. Therefore, the aims of this qualitative research study were to explore teachers' perspectives of Barnet's Golden Kilometre and its perceived impact on pupil experiences and PL development and secondly to identify how the implementation of the intervention could influence pupil PL experiences. The findings of this study can provide an understanding of intervention participation and PL engagement for pupils by considering teacher perception on daily implementation and outcomes which cannot be reported through other methods.

7.2 Methods

The study followed the Consolidated criteria for reporting qualitative research (COREQ) checklist (Tong *et al.,* 2007) (Appendix J) and ethical approval was granted by the institutional ethics committee (Appendix C).

7.2.1 Research design

Phenological qualitative methods were used to identify perceptions and lived experiences of Barnet's Golden Kilometre.

7.2.2 Participant selection

A purposive sample strategy was employed to recruit participants for the study. Teachers from primary schools involved in Barnet's Golden Kilometre research project and who taught pupils in school years three – six were invited for interview as these were the school year groups currently completing the intervention.

The study took an inductive approach to research as determining the sample size or 'sample size saturation' prior to the data collection process could have been problematic and may have limited the exploration of phenomena (Sim *et al.,* 2018; Braun and Clarke, 2021). In line with Sim *et al.* (2018) and Braun & Clarke, (2021), a provisional 'upper sample size' was considered prior to the study commencing that may have generated adequate data for the study aims. Across the two schools, the number of staffs involved in the dissemination of the intervention or engaged with participating pupils was totalled. In the schools, there were PE leads (n=2), years three - six class teachers (n=10) and teaching assistants (~ two per day in each school). Teaching assistants were approached for recruitment but declined due to staff restrictions (this included being needed for one to one pupil care throughout the school day and on temporary agency work) so were removed from the potential sample. Therefore, the final upper sample size was determined to be 12 teachers that would be applicable for interviewing. Between September – December 2021, 12 teachers were approached after an intervention launch assembly to take part in the study. The member of staff in charge of the intervention launch also received information sheets and email templates to share with participants for recruitment. In total, five out of 12 teachers agreed to participate, two participants were unable to participate due to being on temporary staff placement in the school and a further five were unable to participate due to timetable and workload commitments. All participants were provided with information sheets and signed consent forms before proceeding with the interviews (See appendix K).

Participants included three female and two male teachers, of which two were PE leads (One male and one female), one from each school involved and both in charge of Barnet's Golden

Kilometre research project at their school. The remaining participants included one year three class teacher, year five class teacher and the Head of Learning/ year two and four teachers. Participant teaching experience ranged from two -15 years.

To identify if the responses and themes that arose in the analysis were specific to any potential confounding characteristics (classes taught, sex, years of experience, school) the codes were labelled by colour for their participating school and included a summary of the baseline statistics matching to the participant ID code. The themes were summarised and presented in a thematic table and results and discussion (See appendix L).

7.2.3 Protocol

McNamara (1999) General guidelines for conducting interviews, eight steps for preparation were followed for the interviews. The steps are explained in detail throughout the research design protocol. To summarise the steps :1) selecting a setting suitable for the participants to limit distraction and ensure participants are comfortable. 2) Explain the purpose of the interviews to participants including the aims of the research project and interviewer's role. 3) The terms of confidentiality were explained prior to all interviews. 4) The interviewer (SA) explained the format of the interviews and highlighted that questions can be asked throughout or there will be additional opportunities at the end of the discussions. 5) The interviewer (SA) indicated how long the interviews were. 6) All participants were provided with contact details for the interviewer (SA) and school PE lead if they had questions after the interviews. 7) Before all interviews commenced all participants were asked if they had any final questions. 8) All interviews were audio recorded and notes were taken throughout.

7.2.4 Interview guides

Semi-structured guides were developed using pre-planned guides consisting of open-ended questions and prompts (Sparkes and Smith, 2014). The guides were not used in order nor in the same structure at each interview to allow participants to reflect on their thoughts and feelings regarding the topics of discussion (Sparkes and Smith, 2014; Green J, 2018). This method is preferred to structured guides which do not allow the participants to control some elements of discussion limiting their expression and opinions shared (Sparkes and Smith, 2014; Green J, 2018). Unstructured guides and in-depth interviews can also be difficult to analyse and may not produce data reflective of the study aims (Sparkes and Smith, 2014). Through semi-structured guides participants will be able reflect and discuss their experiences and could therefore provide deeper reflection of PL journeys.

Phenological questions should seek to elicit detailed accounts of participants' experiences (Jones, Brown and Holloway, 2013). The phrasing of the questions focused on being open-ended to seek rich accounts of experiences (Jones, Brown and Holloway, 2013; Green J, 2018). This included language such as "Tell me how…" "Please describe…" and were based on published PL and school-based intervention guides and guidelines of questions published in Whiteheads PL Across the world (2019) (Whitehead, 2001; Stanec and Murray-Orr, 2011; Tristani, 2014; Malden and Doi, 2019; Whitehead, 2019; Marchant *et al.*, 2020). Teachers were provided with the definition of PL and asked to reflect on the concept and how the intervention could impact pupils' experiences. The interview guides aimed to determine how schools deliver the initiative and how it is perceived by teachers including perceived benefits for pupils participating and their PL experiences when completing the intervention (See full guide in appendix M).

7.2.4.1 Piloting

The question guides were designed by one researcher (SA) and reviewed by a member of the research team (ES). One teacher participated in the pilot interview during which prompts/ probing questions were adjusted for depth in discussion. The revised guide was rehearsed again before the start of each data collection point. The piloted interview was not included in the final study sample size.

7.2.5 Reflexivity statement

The researcher (SA) was conducting studies two and three as part of a PhD funded project in partnership with Public Health Barnet who designed and rolled out Barnet's Golden Kilometre intervention. The author's research interests also include the fields of PL, PA and school-based interventions. SA acted as the interviewer in both studies (BSc). The researcher is a female student with experience in conducting interviews and focus groups with a range of participants relating to youth PA over two years, and who had undertaken training in qualitative data collection and analysis through the Middlesex University Research Student Workshops (Up to seven hours in workshops and seminars between 2020-2022). The researcher was also mentored throughout the process by the supervisory team (supervised by LW, ES, EE).

The author acknowledges that the partnership with the project funders and research engagement could bring certain biases to the study including initial expectations of the intervention's success. The initial expectations could have influenced the data collection and analysis through oversight of potential negative outcomes of research and favouring or addressing only the positive findings. However, efforts were made to ensure objectivity within the research and limit these potential biases. This included continual engagement in reflexivity and sense checking throughout each study (Braun and Clarke, 2021).

Throughout the process it began to emerge that the researcher's opinion on the matter also changed, potentially as a result of the data collection and interpretation. At the start of the research project after discussing the launch of the intervention the researcher's opinion was that the intervention would be a likely success. However, throughout the implementation of the initiative and having engaged with participants (including staff and pupils) the researchers opinion changed as limitations were emerging in the project, such as bad weather days limiting participation outdoors and mixed perceptions on the design. By immersing in the data, it became clear the opinion had shifted from the perspective that the intervention would be successful for all.

The researchers interest also changed throughout the implementation of the intervention and data collection stages. At the early stages of the project, SA was interested in recruiting schools across the borough and encouraging as many Head Teachers to consider taking part in the intervention. However, following the closure of schools and the pandemic the project interests shifted to focus on how the data collection could commence on a smaller scale and with closer attention being paid to social distancing measures. Once schools reopened and the baseline data collection could commence, the researcher's interests were focused on the schools already recruited (n= two) and how to sustain their participation in the project and intervention rather than recruiting more schools. This focus was maintained throughout the research project in which SA maintained a close relationship and communication with the two schools in order to ensure the data collection was representative of the intervention experiences.

In line with the recommendations of Given (2008) (prolonged engagement), attention was made to build relationships with participants prior to the data collection commencing for all studies. All potential participants (school pupils and teachers) were made aware that the research project was taking part in their school as part of a borough wide initiative to assess

Barnet's Golden Kilometre intervention and its ability to encourage PA and PL in primary school pupils. The researcher visited the gatekeeper schools to host assemblies on the research project, meet school staff and pupils and answer any questions staff or children had on the project. The researcher attended Barnet Public Health meetings which included school representatives and members of Public Health involved in the PhD funding to provide updates on the research project as a whole and discuss future directions with schools.

The researcher had a pragmatic approach to research design. Pragmatism is described by Maarouf (2019) citing the work of Cameron (2011) to be focused on "solving practical problems" rather than on assumptions of knowledge and research is instead "action-oriented" (p5). Pragmatism supports the mixed methods paradigm through an umbrella view on research (Creswell and Plano Clark, 2018; Maarouf, 2019). As such, it is also recommended for convergent research design when mixed methods are used (Creswell and Plano Clark, 2018). PL is a holistic concept but as a pragmatist, it is recognised that raw data and accounting for research is needed for comparability and policy design. PL is a combination of object and subjective measures which should be considered in the capture of pupil experiences and PA participation.

The pragmatic approach is well suited to Barnet's Golden Kilometre intervention where school-based research is often limited on time and resources needed for intervention evaluation. PL research based on pragmatism recommends a measurements-approach to PL analysis in which the domains and their measurements most suited to the research context are the focused outcomes of the research due to the challenges surrounding one form of PL assessment (Green *et al.,* 2018; Barnett *et al.,* 2019; Arbour-Nicitopoulos *et al.,* 2023). Therefore, adopting the pragmatic approach was determined to be an efficient method to provide intervention-specific feedback that can best inform PA and Public Health policy development and PL practise for Barnet's Golden Kilometre.

The epistemological stance taken in studies two and three was also that described by phenomenology (Willig, 2013). Broadly related to that of contextualism, a phenomenological approach considers the lived-experiences of the persons in the study. Unlike positivism which seeks to generate factual knowledge about reality, phenomenology proposes experiences of reality are unique to the individual (Braun and Clarke, 2021).The philosophy is one of the three philosophical foundations of the PL concept which closely aligns with existentialism also noted in the concept (Husserl, 2013; Whitehead, 2001).

7.2.6 Setting

After giving written and a secondary verbal consent, interviews were conducted on school grounds in a comfortable environment, this was either in the teachers usual teaching classroom or staff office. The interviewer (SA) explained the purpose of the interviews including aims of the research, confidentiality and format of the discussion itself (time, contact, and questions). Participants were then asked if they had questions and final verbal consent was given. Following the additional explanation and opportunity for questions, at the time of the interview's participants were aware of the researchers motives for doing the research and were aware what their consent entailed. The relationship between the researcher and participants is explained further in the reflexivity statement and participant selection in 5.2. Only the participant and lead researcher were present during the interviews. Data collection was conducted during school hours and between October – November 2022 in two primary schools.

In order to consider any potential differences between the schools involved in the intervention and how this may influence the study's findings, *Table 21* summarises the school characteristics including school capacity, eligibility for free school meal and intervention

implementation. It is recognised that there is a difference between schools in terms of access to facilities and resources such as playground space, also eligibility for free school meals and capacity which may influence how the intervention is implemented within the setting. To understand if the responses and themes that identified were school specific, the results were colour coded as part of analysis: S1 is coded in red and S2 coded in blue and are discussed in further detail in the studies.

Table 21: Summary of school characteristics

School	Location	School capacity (Percentage % eligible for free school meals)	Year groups completing the intervention	School facilities	Intervention daily completion
S1	suburban	390 (34.2%)	Years 3-6	No access to greenspace within the school grounds but access to local parks	Pupils completed by running laps of the playground
S2	semi-rural area	120 (0%)	Years 3 and 4	No access to greenspace within the school grounds but access to local parks	Pupils completed by running lengths of the playground

7.2.7 Data collection and analysis

Inductive thematic analysis was performed using the Braun and Clarke (2006) six phases of analysis (Braun and Clarke, 2006; Braun and Clarke, 2022). The method is determined to be 'data-driven' and provide a platform for participants to share their lived experiences without confirming or reviewing theory-like deductive approaches (Braun and Clarke, 2022). This approach was used to ensure the data was representative of the participants rather than being influenced by theory or the research hypothesis and is said to support the rich accounts of individuals over quantity of data, similar to that of phenomenology (Gill, 2020). Inductive thematic analysis is described by Braun and Clarke (2019) as a method for organising patterns of meaning which can be themed across data and allow readers to make sense of the experiences. This approach is known for its flexibility in design and can be used to identify patterns in participant experiences, behaviours and practise helping to understand how participants feel, think and do (Clarke and Braun, 2013; Clarke and Braun, 2017). Adopting this method is thought to be more in-tune with the holistic nature of PL which notes the unique and individualised nature of participant experiences. The process of coding the data in studies two and three was conducted as explained by Braun & Clarke (2006), in which SA coded the data without trying to fit the data into predetermined frameworks such as the domains of PL (physical, affective and cognitive). Although it is noted that it is impossible for the researcher (SA) to free themselves of their theoretical beliefs and understandings which is noted throughout the methods of these studies (see reflexivity and trustworthiness) (Braun and Clarke, 2006; Clarke and Braun, 2013; Clarke and Braun, 2017). However, thematic analysis in general is noted to be suited to a variety of different data types large or small, homogenous and heterogenous samples and was determined to be the suitable method for the variation of samples and sizes across the study (Clarke and Braun, 2013).

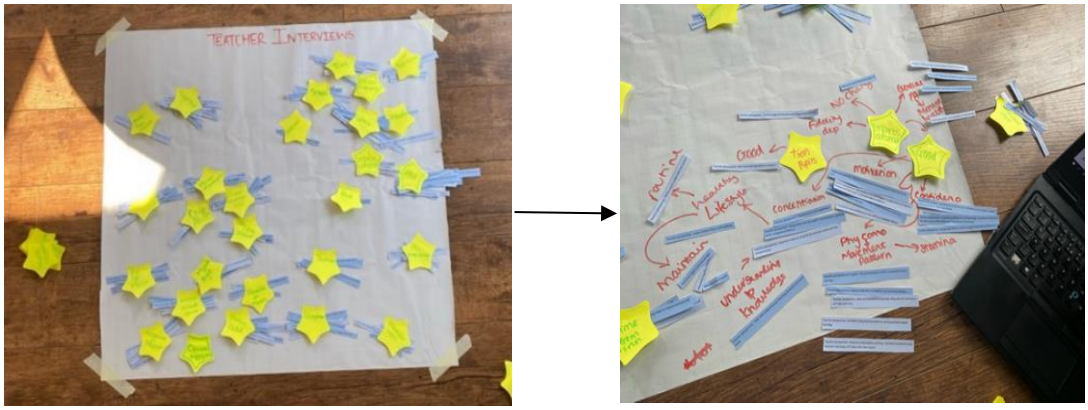

Figure 20: Organising codes into themes for teacher interviews

Familiarisation with the data was conducted by SA. This included transcription, repeat reading of the transcriptions and noting initial ideas for codes. Initial codes were made by coding the entire data set and organising the data into meaningful groups based on themes in interview guides. Codes were defined as stated by Braun & Clarke (2022) as outputs that "capture an analytic insight from researcher's systematic engagement with their data" (pp.284). Concentre codes were identified as factual information and conceptual codes as explanations of meaning/ experiences (Braun and Clarke, 2022). As part of the reflexive process, codes were refined and transcripts revised throughout data analysis. SA then independently searched for themes by collating codes and relevant data. The codes were printed and grouped by hand to help visualise codes into themes, Figure 20: Organising codes into themes for teacher interviews shows images of the codes being organised. To respect the inductive approach, the researcher (SA) did not engage in literature relevant to the research field (Topics relating to PL, PA and of qualitative design) in the early stages of analysis to prevent the process being driven by the theoretical interests or preconceptions of the researchers (Braun and Clarke, 2006). Two researchers from the research team participated in sense checking throughout (EE and LW) to provide alternative perspectives and refine codes and themes, this was a continual process that occurred throughout analysis (Braun and Clarke, 2022). This method is also referred to by Smith and McGannon (2018) as 'critical friends' (Smith and McGannon, 2018; McGannon *et al.,* 2021). The role of critical friends is to encourage reflexivity by exploring interpretations and recognising the varied perspectives of the data and therefore enhancing the analysis process (Smith and McGannon, 2018; McGannon *et al.,* 2021). The three research members continued to review and define themes before interpretation began and coding trees were created at each stage for both studies (See appendix N). NVivo Wise-mapping software was used to establish general dimensions and subsequent themes in the data.

Following the qualitative work of Virginia Braun and Victoria Clarke on the adapted thematic analysis methods in Braun and Clarke (2006) and determining of saturation in thematic analysis (Braun and Clarke, 2021), the study did not employ the concept of data saturation and rather determined upper sample size limits based on participation sample available that would generate acceptable data to answer the research aims (Sim *et al.,* 2018; Braun and Clarke, 2021). In terms of individual interview saturation or 'termination', these were determined as the point where no new information relative to the aims of the study were discussed (Guest, Namey and Chen, 2020).

All interviews were audio-recorded using a Dictaphone (m = 19 mins, range = 12 mins). One researcher (SA) conducted all interviews and transcribed them verbatim in Microsoft Word. Throughout the interview process, SA kept field notes on a university laptop and short reflections were written after each to enhance reflexivity and develop interview technique. Between each group SA then engaged in reflexivity to develop their interviewing technique and consider their own bias in the research process.

7.2.7.1 Trustworthiness

Table 22: Study Three Lincoln and Guba's 1985 4 Step Criteria of Trustworthiness

Trustworthiness	How	Completed by
Credibility	- Engage in school environment to build trust and rapport with participants	SA participated in intervention launch day and assembly at each school as well as taking part in informal staff introduction meetings and providing information sheets with contact information throughout
	- Peer debriefing and member reflection	SA participated in member reflection and peer debriefing. Participants were provided final reports to clarify interpretations and then given a written summary.
Dependability	- Inquire Audit	All data was examined by two researchers throughout (LW and EE)
Confirmability	- Audit trail	An audit trail was kept by SA to provide materials for the sense checking by LW and EE. The audit trail included: raw data, process notes and development information
	- Reflexivity	SA engaged in reflexivity through and kept a reflexive journal.
Transferability	- Thick descriptions	Thick descriptions were used to create transferability in the data.

To enhance trustworthiness in the research studies, Lincoln and Guba's (1985) four step criteria of trustworthiness was followed. The work of Lincoln and Guba (1985) is much-regarded and referred to by many for ensuring quality in qualitative research (Loh and Dahesihsari, 2013; Raskind *et al.,* 2019). In summary, to ensure credibility, efforts were made to engage in the school environment to build trust and rapport with participants. The researcher participated in an intervention launch day and assembly at each school as well as taking part in informal staff introduction meetings and providing information sheets with contact information throughout (5.2). The researcher (SA) also participated in member reflection and peer debriefing throughout. The researcher provided a final report to clarify interpretations and then a written summary to participants in the teacher interviews. All data was examined by two researchers throughout and an audit trail kept by SA to provide materials for the sense checking by LW and EE. The audit trail included: raw data, process notes and development information. Throughout the process the researcher (SA) engaged in reflexivity and kept a reflexive journal in attempts to acknowledge and limit the researcher's effect on the data. Finally, thick descriptions were used to create transferability in the data. This included providing rich descriptions of the research, such as the research design, participant selection and setting of data collection and including many participant perspectives in themes to account for shared experiences.

Qualitative credibility and trustworthiness research have recommended identifying the research paradigms prior to selecting the criteria of trustworthiness to limit bias in data selection. The use of Lincoln and Guba's (1985) 4 step criteria widely applicable across data sources and through reflection is thought to apply to different fields/ paradigms (Cohen and

Crabtree, 2008; Bird, 2019). However, the criteria have been criticised for their ontological and epistemological contractions in qualitative studies, so it is recommended that research is flexible in the list of criteria to adhere to the contextual and situational factors of the study (Bird, 2019). Therefore, to acknowledge the difference in research design and evaluate the approaches employed, the criteria and implementation is noted in *Table 22* (Bird, 2019). More radical methods of qualitative research are thought to not be suited to health-related research as they limit evaluation criteria (Cohen and Crabtree, 2008). Rather 'generic' tools are thought to encourage reflection in research and are suited to non-qualitative experts (Cohen and Crabtree, 2008; Bird, 2019).

7.3 Results

Six themes were identified: perceived experiences, perceived outcomes of participation, teacher attitudes, fidelity/adherence, logistics, and intervention suggestions.

7.3.1 Perceived experiences

Overall teachers reported mixed experiences for pupils involved and five sub themes were identified: in/lack of motivation, pupil ability, pupil age, gender differences and taking part with friends.

Teachers mentioned that a pupil's motivation to take part would often influence their participation and experiences of the intervention. This was reported in both positive and negative lights and grouped as a subcategory 'interest in/lack of motivation'. Children's motivation to take part was often associated with pupil's enjoyment levels. Specifically, teachers observed how the initial roll out of the research project influenced pupils' motivation.

"…. the fact we had a whole school assembly had a massive impact, the children were really keen and buzzing and you know it was and the fact that we had an official launching ceremony technically helped and you know the little flags" (p2)

Teachers reported that the intensity in which the intervention was completed (self-select nature) would vary based on sex. Boys tended to be more competitive than girls, choosing to sprint or run the kilometre or even cheat to try to finish before their peers. Whereas girls would take a varied pace (walk, jog and run) and were more likely to cheer each other on than cheat or try to finish first.

"…the boys you know are very competitive so in the beginning they always sprint even if we explain they should be jogging and pacing themselves but anyway they sprint for 2/3 laps then they get really really tired…. Some girls are a little more sensible and some boys that have been jogging slowly and pushing themselves" (p2)

Taking part with friends was seen to influence participants willingness to take part, PE leads noted that pupils were less likely to participate if their friends were present. Social setting appeared to aggravate competitiveness, which would lead to cheating in intervention participation as pupils wanted to be the first back.

"they often lose interest if it's not with everyone else and they're like 'oh but my friend in the other year isn't doing it…I feel like at that age a lot of them are just interested in friends like 'oh you're doing it, maybe I should as well" (p5)

7.3.2 Perceived outcomes of participation

Following the introduction of the IPLA definition of PL teachers were then asked what perceived outcomes of pupil's experiences as a result of participating. In total, six different sub categories were developed, these included outcomes both relating to PL, PA and other health related measures and were grouped as: physical related outcomes, concentration, healthy lifestyle, knowledge and understanding, confidence and motivation and general PA benefits.

Outcomes related to confidence and motivation were most commonly mentioned and featured in all interviews. Teachers explained that completing the kilometre would improve pupil's confidence and self-belief that they can complete the distance and in-turn motivate pupils to achieve a kilometre and continue to challenge themselves with the self-selected pace.

"Well I think it would help their motivation and confidence in their own abilities to sort of run a set distance because they might initially start off by think a kilometre that's just miles I

can possibly run that, then pretty soon they'll realise exactly how far it is and then suddenly realise too I did it today and it wasn't as hard as I thought, maybe I could run two kilometres by this time next week" (p3)

Teachers also noted that the kilometre would help pupils to build confidence in their own physical ability in relation to their stamina and running technique. One teacher mentioned that the self-selecting nature of the intervention enabled pupils to work at their own level without anyone watching.

"...the run is quite good because there is no one is really looking at them. Everyone's sort of taking part and everyone's in their own little bubble and they're not, no one's looking at them. The focus isn't on them so their able to just sort of comfortably do it and I saw some I can definitely say some children did develop their confidence in this area." (p1)

Physical related outcomes were also commonly reported and featured in all interviews, elements such as stamina, physical competence and motor control/ coordination were all suggested to improve as a result of participating in the intervention.

"...it definitely does build their physical competence, even if it's just their stamina with running and being able to maintain that" (p1)

Interestingly, one teacher reported general PA benefits and did not associate the outcomes directly to the intervention and instead discussed how any forms of activity would result in the above benefits.

"If they can do anything for a year you're bound to start seeing results and improvement" (p4)

7.3.3 Teacher attitudes

Three subcategories were found within teacher attitudes: teacher PL, teachers past negative experiences of PA and punishment.

When discussing perceived outcomes and experiences, teachers were asked to reflect on the concept of PL and how the intervention may or may not impact pupils' journeys. All teachers were introduced to the IPLA definition in the interview and asked if they had any questions regarding the concept. Overall, teachers reported that the definition seemed straightforward and were respective to the concept and its underpinning domains. Only one PE lead was familiar with the term of PL prior to the interview and all other teachers had not heard of the concept before but most suggested it would be associated with physical demand.

"I guess learning about fitness or something along those lines." (p4)

Throughout the interview's teachers were often reflecting on their own past experiences of PE and PE. Often, non-specialist PE teachers reflected negatively on their own experiences of PA, when discussing pupils' experiences of the intervention it was suggested that the kilometre aspect may not suit all pupils and in turn could put some off rather than benefit performance.

"I think they'll be put off trying certain running activities because they are always the last and always the slowest… Speaking as someone who was always picked last for netball ha-ha" (p4)

"Well you know just thinking about when I was a kid at school and just having to do something in PE that you don't want to do can kind of demoralise you a little bit and if you think you are not very good at it and perhaps not fit enough then you're going to find it hard to keep going.

In the old days we didn't have teachers to encourage us ha-ha which obviously doesn't happen now ha-ha. Erm but you know a lot of PE in those days was kind of abusive and demoralising for kids so even now they can see other people doing it better than them so that can always set people back a little bit and impact their self- confidence." (p3)

7.3.4 Fidelity/ Adherence

Four sub themes were identified within fidelity/ adherences. These were: why the school opted to take part, variation in distance and/or pace, frequency and cheating.

Both schools aimed to follow the same principles and protocol for the intervention but the initial reasoning for the uptake of the intervention varied between the two (*Table 22*).

"No one does anything other than me (PE lead) so yeh a bit. I mean if I asked them to help I'm sure they would but I don't need any. Other than the headteacher saying 'PE lead, are you doing this?' and I go 'yep'" (p5)

The distance and/or pace of the intervention between classes and schools varied. One participant noted that the focus of the intervention was on the distance covered and not the intensity at which it was completed. Another class teacher instead noted that the distance the class covered varied in order to tailor to children's abilities and therefore the full distance (1km) may not have been covered.

"Erm when we started it off we did 10 laps but it became too much so we reduce the number of laps the first week then started to build back up to 10… We do have some children that will only do 3 laps but they are meeting their set target as last week they may have only been walking it. The majority of children do 8" (p1)

Interestingly, a PE lead shared that pupils would not want to do the intervention if they thought it was just running, the self-select nature appeals to more pupils and was more enjoyable than 'just running'. The teacher's behaviour in providing these instructions was suggested to influence pupil autonomy.

"It's just trying to make it fun in a way that you're just not running for running's sake erm like if I tell them to run they won't want to run. But if I say you can run, you can walk it, you can jog it but just need to get it done then they definitely enjoy it more" (p5)

Cheating was believed to be a problem that meant participants were not completing the full kilometre distance each time. The causes of cheating varied but were often associated with pupil's motivation, pupils were also responsible for counting the number of laps in S2 so teachers questioned the accuracy of self-reported numbers from the children.

"someone was leading it but I think the children were counting their own…I'd love to know if what the children counted and they actually ran were the same though!" (p4)

Neither schools had a route or markings for the intervention which was perceived to contribute to completion. Lack of route markings were suggested to be a potential mediator for cheating.

Teachers also mentioned that the frequency of the intervention often varied from the intended Five times per week. Instead teachers reported that they were aiming but not always for three-four times per week, this was not measured in any school and reported to not be consistent each week although it was clear that Five times per week was more than often not met. Both schools expressed similar thoughts on frequency and mentioned the curricular restrictions affect the frequency of completion.

"Err we be aiming for at least 4 times… Erm we have been aiming but not always." *(p2)*

7.3.5 Logistics

Within this theme, four subcategories arose that were: staff, time, space and weather and the intervention being simple to implement.

Often when frequency of participation was raised, teachers mentioned that the classes may miss completing the intervention on days when the usual class teachers were not present and the staff in place were not aware. This was mentioned to occur most often when classes were shared by different teachers or supply staff were stepping in.

"Yeh if they have different class teachers in the class on different days if they are not aware of the routine you know sometimes erm Yeh it happens to skip it" *(p2)*

Both schools mentioned an optimum time for completing the intervention would be in the afternoon or straight after play. This was because of pupil attitudes, it was explained that pupils may be less likely to drop out, focus more in class and take their time in the intervention.

"Sometimes children need to have that run destress, burn off the energy and come back into class. So, it can positively impact their learning in class as well" *(p1)*

Space and weather were mentioned to be two of the main hindrances in intervention participation. For the school that had a small playground area, space was a limitation in completing the intervention and pupils were having to run several lengths of the playground.

"…In an ideal world, it would be very lovely if they could go out and run around the block but space/staffing for this is tricky" *(p4)*

Often, if there was bad weather, completing the intervention outside was unrealistic for both schools due to unsuitable surfaces e.g. playground slippery or flooded and thus unsafe to use. It appeared that poor weather conditions would aggravate the barrier of limiting space as the included schools do have additional/ suitable facilities to use.

"It's sometimes our playground is very quiet slippy so it can get quite dangerous. So, if it's too wet on the floor or icy we'll avoid" *(p5)*

The lack of instruction and resources needed to implement the intervention meant that staff knew how to roll out the programme and it was simple to model so children were able to complete it themselves with little guidance and teaching time.

"It's pretty straight forward I think" *(p4)*

7.3.6 Intervention suggestions

Teachers were asked at the end of the interview if they had any suggestions or ideas on how to adapt the intervention for pupils. The ideas discussed were grouped into three subcategories: route, reward systems and not just running.

Having a clear route to complete the kilometre including start and finish lines and dedicated playground space was raised by both PE leads and class teachers. It was suggested that having a clear route would help pupils to stay on track, prevent boredom and visualise the end in both schools. The school with less space mentioned that the small school playground may make the kilometre seem boring for some pupils and instead having a clear route or park/ bigger space to run around would be more beneficial.

"perhaps those markings or little start and finish lines maybe as signs would defiantly be beneficial" *(p2)*

Allowing children to monitor their progress and also providing prizes or rewards such as stickers when children achieve certain milestones was suggested to help with motivation and also make the intervention a more meaningful experience for children.

"…if children were able to track their run and keep record like today I've done this much and tomorrow I've been able to exceed that. Maybe if children were able to see and track how much they were doing it might motivate them all a little more. And it might make it more meaningful for them." (p1)

Not just running was also suggested throughout to prevent boredom and increase enjoyment for those pupils that do not like the idea of running. One PE teacher discussed altering the course to include more obstacles or challenges throughout.

"…it's kind of like not just running but having like doing things whilst running if that makes sense?" (p5)

7.4 Discussion

This study presented teachers' perceptions of Barnet's Golden Kilometre intervention and their perceived pupils' PL experiences. The aims were to explore how teachers perceived the intervention to contribute to elements of pupils PL and examine how the implementation of the intervention contributed to these impacts. Overall, the study identified mixed teacher perceptions, in which teachers liked the design and self-select nature as they felt it would help pupils perceived physical competence, but felt the intervention experiences would vary for pupils based on their current PA and PL capabilities. The discussion highlights the importance of a 'no one size fits all approach' to implementation and PL related experiences.

The self-selected pace of the intervention was thought to be a key contributor to developing pupils' motivation and confidence in their own abilities. Teachers expressed how the self-select nature allowed children to work at their own level and challenge themselves without worrying about others watching. One attribute for the development in the affective domain of PL is establishing confidence in one's own ability (Whitehead, 2019). Existing research on school-based run/walk programmes has suggested that the self-select design and participation alongside classmates could promote pupil autonomy and encourage PL progression through increased motivation and confidence in pupil's perceived ability (Chalkley *et al.,* 2020b; Sherar *et al.,* 2020). Whitehead (2019) states individuals need confidence to progress in their learning and assurance the experience will be rewarding to engage in PA. Similarly, teachers in this study suggested that if pupils were able to perceive the intervention as self-select and non-competitive they would be likely to progress within their PL capabilities as they can focus on their own performance. Children would therefore be motivated to persevere through challenges and confident in their ability to progress which was thought to increase PA participation and to reduce the chance of dropout in the intervention (Whitehead, 2019).

However, teachers raised concerns surrounding pupils' experiences and potential PL development if the interventions self-select pace was not highlighted. One teacher added that pupils may feel less motivated to take part and perceive the intervention as 'competition' if they were not clear on the self-referenced nature of the design. This in turn was raised as a concern for teachers as it would create negative PA experiences as pupils would be more likely to 'give up' if they thought it was competition and/or they would not win. One theory that can be used to understand pupils' motivation in PA settings is self-determination theory (SDT) (Ryan and Deci, 2000). SDT specifies six forms of motivation with intrinsic being the most autonomous form of motivation whereby the individual is active by choice and inherent interest (Sebire *et al.,* 2013; Ryan and Deci, 2000). Child research shows autonomous motivation is positively associated with an increased PA and SDT proposes three basic needs for its progression (Sebire *et al.,* 2013; Ryan and Deci, 2000). These are 'autonomy' (perceived ability to have choice and input), 'relatedness' (perceived social connection and support from significant others) and 'competence' (perceived ability to meet the demands of the environment) (Ryan and Deci, 2000). Teachers highlighted that if pupils were to perceive the intervention as competition coupled with initial doubt of their own physical capabilities it could have potentially damaging impacts on pupil motivation and confidence (affective). This was noted in particular for pupils who would perceive themselves to be 'slower' or physically 'unfit' compared to their peers. Run/walk research has also highlighted similar, in which studies have recommended that in order for these interventions to encourage positive pupil experiences the way teachers and schools implement the intervention is important and should enable choice (Chalkley *et al.,* 2018b; Ryde *et al.,* 2018; Malden and Doi, 2019). These study findings reported that children would be motivated to challenge themselves to complete the activity (such as varying from walk to run) when they see and feel themselves improving (stamina development) and increase their self-belief when they participate at self-selected

pace. However, if pupils were to perceive the intervention as competition or doubt their own physical capabilities they would lack motivation and confidence to take part increasing the likelihood of drop-out. It would be worthwhile for future research to identify how pupils perceived the intervention to determine if pupils are able to articulate the self-select design. These findings may help to provide further insight into how pupils PL can be protected through preventing potential negative PA experiences and instead developed through increased motivation and confidence in their physical capability.

The approach to intervention implementation can play a key role in determining if the schools are following intervention aims and pupils perceive the intervention as intended (Nathan *et al.,* 2018). Run/walk intervention research shows that teachers who have autonomy over delivery and implementation themselves have better intervention adherence and pupil experiences (Brustio *et al.,* 2018; Chalkley *et al.,* 2018; Ryde *et al.,* 2018; Malden and Doi, 2019). Our findings agree and highlight the importance of effective teacher delivery in facilitating positive pupil experiences and supporting motivational processes. For example, teachers reported that without support and autonomy focused motivation, some pupils could have negative experiences when completing the intervention. Teachers expressed that a more standardised approach to delivery would 'work for some but not others' and as noted above, some children may be put off by the activity if they were to perceive it as a competition. Teachers did note several positive characteristics that worked for the intervention implementation and promoted pupil autonomy, these were: highlighting the importance of self-selected pace and freedom of movement, taking part with friends and the flexibility and simplicity in delivery (for pupils and staff). Chalkley *et al.* (2018b) has highlighted that interventions like MK are adjusted by schools to suit their school and pupil needs. The authors noted a 'no 'one size fits all'' approach would be suitable for promoting pupil motivation and engagement (Chalkley *et al.,* 2018b).

Similarly, the 'no one size fits all approach' fits the findings of this study (Chalkley *et al.,* 2018b). One class teacher noted that for their class, the kilometre distance would be too challenging and rather they would need to 'build up' to the distance covered over the weeks/ months of taking part. According to Whitehead (2019), an individual making progress in their PL is aware of the demands of PA and how to improve their performance. If pupils are aware of the challenges of participating and they are able to adapt the intervention to suit their needs, such as building up to 1km distance, they may progress within their PL by developing self-awareness and knowledge on improving their own physical capabilities. This would then increase the likelihood of prolonged PA engagement as children will also be likely to overcome future obstacles to participation (Whitehead, 2019). However, to support pupils with their PL progression, schools and teachers would need to adopt the 'no one size fits all' approach and allow flexibility in the intervention participation to support the needs of their pupils in overcoming challenges.

In young children, teacher engagement and peer support are believed to influence motivation and PA participation. Research shows social contextual factors can influence autonomous behaviour (Sebire *et al.,* 2013; Ryan and Deci, 2000). This study along with other run/walk interventions have confirmed the importance pupil and staff influence on participation (Malden and Doi, 2019; Chalkley *et al.,* 2020a). Teachers reported that their encouragement (teacher behaviour) in this scenario would be key to participation and one teacher highlighted the importance of conveying the message of the self-select nature again to avoid pupils 'running for running's sake' or leading to competition in performance. Teachers reported that girls in particular were seen to provide one another with social support whilst boys were more likely to challenge each other. One teacher reported how younger year groups (years three-four) were keener to take part without guidance compared to older years (five-six) who

required greater teacher support throughout participation. However, some teachers were concerned that these intervention experiences could be demoralising and negatively impact self-confidence if pupils perceive others to be better than them and 'finishing last' could put pupils off participation by encouraging dropping out or giving up. According to SDT, in a social context where these three needs are not met/supported it can result in a negative impact on intrinsic motivation (Ryan and Deci, 2000). Although, part of PL progression according to Whitehead (2019) notes that an individual is able to work independently and with others in both competitive and cooperative environments. These mixed findings have highlighted both potential positive and negative scenarios of intervention participation such as peer support or peer competition, although teachers are not able to reflect directly on how these scenarios may impact pupils' PL experiences, rather these are suggestions of potential scenarios. Therefore, future research would be needed with pupils who can provide lived experiences and account for how these may influence their PL journeys.

Interestingly, teachers' attitude towards the intervention and PE also appeared to coincide with their perceptions of pupil's experiences and outcomes. Two non-specialist teachers reflected on their own negative experiences of PE and PA as children in which they discussed how some pupils could feel similar emotions through negative experiences in the intervention. For example, one teacher stated how pupils may feel disheartened if they were to finish last; referring to their own experience of being picked last for physical activities as a child. Studies have indicated that personal school experiences of PE and PA can potentially affect teachers' attitudes and practises in the subject (Keating, Silverman and Kulinna, 2002; Morgan and Bourke, 2008; Elliot *et al.,* 2013). Teacher socialisation theory (Zeichner and Gore 1990) states how past positive and/or negative experiences in school can affect teacher's belief into their careers, which may indicate why those teachers who have negative experiences of PE as a child may feel the intervention could have similar impact on pupils now. Research that has looked into non-specialist teachers experiences in PE specifically have often found those that negative experiences of PE, lack confidence to teach the subject and can have negative views towards PA/PE engagement (Morgan and Bourke, 2008; Morgan *et al.,* 2019; Barber *et al.,* 2022).Given the influence that teachers have on pupil's PL and PA behaviours in school, teachers' past experiences on PE and PA participation could be a key contributing factor to how school-based interventions are implemented within schools (Morgan and Bourke, 2008; Morgan *et al.,* 2019; Barber *et al.,* 2022). As mentioned previously, Nathan *et al.* (2018) has noted teacher and staff support to be a key factor to schools continued participation in interventions. If teachers are to have negative perceptions of PE or PA themselves and concerns pupils may experience similar in partaking in the intervention classes would be less likely to sustain participation in interventions. Therefore, future research may benefit from identifying teacher buy-in and support for intervention participation.

One interesting finding that arose and could contribute to developing teacher buy-in is to consider how a teacher's own PL journey could influence their implementation of interventions. Research has suggested that teachers perceived PL influences their teaching behaviours in PE settings suggesting teachers who have no prior knowledge of PL combined with their own negative experiences of PE or PA (poor PL) may not be able to adequately support pupils PL experiences themselves (Choi *et al.,* 2020; Yıldızer and Munusturlar, 2022). However, teachers in the present study were able to reflect on their own past experiences and recognise the need for the intervention to be adapted to suit the abilities of their classes and prevent their class from experiencing similar. Understanding teachers own PL journeys and their own awareness of their PL position could enhance teacher efficacy in delivering interventions like Barnet's Golden Kilometre where implementation in a motivation supportive climate is key to pupil experiences (Keating, Silverman and Kulinna, 2002; Morgan and Bourke, 2008; Elliot *et al.,* 2013). Reflection and recognising one's own ability

can also lead to progression within the cognitive domain of PL (Whitehead, 2019). Whitehead (2019) states that identifying the essential qualities that influence performance is part of PL development at any age. If pupils and teachers are able to reflect and recognise the demands of the intervention and pupils are confident and motivated to progress in their physical abilities they would progress in their PL and therefore engage in PA through intervention participation. However, for this, teachers would need to encourage pupil reflection and support pupil's participation.

The final two themes that developed in the study were in relation to the implementation and daily completion of the intervention. These were reported as fidelity/adherence and logistics. Teachers expressed that finding time in the day with a busy workload impacted the time available to complete the intervention but the flexibility of the intervention design was useful. Similar studies on TDM (Harris, Milnes and Mountain, 2020) and school-based PA programmes (Naylor *et al.,* 2015) have also reported that teacher workload can be a barrier but have shown that adaptability can support implementation. Overall teachers from both schools in the study reported that their school still did not undertake the intervention every school day as planned but rather both schools completed the intervention 'on average' three/ four times per week. These findings appear to be consistent across school-based interventions aimed for five times completion per week (Brustio *et al.,* 2018; Ryde *et al.,* 2018; Brustio *et al.,* 2019; de Jonge *et al.,* 2020) which could suggest further consideration should be paid to the wider curriculum aims as time is a common limitation. Despite the decrease in daily completion, TDM research has shown three times completion per week to improve cardiovascular fitness (Brustio *et al.,* 2018; Brustio *et al.,* 2019; de Jonge *et al.,* 2020) which is thought to contribute to wider health benefits and potential PL progression (Ruiz-Ariza *et al.,* 2017; Marques *et al.,* 2018). However, there is no research considering if the psychological and/or qualitative reported benefits are similar when the intended five times per week completion is not met. A key perceived outcome of participation reported by teachers in this study was improved pupil motivation and self-confidence however, it is unclear if this pupil would experience these outcomes with three times participation per week. Therefore, further research is needed to clarify these findings with children and identify if these perceived outcomes are similar and when the intervention is completed less than five times per week.

Based on the findings of this study, we have proposed practical recommendations for schools to facilitate the implementation of the intervention. These are; to conduct an assembly for staff and pupils to drive the project and establish teachers' roles in participation, to identify the aims of the intervention to be self-selecting, non-competitive and highlight the potential unintended outcomes if this is not adhered to (e.g. likelihood of dropout and importance of PL development), and where possible, engage pupils and staff in the implementation and design of the intervention route and discuss the flexibility suit each class completed (e.g. time of day).

7.4.1 Study limitations

The recruitment for this study posed some challenges and at the time of interview, schools had just reopened after COVID-19 closure which is thought to have influenced recruitment due to increased timetable pressures from missed/online teaching. Many of the teachers and other school staff were also on temporary staff contracts at the school due to lack of full-time staff over the COVID-19 period so were unable to participate. Notwithstanding, this study recorded both positive and negative responses to the intervention so feel we have captured truth from the sample. Future research however, would benefit from recruiting across more schools and a range of participants including teaching assistants, head teachers and children to provide a deeper insight into the implementation of the intervention in different settings. Due to restriction in staff contracts and lower numbers of staff to pupil ratios in the recruited school this was not possible to this study.

Secondly, it is important to address that the research can never truly be inductive because of researcher training and beliefs. By engaging in reflexivity and sense checking throughout, attempts were made to limit researcher bias although it is recognised that this may still be present.

7.5 Summary of chapter and conclusion

This study aimed to explore teachers' perceptions of Barnet's Golden Kilometre intervention and its perceived impact on developing pupils' PL. Teachers enjoyed the flexibility and simplicity of design although the five times per week participation was found to be challenging due to curricular pressures and rather both schools aimed for three -four times per week instead. Overall, the self-select design was thought to be a key contributor to the development of PL for pupils in which it was thought to contribute to developing pupil motivation and confidence in their own physical ability and self-reflection on the improved performance. Teachers were concerned that if this was not conveyed, pupils would perceive the intervention to be a competition, and that this was thought to negatively impact pupils' experiences, particularly for those with poorer PL/ perceived competency initially. Combined with existing research a 'no one size fits all' approach was deemed to be important for school's participation as well as supporting pupils' PL development. The approach was suggested to allow flexibility in the intervention participation and support pupils in overcoming their personal challenges rather than feeling in competition or compared to their peers. However, further research is needed to determine the potential influence the intervention can have towards developing pupils' PL experiences. The findings of this study presented both potential positive and negative scenarios for pupils PA engagement and PL development depending how the intervention was perceived (e.g. competition being positive or negative). Interestingly, teachers own PA experiences and potential PL could impact their perception of the intervention and how it is implemented in practise and should be considered in future investigation. To confirm these findings and identify how the intervention is experienced by pupils, it is recommended that future research identifies how children account for their own lived experiences of the intervention and how it is implemented by teachers in their school.

Chapter Eight: Study Four

8.0 Discussing primary school pupils' experiences of Barnet's Golden kilometre

Abstract

Introduction: Study three identified teachers' perceptions of children's physical literacy (PL) experiences following participation in Barnet's Golden Kilometre. However, Self-reflection and accountability of lived experiences can only be sought through a child's own account and PL is reflecting on one's own physical performance and interactions with the environment. *Research aims:* To discuss how Barnet's Golden Kilometre has influenced children's perceived physical activity (PA) and PL experiences throughout the year and explore children's perceptions of Barnet's Golden Kilometre intervention. *Methods:* Two primary schools in the London Borough of Barnet participated in Barnet's Golden Kilometre intervention. A purposive sample strategy was employed to recruit pupils from years three – six. Focus groups were conducted at baseline and end of term one with each year group and an additional for mixed classes (n=29). Focus group guides aimed to investigate unique experiences of the intervention and perceived outcomes of participation to gain individualised understanding of experiences. Inductive thematic analysis was performed using the Braun and Clarke (2006) six phases of analysis. *Results:* Six themes developed relating to PA and health status can influence pupil's intervention perception and experiences, perceived outcomes of participation, sex differences, barriers to design and participation, enablers to daily participation, and intervention suggestions. *Discussion and conclusion:* Overall, it was found intervention experiences varied based on pupils initial PL. The results suggested pupils' initial PA and health status perceptions influenced their intervention experiences whereby participants with higher perceived physical competencies or healthier weight had more enjoyable intervention experiences and motivation to participate. Although, all pupils regardless of initial perceptions reported feeling fitter and healthier from daily activity and valued participating in regular PA at school. However, by the end of term found the intervention repetitive and boring. Pupils also did not enjoy feeling rushed to complete the distance by their teachers and need space and time to participate. Therefore, it is recommended that the intervention focuses on providing children with time, space to participate and vary type of activity style such as introducing a mixture of locomotor skills may be more worthwhile for longevity of participation and PL.

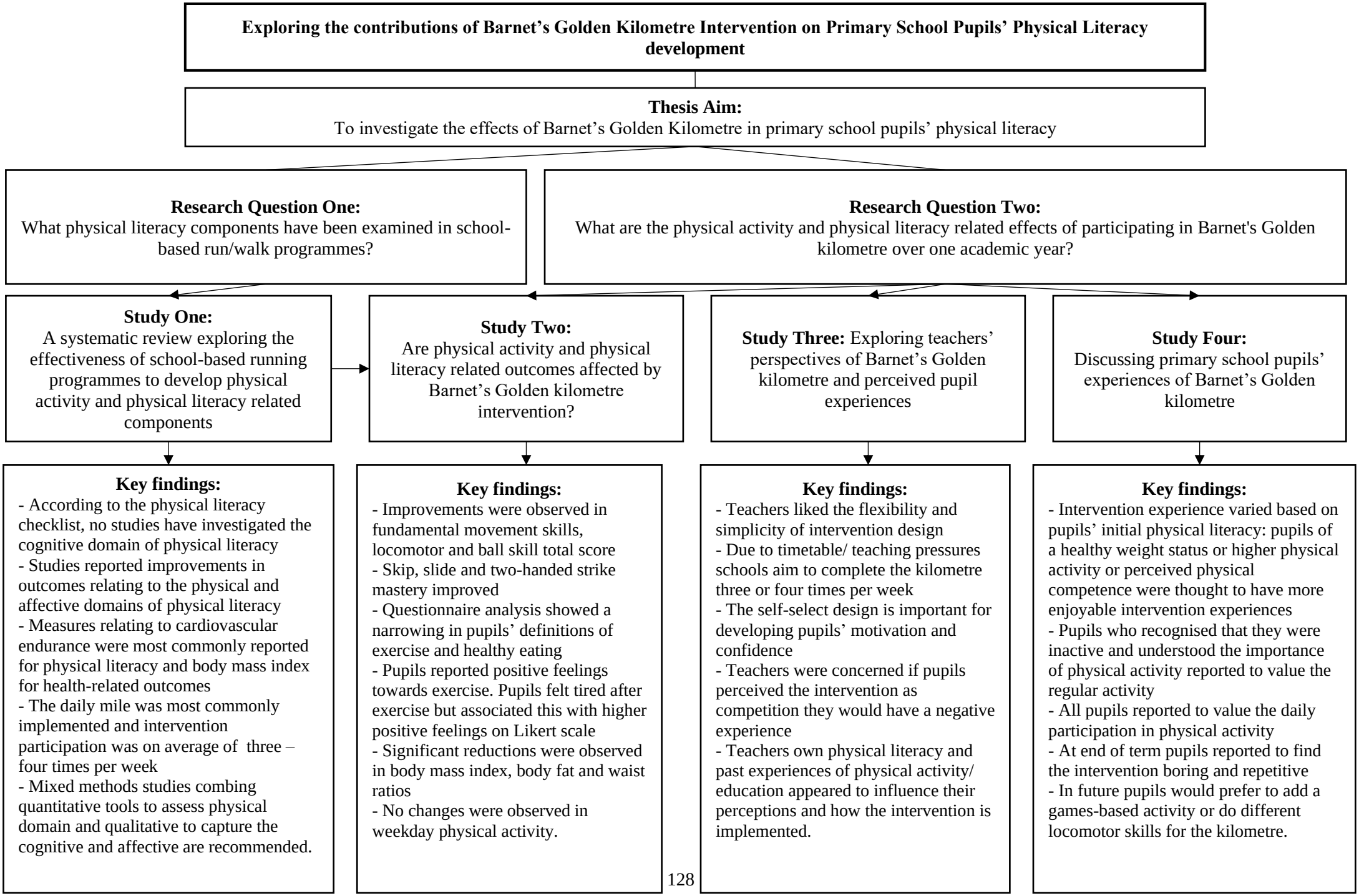

Figure 21: Thesis map and study four key findings

8.1 Introduction

Whilst at primary school Whitehead (2019) explains children are ever-more unique in their PL experiences and is something that should be reflected in practice. Much research has emphasised the implications of parents and carers (including educators and practitioners) in developing PL throughout pre-school and primary age to create and facilitate these pivotal moments into adolescence (Delaney, Donnelly and News, 2008; Whitehead, 2013; Whitehead, Durden-Myers and Pot, 2018; Paponetti *et al.,* 2023). However, the concept of PL includes having the ability to reflect on one's performance and the relationship between perception and movement which cannot be understood without an individual's own account of their experience (Lundvall, 2015). Self-reflection and accountability of lived experiences can only be sought through a child's own account (Whitehead, 2019). Therefore, understanding where children are in their PL journey and their potential progression would be beneficial. Knowing these implications can help parents, educators and practitioners by allowing them to support a child in developing the necessary PL attributes (Barnett *et al.,* 2020) which in turn could increase the likelihood of a child participating in regular PA (Green *et al.,* 2018).

PL research has suggested forms of regular observations where interactions or account for the changing and instability of children's thoughts and feelings would be appropriate to assess PL experiences (Edwards *et al.,* 2018). Although, tools like researcher observations can be time consuming and require trained assessors ((Green J, 2018). For young children, assessments should provide the opportunity to reflect on their own PL and look to monitor pupils' satisfaction and interpretation of their PL over time (Green *et al.,* 2018; Shearer *et al.,* 2021). Therefore, employing tools like focus groups or interviews with follow-up could provide insight into perceived abilities and meaningful experiences throughout intervention participation, helping to also develop self-awareness and reflection which are important in PL progression (Shearer *et al.,* 2021; Edwards *et al.,* 2018). Focus groups in particular are appropriate tools for research in young children (<12 years) and for reflecting on health interventions (Judith Green, 2018). This method can also allow for the measure of social interactions and other factors that influence motivation in PA participation which cannot be captured through other tools (Whitehead and Biddle, 2008; Edwards *et al.,* 2018). Hosting regular or follow-up group discussion would allow the recording of potential PL progression and reflection on how children's opinions change over time with specific attention to the intervention experiences (Whitehead and Biddle, 2008; Edwards *et al.,* 2018). Therefore, the aims of this study were to explore children's perceptions of Barnet's Golden Kilometre over one academic year and discuss how the intervention has influenced children's unique perceived PA and contributions towards their PL.

8.2 Methods

This study was approved by Middlesex University ethics committee as part of joint ethical application with study two and four (See appendix C) and adhered to the COREQ checklist (Tong, Sainsbury and Craig, 2007) (Appendix O). All participants were provided with participant information sheets and consent forms (See appendix G). As the study worked with vulnerable populations (<18 years) information sheets were provided for parents/guardians who also had to provide written consent for the individual to participate.

8.2.1 Research design

See chapter 7.21.

8.2.2 Participant selection and sample

Children invited to participate in the focus groups followed a purposive selection as explained in chapter five heading 5.1.3. Specifically, a criterial purposive sampling was followed for the focus group selections. The criteria were designed to be exogenous homogeneous groups, in which participants were grouped by school year and class. This form of grouping is said to be cohesive as participants are more trusting and accepting of one another (Keown, 1983; Corfman, 1995). Therefore, would be likely to share a more in-depth response, allowing richer discussion, and limiting conflict whilst still representing a variety of opinions (Cartwright and Zander, 1968; Shaw and Marvin 1981; Corfman, 1995). Class teachers were asked to select four – five participants that shared the above characteristics and varied in PA status and sex to provide maximum variation within this sample and therefore ensure a range of different pupil perspectives on the intervention are still explored (Sparkes and Smith, 2014; Green J, 2018; Bird, 2019). Research suggested three to eight participants is suitable (Fielden, Silence and Little 2011 and King 2018). Prior to attending the focus groups, the protocol of the study was briefly explained to all selected participants individually. This was to provide participants with the opportunity to ask any questions and provide a second form of consent by verbally expressing if they wished to participate or not.

Due to pressures on school timetables including, preparation for exams, upcoming school plays and concerts, both schools agreed one focus groups per year and an additional focus groups for the mixed year three – four class at S1 would be appropriate to limit class disturbances. In total, seven focus groups (m= 19 mins, range= 16mins) were conducted at each time point, 14 in total (n=29).

To identify if the responses and themes that arouse in the analysis were specific to any potential confounding characteristics (sex, age/ year group, time point, school) the codes were labelled by colour for their participating school and included a summary of the baseline statistics matching to the participant ID code (sex, year group, time point, school). The themes were then summarised to determine if there were any connections between themes that developed and sex, age, timepoint and school. The connections that were identified are summarised in the results and discussion. As presented in study two, S1 is coded in red and S2 coded in blue.

8.2.3 Protocol

McNamara (1999) General guidelines for conducting interviews, eight steps for preparation were followed for the focus groups. In addition to the information explained in 7.2,3: 3) The terms of confidentiality for focus groups the teaching staff present explained further school confidentiality protocols with pupils and supported answering pupils' questions on confidentiality when applicable, this was the protocol applicable to the school and all training was conducted in house.

8.2.4 Focus group Guides

In addition to the guide design explained in 7.2.4, Ice-breaking tasks were introduced at the start of each focus group to generate discussion between participants. Participants were asked to write words they would use to describe PA and draw a picture of themselves taking part in PA, PE or sport. The tasks were designed to allow every participant a chance to speak and interact with one another and draw the attention of discussion to the topic at hand (Green J, 2018). The focus group guides aimed to investigate unique experiences of the intervention and perceived outcomes of participation to gain individualised understanding of participants' experiences (Whitehead, 2001). Following the recommendations of Whitehead the focus groups guides did not explicitly ask pupils about PL due to potential confusion around the topics meaning, rather the questions were designed to reflect elements of PL including perceived competence, experiences and emotional responses to participation (PL attributes) (Whitehead, 2010; Whitehead, 2019).

8.2.4.1 Piloting

The baseline and follow-up focus group guides were rehearsed on separate occasions with an experienced researcher in child focus groups (ES). Baseline focus group guides were piloted with one year three and one year six class (n=8) after which the wording of questions included in the guide were adjusted for participant responses and conversation probes added. Questions using language and prompts such as “what does everyone else think?” or following-up closed questions with “why?” helped to improve flow of discussion and enhance conversation with quieter participants (Lund, Helgeland and Kovac, 2016). The revised guides were then rehearsed again before the start of each data collection point. The piloted focus groups were not included in the final study sample size. All guides are included in appendix P.

8.2.5 Reflexivity statement

See 7.2.5.

8.2.6 Setting

See 5.2 and 7.2.6 for information on school settings. The focus groups were conducted in an empty school classroom with a teacher and were led by the researcher (SA) and the children’s teacher to ensure the children were comfortable when sharing their opinions (Roetert and Jefferies, 2014; Thorogood and Green, 2018). The member of teaching staff at S1 was a cover teacher and year five teacher who had a relationship with all pupils. At S2 each class teacher participated as the assistant. The teachers explained the protocol and focus group etiquette to pupils encouraging them to not talk over one another and that their discussions were confidential. Baseline data collection was conducted shortly after Teacher interviews (November – December 2021) and final end of term assessment at the end of the academic year between June-July 2022.

8.2.7 Data collection and analysis

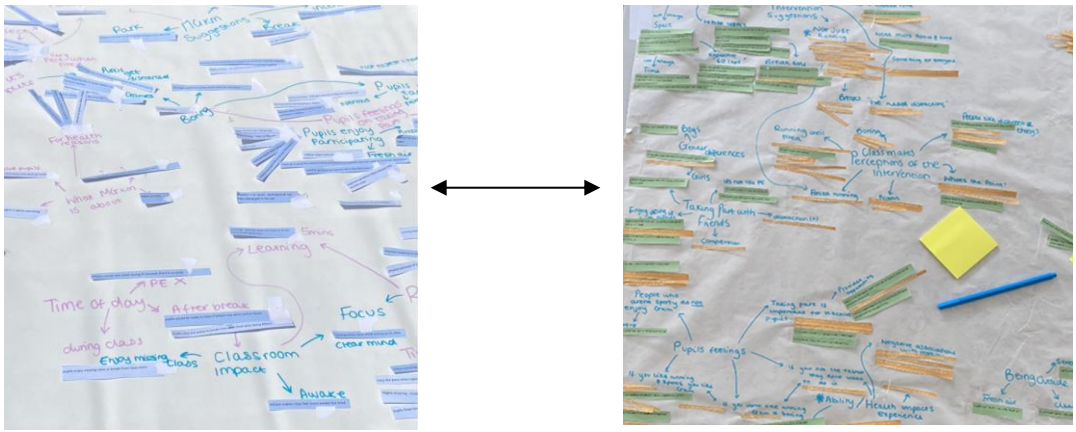

Figure 22: Organising codes into themes for child focus groups

In addition to the methods noted in chapter seven, one researcher (SA) conducted all of the focus groups and the same teacher(s) were present at the baseline and end of term focus groups. SA transcribed the focus groups verbatim in Microsoft Word. Throughout the focus group process SA kept field notes on a university laptop and focus group reflections which were written after each group. The focus groups were coded at each time point and themes were then merged once all initial data collection and analysis was complete, Figure 22: Organising codes into themes for child focus groups shows an example of the codes from each stage being organised into themes. The research members continued to review and define themes before interpretation began and coding trees were created at each stage of data collection (baseline and end of term) and merged to create a final coding tree and summary of findings (See appendix Q). NVivo Wise-mapping software was used to establish general dimensions and subsequent themes in the data. Trustworthiness is explained in detail in 7.2.7 and *Table 22*. The researcher provided a final report to clarify interpretations and then a written summary to teaching assistants present in the child focus groups.

Table 23: Lincoln and Gubas's 1985 4 step criteria of trustworthiness

Trustworthiness	How	Completed by
Credibility	- Engage in school environment to build trust and rapport with participants	SA participated in intervention launch day and assembly at each school as well provided information sheets with contact information throughout to parents and guardians. Only pupils that had participated in baseline study two data collection were selected for participation so they were informally introduced to SA prior to study four data collection.
	- member reflection	SA participated in member reflection. The class teachers present in the focus groups were provided final reports to clarify interpretations and then given a written summary of each groups for clarification.
Dependability	- Inquire Audit	All data was examined by two researchers throughout (LW and EE).
Confirmability	- Audit trail	An audit trail was kept by SA to provide materials for the sense checking (critical friends) by LW and EE. The audit trail included: raw data, process notes and development information
	- Reflexivity	SA engaged in reflexivity through and kept a reflexive journal.
Transferability	- Thick descriptions	Thick descriptions were used to create transferability in the data.

8.3 Results

Six themes were identified as contributing to pupils' experiences of Barnet's Golden Kilometre. These were: PA and health status can influence pupil's intervention perception and experiences, perceived outcomes of participation, sex differences, barriers to design and participation, enablers to daily participation, and intervention suggestions. Within these themes sub-themes are also described to identify the different perceptions and compare opinions from baseline to end of term.

8.3.1 PA and health status can influence pupil's intervention perception and experiences

Pupils' reflections on their own and/or their classmates' existing PA capabilities and health status was found to influence perceptions on factors such as to why the school is taking part in the intervention, the perceived outcomes for pupils and individual intervention experiences. This was found to be the largest theme from focus groups discussions in which almost all focus groups noted how PA and health status has played a role in intervention participation. Participants from all year groups that were of healthy weight status or considered themselves physically active recognised that not all children in their classes are 'healthy' or active enough for their age and that taking part in the Golden Kilometre intervention was important to help these pupils to either lose weight or improve their fitness.

"*Some people might not be active enough for their age so erm so I think that it helps out a lot for people who don't do sport like often it helps erm it helps erm you become more fit and it helps erm it makes you more healthy. It can also help you have a healthy weight for your heart as well and it can make your heart start beating more" (Male, year four, baseline)*

However, other pupils in year groups five or six noted that those classmates who are physically inactive or currently do not take part in sport have not enjoyed taking part in the intervention like their active counterparts. One student who considered themselves physically active or 'sporty' described how their classmates who don't like sport do not like taking part in the Golden Kilometre intervention. This was similar with other focus groups in which pupils also reported that 'sporty' pupils liked the intervention or that 'non-sporty' pupils did not, however this connection was only made in older year groups.

'Erm I think because some people in our class they aren't sporty so they might erm… some people not in a rude way but they can be a bit lazy and…. they're not… they don't want to do it. Most people they usually like…. the people who don't do sport erm they don't like doing the golden kilometre but erm for some people like me and some others in my class that are very active they like to go outside and get fresh air' (Female, year five, end of term)

Although, pupils who recognised that they were inactive or of poorer health status for their age compared to their classmates reported that they found the intervention enjoyable and beneficial to take part. Participants who felt they did not do enough PA and needed to do more exercise but were unlikely to do it any other way such as outside of school or in the playgrounds at lunch thought that taking part in the Golden Kilometre intervention provided them with the opportunity to do more regular PA that they wouldn't have done otherwise. This was found to then influence their perceived physical outcomes as they reported they would be 'healthy' like their classmates.

'I found it a bit enjoyable because I am not really used to doing exercise and it was the most running I have ever done in my life in one go' (Male, year three, end of term)

'Student X: Well for me at home I do a lot of sports…sometimes I wake up early I can either go back to bed or sometimes I just get up and go for a run outside.

Student Y: Well I know that I am not that type of person. I am a different type of person. I like wake up late and go bed late, I'll always not do anything I'll just sit on the couch all day doing nothing and this can make a real change' (Females, year five, baseline)

Pupils also recognised that not all classmates have the same opportunity to take part in PA and maintain a healthy lifestyle outside of schools like they or their classmates do so the intervention was seen to provide everyone with the opportunity to take part in daily PA.

'It would be good to keep fit and healthy because some people don't have the opportunity to keep fit so this is a good opportunity for children to erm have running space' (Female, year six, baseline)

In S2 where there is smaller playground space, one pupil recognised that there isn't much opportunity for everyone to run in the playground because others dominate the space so the intervention would allow everyone to run or do PA during school.

'It would definitely give everybody and opportunity to run because like some kids just like dominate the playground and no one can run anywhere because there's like a group of people in the middle (Male, year four, baseline)

Particularly younger pupils (years three/ four) reported that children who are active or have a healthy weight status have better school experiences in general. Some pupils reflected on how children with poorer weight status would have poorer intervention experiences compared to healthier students because of reasons such as not being physically fit enough to take part, finishing last or not being able to 'run'. One pupil thought that taking part in the intervention and regular PA would help to improve their overweight classmate's confidence because physically active pupils have more enjoyable school experiences and social interactions.

'Well if you are more fitter and like let's say you weren't fit and you were a bit overweight everyone says "ahah you're overweight" you won't have enough friends but if you are fit and you're not overweight you might have better time' (Male, year four, end of term)

8.3.2 Sex differences

There was also a notable difference between children's intervention participation and experiences based on sex. This difference was highlighted in pupils' responses during analysis and acknowledged by the children as a difference themselves during discussion. Participants across year groups reported that boys were generally more likely to race one another and perceive the intervention as a competition whereas girls would support one another or socialise during the intervention. Girls also noted that they are not as active during school hours compared to boys and this intervention would provide them with the opportunity to do more PA.

'I think in general the boys will enjoy it a lot (The intervention) because they've been enjoying racing each other and sometimes I think they have arguments over who's the winner' (Female, year four, baseline)

'Student X: mostly boys are the one who run a lot because they play football and all sorts of things like that but erm…'

'Student Y: It gives us that time to do running'

'Student X: Yeh because mostly we sit down. Even at break times we sit down and just talk but since we have signed up for the kilometre we need to run' (two females, year six, end of term)

Pupils acknowledged that these differences are not specific to the intervention participation and rather are also seen during play time, PE and after school. One pupil noted that pupils tend to stay in their 'groups' during break times.

'It's it's usually more boys play with the boys and girls play with the girls' (Male, year four, baseline)

8.3.3 Perceived outcomes of participation

Within the theme of perceived pupil outcomes, the results were split into three subthemes, these are: sense of achievement, enjoyable but tiring and fitter and healthier. Within these sub themes' pupil reflections from baseline and actual end of terms benefits are reported.

8.3.3.1 Enjoyable but tiring

When discussing the intervention outcomes pupils often reflected on how the experience made them and their classmates feel. Young pupils most commonly reported feeling tired or thirsty immediately after *'Student X: I feel so so exhausted… Student Y: I feel tired too' (Male and female, year 3, end of term)* this was the same for baseline and end of term. Although some pupils did not associate this negatively with the intervention "*I feel tired but when I actually did it it was really fun*" *(Male, year four, end of term)* and rather pupils enjoyed the aspect of daily PA.

"I'm exhausted and tired but happy…Because you get a bit of exercise everyday" (Male, year four, baseline)

Overall pupils reported that they found the intervention enjoyable but tiring. It was suggested that the tiring element of the intervention did not influence the pupil's choice to take part or continue participating in the intervention. Rather, they reflected on feeling tired after the intervention. Interestingly, one pupil did also report that they are less likely to want to take part in the intervention each day if they feel tired before and they feel they have to take part rather than having a choice.

'Student X: I like doing it every day…

'Student Y: ...Yes, me too, well only sometimes because if you are tired and the teacher tells you you have to do it' (Females, year three, end of term)

8.3.3.2 Sense of achievement

At baseline pupils thought that by taking part regularly in the Golden Kilometre intervention would make them and their classmates proud of their achievements (regular PA and completing the distance). '*Student X: I feel proud of myself' 'Student Y: I think they (classmates) will feel proud too (Males, year five, baseline)*. One pupil in S2 noted that they felt proud when they would achieve their daily step count on their Fitbit which their class mates agreed with.

'Erm I use my fit bit a lot and on a daily basis I normally get around 5000 steps and when I do the golden kilometre I got tones and that made me feel really proud which Is why I thought it was very beneficial' (Female, year four, end of term)

At baseline, children thought that taking part in a form of regular PA would inspire them to continue to do regular PA or make them want to continue to do more activity. This correlated into end of term focus group discussion where pupils recognised that taking part in the intervention each day helped them to build a habit of regular PA participation. Pupils associated this with feeling proud or positive and motivated to continue to participate in more PA outside of school. One pupil noted that they enjoyed the feeling of exercising which in turn made them want to do more PA outside of school.

'I think when when you keep on running you get used to it so so you want to do it more' (Female, year four, baseline)

'Outside of school it makes you want to do more exercise because it feels good when you exercise' (Male, year six, end of term)

8.3.3.3 Fitter and healthier

Within perceived outcomes, pupils commonly reported how they thought the intervention would make them and their classmates feel (baseline) and that they felt fitter and healthier at the end-of-term. When discussing perceived outcomes at the end of term, pupils reported feeling healthier and better within themselves, in younger classes (often year three) pupils also noted they feel faster after taking part in the intervention each day. One pupil in year five noted the value of perceived physical improvements adding that if someone was slower they would enjoy doing the intervention each day once they realise they are improving and feel themselves getting faster and fitter. All pupils noted that these feelings of physical improvement would lead to pupils feeling better overall such as improving happiness, limiting self-doubt or better in relation to their bodily health.

'Well every day that we do it you can get a little bit faster and now we've done it a lot of times I can get a little bit more faster' (Female, year three, end of term)

'let's say that you are very slow you can actually realise that you are actually improving so you are getting fast and can see it is actually helping and everything in your body. It helps you becomes healthier and people can actually realise that' (Female, year five, end of term)

'so, it makes you more healthier and like sometimes that makes you like more happy' (Male, year six, end of term)

Some pupils also added at both time points that they thought/ felt (baseline/ end-of-term) that the intervention improved their confidence and competence in other sports activities including competitive and social games.

'Erm it will help make changes to somebodies' strength and speed. And it will help someone like they'll become very good at sports and they'll play more often' (Male, year four, baseline)

'it helps like let's say that you get invited to a sports tournament and you're not ready for it because you've never participated in something like that so let's say you have to go do a very long run and you have to train your muscles and you don't have enough time to do that but at school you can actually do the golden kilometre which trains your muscles so it won't start to hurt when your actually doing it (a sport tournament)' (Female, year five, end of term)

8.3.4 Barriers to design and participation

The theme barriers to design and participation includes factors that pupils found limited their participation in The Golden Kilometre each day. These included limitations in design and also limitations in taking part, such as spaces, time, weather, the physical demands of taking part and finding the intervention boring. Barriers to design are summarised in two sub themes: space and time and the individual challenges of participation.

8.3.4.1 Space and time

Having limited space was one of the main reported barriers to pupil's participation, this was noted in both schools but particularly for S2 who had stopped taking part in the intervention. Having limited playground space on both school grounds impacted how pupils were able to complete the intervention each day with some noting that the lack of space put them off want to take part each day. In S1, one student reported feeling squished at the start of the intervention as everyone would crowd to begin and in S2 pupils described having a small

space to complete the kilometre distance meant the route would be repetitive. Almost all students in S2 at the end of term described the intervention as being boring due to the repetitive nature of running back and forth and some also thought this would be more challenging then running in a larger open space.

'When I actually heard of it (The Golden Kilometre) I thought "I do three k runs anyway" which I'm not usually dead after. So, when I heard of it I thought it would be quite easy. When we do 1k run it normally is quite easy but when we had to do the 60 laps there and back I actually found it quite hard because we didn't have breaks' (Male, year three, end of term)

'And if we don't have space, we are literally just walking in circles round and round' (Male, year four, end of term)

In S2, according to the participants, space and time were the two key contributors for why the school stopped taking part in the intervention. In addition to the limited space noted above, children reported that the teachers would struggle to find time in the day to go outside and do the kilometre, often they were given limited time to complete the distance and instead felt rushed. One pupil recognised that without space and time their class wouldn't want to do the intervention each day.

"Well they should give us actual times instead of saying 'you have five mins to run a kilometre do it now or your coming inside' they need to actually give us like a slot" (Male, year three, end of term)

"Yeh to inspire us I think we need space and time" (Male, year four, end of term)

Both schools added that teachers may struggle to find the time in the school day to do the intervention. Participants added that it depends on the class teacher and day of the week if they complete the intervention regularly. Participants from S1 stated that it would depend how much work they do that day if they could complete the intervention. One pupil explained that they had been catching up on lots of work after their teacher had been away which meant they couldn't always do the intervention. Other pupils reported that it depends on the class teacher they have each day if they complete the intervention or not, PE teachers or those that are involved in sports at school would be more likely to take them outside for the intervention each day than a non-sports related member of staff.

'Ermm it kinda depends on Miss A it depends if they remember about it but Mr B is like the sports teacher, he makes us do it' (Male, year five, end of term)

8.3.4.2 Individual challenges of participation

Pupils from both schools also mentioned that they or their classmates do not see the purpose of the intervention. The simple intervention design was seen to not be challenging enough for some or boring other pupils who found it repetitive.

'I think that we would run a kilometre outside while we're outside in just lunch or break or together anyway so I don't really know what the point in running was' (Male, year four, end of term)

In S1, children also reflected on how PA and health status could be a barrier to participation for pupils. For younger children (year three/ four) the intervention distance and continuous running was reported to be challenging for inactive pupils which was thought to result in them giving up. Whereas older children (year five/ six) reported that they found the design too easy and were bored of participating as they failed to see the benefits for them. Older participants noted that they have already mastered the skills required to complete the intervention so do not see the point in taking part.

'because they weren't as fit they didn't want to (take part) because they found it challenges so gave up' *(Female, year three, end of term)*

'I already knew how to run so it isn't much help ha-ha' *(Male, year five, end of term)*

Not related to age, pupils who reported themselves to have poorer physical fitness or doubted their own physical capabilities reported that the intervention was challenging and not as enjoyable for them compared to more physically active or capable classmates. Pupils that reported they were physically challenged by the intervention or felt they were not as physically fit as their classmates also reported that they did not want to continue to take part in the intervention.

'I find it stressful if someone is coming and they are faster than you' *(Male, year six, end of term)*

8.3.5 Enablers of participation

The theme enablers to participation included factors pupils felt would or had (baseline/ end of term) supported their participation and daily completion of the intervention. This theme addresses two sub-themes pupils determined to be valuable to their intervention experiences at baseline and end of term. These themes included: Fresh air and being outside and social influences.

8.3.5.1 Fresh air and being outside

At both time points participants highlighted the value of being outside to complete the intervention. Being outdoors allowed pupils a break from the class room which has perceived as a benefit of participation too as they could clear their mind, stretch their legs and return to class feeling fresh and/or ready to learn. The intervention was seen to be an additional break from class in addition to the playtime breaks children already get otherwise they are sat indoors for most of the day.

'I like the wind hitting my face so I get more fresh air' *(Female, year five, baseline)*

'It's like fun to get fresh air because we're normally in the class room until playtime' *(Male, year three, baseline)*

'I feel it's like erm really fun when you just go outside and start running around because you're just sitting in class' *(Male, year six, end of term)*

'I think that erm we spend most of the time in school sitting down which I don't think is very very healthy… you work you sit down you do this you sit down you do that you sit down so most of all we sit down and I think if we do the golden kilometre it will make us run more' *(Female, year four, baseline)*

8.3.5.2 Social environment

Social influences were commonly reported as facilitating children's participation in the intervention or PA habits generally. These influences could be divided in friends and family involvement in which pupils from all years discussed the value of these interactions and how they had shaped their perceptions and experiences of the intervention.

Friends

Children valued the social context of the intervention and reported finding it motivating to take part with friends as it would distract them from feeling tired and encourage them to keep going. Despite children reported sex differences in perceptions of the interventions (boys' racings, girls supporting one another) there was no reported difference between the value of

social interaction and sex differences. Both male and female participants found running with friends would help them to keep going and prevent drop out in the intervention.

'you could talk to your friend while running and then you won't feel tired after and you'll be distracted from the tiredness' (Male, year four, end of term)

"Because it keeps me a bit more motivated (taking part together)" (Female, year four, end of term)

Two pupils mentioned how they are unable to socialise with their class friends in other PA during schools like PE and would not have the opportunity to go outside of school or home. Whereas the intervention provided them with the opportunity to socialise and exercise with their friends which they enjoyed.

'We can exercise with our friends because normally we don't really do that when we do it at home….'

'And and in PE we're not really allowed to talk to each other' (Males, year four, baseline)

Participants mentioned that taking part alone would change their experience of the intervention and that taking part with friends is what would encourage them to continue taking part in The Golden Kilometre. Without the social aspects of participation, participants suggested they would not experience the same enjoyment from the intervention nor push themselves to continue when they were tired. This was also reported by both male and female participants.

'We are doing it together as a team so it wouldn't be really nice if one of the girls were like out because all of us try to participate together and help run back and forth which is actually nice team work to do' (Female, year four, end of term)

'Some people might find it tedious just walking around the laps but if you can talk whilst doing it then it's a good chance to catch up whilst also doing PA' (Male, year four, baseline)

Family

When asked their thoughts on taking part in the intervention at baseline and how children had found taking part at the end of term, children reported they enjoyed the activity because of reasons relating to family influence. Some of these influences were specific to the intervention such as family had relayed the importance of taking part, pacing themselves and daily PA in school and some were related to PA behaviours in general such as being active together outside of school and valuing PA habits for health-related reasons. Participants that reported they were excited to take part in The Golden Kilometre each day or had enjoyed participation so far at baseline because of reasons relating to family influence such as having their parents/ families reinforced the value of PA or the importance of being outdoors or that they enjoy being active with their parents so like PA.

'My mum says it's good to be outside' (Female, year five, baseline)

'I'm happy (to take part) because my mum and dad say I need to do more exercise. I would do more at home if I had a friend to do it with but I don't really have any friends because my brothers are in university or doing his GCSEs' (Female, year three, baseline)

'Well my dad normally exercises with this trainer at our house and then after we normally go for a jog' (Male, year four, baseline)

Despite the intervention being an individualised self-select pace some children still perceived it as a race or competition with one another, although for some this was not always reported

to be a negative perspective. However, children who valued the importance of regular PA and focused on self-referenced improvements mentioned how their parents had highlighted the value of taking part in the intervention over winning or competition.

'My mum says it's not about winning it's about participating in the kilometre' (Female, year five, baseline)

8.3.6 Intervention suggestions

At the end of term focus groups pupils were asked if they had any suggestions for how the intervention could be changed or improved in any way. Overall, the responses could be split into three sub-themes, not just running, adding breaks and adapting the intervention route.

8.3.6.1 Not just running

Many of the participants' initial responses to this question in their groups was to adapt the intervention to be 'not just running'. Participants added that even those pupils that enjoy PA may not enjoy the running and therefore would not be interested in continuing to take part in the intervention. Pupils suggested that introducing a variety of activities would help improve pupil experiences for a number of factors such as reducing boredom, challenging pupils and encouraging others to take part who don't enjoy PA or running.

'Everyone likes different things' (Female, year three, end of term)

The suggested variations include adding more locomotor movements like jumping or skipping or adding sports or introducing games-based activities to keep people motivated. Participants thought that varying the demands or skills of the intervention would make participation more appealing to pupils who have not enjoyed participating but also help to prevent boredom in the long-term as well.

'You can erm help people by playing games like IT, like Participant A said too. But like maybe feel like someone is chasing you and you are running for your life or like a game' (Female, year five, end of term)

'Add obstacles and and how about erm add some erm or like erm hmm something that would make them more interested like parkour like some platforms to jump' (Male, year four, end of term)

'So, if people like that aren't active they say it's boring well if we can turn the sport into some sort of game or something they can be persuaded to join it' (Male, year six, end of term)

One child noted that during play, when the class engages in game-based activities together more children are physically active without realising. Creating active games was suggested to be a way to encourage children who do not like the Golden Kilometre concept to participate in PA.

"Erm I also noticed that when sometime we get erm time to go out when we're allowed too and we get to play a class game many more people actually like to participate because erm you know sometimes we can play games that like included sport and some people they might get persuaded like Participant B said as well. I've noticed that even the people who don't like to the golden kilometre they actually participate in other games that includes the same thing you so… So, what I'm trying to say is we can change it so we don't have to just run around we can run and it could be like a sort of game in a sort of way" (Female, year five, end of term)

8.3.6.2 Adapting the intervention route

Participants also suggested that altering the route of the intervention would increase pupil enjoyment by preventing boredom and help to reduce the feeling of tiredness from the repetitive nature of participating in a small space. Participants suggested going to parks or places with open green space as their playgrounds/ school grounds did not have any grass would increase their motivation and inspire them to continue participating as there were more visual aids to take in.

'Having little space, I have a feeling it makes you more tired and because it's a very little space and there's no grass there not loads of living things you can't really get that fresh breath. If you go to an open space with plants and leaf's and grass I think you can have more fresh air and you can just feel the wind and even if you run you are still cold but fresh' (Female, year three, end of term)

Interestingly, pupils noted that since the COVID-19 bubble rule was lifted that they would rather go to the park because there is more space. Participants in S2 noted that participating in the intervention was easier and more enjoyable when the bubble rule was in place in their schools as they had more space to complete the intervention around their playground without worrying about bumping into one another but since this has been removed there is not enough space on school grounds to do the intervention.

'If we were in the park it would be better because in our playground now we have mixed bubbles and no separate area of the playground I think it was better when it was with bubbles because we had the space to run then and no one else was there and now because we're mixed we should probably go the park because there a less people there and we can just run free' (Female, year four, end of term)

'I would rather do it at the park because it's more fun. There much more space and everybody else because now we can share bubbles everyone would be running around' (Female, year four, end of term)

Other pupils suggested painting the school playground or adding a route for the intervention would be more inspiring and help pupils track their progress by counting the distance covered. Pupils thought adding a route would be more exciting for pupils to run around than the playground which did not have any markings or visual guides on during their current period of participating.

'We can make it look more fun and exciting. As like even paint it (the playground) and do other games too' (Female, year three, end of term)

8.3.6.3 Adding break

Lastly, pupils also suggested adding in breaks throughout the intervention either to rest, prevent boredom or have water stations if they are thirsty. This suggestion for younger pupils (year 3/4) was associated with helping participants keep going who may find the intervention challenging or are tired whilst participating. Older participants (year five/ six) suggested adding breaks to break up the intervention from feeling like a continuous run with no rest before returning to class, to help track progress or as a way of preventing boredom by adding activity stations at the breaks if pupils wished.

'So, like a three min break during would allowed us to do it faster after' (Male, year four, end of term)

'I'd probably make it into 15mins (the intervention time) Its best if you get more exercise. I'd also let you have like ten mins not ten actually like three min break to drink water' (Female, year six, end of term)

'I would do a break after 1 lap' (Female, year four, end of term)

'Erm you know how someone suggested about check points. They can have a break but then erm after the break you can like you can do a quick warm up like high knees' (Female, year five, end of term)

8.4 Discussion

This study presented primary school children's perceptions and experiences of Barnet's Golden Kilometre intervention over an academic year. The aims were to explore perceptions of Barnet's Golden Kilometre and discuss how the intervention has influenced children's unique perceived PA and PL journey. Overall, the study identified PA and health status to be key influences in children's experiences and perceptions of the intervention but all pupils valued the opportunity for outdoor daily PA which made them feel fitter and healthier. However, overtime pupils did find the intervention boring and repetitive. The discussion highlights the individual factors and interactions these had on intervention experiences and potential PL progression for pupils across both schools.

A key finding of this study that was reported across both schools but featured more predominantly within discussion between older participants (year five and six) was that intervention experiences varied based on pupils' existing PA and/or weight status. Pupils felt that those who were more physically active or had higher perceived physical competence enjoyed the intervention and had more rewarding experiences than those with poorer physical competence. Pupils reported that if they or their classmates had less physical ability or did not enjoy the activity were more likely to drop out or walk the intervention distance rather than challenge themselves to complete the activity. According to Whitehead (2019), an individual progressing in their PL should be able to persevere through challenging environments in order to develop their physical skills but also should apply themselves to these challenging tasks with enthusiasm and interest to learn. Whitehead (2019) reflections are in relation to the affective attributes of PL which consist of having the motivation and confidence to combat new tasks and can be used to understand why pupils could be experiencing negative intervention experiences due to initial poor levels of PL attributes (lack of motivation, confidence, poor perceived physical competence, failure to overcome challenge). One theory that is popularly used in children's PA intervention research and to understand motivation in participation is SDT (Klos *et al.*, 2020). SDT research shows when pupils are intrinsically motivated to participate in an activity it leads to positive affective experiences (enjoyment and confidence) and extrinsic motivation which can encourage future participation in PA (perseverance) (Ntoumanis, 2001; Klos *et al.*, 2020). According to Ntoumanis (2001) perceived competence has the largest effect on motivation in children. Although, the work of Deci and Ryan (1985) states that the relative impact of this will depend on the perceived situation. In situations where, comparative environments are created (such as competition) perception of competence can become more fragile and amotivation increases (Ntoumanis, 2001; Ryan and Deci, 2020). In these circumstances' pupils are not intrinsically motivated to take part and therefore are more likely to drop out (threatening experience). The theory can be used to explain how pupils' perceived competence and motivation may have influenced their intervention experiences. For example, if participants completing the Golden Kilometre were to perceive their peers to be more physically active than themselves or as competition coupled, with doubt about their own physical capabilities they may be less motivated to take part in the intervention. Whereas pupils with higher perceived physical competence initially may have been more intrinsically motivated to take part in the intervention and therefore be more likely to enjoy taking part and want to develop their skills further, because they are motivated to do so (Ntoumanis, 2001).

However, only boys reported to perceive the intervention as competition in which pupils expressed that they would race their friends to finish the kilometre whereas girls would be more likely to support one another. When pupils noted the PA and weight difference they often instead reflected on the impact this had on pupils finishing the intervention and covering the full kilometre distance rather than it being a competition. Participants reported that they

understood the intervention was not designed to be a race, however went on to discuss that those who did not cover the kilometre distance within the time allocated may have felt disheartened and led to them giving up. Interestingly, competition was noted as in published run/walk interventions which have since highlighted the importance of articulating the self-selected design to pupils and future schools looking to implement these initiatives (Chalkley *et al.*, 2018b; Ryde *et al.*, 2018; Malden and Doi, 2019). The findings of this study suggest that whilst self-selected pace is important to limit the competition element, the focus on covering the distance and within a restricted time could also be challenging for pupils with poorer PL initially (perceived physical competence, motivation and confidence). Instead, the intervention may benefit from focusing on skills such as freedom of movement and choice in intervention design whether that be distance or pace in order to encourage intrinsic motivation and progression in affective attributes of PL.

Research shows when the motivational climate is focused on mastery development rather than comparison to others, autonomy, competence and relatedness are positively influenced which leads to higher enjoyment (Klos *et al.*, 2020). Basic needs theory highlights that relatedness, autonomy and competence facilitate motivation (Vansteenkiste, Ryan and Soenens, 2020). The mini theory of SDT argues the importance for satisfaction of these needs for development and self-flourishing (Ryan and Deci, 2020; Vansteenkiste, Ryan and Soenens, 2020). If the motivational climate does not meet the individual's basic needs they can become 'frustrated' and experience failure or helplessness which can lead to negative PA experience (Vansteenkiste, Ryan and Soenens, 2020). The concept of PL regards the importance of valued PA experiences from a young age in order to shape children's future habits (Whitehead, 2019). Meaning pupils could have potentially harmful PA experiences if their needs are not met. However, Whitehead (2019) also highlights the importance of the interaction between these needs such as enjoyment, positive physical competence and meaningful engagement in PA. Therefore, if interventions are able to support a pupil's autonomy, competence and relatedness it may facilitate PL progression by creating a motivated and positive PA environment for individuals to flourish.

Interestingly, participants reported both the positive and negative experiences that may influence their motivation to take part and experience of the intervention (enablers and barriers). Participants reported that teachers' roles were important in the daily completion as they have control over the time of day the intervention takes place and how much time they have to take part. It was found that children did not enjoy taking part in the intervention if they felt rushed by their class teacher or if they felt the intervention to be a forced activity. Children thrive in situations where they feel valued and motivation is enhanced by positive and non-judgemental guidance (Whitehead, 2019). Clearly, teachers have an important role in the climate created for their pupils and research should consider their roles in creating the ideal motivational climate for pupils to thrive. However, the concept of run/walk interventions like Barnet's Golden Kilometre were designed to limit the additional work-load for teachers that may be created by multi-competent or complex interventions. Children in this study may have felt rushed to complete the intervention because teachers struggle to allocate enough free time in the curriculum to allow children to take part each day. Similar TDM research has also found teacher reported time constraints on busy school curriculums makes implementing and sustaining these interventions challenging (Malden and Doi, 2019). One suggestion to support teacher pressures whilst also still providing children with freedom would be to integrate these interventions into the curriculum where time can be allocated to participate each day. Participants within this study reported that if they had set time and clear schedules they would be able to set targets and be motivated to take part each day which would help to sustain their participation.

In addition to time, participants also reported needing space and purpose to inspire them to continue to participate in the intervention. Children of higher self-reported activity status reported that they didn't see the purpose of taking part each day because they felt they already covered a kilometre distance or had the physical competencies required to take part. If children do not value participation it can lead to increases in boredom and amotivation, likely leading to drop out (Ryan and Deci, 2020; Ntoumanis, 2001). Although contrastingly, children who were physically inactive prior to the intervention valued taking part in the activity each day because they did not have the opportunity to take part in regular PA otherwise. Both groups of participants valued the importance of regular PA but had conflicting views on the design with some saying they were bored after having participated for the year. Children added that they each like different activities and their classmates would not be able to agree on an activity for all. Instead, promoting these needs of SDT may provide a means to accommodate all pupils. Children noted they need choice in activity (Autonomy) but also need to feel physically competent to take part without feeling compared to their peers (Competency) and children all valued the social context of the intervention (Relatedness). Participants in this focus group all suggested games-based activities would be a suitable way to engage all their peers (inactive and active).

There appeared to be a relationship between the enablers and perceived outcomes of participation. Children all reported that they valued the opportunity for fresh air and being outside (enabler) which led to helping pupils clear their minds for learning, stretch their legs and/or achieve their daily step counts (outcome). Having the time to go outside and complete an activity appeared to be valued by all the participants and contributed to their perceived outcomes overall. The changes in children's social environments over the years has meant children are spending increasingly less time outside and increasingly more time indoors in sedentary based activities like watching tv (Larson *et al.*, 2011). However, research has shown outdoors time is positively associated with PA, CE, social connectedness and decreases in sedentary behaviour in primary aged children (Wray *et al.,* 2020; Gray *et al.,* 2015). During the pandemic, outdoor and unstructured play increased, although this depended on the housing situations (Rossi, Behme and Breuer, 2021). Similarly, to this study, children reported valuing the time outdoors since the pandemic and having the opportunity to participate regularly which they may not have otherwise. The value of outdoor PA during school was a key contribution to intervention success and perceived experiences particularly since the pandemic.

Almost all reflections on the perceived outcomes are also related to the daily completing of the activity. Participants reported the value of daily exercise and how overtime this had made them feel motivated to do more exercise, feel fitter and/or healthier and children felt this would help them also feel more prepared for other sports activities too. As previously noted, SDT highlights children with higher intrinsic motivation are more likely to participate in PA and develop their competency skills. By having a regular habit of participating in PA children reported they feel better (competence and health wise) which has made them want to participate in more PA (intrinsic motivation). Whilst pupils reported initially differences between PA and health status, focusing on building regular habits coupled with the previous points of not competition/ comparable experiences (not distance focused) may help to develop pupil motivation and confidence in activities outside of school settings as well as intervention experiences. Within older years, research has also reported that priority needs to be placed on adolescent routines to help maintain healthy active lifestyles post pandemic and into adulthood (Rossi, Behme and Breuer, 2021). By providing children with not only the opportunity for outdoor activity but also as a regular activity this may help to develop PA habits which can correspond outside of school and into adolescents (Whitehead, 2019). Developing healthy habits is part of PL and may therefore help children to flourish in other PA environments as

they become more motivated and confident to challenge themselves and develop their physical skills which children reported in this study (Whitehead, 2019).

8.4.1 Study limitations

Qualitative research with child participants can pose a number of challenges with responses. Firstly, Barnet London is a multicultural society and cultural backgrounds/ belief can influence participant responses (Barnett *et al.,* 2020). However, due to school data protection policies cultural data was not collected which may limit the reflections in this study (Barnett *et al.,* 2020). Within school settings, social context is important and qualitative research has noted concerns with this leading to pupils reporting socially-desirable responses to try win their peers or teacher approval (Morgan *et al.,* 2002). However, teacher presence is said to help with shyness for pupils and school settings are cost-effective tools to work with children in secure and familiar environments which can otherwise be challenging to achieve (Morgan *et al.,* 2002; Norris *et al.,* 2012; Adler, Salanterä and Zumstein-Shaha, 2019). Between the ages of seven to 11 children begin to develop their skills in problem solving, reflection on their own performance and comparison to other (Adler, Salanterä and Zumstein-Shaha, 2019). From the age of ten social status does however become of more value as children develop a reciprocal relationship in which they interact and share feelings with one another (Adler, Salanterä and Zumstein-Shaha, 2019; Lund, Helgeland and Kovac, 2016). Children can also lose interest in focus groups if timings are too long (recommended 20-30mins, (Adler, Salanterä and Zumstein-Shaha, 2019)) and others may become inactive (Adler, Salanterä and Zumstein-Shaha, 2019). To limit pupil isolation and encourage interaction and interest the pupils sat on an oval table to encourage interaction and help pupils with hearing one another (Adler, Salanterä and Zumstein-Shaha, 2019). However, it is recognised that these factors may contribute to the answers pupils communicated in focus groups which could limit the conclusions drawn of pupils actual intervention experiences and PL impact.

8.5 Conclusion

This study is the first to consider the impact participating in a run/walk intervention may have on pupils' PL journeys. The study's overall aim was to explore children's perceptions of the intervention and how this may have influenced their PA and PL. The results of this study show pupils' initial PA and health status perceptions influenced their intervention experiences whereby participants with higher perceived physical competencies, higher PA status and healthier weight status were perceived to have more enjoyable intervention experiences and were seen to be more motivated to participate. However, all children reported to value the opportunity for regular outdoor PA which, when coupled with time and space, increased positive intervention experiences and improved intrinsic motivation. Over time, pupils reported feeling fitter and healthier and more motivated to participate in other physical activities after building a habit of regular participation through intervention participation. However, over the academic year pupils reported becoming bored with the repetitive nature of design and the focus on distance covered is thought to also have potential negative impacts for pupils with initial poorer PL than their counterparts. Therefore, based on pupil suggestions it is recommended that the intervention focuses on the outdoor activity and providing children with time, space and the opportunity to build habits. However, varying the activity completion such as introducing games-based activities or mixture of locomotor skills may be more worthwhile for longevity of participation and PL development. Future research would benefit from exploring the types of activities that would be suitable in this context whilst still not creating additional burden for schools.

Chapter Nine: Integration of Studies Two, Three and Four

9.1 Integration statement (Creswell & Plano Clark, 2018)

The integration involved the merging of results from the quantitative data presented in study two and qualitative data presented in studies three and four through a joint display table. This is to allow a comparison to be made between the sets of data and provide a more insightful view of PL progression that would not be provided by either qualitative or quantitative results alone. The thesis followed a parallel convergent approach in which the data were analysed independently in chapters six, seven and eight and integrated through visual comparison in this chapter and discussion in chapter ten. To support the synthesising of the data *Table 24* presents the joint display table where the mixed methods comparison can be made between results.

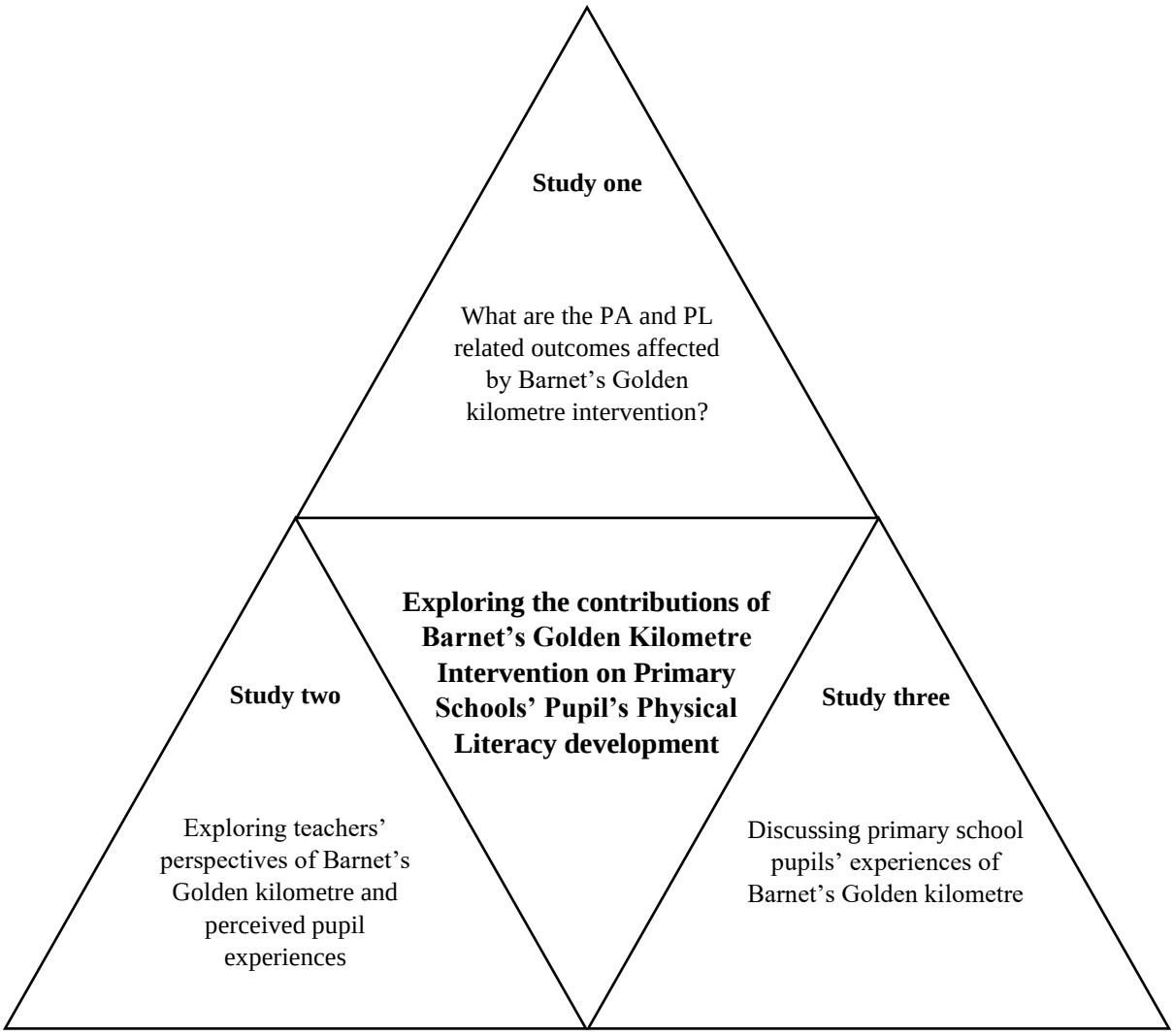

Figure 23: Diagram showing the merging on studies two, three and four

Table 24: Joint display table of studies two, three and four

Results			
Study Two	**Study Three**	**Study Four**	**PL concept**
- FMS total score ↑ - Locomotor total score ↑ - Ball skill total score ↑ - Slide, Skip and two-handed↑ strike mastery↑	- Participants with poor physical competence or self-confidence may feel put off participation and doubt their ability - Someone finishes last - Participants with higher perceived competence or physical capability would enjoy the intervention - Teacher support and autonomy motivation and important to prevent drop-up	- Participants with higher perceived competence, PA and healthier weight may have more enjoyable intervention experience and be more motivated to participate - Participants feel fitter and healthier - Participants feel more prepared for sport-specific activities	**Physical domain:** Physical competence **Affective domain:** Motivation, confidence and enjoyment
-Positive feeling towards exercise (before and after) -Participants felt tired after exercise at follow up but reported this with higher positive feelings on the Likert scale -Participants felt happy before exercise		- Participants valued the opportunity for daily PA. - Participants who were sedentary of inactive recognise they need more PA and liked the opportunity to do regular PA - Social aspects were important for participation	**Affective domain**: Attitudes **Cognitive domain:** Value of participation, self-reflection
-Exercise is about keeping fit and healthy - Healthy eating is about vegetable and fruit consumption	- Participants need to understanding intervention is not a race - Self-select nature is important for experiences	- Participants reported the importance of daily PA - Value social time	**Cognitive domain:** Value of participation **Health related outcomes**
-BMI↓ -BF% ↓ Waist circumstances ↓	- Intervention participation will improve stamina and healthy lifestyle habits from regular PA	- Participants valued the opportunity to take part in PA via the intervention each day	
-No change in daily PA -Weekend VPA↓		- Participants who thought they were physically active already don't see the point - Participants who do not enjoy the intervention or do not see the point either drop out or walk	**Cognitive domain:** Value for regular PA **Affective domain:** Enjoyment
- One school dropped out of intervention	- Teachers own PL/ past experiences influence intervention perceptions - Intervention is complete 3-4 times per week	- Focusing on distance can negatively impact pupil experiences - Space and time are important (Barrier/ facilitators) - Intervention is not completed every day the teacher decides if they have time - Participants do not enjoy feeling rushed	**PA/ intervention experiences** **Health related outcomes:** influence PL experiences

Chapter Ten: Overall discussion

The aim of this thesis was to investigate the effects school-based run/walk interventions may have on primary school pupils' PL journeys. Overall, the thesis provides novel insights into PL including; the role teachers play in implementing interventions to support their pupils' experiences, and the development of the physical (actual and perceived), affective (attitudes, confidence and motivation) and cognitive domains (knowledge and understanding). Interestingly, the thesis highlighted that these interventions may not be suitable for all class pupils due to factors such as variation in age, ability and initial PL. As well as this, teachers' busy curricula and school facilities pose potential barriers to sustained participation from both schools and pupils. Rather, schools should consider how the interventions should be tailored to the needs of each class, including factors such as their initial ability, creating challenge, and providing space and time. To draw these conclusions, the thesis first investigated which PL components have already been examined in run/walk research to identify the areas of PL domains that needed further investigation.

In study one a systematic review was conducted which outlined the research on school run/walk interventions and their influence on PL and PA related outcome variables. The findings showed that interventions improved components of the physical (CE, stability, power, muscular endurance) and affective (motivation, self-efficacy, emotional regulation) domains over six month periods, as well as contributing to positive small improvements in health outcomes (PA and body composition). Crucially, study one also found that no intervention studies had investigated the cognitive domain of PL. The methods adopted had typically focused on three or six month follow up, but few studies considered the development over longer periods and whether reported outcomes were sustained. For physical domain, studies most commonly investigated time-based outcomes and no studies considered the effects on movement quality, which is an important part of PL development. For affective domain, only questionnaire or adapted scale tools were implemented which despite providing feasible insight into these elements of PL, do not capture unique experiences of participation which could be understood through qualitative methods. A qualitative approach was also thought to support the capture of cognitive domain where quantitative tools are limited. Based on the findings of study one, study two was designed to explore the domains of PL which had not yet been considered in run/walk interventions. Combining a questionnaire tool with a movement assessment would allow simultaneous insight into the physical (movement quality), affective (feelings) and cognitive (knowledge and understanding) domains, which has not yet been considered. Coupled with this, providing informative and comparable data for policy and research, and PA related health outcomes such as BMI is recommended for further investigation. These too could also be seen as indicators of PL progression due to the benefits associated with PA participation (Cairney *et al.,* 2019b). Study two explored the effects of Barnet's Golden Kilometre on PA and PL related outcomes through the investigation of FMS, a well-being and lifestyle questionnaire, BMI, BF%, waist circumstance and PA measures. The study found no significant difference in pupils' feelings before or after exercise, however pupils reported overall positive feelings towards participation. At end of term, children's knowledge of exercise and healthy eating commonly referred to more narrowing definitions including keeping fit and healthy and consuming fruits and vegetables. FMS improvements were observed in total scores, skip, slide and two-handed strike mastery but no changes were observed in weekday PA. A key finding of this study was the improvements in health-related outcomes of PL (BMI, BF% and waist circumstance). However, without control groups it is difficult to determine if the findings are natural progressions or influenced by intervention participation. To enhance the quality of PL capture and the individualised experiences, the

final two studies conducted qualitative assessments, and themes of all three studies were compared in chapter nine (*Table 24*).

Study three discussed teachers' perceptions of pupil experiences following participation in Barnet's Golden Kilometre, and potential contributions to their PL development. The study found teachers had mixed perceptions of the intervention. Teachers liked the self-select design for pupils' motivation and the flexibility and simplicity of the design for implementation but stated that participating five times per week was challenging. Teachers reported struggling to find free time in the curriculum to take part each day due to their busy schedules and therefore aimed to participate three to four times per week. A key finding was that teachers felt pupils PA and PL experiences would vary based on their initial PA and PL capabilities. Finally, study four explored children's perceptions of Barnet's Golden Kilometre following participation over one academic year. Pupils reported that they initially enjoyed the intervention design but found it repetitive and boring over time. In future, they would prefer more game-based activities or a mixture of locomotor styles to complete during the intervention. Older pupils felt they had already mastered the skill of running so did not value participating in the repetitive activity each day. Another key finding of the study was that children valued being outdoors, having space and time to be physically active and develop a regular habit of PA. However, pupils reported that they felt intervention experiences would vary based on their initial PA and health related capabilities. Pupils felt that those class mates who had higher physical competence, participated in more PA outside of school and/or had a healthier weight status perceived the intervention to be more enjoyable and were more motivated to take part. Although, participants who recognised they were inactive and valued the importance of regular PA reported they were motivated to take part and enjoyed participating in regular PA in school. The study concluded that pupils have mixed experiences of intervention participation which may be influenced by their initial PL journey.

Collectively, these findings demonstrate that participating Barnet's Golden Kilometre intervention can have varied impact on pupils' PL journeys. Both teachers and pupils recognised that initial and perceived physical capabilities would impact pupils' experiences of the intervention. Children with higher perceived physical competency were said to be more motivated and had more enjoyable experience. Although, children with knowledge and understanding about regular PA and self-awareness of their own current PA status could have greater intervention experiences regardless of their perceived physical competence. These findings are representative of Jurbala (2015) Cycle of PL which reflects the dynamic relationships between PL and the physical environment which can lead to changes in health outcomes (Figure 2). The model depicts the way PL journeys and their interaction with the environment can produce both positive and negative outcomes. Positive experiences lead to ascension through the spiral such as FMS development and BMI improvements observed in study two (Jurbala, 2015). Conversely, negative experiences can cause an individual to descend on the spiral such as boredom and drop-out from repetitive activity shown in study four (Jurbala, 2015). It has been established that PL is not stable (Whitehead, 2019) and neither are children's emotions (Krenz *et al.,* 2022), however, schools are encouraged by policy to provide equal, enjoyable and sustainable PA opportunities for all children meaning all pupils should ascend through this cycle (Department of Culture Media & Sport, 2023). Studies three and four suggest that factors such as access to time and space, teacher attitudes, PA participation and social interaction are just some of the factors that influence pupils' intervention experiences, and ultimately influence PA and PL. Further research is needed, and intervention development may benefit from the integration of theory such as the social ecological model to understand the broader factors that influence PA engagement and intervention experiences for pupils. Development is needed on run/walk intervention like Barnet's Golden Kilometre to determine how the intervention can encourage positive PL for

all pupils, and encourage PA engagement and sustained intervention participation throughout the school year.

Given these findings, it is recommended that teachers and educators should consider how their own PA experiences may influence intervention implementation and how an autonomy supportive climate may help to develop pupils' PL by encouraging motivation and improved perceived physical competence. Children reported they need space and time to enjoy participation, and to not feel rushed by their teacher, although, teachers reported in study two they struggled with curriculum pressures and finding the time to complete the daily activity. For practitioners, policy makers and researchers, further development is needed on the intervention design to create an inclusive and engaging activity that is sustainable over the school years, both for teachers to implement and children to participate. For example, focusing on completing a distance like running one kilometre could negatively impact some pupils PL and rather focusing on the time spent outdoors may help to promote self-referenced behaviour and reduce competition. Varying the movement pattern or activity style during the intervention for example implementing skips or jumping, was suggested by pupils as a simple way to increase engagement. Based on these results, the next section will explore the main research question "What are the PA and PL related effects of participating in Barnet's Golden Kilometre over one academic year?" in further detail.

10.1 What are the PA and PL related effects of participating in Barnet's Golden Kilometre over one academic year?

The thesis took a mixed methods approach to answering the final research question in which the findings of studies two, three and four were merged through side-by-side comparison on a joint display (*Table 24*). The overall findings were that participating in Barnet's Golden Kilometre intervention had mixed impacts on primary school pupils' PA and PL over the academic year. It was found that initial PL capabilities including perceived competence and knowledge of the importance of a healthy active lifestyle, as well as factors such as the school facilities, method of implementation, and teachers role in daily completion may have influenced pupil experiences during intervention participation and ultimately the outcomes identified in the individual studies. When implemented within the right settings and with pupils at optimal PL levels (positive perceived competence, self-confidence in participation, motivation, value of daily PA) the intervention could have the potential to contribute to perceived physical competence and areas of the affective and cognitive domains, however further research is needed to confirm ideal intervention implementation for PL development. This thesis has noted some recommendations for intervention development and future research which can be used to inform policy.

A key finding that developed in strength across the studies was that pupils initial PL may impact their intervention experiences and outcomes reported in the studies. The youth promotion model proposed by Welk (1999) adopts a social-ecological framework by recognising the broad influences on children PA (social, personal, environmental). The findings of the thesis could be linked with the model and its pathways to promoting PA in children as these show similarities with the PL attributes identified in the thesis. Within study three, teachers had mixed perceptions on the intervention and raised concerns that some pupils may not enjoy participation due to perceiving the intervention to be a competition, and doubting their own physical ability to take part. In study four, when reflecting on their experiences, children also thought that participants with poorer PA or weight status would have reduced motivation to participate. Children thought that 'sportier' or more active pupils would enjoy the intervention more because they are motivated to take part and enjoy exercise. Both study three and four reported that children who had poorer perceived physical ability would be more likely to give up during the intervention. The youth promotion model states

that pre-disposing factors are associated with regular PA engagement such as enjoyment, perceived competence and attitudes (Welk, 1999). Secondly, enabling factors are important which allow children to engage in PA from physiological (e.g. physical skill or fitness) and environmental perspective (e.g. access to equipment or greenspace) (Welk, 1999). Part of PL is about children having confidence when taking part in PA (affective) and the abilities to move efficiently during participation (PA), if children had not developed these qualities or engaged in regular PA themselves then they would be unlikely to challenge themselves to try new tasks or persevere (Pot, Whitehead and Durden-Myers, 2018). This may explain why pupils with poorer perceived competence or confidence gave up during Barnet's Golden Kilometre. Similar run/walk interventions have also reported mixed responses for pupils enjoyment (Malden and Doi, 2019; Hatch *et al.,* 2021). Specifically, Hatch *et al.* (2021) also identified that perceived/ actual exercise ability influenced pupils' enjoyment. The study reported conflicted findings when pupils were asked about intervention participation, where some pupils reported they would be happy to extend TDM distance in order to challenge themselves, whilst others were reluctant as they would not be physically capable (Hatch *et al.,* 2021). These findings may have impacted overall intervention results as intervention compliance may have been affected. This also highlights however, that children experience different constraints and enablers to PA or intervention participation such as perceived ability which has led to mixed responses. Therefore, this could influence sustained intervention participation as there may be a drop-off in participation.

Chalkley *et al.* (2020) found indication of novelty effect in their evaluation of MK implementation. It was suggested that the initial roll-out of the intervention was thought to influence initial motivation for participation which was then not sustained over time (Chalkley *et al.,* 2020b). The novelty effect has been suggested to influence activity pattern during PA participation and also children's boredom which could influence participation and compliance (Chalkley *et al.,* 2020b; Gonzales-Cutre 2016). This may have led to the lack of compliance reported in study two as well. Study two reported no change in weekday PA and significant reduction in weekend VPA although, there was only a 9% watch compliance for PA wear time at the end of term (n=12) with an initial sample of 132 at baseline. Similarly, the study found potential improvements in FMS however initial FMS ability may have hampered the study's capacity to identify worthwhile skill development. An initial novelty effect may have contributed to the large amount of missingness in data but also the lack of representability in the findings. Considering study four and similar intervention findings, children whom may have poorer FMS or PA initially, may not have participated in the intervention as intended (e.g. given up), or complied with the data collection (e.g. watch wear time) therefore these findings of study two may not be an accurate representation of intervention impacts. Enjoyment is a motivational construct and therefore could influence participation and sustaining PA as children are more likely to participate and sustain participation in activities they enjoy (Chalkley *et al.,* 2020b; Klos *et al.,* 2020), coupled with the limitations noted in study two (lack of control group etc) the findings of study two should be interpreted with caution.

However, study four did identify that children who recognised they were sedentary or less physically active compared to their peers reported to value the intervention as it created opportunity for regular participation that they may not have had otherwise. Similarly, all pupils reported to value the opportunity for daily activity, which when reflecting on the impacts of participation associated this with making them "feel fitter" and feel more prepared for other sports activities. Marchant *et al.* (2020) also found children reported to value the opportunity for daily PA created by TDM and how this could contribute towards wider PA skills. Study two highlighted that health related outcomes (BMI, BF% waist circumstance) improved throughout the school year which could be connected with increase in regular activity

particularly for pupils that are usually sedentary. Children also defined exercise at end of term to be associated with "keeping fit and healthy" whereas initially a larger focus was on refencing sports specific activities like football. Following the intervention, participants' definitions of healthy eating also related to both fruit and vegetable consumption, with less focus on specific foods. A recent run/walk study by Scannell *et al.* (2023) reported a narrowing in pupils understanding of PA, similar to narrowing on exercise definition in study two children referred to more daily activities and how PA was not just sport specific skill after participating in TDM. Self-reflection and knowledge and understanding of the value and importance of regular PA are key to the cognitive domain of PL. Individuals who understand how PA improves health, and are also able to reflect on how to improve their own performance in PA embody the two key attributes to PL progression noted by Whitehead (2019). These may be valuable attributes to encourage PA participation in the intervention regardless of perceived physical competence as pupils rather understand the value of daily PA and opportunity to develop their skills. These combined thesis and published study findings demonstrate that participating in run/walk interventions each day contributes to pupils understanding and value of regular / daily PA (Marchant *et al.,* 2020; Scannell and Murphy, 2023). Developing these qualities would increase the likelihood that an individual would continue to lead a healthy active lifestyle into adulthood (Bailey, 2006; Green *et al.,* 2018; Brown, Dudley and Cairney, 2020), and provides evidence to support the sustainable impacts of these intervention designs.

A suggestion for the varying experiences in the intervention participation itself was noted by teachers in study three. Initially, teachers stated that children need to understand the self-select nature of the Barnet's Golden Kilometre to avoid "running for running's sake" or competing with each other. A concern for teachers was that children would perceive the intervention to be a race which could create a negative experience particularly for the pupils who may finish last or doubt their own physical capabilities. Marchant *et al.* (2021 reported conflicting issues with competition associated with TDM, the study found some pupils were motivated by the competitive aspects where as other pupils were disengaged by it. Further run/walk studies have also highlighted the importance and value of the self-select design in promoting pupil autonomy and maintaining PA participating (Chalkley *et al.,* 2020b; Hatch *et al.,* 2021). The focus groups with children in study four found that children understood that the intervention was not a race and focused on self-select pace but also felt the purpose of the intervention was to complete the kilometre distance each day.

Whilst these perceptions of the interventions from pupils may be seen as a success to teachers who were concerned about the competitive aspects, these were noted to also negatively impact pupils experiences when coupled with time pressure. For example, pupils reported that they felt pressured to complete the full kilometre distance within the allocated time or sometimes rushed by teachers. In study three, one teacher explained how the intervention needed to be adapted to meet the needs of their class in which they worked towards covering the kilometre distance and rather focused on 15 minutes of walk, jog, run activity. Goodway, Crowe and Ward (2003) reported that a constrained based approach to intervention participation can help teachers plan instruction and understand the environment factors that influence children development and learning and could be worth consideration in future implementation. This approach would allow teachers to accommodate for individual child ability by manipulating the environment and equipment in this manner such as building up to the distance identified in study three (Goodway, Crowe and Ward, 2003). Many run/walk interventions have also highlighted the importance of adapting interventions to suit the school context (Ryde *et al.,* 2018; Malden and Doi, 2019; Chalkley *et al.,* 2020). For example, Malden *et al.* (2019) found within the same school, some classes focused on distance and others on 15 minute time to suit the ability of the class. However, study three did highlight that teachers' attitudes may impact

implementation and could also have negative impacts on children's experiences if the intervention does not meet their needs. Similarly, Marchant *et al.* (2020) found teachers played an important role in children's experiences. The study reported that positive involvement and modelling behaviour enhances pupil engagement however disengaged teachers would also lead to poor engagement from pupils. Children in study four also then noted the valuable role teachers play. Child participants reported that they did not enjoy the intervention when they felt rushed by teachers and rather needed both space and time to reap the benefits of participation. Both teachers and children reported the importance of teacher encouragement for motivation and pupils' confidence as well as wider social contextual factors such as support from peers. These findings are again also reflective of the youth promotion model which features enabling and predisposing factors that influence children's PA (Welk, 1999). This can be in the form of social connection or family influence but also through coach and teacher roles (Welk, 1999). The teachers play an important role in reinforcing positive behaviour whether that be encouragement or through implementation. When combined with similar run/walk research, it is clear that teacher buy-in is important for intervention implementation (Marchant *et al.,* 2020), and plays an important role in pupils' intervention experiences which can be carried over into PA habits and requires further attention.

Neither of the qualitative studies presented herein reported that adaptions to the intervention had taken place, despite teachers' initial concerns with engagement. Malden *et al.* (2018) found that almost half of the teachers completing TDM (n=8) used a form of motivational or incentive tool to encourage participation in TDM such as tracking distance and rewards, however these adaptions have been criticised for not adhering to the intervention aims as intended. Ram *et al.,* (2023) reported a real-world application of TDM and found no schools in Greater London (n=196) implemented the intervention in line with all 10 core principles. Within the thesis findings, children also reported the need for additional adaptations to be made to the intervention in order to prevent boredom and maintain participation. The need for adaption in these intervention designs raises concerns regarding the successful adoption of these interventions in real-world settings (Ram *et al.,* 2023). The key principles thought to influence feasibility in real world settings were: it being simple, fun and no need to change shoes/ clothes (Ram *et al.,* 2023). The simple design of Barnet's Golden Kilometre was also noted by teachers to be a facilitator in school adoption. Children also added the value of social interaction with peers, getting fresh air/ being outdoors, and developing regular PA habits in school to be positive aspects of design, similar to Hatch *et al.* (2021) (outside location, self-select, social). Ram *et al.* (2023) and Daly-smith *et al.* (2019) have both recommended the needs for whole-school implementation for sustainable measures and population health. However, considering the limitations noted within this thesis and published literature, this may not be feasible nor valuable to long-term PA. All three studies in this thesis recorded the challenges of daily completion in school, many other similar studies have also said implementing run/walk interventions according to their core principles is challenging, and often schools aim to participate three times per week instead of five (Eggeling *et al.,* 2021; Routen *et al.,* 2021; Ram *et al.,* 2023).

To maximise the potential of PL development in these settings, studies two and three suggest pupils needs to enjoy the activity and have the perceived physical competence to take part. The findings of the studies in this thesis disagree with run/walk intervention research about implementation approaches (Marchant *et al.,* 2020; Ram *et al.,* 2023). Particularly, the thesis highlighted that adopting a whole-school approach to run/walk interventions could risk potential negative impacts on PL by leading to negative experiences of PA or responses such as poor perceived competence, self-doubt, giving up, or drop-out from boredom. Rather, as highlighted in the qualitative findings of this thesis, the interventions should be tailored to the abilities and needs of the class, and include variety in activity which is where pupils reported

to thrive. For example, participants in study four suggested a range of games-based activities or locomotor skills (skipping, jumping galloping etc) within the kilometre. This variation could still adhere to the core focus of the intervention by allowing pupil autonomy and limiting teacher instruction by providing choice in activity (run, skip, gallop etc) and pace, whilst preventing boredom.

Whole-school approaches to intervention implementation may also not be suitable for pupils of all ages and could create negative experiences of PA in adolescents if pupils do not value or enjoy participation. It is well known that as children get older their PA participation generally declines (Somerset and Hoare, 2018; Basterfield *et al.,* 2016; Hesketh, Lakshman and van Sluijs, 2017) so generating positive PL related experiences as a child is crucial to lead into their later life. The base of the youth promotion model is also underpinned by personal demographic variables that have a direct influence of children's PA pathway (Welk, 1999). These factors include age, sex, ethnicity/ culture and socio-economic status (Welk, 1999). This thesis did not assess ethnic or socio-economic difference in intervention experiences which may require further attention, however, the findings of study three and four both suggested age and sex played a role in PA engagement. For example, study four highlighted that particularly older pupils (year five and six) reported that they felt bored and did not see the purpose in participation as they have already mastered the skill of running which was also reflected in study one FMS findings. Older pupils also reported needing more challenge whereas younger pupils and their teachers (study three and four) felt the intervention was challenging enough and some would need to 'build up' to the kilometre distance. Run/walk initiatives like TDM are targeted towards whole-school implementation which is thought to encourage sustainability and be completed by every school year (Innerd, Azevedo and Batterham, 2019; Malden and Doi, 2019; Marchant *et al.*, 2020). However, this thesis suggested that these intervention designs may not adequately meet the needs of pupils across the years and result in the positive outcomes which are promoted in policy. The strong policy backing and promotion of TDM has raised concerns that schools are also adopting these programmes to meet required standards set by school managements and governments which do not situate children's development as a central focus (Ward and Scott, 2021; Thorburn, 2020). Developing PA and wider skills like FMS is complex and may be outside of school interventions like these to achieve (Ward and Scott, 2021; Horell, 2012). PE should instead provide children with opportunity to refine and develop technique and interventions may rather be best focusing on providing opportunity to encourage daily PA and positive health behaviours which children in study four all valued regardless of age or ability (Sherar *et al.*, 2020). This would therefore provide more positive PL experiences which in turn would increase the likelihood of pupils participating in PA into adulthood. The youth promotion model could be one approach used to refine the intervention and promotion strategy used by Public Health Barnet by allowing researchers and policy makers to consider the effective pathways to promote the intervention and PA engagement for pupils (Welk, 1999). Adopting broader interpersonal theories like social cognitive theory could provide depth and more complex insights into PA however, for policy and specific PA behaviour in children the youth promotion model may be a more simplified approach to development (Welk, 1999).

10.1.1 Strengths and Limitations

This thesis explored a broad range of PL domains through a mixture of methods; a systematic review, and by collecting both qualitative and quantitative data and from varied participants (teachers and children) in school settings. This allows the thesis to collect various PL outputs including motor competence (FMS), thoughts, feelings, knowledge and understanding (Questionnaire and focus groups), health outcomes (BMI, BF%, Waist circumstances), PA (accelerometery), perceived experiences (interviews and focus groups) and perceived

outcomes (interviews and focus groups). Adopting a pragmatic approach to PL data collection provides a rich account of different characteristics that contribute to PL development, but also provides comparable research as individual outcomes that can inform policy where health related measures are often used (e.g. BMI, BF%). These findings can be combined (mixed-methods) or interpreted separately which can increase applicability in a range of contexts (research, education and policy). The thesis is the first known mixed-methods approach to capturing PL experiences through run/walk interventions which can be used to contribute to the field of PL assessment and intervention development.

The thesis is not without limitations, and these have been addressed throughout (sub-headings 1.2, 6.42, 7.42 and 8.42), and these must be considered when interpreting the findings. . In terms of the general methods, the adoption of a convergent mixed methods design allowed the study findings to complement one another and create a more detailed capture of PL. However, the different sample sizes throughout the studies may limit the rigour of the findings, and the strength of conclusions that can be drawn overall (Creswell J.W and Creswell J.D, 2023). The convergent design can be limiting in validity as a whole through the individual studies validity threats (Creswell J.W and Creswell J.D, 2023). Without repeatability or follow-up in methods, the studies can tell different stories which may limit the generalisability of the findings. Secondly, the studies all aimed to capture different aspects of PL; whilst the overarching questions remained the same throughout the three studies, the research questions asked were different. This can also impact the conclusions drawn in the data by limiting the comparison in findings, however, this did allow a broader capture of the PL domains which may not have been achieved otherwise.

10.1.2 Recommendations

Based on the findings of the thesis the following recommendations have been suggested:

- Due to the challenges faced in large study data collection, future research may benefit from ethnographic qualitative approaches including observations and interviews to identify social phenomena and unique school experiences/ implementation of the intervention.
- Adopting the youth promotion model developed by Welk (1999) may help researchers and policy makers to develop the intervention to better encourage children's' PA engagement. This thesis found insight into sex difference, enablers and reinforces of PA however consideration of not only age and sex, but also cultural aspects and socioeconomic status in future studies would allow policy makers to understand the underpinnings of children PA pathways and make recommendations for schools implementation. Using behaviour change theories or PA/PL models within intervention design can also help to identify determinants that should be targeted through the intervention and help to understand the process of encouraging positive behaviour change/ PA engagement. This approach may help to further promote PL and encourage sustainable intervention participation.
- Barnet's Golden Kilometre should be implemented to suit the needs of the class and focus on factors such as the time spent outdoors being active, a break from sitting time or providing another opportunity to be active outside of break/ lunch, rather than on distance or just running.
- Future research should investigate the different types of activities children can complete for ~15mins or 1km such as locomotor or games-based activities.
- Barnet's Golden Kilometre should be implemented with a clear aim to provide children with a purpose or challenge to participate. When children see the value in the intervention it can contribute to developing PL through affective and physical

domains as children are motivated, enjoy participation, have a positive attitude and are keen to develop their physical competence (perceived and actual).

10.2 Conclusion

This PhD thesis has highlighted the research on run/walk interventions and its contribution to developing primary school pupils' PL. The findings highlight the benefits of participating in run/walk interventions on the physical and affective domains of PL such as CF and motivation. Specifically, the thesis identified the contributions Barnet's Golden Kilometre had towards PL and PA related health outcomes including perceived and actual physical competence (physical domain), thoughts and feelings towards participation (affective domain), knowledge and understanding on leading a healthy active lifestyle (cognitive domain) and BMI, BF% and waist circumference (Health outcomes). Given the variety in sample size and lack of control measures, further high-quality research is needed to confirm the findings of study two and the causality of intervention participation on health outcomes. Considering the responses given in study three and four, future studies may also benefit from considering how initial PL impacts intervention experiences, both for teachers implementing and children participating. It has been suggested that adopting the youth promotion model may help policy makers and educators understand these contributions and encourage intervention participation.

To conclude, the thesis demonstrated that Barnet's Golden Kilometre can enhance the domains of PL when implementation considers the pupils' needs and abilities. These findings can be used to inform schools and policy on implementing and developing these interventions to enhance pupils PL experiences and increase the likelihood of PA participation in other settings. Additionally, suggestions from study two can be used to inform future data collection in school settings, and recommendations from study three and four can be used to inform the development of the intervention to be more enjoyable and worthwhile for children and teachers which may create a more sustainable intervention in schools.

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Appendix

Appendix A: PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 38
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 38
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	4.1 Introduction
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	4.1 Introduction
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	4.2.2 Inclusion and exclusion criteria
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	4.2.1 Search strategy
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	4.2.1 Search strategy
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	4.2.3 Study selection and extraction
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	4.2.3 Study selection and extraction

Section and Topic	Item #	Checklist item	Location where item is reported
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	4.2.3 Study selection and extraction
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	4.2.3 Study selection and extraction
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	4.2.4 Quality and reporting
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	n/a
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	4.2.5 Data synthesis
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	4.2.5 Data synthesis
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Table 4 and 5
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	4.2.5 Data synthesis
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	n/a
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	n/a
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	4.2.4 Quality and reporting

Section and Topic	Item #	Checklist item	Location where item is reported
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	4.2.4 Quality and reporting
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	4.3.1 Study selection Figure 8
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	4.4
Study characteristics	17	Cite each included study and present its characteristics.	Table 6
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Table 5
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimates and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	4.3.1, 4.3.4 and 4.3.5
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	4.2.4 and 4.4
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	4.3 Results
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	4.3 and 4.4
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	4.3 and 4.4.
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	4.2.5 and 4.4
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	4.2.4 and 4.4

Section and Topic	Item #	Checklist item	Location where item is reported
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	4.4
	23b	Discuss any limitations of the evidence included in the review.	Limitations
	23c	Discuss any limitations of the review processes used.	Limitations
	23d	Discuss implications of the results for practice, policy, and future research.	4.4
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	4.2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	4.2
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	n/a
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	n/a
Competing interests	26	Declare any competing interests of review authors.	n/a see publication
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	n/a

Appendix B: Study 1 Ethical Approval granted by Middlesex University Ethics Committee

Middlesex University London

London Sport Institute REC

The Burroughs
Hendon
London NW4 4BT

Main Switchboard: 0208 411 5000

04/05/2021

APPLICATION NUMBER: 18014

Dear Shannah Anico and all collaborators/co-investigators

Re your application title: School-based Running programmes and physical literacy

Supervisor: Lizi Smith, Laura Wilson

Co-investigators/collaborators:

Thank you for submitting your application. I can confirm that your application has been given APPROVAL from the date of this letter by the London Sport Institute REC.

The following documents have been reviewed and approved as part of this research ethics application:

Document Type	File Name	Date	Version
Methods and data	SR&MA For ethics	29/04/2021	1

Although your application has been approved, the reviewers of your application may have made some useful comments on your application. Please look at your online application again to check whether the reviewers have added any comments for you to look at.

Also, please note the following:

1. Please ensure that you contact your supervisor/research ethics committee (REC) if any changes are made to the research project which could affect your ethics approval. There is an Amendment sub-form on MORE that can be completed and submitted to your REC for further review.

2. You must notify your supervisor/REC if there is a breach in data protection management or any issues that arise that may lead to a health and safety concern or conflict of interests.

3. If you require more time to complete your research, i.e., beyond the date specified in your application, please complete the Extension sub-form on MORE and submit it your REC for review.

4. Please quote the application number in any correspondence.

5. It is important that you retain this document as evidence of research ethics approval, as it may be required for submission to external bodies (e.g., NHS, grant awarding bodies) or as part of your research report, dissemination (e.g., journal articles) and data management plan.

6. Also, please forward any other information that would be helpful in enhancing our application form and procedures - please contact MOREsupport@mdx.ac.uk to provide feedback.

Good luck with your research.

Yours sincerely

Chairs Dr Rhonda Cohen/ Dr Anne Elliott

Appendix C: TIDier Checklist

Item number	Item	Where located **	
		Primary paper (page or appendix number)	Other † (details)
	BRIEF NAME		Heading
1.	Provide the name or a phrase that describes the intervention.	64	5.2.1
	WHY		
2.	Describe any rationale, theory, or goal of the elements essential to the intervention.	64	5.2.1
	WHAT		
3.	Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).	64	5.2.1
4.	Procedures: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.	64	5.2.1
	WHO PROVIDED		
5.	For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.	64	5.2.1
	HOW		
6.	Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.	64 - 65	5.2.1
	WHERE		
7.	Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.	64 - 65	5.2.1

	WHEN and HOW MUCH		
8.	Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.	67	5.2.2
	TAILORING		
9.	If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.	66	5.2.2
	MODIFICATIONS		
10.‡	If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).	66	5.2.2
	HOW WELL		
11.	Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.	67	5.2.2
12.‡	Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.	66	5.2.2

Appendix D: Intervention Logbook

BARNET LONDON BOROUGH

Middlesex University London

Date	Pupils in class	Pupils that took part	Notes
E.g. 20/09/2021	*E.g. 30*	*E.g. 28*	
E.g. 21/09/2021	*E.g. 30*	*E.g. 0*	*Intervention missed - Bad weather*

Appendix E: Study 2, 3 and 4 Ethical Approval granted by Middlesex University Ethics Committee

Middlesex University London

London Sport Institute REC

The Burroughs
Hendon
London NW4 4BT

Main Switchboard: 0208 411 5000

14/11/2019

APPLICATION NUMBER: 8315

Dear Shannah Anico and all collaborators/co-investigators

Re your application title: Physical Literacy and the Mayors Golden Km

Supervisor: Elizabeth Smith

Co-investigators/collaborators:

Thank you for submitting your application. I can confirm that your application has been given APPROVAL from the date of this letter by the London Sport Institute REC.

Changes are made to a good standard and provides a more robust application - happy to approve. Good luck with the data collection.

The following documents have been reviewed and approved as part of this research ethics application:

Document Type	File Name	Date	Version
Materials	Materials and equipment information	04/10/2019	M&E extended
Permission/Agreement Letter	Signed gatekeeper letter	17/10/2019	2
Parent/Guardian Informed Consent	Child Parent consent form	18/10/2019	1
Data Protection Act checklist	(LSI) Data Protection Checklist	30/10/2019	1
GDPR Declaration	Data Protection Declaration Form	31/10/2019	1
Aims, objectives and hypotheses	PLMGKM Rationale	04/11/2019	1
Participant Information Sheet	Teacher information sheet	04/11/2019	2
Participant Information Sheet	Parent Teacher consent form	04/11/2019	2
Participant Information Sheet	Child Parent consent form	04/11/2019	1
Methods and data	Methods	05/11/2019	2
Participant Recruitment Information	Information sheet	05/11/2019	2
Further details	6.3a comments	05/11/2019	1
Participant Information Sheet	Child Information sheet	05/11/2019	2
Participant Information Sheet	Parent Child information sheet 1	12/11/2019	3
Risk Assessment	Interview Risk Assessment Form (1)	12/11/2019	2
Risk Assessment	Risk Assessment Form Quantitative (1)	12/11/2019	2
Participant Information Sheet	Parent information sheet (5)	12/11/2019	3
Resubmission Response to Feedback Summary	Resubmission Feedback Summary (1)	12/11/2019	2
Revised documents as part of resubmission	Parent information sheet (5)	12/11/2019	2
Revised documents as part of resubmission	Interview Risk Assessment Form (1)	12/11/2019	2
Revised documents as part of resubmission	Risk Assessment Form Quantitative (1)	12/11/2019	2

Although your application has been approved, the reviewers of your application may have made some useful comments on your application. Please look at your online application again to check whether the reviewers have added any comments for you to look at.

Also, please note the following:

1. Please ensure that you contact your supervisor/research ethics committee (REC) if any changes are made to the research project which could affect your ethics approval. There is an Amendment sub-form on MORE that can be completed and submitted to your REC for further review.

2. You must notify your supervisor/REC if there is a breach in data protection management or any issues that arise that may lead to a health and safety concern or conflict of interests.

3. If you require more time to complete your research, i.e., beyond the date specified in your application, please complete the Extension sub-form on MORE and submit it your REC for review.

4. Please quote this application number in any correspondence.

5. It is important that you retain this document as evidence of research ethics approval, as it may be required for submission to external bodies (e.g., NHS, grant awarding bodies) or as part of your research report, dissemination (e.g., journal articles) and data management plan.

6. Also, please forward any other information that would be helpful in enhancing our application form and procedures - please contact MOREsupport@mdx.ac.uk to provide feedback.

Good luck with your research.

Yours sincerely,

Chair Dr Rhonda Cohen

London Sport Institute REC

Appendix F: Gatekeeper letters

Wessex Gardens Primary and Nursery School
Wessex Gardens, Golders Green, London NW11 9RR

☎ 020 8455 9572 office@wessexgardens.barnet.sch.uk
www.wessexgardens.co.uk

Alexander Banks Headteacher
Gorana Henry Deputy Headteacher

To Whom it may concern,

I certify that Shannah Anico has been granted permission to collect data in relation to the study: ***Physical Literacy and The Mayor of Barnet's Golden Kilometre.***

Participation in this study includes data collection with Reception, Year 1, 2, 3, 4, 5, and 6 children, teaching staff and parents/carers. Specifically, data collection will relate to the following:

Pupil Participation:
Each pupil participant will participate in the tests listed below during PE lessons or organised school sessions. Follow up assessments at 6 and 12 months from starting The Mayor of Barnet's Golden Kilometre will also be conducted.

- Fundamental movement skill tests lasting up to 1 hour/ one PE lesson. This requires the pupil participants to perform six locomotor skills (run, slide, hop, leap, gallop and horizontal jump) and six object control skills (catch, kick, underarm roll, overarm throw, stationary dribble and striking a stationary ball). This measure will be filmed using video cameras for later analysis off out of school.
- Anthropometric measures: This includes taking height, mass, gender and date of birth to calculate age and BMI Z scores.
- Body fat percentage using impedance scales. Pupil participant's sex, age, height and activity level (active or non-active) will be entered into the impedance scales. The researcher will record the pupil participant's weight to the nearest kg, and body fat percentage.
- Waist to hip ratio recordings using a non-stretchable anthropometric tape measure. Waist circumference will be taken by placing the tape midway between the 10th rib and superior iliac crest. Hip circumference will be measured around the widest portion of the buttocks. Both measurements will be recorded to the nearest cm and waist to hip ratio calculated by diving waist by hip readings.
- Physical activity data will be obtained by the participants wearing a waterproof GeneActiv Accelerometer watch. The watches objectively measure physical activity behaviour. The watches will be configured to each participant using the anthropometric data collected. The participants will wear the watches for seven days before returning them to school for the research team to later analyse.
- The Canadian assessment of physical literacy questionnaire assessing motivation and confidence will be completed by children from the age of 6 years+ in a quiet classroom with assured confidentiality. The questionnaire is made up of 12 questions that addresses; adequacy, predilection, intrinsic motivation, and perceived competence satisfaction. Children below age six will not be required to complete a questionnaire.
- Wellbeing and lifestyle questionnaire developed by a child psychiatrist, comprising of 11 questions about thoughts and feelings towards exercise and healthy eating. Some items use the smiley face 1-10 Likert scale, and other questions will require writing or drawing.
- One or two focus groups per year group with 5 participants will be conducted to investigate unique experiences and gain individualised understanding of the participant's physical literacy journey. The groups will be led by the researcher and the children's teacher to ensure participants are comfortable when sharing their opinions. The focus groups will be conducted in school or virtually using the online platform 'ZOOM'. Focus groups in school will be recorded using a dictaphone, and virtual discussions recorded and saved directly to a password secure laptop.

As an intervention school, the participants will also take part in the Mayors Golden Kilometre intervention. The children will walk, run or jog one kilometre every day they are at school supervised by teachers. We ask that you complete our Mayor for Barnet's Golden Kilometre diary that details a record of any missed days.

Parent/ Carer and School Staff Participation
The tests listed below will be performed by each parent/carer and teacher participant in school. Follow up assessments at 6, and 12 months from starting The Mayor of Barnet's Golden Kilometre will also be conducted.

- One off online questionnaires will be distributed to parents/carers and teaching staff via SchoolPing email. The short questionnaires ask briefly for parents/carers and teachers opinions on implementing the Mayor's golden kilometre and physical literacy.
- Focus groups with parents/carers will also be organised to explore their perceptions towards physical activity and the Mayor of Barnet's Golden Kilometre in more detail. The focus groups will be conducted in school or virtually using the online video call platform 'ZOOM'. Focus groups in school will be recorded using a dictaphone, and virtual discussions recorded on a secured laptop and saved directly to a password secure laptop.
- One to one interviews will be conducted with a number of teachers to gain an understanding of their knowledge and experience of physical literacy and thoughts on The Mayor of Barnets Golden Kilometre. Interviews will be conducted in a private room in school or virtually using the online video call platform 'ZOOM'. The interviews in school will be recorded using a Dictaphone, and virtual discussions recorded on a secured laptop and saved directly to a password secure laptop.

I acknowledge that reception, Year 1, 2, 3, 4, 5 and 6 pupils, teaching staff and parents/carers will be required to provide consent forms and participant information sheets to take part in the study.

Following the COVID-19 outbreak, I understand and agree with all the health and safety measures Middlesex University will follow throughout data collection. Middlesex University will also adhere to school data protection policies and risk assessments that the school lead will disclose to the research team prior to data collection commencing.

The study may proceed subject to approval from the Middlesex University Ethics Sub-Committee.

Yours sincerely,

Alexander Banks
Headteacher

St Martins School
22 Goodwyn Avenue
NW7 3RG

To Whom it may concern,

I certify that Shannah Anico has been granted permission to collect data in relation to the study:

Physical Literacy and The Mayor of Barnet's Golden Kilometre

Participation in this study includes data collection with Year 3, 4, 5 and 6 pupils, teaching staff and pupil parents/guardians. Specifically, data collection will relate to the following:

Pupil Participation:
Each pupil participant will participate in the tests listed below during PE lessons or organised school sessions. Follow up assessments at 6, and 12 months from starting The Mayor of Barnet's Golden Kilometre will also be conducted.

- Fundamental movement skill tests lasting up to 1 hour/ one PE lesson. This requires the pupil participants to perform six locomotor (Run, slide, hop, leap, gallop and horizontal jump) and seven object control skills (Catch, kick, underarm roll, overarm throw, stationary dribble and striking a stationary ball). This measure will be filmed using video cameras for later analysis off school grounds.
- Anthropometric measures: This includes taking height, mass, gender and date of birth to calculate age and BMI Z scores.
- Body fat percentage using impedance scales. Pupil participants sex, age, height and activity level (active or non-active) will be entered into the impedance scales. The researcher will record the pupil participants weight to the nearest kg, and body fat percentage.
- Waist to hip ratio recordings using a non-stretchable anthropometric tape measure. Waist circumference will be taken by placing the tape midway between the 10th rib and superior iliac crest. Hip circumference will be measured around the widest portion of the buttocks. Both measurements will be recorded to the nearest cm and waist to hip ratio calculated by diving waist by hip readings.
- Physical activity data will be obtained by the participants wearing a waterproof GeneActiv Accelerometer watch. The watches objectively measure physical activity behaviour. The watches will be configured to each participant using the anthropometric data collected. The participants will wear the watches for seven days before returning them to school for the research team to later analysis.
- The Canadian assessment of physical literacy questionnaire assessing motivation and confidence will be completed by children from the age of 6 years+ in a quiet classroom with assured confidentiality. The questionnaire is made up of 12 questions that addresses; adequacy, predilection, intrinsic motivation, and perceived competence satisfaction. Children below age six will not be required to complete a questionnaire.
- Wellbeing and Lifestyle questionnaire developed by a child psychiatrist, comprising of 11 questions about thoughts and feelings towards exercise and healthy eating. Some items use the smiley face 1-10 Likert scale, and other questions will require writing or drawing.
- One or two focus groups per year group with 5 participants will be conducted to investigate unique experiences and gain individualised understanding of the participant's physical literacy journey. The groups will be led by the researcher and the children's teacher to ensure participants are comfortable when sharing their opinions. The focus groups will be conducted on school grounds or virtually using the school's online platform 'ZOOM'. Focus groups on school grounds will be recorded using a Dictaphone, and virtual discussions recorded on a secured laptop and saved directly to a password secure laptop.

As an intervention school, the participants will also take part in the Mayors Golden Kilometre intervention. The children will walk, run or jog one kilometre a day, every day they are at school supervised by teachers. We ask that you complete our Mayor for Barnet's Golden Kilometre diary that details a record of any missed days.

Parent/ Guardian and School staff Participation
The tests listed below will be performed by each parent and teacher participant on school grounds. Follow up assessments at 6, and 12 months from starting The Mayor of Barnet's Golden Kilometre will also be conducted.

- One off online questionnaire will be distributed to parents and teaching staff via email. The short questionnaires ask briefly for parents and teachers' opinions on implementing the Mayors golden kilometre and physical literacy.
- Focus groups with parents will also be organised to explore their perceptions towards physical activity and the Mayor of Barnet's Golden Kilometre in more detail. The focus groups will be conducted on school grounds or virtually using an online video call platform 'ZOOM'. Focus groups on school grounds will be recorded using a Dictaphone, and virtual discussions recorded on a secured laptop and saved directly to a password secure laptop.
- One to one interview will be conducted with a number of teaching staff to gain an understanding of their knowledge and experience of physical literacy and thoughts on The Mayor of Barents Golden kilometre. Interviews will be conducted in a private room on school grounds or virtually using the online video call platform 'ZOOM'. The interviews on schools' grounds will be recorded using a Dictaphone, and virtual discussions recorded on a secured laptop and saved directly to a password secure laptop.

I acknowledge that Year 3 and 4 pupils, teaching staff and pupils' parents/ guardians will be required to provide consent forms and participant information sheets to take part in the study.

Following the COVID-19 outbreak, I understand and agree with all the health and safety measures Middlesex University will follow throughout data collection. Middlesex University will also adhere to school risk assessments and that the school lead will disclose with the research team prior to data collection commencing.

The study may proceed subject to approval from the Middlesex University Ethics Sub-committee.

Yours Sincerely,

Sam Mbah
Head Teacher

Appendix G: Study two and four information and consent forms

MIDDLESEX UNIVERSITY

SCHOOL OF SCIENCE AND TECHNOLOGY

LONDON SPORT INSTITUTE ETHICS SUB-COMMITTEE

PARTICIPANT SHEET (PS) INTERVENTION SCHOOL

Congratulations! You are being asked to take part in this exciting study. This means that you will be required to participate in some small tests twice per year and participate in the ongoing Mayors Golden Km with your school. If that sounds good just read on and see if you still like the idea at the end.

All data collection will be completed during your school PE lessons or class time. The tests included:

You will be asked to do some skills like running and catching. We will do some body measurements on you to see how tall you are and how much you weigh. We will ask you to fill out some questionnaires about your feelings towards physical activity and your lifestyle. We might ask you to talk to us about your feelings too with some of the other children.

If all of this sounds good and you want to take part then that's great, just let your parent or guardian know. If you can't take part or you don't want to that is fine too. If you start the study and you don't like it and want to drop out then that is no problem either.

Thank you,

Shannah Anico

S.Anico@mdx.ac.uk

Lizi Smith

L.smith@mdx.ac.uk

MIDDLESEX UNIVERSITY

PARENT/ GUARDIAN INFORMATION FOR CHILD PARTICIPATION

SECTION 1

1. Study title

Physical Literacy and the Mayors Golden Km

2. Invitation paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

3. What is the purpose of the study?

To evaluate the effects on physical literacy components (height, weight, BMI, physical activity, fundamental movement skills competency, student behaviour and mental well-being) on primary school children who run or jog a km every day whilst at school. To explore the teacher's current knowledge and understanding of physical literacy and its assessment. To explore student and parent's perceptions of the daily kilometre and physical.

4. Why have I been chosen?

It is important that we assess as many participants as possible, and you have indicated that you are interested in taking part in this study.

5. Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. If you do decide to withdraw from the study then please inform the researcher as soon as possible, and they will facilitate your withdrawal. If, for any reason, you wish to withdraw your data please contact the researcher within a month of your participation. After this data it may not be possible to withdraw your individual data as the results may have already been published. However, as all data are anonymised, your individual data will not be identifiable in any way.

A decision to withdraw at any time is fine. Any data collected so far will be removed from the study and deleted.

6. What will I have to do?

The data collection will be spread out over one school week and will take place during PE classes or assigned sessions by the school. Participants will complete data collection groups based on their already allocated school registration classes

- Fundamental movement skill tests. This requires the pupil participants to perform 6 locomotor (Run, slide, hop, leap, gallop and horizontal jump) and 6 object control skills (Catch, kick, underarm roll, overarm throw, stationary dribble and striking a stationary ball). This test will be video recorded for later analysis.
- Height, weight, gender and date of birth obtained to allow age and BMI Z scores to be calculated.
- Body fat percentage using impedance scales
- Waist to hip ratio recordings using a tape measure. Waist circumference will be taken my placing the tape midway between the bottoms of the ribs and tip of the hip. Hip circumference will be measured around the widest portion of the buttocks.
- The participants will wear accelerometer watches on their non dominant wrist for one week to measure physical activity behaviour. The watches will be configured to each individual participant using the previous height and weight data collected.

- A quick motivation and confidence questionnaire will be completed by children from the age of 6 years and above in a quiet classroom with assured confidentiality. It is made up of 12 questions that addresses; adequacy, predilection, intrinsic motivation, and perceived competence satisfaction. Children below age 6 will not be required to complete a questionnaire.
- A second well-being questionnaire comprising of 11 questions about thoughts and feelings towards exercise and healthy eating. Some questions use the smiley face 1-10 likert scale and other questions participant can write or draw their answers.
- One or two focus groups per year group will be conducted to investigate gain an understanding of physical literacy journey. The groups will be led by the researcher and children's teacher to ensure participants were comfortable when sharing their opinions, 5/6 participants will participate per group and will be selected at random by class teachers using a random computer generator. This focus group will be voice recorded for analysis at a later date.

Collection of postcode via school data base. The primary school head teacher will provide pupils postcodes to the research team. Participants ID is anonymised and the research team will not have access to any personal details including participant names. Only the school head teacher will access school registers to match ID and names.

Please note that in order to ensure quality assurance and equity this project may be selected for audit by a designated member of the committee. This means that the designated member can request to see signed consent forms. However, if this is the case your signed consent form will only be accessed by the designated auditor or member of the audit team.

7. Will I have to provide any bodily samples (i.e. blood/saliva/urine)?

No

8. What are the possible disadvantages and risks of taking part?

Participants are required to take part in the school run Mayors Golden km once per day every school day, this involved a light run or jog of 1km. Additionally the fundamental movement skill tests are of a low intensity. This may cause some tiredness and fatigue for participants, but it is unlikely. If participate do become tired or fatigued they will be able to stop immediately.

Will there be any psychological discomfort or embarrassment?

Focus groups are conducted with some participants selected at random. The group will be led by the researcher and the class teacher to ensure participants are comfortable. Participants can verbally opt to not to be selected for the focus groups if they wish. Appropriate risk assessments for all procedures have been conducted, and will be followed throughout the duration of the study.

9. What are the possible benefits of taking part?

We hope that participating in the study will help you. However, this cannot be guaranteed. The information we get from this study may help us to develop the concept of physical literacy and participants understanding, As well as develop the roll out of the Mayors Golden Km and therefore help to encourage the participation in physical activity.

9. Will my taking part in this study be kept confidential?

The research team has put a number of procedures in place to protect the confidentiality of participants. You will be allocated a participant code that will always be used to identify any data you provide. Your name or other personal details will not be associated with your data, for example, the consent form that you sign will be kept separate from your data. All paper records will be stored in a locked filing cabinet, accessible only to the research team, and all electronic data will be stored on a password protected computer. All information you provide will be treated in accordance with the UK Data Protection Act.

10. What will happen to the results of the research study?

The results of the research study will be used as part of an Postgraduate dissertation. The results may also be presented at conferences or in journal articles. However, the data will only be used by members of the research team and at no point will your personal information or data be revealed.

11. Who has reviewed the study?

The study has received full ethical clearance from the Research ethics committee who reviewed the study. The committee is the London Sports Institute ethics committee

12. Contact for further information

If you require further information, have any questions or would like to withdraw your data then please contact:

Shannah Anico

S.Anico@mdx.ac.uk

Supervisor:

Dr Laura Wilson

L.Wilson@mdx.ac.uk

Thank you for taking part in this study. You should keep this participant information sheet as it contains your participant code, important information and the research teams contact details

SECTION 2

Middlesex University Guide to Research Privacy Notices

Privacy notices need to be presented whenever data is collected and should be understandable and accessible. Privacy notices must explain the type and source of data that will be processed. They will also set out the processing purpose, data retention schedules and data sharing. Privacy notices must include details of the subject's rights and who the subject can complain to.

Middlesex University Privacy Notice for Research Participants

The General Data Protection Regulation (GDPR) protects the rights of individuals by setting out certain rules as to what organisation can and cannot do with information about people. A key element to this is the principle to process individuals' data lawfully and fairly. This means we need to provide information on how we process personal data.

The University takes its obligation under the GDPR very seriously and will always ensure personal data is collected, handled, stored and shared in a secure manner. The University's Data Protection Policy can be accessed here: https://www.mdx.ac.uk/__data/assets/pdf_file/0023/471326/Data-Protection-Policy-GPS4-v2.4.pdf.

The following statements will outline what personal data we collect, how we use it and who we share it with. It will also provide guidance on your individual rights and how to make a complaint to the Information Commissioner's Officer (ICO), the regulator for data protection in the UK.

Why are we collecting your personal data?

As a university we undertake research as part of our function and in our capacity as a teaching and research institution to advance education and learning. The specific purpose for data collection on this occasion is to evaluate the effects on weight status, physical activity, fundamental movement skills competency, student behaviour and mental well-being throughout participation in the mayors golden km, And additionally to explore student perceptions of the mayors golden km and physical literacy.

The legal basis for processing your personal data under GDPR on this occasion is Article 6(1a) consent of the data subject.

Transferring data outside Europe

In the majority of instances your data will be processed by Middlesex University researchers only or in collaboration with researchers at other UK or European institutions so will stay inside the EU and be protected by the requirements of the GDPR.

In any instances in which your data might be used as part of a collaboration with researchers based outside the EU all the necessary safeguards that are required under the GDPR for transferring data outside of the EU will be put in place. You will be informed if this is relevant for the specific study you are a participant of.

Your rights under data protection

Under the GDPR and the DPA you have the following rights:

- to obtain access to, and copies of, the personal data that we hold about you;
- to require that we cease processing your personal data if the processing is causing you damage or distress;
- to require us to correct the personal data we hold about you if it is incorrect;
- to require us to erase your personal data;
- to require us to restrict our data processing activities;
- to receive from us the personal data we hold about you which you have provided to us, in a reasonable format specified by you, including for the purpose of you transmitting that personal data to another data controller;
- to object, on grounds relating to your particular situation, to any of our particular processing activities where you feel this has a disproportionate impact on your rights.

Where Personal Information is processed as part of a research project, the extent to which these rights apply varies under the GDPR and the DPA. In particular, your rights to access, change, or move your information may be limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we may not be able to remove the information that we have already obtained. To safeguard

your rights, we will use the minimum personally-identifiable information possible. The Participant Information Sheet will detail up to what point in the study data can be withdrawn.

If you submit a data protection rights request to the University, you will be informed of the decision within one month. If it is considered necessary to refuse to comply with any of your data protection rights, you also have the right to complain about our decision to the UK supervisory authority for data protection, the Information Commissioner's Office. None of the above precludes your right to withdraw consent from participating in the research study at any time.

Collecting and using personal data

Data will be collected following the tests stated above in section 1 part 8. All data will be coded to an ID Number per participant to anonymise the data

Data sharing

Your information will usually be shared within the research team conducting the project you are participating in, mainly so that they can identify you as a participant and contact you about the research project.

Responsible members of the University may also be given access to personal data used in a research project for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your records. All of these people have a duty to keep your information, as a research participant, strictly confidential.

If we are working with other organisations and information is shared about you, we will inform you in the Participant Information Sheet. Information shared will be on a 'need to know' basis relative to achieving the research project's objectives, and with all appropriate safeguards in place to ensure the security of your information.

Storage and security

The University takes a robust approach to protecting the information it holds with dedicated storage areas for research data with controlled access.

Alongside these technical measures there are comprehensive and effective policies and processes in place to ensure that users and administrators of University information are aware of their obligations and responsibilities for the data they have access to. By default, people are only granted access to the information they require to perform their duties. Training is provided to new staff joining the University and existing staff have training and expert advice available if needed.

Retention

Under the GDPR and DPA personal data collected for research purposes can be kept indefinitely, providing there is no impact to you outside the parameters of the study you have consented to take part in.

Having stated the above, the length of time for which we keep your data will depend on a number of factors including the importance of the data, the funding requirements, the nature of the study, and the requirements of the publisher. Details will be given in the information sheet for each project.

Contact us

The Principal Investigator leading this research is Shannah Anico

07521007963

S.Anico@mdx.ac.uk

The University's official contact details are:

Data Protection Officer

Middlesex University

The Burroughs

London

NW4 4BT

Tel: +44 (0)20 8411 5555
Email: dpaofficer@mdx.ac.uk

CONSENT FORM

Child/Young Person and Parent/Guardian

Please initial box

1. The study has been explained to me by ……. and explained in further detail on the information sheets provided

2. I have been asked if I have any questions and all my questions have been answered so that I understand more about the study and how it will affect me.

3. I know that I do not have to take part and can stop at any time without giving a reason (2).

4. I agree to take part in the study on Physical Literacy and the Mayors Golden Km

Name: Date:

Signature: Age:

PART B MUST BE COMPLETED BY THE PARENT/GUARDIAN

1. I confirm that I have read the information sheet dated..... for the above study. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.

2. I understand that my child/young person's participation is voluntary and that he/she is free to withdraw at any time without giving any reason, without his/her medical care or legal rights being affected.

3. I understand that the information collected about my child/young person will be used to support other research in the future and may be shared with other researchers. The data will be anonymised/pseudo-anonymised (delete and explain as appropriate).

4. I agree for my child/young person to take part in the study on The Mayor of Barnet's Golden kilometre.

This form must be completed and returned to the research team for the named child/young person to be included in this study

Please return the consent letter to your child's school teacher by

Further information about the study is contained in the information sheet for young people and parents/guardians.

Add the name of the person taking consent (Student name): _____

Date _____

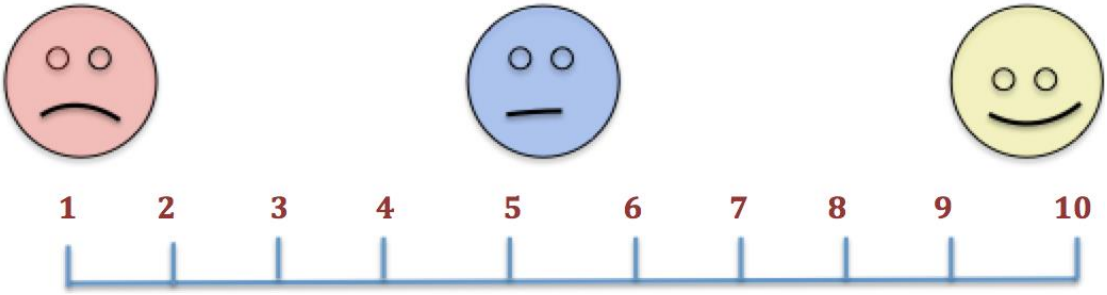
Signature_____

Appendix H: Well-being and lifestyle questionnaire

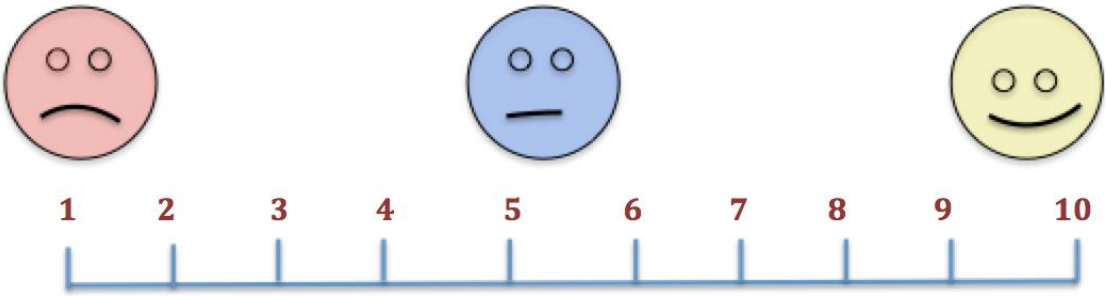
Name: Year Group: Date:

Before the daily kilometre:

1. On a scale of 1-10 how much energy do you think you have?



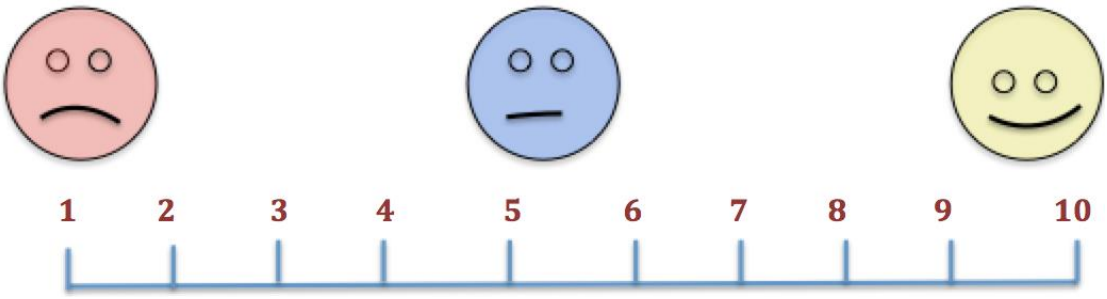
2. On a scale of 1-10 how do you feel before exercise?



3. What words would you use to describe this feeling?

4. What is exercise?

5. On a scale of 1-10 how do you feel after exercise?



6. What words would you use to describe this feeling?

7. Do you exercise at home after school or on the weekends?

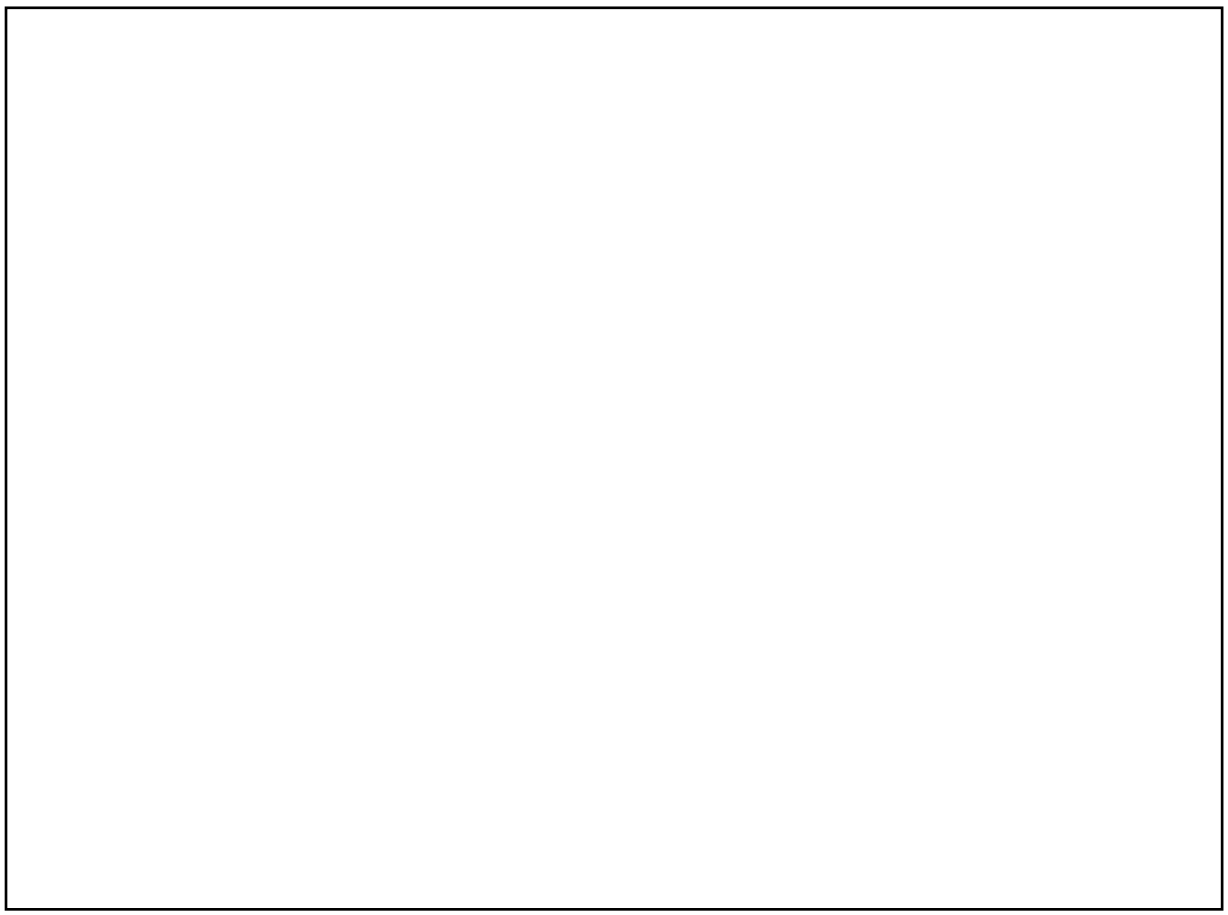
8. If so what exercise do you do?

9. What do you think is healthy eating?

10. Do you enjoy eating healthily?

11. What is your favourite food?

Please feel free to draw a picture of how running the Mayors Golden Kilometre makes you feel:



Appendix I: PA Data

Weekly Table

	Baseline vs. Mid		Mid vs. End of term		Baseline vs. End of term	
	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value
Weekly Sedentary						
Morning						
All	-4.204 (-13.342 to 4.934)	.663	1.987 (-12.509 to 16.483)	1	-2.217 (-14.392 to 9.957)	1
Female	-6.390 (-21.277 to 8.496)	.738	0.207 (-23.671 to 24.084)	1	-6.184 (-25.757 to 13.389)	
Male	-2.643 (-15.224 to 9.938)	1	3.259 (-16.922 to 23.439)	2	0.616 (-15.926 to 17.158)	1
Year 3	-9.790 (-25.541 to 5.960)	.293	7.375 (-12.252 to 27.002)	.870	-2.415 (-19.297 to 14.466)	1
Year 4	-2.143 (-22.477 to 18.191)	1	6.698 (-18.640 to 32.036)	1	4.556 (-17.238 to 26.349)	1
Year 5	2.048 (-18.286 to 22.381)	1	-18.114 (-43.452 to 7.224)	.190	-16.067 (-37.860 to 5.727)	.171
Year 6	-1.214 (-36.433 to 34.005)	1	21.214 (-22.673 to 65.101)	.549	20.000 (-17.748 to 57.748)	.446
Day						
All	-7.780 (-38.261 to 22.701)	1	9.974 (-16.855 to 36.804)	.951	2.194 (-18.713 to 23.102)	1
Female	-15.324 (-64.924 to 34.277)	1	11.133 (-33.211 to 55.478)	1	-4.190 (-37.922 to 29.541)	1
Male	-2.391 (-44.311 to 39.529)	1	9.146 (-28.332 to 46.624)	1	6.755 (-21.753 to 35.263)	1
Year 3	2.129 (-45.920 to 50.178)	1	10.097 (-31.709 to 51.903)	1	12.226 (-22.164 to 46.615)	.945
Year 4	-10.095 (-72.126 to 51.936)	1	20.056 (-33.915 to 74.027)	.885	9.960 (-34.436 to 54.357)	1
Year 5	-37.373 (-99.404 to 24.658)	.320	19.862 (-34.109 to 73.833)	.898	-17.511 (-61.907 to 26.885)	.805
Year 6	38.405 (-69.036 to 145.846)	.937	-50.548 (-144.028 to 42.933)	.425	-12.143 (-89.040 to 64.754)	1
Evening						
All	-2.411 (-22.386 to 17.565)	1	-0.067 (-23.511 to 23.376)	1	-2.478 (-31.441 to 26.485)	1
Female	3.076 (-29.307 to 35.459)	1	-14.119 (-49.105 to 20.867)	.821	-11.043 (-57.844 to 35.758)	1
Male	-6.330 (-33.698 to 21.039)	1	9.969 (-19.599 to 39.538)	1	3.639 (-35.914 to 43.193)	1
Year 3	10.681 (-16.660 to 38.022)	.818	-6.623 (43.140 to 29.894)	1	4.058 (-50.446 to 58.562)	1
Year 4	-14.714 (-50.012 to 20.583)	.732	17.175 (-29.969 to 64.318)	.912	2.460 (-67.905 to 72.825)	1
Year 5	-21.865 (-57.163 to 13.432)	.296	8.300 (-38.843 to 55.443)	1	-13.565 (83.930 to 56.800)	1
Year 6	27.405 (-33.732 to 88.542)	.640	-44.119 (-125.773 to 37.535)	.426	-16.714 (-138.590 to 1-5.161)	1
Weekly Light						
Morning						

All	2.990 (-3.826 to 9.806)	.725	1.509 (-9.760 to 12.778)	1	4.499 (-4.941 to 13.939)	.618
Female	7.652 (-2.163 to 17.468)	.148	2.960 (-15.595 to 21.515)	1	10.612 (-3.205 to 24.430)	.156
Male	-0.340 (-8.636 to 7.956)	1	0.473 (-15.209 to 16.154)	1	0.133 (-11.545 to 11.810)	1
Year 3	9.367 (-0.380 to 19.113)	.060	-2.645 (-17.554 to 12.265)	1	6.722 (-4.584 to 18.028)	.332
Year 4	-0.619 (-13.202 to 11.964)	1	-5.190 (-24.438 to 14.057)	1	-5.810 (-20.406 to 8.786)	.793
Year 5	-2.381 (-14.964 to 10.202)	1	18.127 (-1.121 to 37.375)	.065	15.746 (1.150 to 30.342)	.035*
Year 6	-1.952 (-23.746 to 19.841)	1	-7.476 (-40.815 to 25.862)	.880	-9.429 (-34.710 to 15.852)	.880
Day						
All	-5.798 (-31.288 to 19.693)	1	-5.421 (-28.448 to 17.606)	1	-11.219 (-25.972 to 3.535)	.166
Female	4.262 (-36.159 to 44.683)	1	-12.468 (-49.614 to 24.679)	1	-8.206 (-32.339 to 15.928)	1
Male	-12.983 (-47.145 to 21.179)	.903	-0.388 (-31.782 to 31.006)	1	-13.371 (-33.767 to 7.026)	.268
Year 3	-8.395 (-45.398 to 28.607)	1	-9.709 (-41.221 to 21.804)	1	-18.104 (-41.599 to 5.392)	.146
Year 4	-4.905 (-52.675 to 42.865)	1	-13.071 (-53.753 to 27.611)	1	-17.976 (-48.309 to 12.356)	.335
Year 5	16.571 (-31.198 to 64.341)	.978	-11.821 (-52.503 to 28.861)	1	4.751 (-25.582 to 35.083)	1
Year 6	-62.595 (-145.335 to 20.144)	.156	58.167 (-12.297 to 128.630)	.113	-4.429 (-56.966 to 48.109)	1
Evening						
All	-0.931 (-18.044 to 16.183)	1	1.831 (-10.314 to 13.977)	1	0.901 (-10.700 to 12.502)	1
Female	-0.781 (-27.293 to 25.731)	1	6.176 (-12.639 to 24.992)	1	5.395 (-12.577 to 23.368)	1
Male	-1.037 (-23.444 to 21.370)	1	-1.272 (-17.174 to 14.630)	1	-2.310 (-17.499 to 12.880)	1
Year 3	-11.971 (-31.687 to 7.744)	.313	6.580 (-10.004 to 23.164)	.797	-5.391 (-24.933 to 14.150)	1
Year 4	11.190 (-14.262 to 36.643)	.664	-7.079 (-28.490 to 14.331)	1	4.111 (-21.116 to 29.339)	1
Year 5	14.651 (-10.802 to 40.104)	.362	-5.316 (-26.726 to 16.094)	1	9.335 (-15.893 to 34.562)	.891
Year 6	-28.833 (-72.919 to 15.252)	.252	26.262 (-10.822 to 63.346)	.196	-2.571 (-46.267 to 41.124)	1
Weekly Moderate						
Morning						
All	1.349 (-2.863 to 5.562)	1	-2.963 (-7.984 to 2.057)	.373	-1.614 (-7.128 to 3.900)	1
Female	-1.119 (-7.437 to 5.199)	1	-2.650 (-10.945 to 5.644)	1	-3.770 (-12.520 to 4.981)	.734
Male	3.112 (-2.227 to 8.452)	.376	-3.187 (-10.197 to 3.823)	.664	-0.075 (-7.471 to 7.321)	1
Year 3	0.624 (-7.287 to 8.535)	1	-4.071 (-12.094 to 3.941)	.493	-3.448 (-12.826 to 5.931)	.899
Year 4	3.095 (-7.117 to 13.308)	1	-1.595 (-11.952 to 8.762)	1	1.500 (-10.608 to 13.608)	1

Year 5	0.190 (-10.022 to 10.403)	1	0.598 (-9.758 to 10.955)	1	0.789 (-11.319 to 12.897)	1
Year 6	3.214 (-14.475 to 20.903)	1	-12.214 (-30.153 to 5.724)	.222	-9.000 (-29.972 to 11.972)	.695
Day						
All	9.581 (-3.453 to 22.615)	.187	-7.327 (-21.080 to 6.426)	.483	2.254 (-11.934 to 16.443)	1
Female	7.567 (-13.854 to 28.987)	1	0.034 (-20.959 to 21.027)	1	7.601 (-14.985 to 30.187)	1
Male	11.020 (-7.083 to 29.124)	.334	-12.585 (-30.327 to 5.157)	.207	-1.565 (-20.654 to 17.524)	1
Year 3	4.052 (-19.847 to 27.952)	1	-2.956 (-28.647 to 22.735)	1	1.096 (-26.188 to 28.380)	1
Year 4	10.857 (-19.997 to 41.712)	.959	-7.302 (-40.469 to 25.866)	1	3.556 (-31.668 to 38.779)	1
Year 5	14.714 (-16.140 to 45.569)	.565	-14.127 (-47.294 to 19.040)	.705	0.587 (-34.636 to 35.811)	1
Year 6	18.000 (-35.442 to 71.442)	1	-8.857 (-66.304 to 48.590)	1	9.143 (-51.866 to 70.151)	1
Evening						
All	2.026 (-6.425 to 10.476)	1	-0.963 (-15.025 to 13.099)	1	1.063 (-16.622 to 18.749)	1
Female	-0.143 (-0.622 to 0.337)	1	-0.516 (-1.765 to 0.733)	.789	-0.659 (-1.912 to 0.594)	.487
Male	5.963 (-4.470 to 16.395)	.396	-7.255 (-24.804 to 10.294)	.788	-1.203 (-25.787 to 23.202)	1
Year 3	-0.090 (-16.230 to 16.049)	1	3.878 (-21.065 to 28.821)	1	3.788 (-29.275 to 36.850)	1
Year 4	3.381 (-17.455 to 24.217)	1	-8.794 (-40.995 to 23.407)	1	-5.413 (-48.096 to 37.270)	1
Year 5	3.960 (-16.876 to 24.796)	1	-5.656 (-37.857 to 26.546)	1	-1.695 (-44.378 to 40.988)	1
Year 6	2.738 (-33.351 to 38.827)	1	12.405 (-43.369 to 68.179)	1	15.143 (-58.787 to 89.072)	1
Weekly Vigorous						
Morning						
All	-0.135 (-0.425 to 0.155)	.649	-0.533 (-1.288 to 0.223)	.217	-0.667 (-1.425 to 0.91)	.091
Female	-0.143 (-0.622 to 0.337)	1	-0.516 (-1.765 to 0.733)	1	-0.659 (-1.912 to 0.594)	.0487
Male	-0.129 (-0.534 to 0.276)	1	-0.544 (-1.600 to 0.511)	.509	-0.673 (-1.733 to 0.386)	.294
Year 3	-0.200 (-0.681 to 0.281)	.736	-0.659(-1.942 to 0.623)	.479	-0.859 (-2.198 to 0.480)	.267
Year 4	-0.333 (-0.954 to 0.288)	.432	0.087 (-1.568 to 1.743)	1	-0.246 (-1.974 to 1.482)	1
Year 5	0.143 (-0.478 to 0.764)	1	-0.611 (-2.267 to 1.045)	.894	-0.468 (-2.197 to 1.260)	1
Year 6	-0.048 (-1.123 to 1.028)	1	-1.524 (-4.392 to 1.344)	.443	-1.571 (-4.565 to 1.422)	.456
Day						
All	3.996 (-0.356 to 8.348)	.076	2.774 (-3.949 to 9.497)	.808	6.770 (-1.450 to 14.990)	.121
Female	3.495 (-3.677 to 10.668)	.576	1.300 (-9.679 to 12.279)	1	4.795 (-8.594 to 18.184)	.985
Male	4.354 (-1.708 to 10.416)	.199	3.827 (-5.452 to 13.105)	.792	8.180 (-3.136 to 19.496)	.194

Year 3	2.214 (-5.772 to 10.201)	1	2.568 (-10.018 to 15.153)	1	4.782 (-10.280 to 19.844)	1
Year 4	4.143 (-6.168 to 14.453)	.781	0.371 (-15.931 to 16.565)	1	4.460 (-14.985 to 23.906)	1
Year 5	6.087 (-4.223 to 16.398)	.339	6.086 (-10.162 to 22.334)	.874	12.173 (-7.272 to 31.618)	.287
Year 6	6.190 (-11.668 to 24.049)	.979	1.238 (-26.904 to 29.381)	1	7.429 (-26.252 to 41.109)	1
Evening						
All	1.427 (-1.117 to 3.970)	.426	-0.884 (-6.996 to 5.228)	1	0.543 (-7.155 to 8.240)	1
Female	1.281 (-2.922 to 5.484)	1	-0.016 (-10.071 to 10.038)	1	1.265 (-11.435 to 13.965)	1
Male	1.531 (-2.021 to 5.083)	.733	-1.503 (10.001 to 6.994)	1	0.027 (-10.706 to 10.761)	1
Year 3	1.438 (-2.962 to 5.838)	1	-3,983 (-14.571 to 6.606)	.868	-2.545 (-16.209 to 11.119)	1
Year 4	0.286 (-5.395 to 5.966)	1	-1.397 (-15.067 to 12.273)	1	-1.111 (-18.751 to 16.529)	1
Year 5	3.405 (-2.276 to 9.085)	.325	2.690 (-10.979 to 16.360)	1	6.095 (-11.545 to 23.735)	.984
Year 6	-1.143 (-10.982 to 8.696)	1	5.429 (-18.248 to 29.105)	1	4.286 (-26.268 to 34.839)	1
Weekly MVPA						
Morning						
All	1.214 (-3.001 to 5.430)	1	-3.496 (-8.925 to 1.933)	.290	-2.282 (-8.045 to 3.481)	.864
Female	-1.262 (-7.582 to 5.058)	1	3.617 (-12.135 to 5.802)	1	-4.429 (-13.611 to 4.754)	.589
Male	2.983 (-2.358 to 8.324)	.420	-3.731 (-11.311 to 3.849)	.564	-0.748 (-8.509 to 7.012)	1
Year 3	0.424 (-7.534 to 8.382)	1	-4.730 (-13.372 to 3.911)	.412	-4.307 (-13.894 to 5.280)	.638
Year 4	2.762 (-7.512 to 13.036)	1	-1.508 (-12.664 to 9.648)	1	1.254 (-11.123 to 13.631)	1
Year 5	0.333 (-9.941 to 10.607)	1	-0.013 (-11.168 to 11.143)	1	0.321 (-12.056 to 12.697)	1
Year 6	3.167 (-14.628 to 20.962)	1	-13.738 (-33.060 to 5.584)	.193	-10.571 (-32.009 to 10.866)	.526
Day						
All	13.577 (-0.492 to 27.647)	.060	-4.553 (-21.303 to 12.197)	1	9.024 (-7.040 to 25.089)	.424
Female	11.062 (-12.011 to 34.135)	.579	1.334 (-25.466 to 28.134)	1	12.396 (-13.865 to 38.657)	.616
Male	15.374 (-4.126 to 34.875)	.141	-8.759 (-31.408 to 13.891)	.879	6.616 (-15.579 to 28.810)	1
Year 3	6.267 (-18.708 to 31.241)	1	-0.389 (-32.398 to 31.621)	1	5.878 (-24.773 to 36.530)	1
Year 4	15.000 (-17.242 to 47.242)	.595	-6.984 (-48.308 to 34.340)	1	8.016 (-31.555 to 47.587)	1
Year 5	20.802 (-11.440 to 53.043)	.263	-8.041 (-49.365 to 33.283)	1	12.760 (-26.811 to 52.331)	1
Year 6	24.190 (-31.654 to 80.035)	.683	-8.041 (-49.365 to 33.283)	1	16.571 (-51.967 to 85.110)	1
Evening						
All	3.452 (-6.366 to 13.270)	1	-1.251 (-20.267 to 17.765)	1	2.201 (-21.425 to 25.828)	1
Female	-2.2-5 (-16.983 to 12.574)	1	9.259 (-19.600 to 38.118)	1	7.054 (-31.588 to 45.696)	1

Male	7.493 (-4.997 to 19.983)	.347	-8.759 (-33.149 to 15.632)	.981	-1.265 (-33.924 to 31.393)	1
Year 3	1.348 (-17.294 to 19.989)	1	1.324 (-33.574 to 36.221)	1	2.671 (-41.868 to 47.211)	1
Year 4	3.667 (-20.399 to 27.732)	1	-10.190 (-55.243 to 34.862)	1	-6.524 (-64.024 to 50.976)	1
Year 5	7.365 (-16.701 to 31.431)	1	-2.965 (-48.018 to 42.088)	1	4.400 (-53.100 to 61.900)	1
Year 6	1.595 (-40.088 to 43.278)	1	17.833 (-60.200 to 95.867)	1	19.429 (-80.164 to 119.022)	1

Weekday Table

	Baseline vs. Mid		Mid vs. End of term		Baseline vs. End of term	
	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value
Weekday Sedentary						
Morning						
All	-3.700 (-11.709 to 4.309)	.658	0.671 (-18.209 to 19.551)	1	-3.029 (-18.530 to 12.472)	1
Female	-3.160 (-16.389 to 10.069)	1	-0.740 (-31.916 to 30.436)	1	-3.900 (-20.512 to 21.712)	1
Male	-4.086 (-15.266 to 7.095)	.957	1.679 (-24.670 to 28.0270	1	-2.407 (-24.053 to 19.239)	1
Year 3	-7.200 (-21.634 to 7.234)	.513	6.480 (-19.281 to 32.241)	1	-0.720 (-21.348 to 19.908)	1
Year 4	-2.200 (-20.835 to 16.435)	1	6.917 (-26.341 to 40.174)	1	4.717 (-21.914 to 31.347)	1
Year 5	1.333 (-17.301 to 19.968)	1	-24.633 (-57.891 to 8.624)	.168	-23.300 (-49.930 to 3.330)	.089
Year 6	-5.800 (-38.076 to 26.476)	1	28.800 (-28.804 to 86.404)	.510	23.000 (-23.125 to 69.125)	.513
Day						
All	-7.167 (-42.850 to 28.517)	1	17.708 (-7.634 to 43.051)	.223	10.542 (-14.008 to 35.092)	.754
Female	-6.600 (-65.604 to 52.404)	1	21.000 (-20.724 to 62.724)	.538	14.400 (-25.937 to 54.737	.989
Male	-7.571 (-57.439 to 42.296)	1	15.357 (-19.906 to 50.621)	.719	7.786 (-26.306 to 41.877)	1
Year 3	7.280 (-45.067 to 59.627)	1	14.950 (-22.814 to 52.714)	.800	22.230 (-16.258 to 60.718)	.359
Year 4	0.067 (-67.513 to 67.646)	1	22.683 (-26.070 to 71.437)	.595	22.750 (-26,938 to 72.438)	.614
Year 5	-52.400 (-119.980 to 15.180)	.143	36.300 (-12.453 to 85.053)	.165	-16.100 (-65.788 to 33.588)	1
Year 6	34.600 (-82.451 to 151.651)	1	-39.200 (-123.643 to 45.243)	.597	-4.600 (-90.663 to 81.463)	1
Evening						
All	3.433 (-14.089 to 20.955)	1	-12.213 (-35.526 to 11.101)	.503	-8.779 (-35.127 to 17.569)	1
Female	7.880 (-20.609 to 36.369)	1	-23.020 (-59.370 to 13.330)	.298	-15.140 (-58.049 to 27.769)	1
Male	0.257 (-23.821 to 24.335)	1	-4.493 (-35.214 to 26.229)	1	-4.236 (-40.501 to 32.029)	1
Year 3	6.700 (-84.540 to 97.940)	1	21.500 (-52.020 to 95.020)	1	28.200 (-73.558 to 129.958)	1
Year 4	-26.500 (-170.763 to 117.763)	1	43.250 (-72.996 to 159.496)	.848	16.750 (-144.143 to 177.643)	1
Year 5	-40.167 (-157.957 to 77.623)	.965	54.833 (-40.081 to 149.748)	.341	14.667 (-116.702 to 146.036)	1
Year 6	-23.500 (-227.518 to 180.518)	1	-46.500 (-219.897 to 117.897)	1	-70.000 (-297.538 to 157.538)	1
Weekday Light						
Morning						

All	2.117 (-3.206 to 7.440)	.858	2.904 (-10.800 to 16.608)	1	5.021 (-6.704 to 16.746)	
Female	5.600 (-2.168 to 13.368)	.196	4.910 (-17.626 to 27.446)	1	10.510 (-7.749 to 28.769)	.389
Male	-0.371 (-6.937 to 6.194)	1	1.471 (-17.575 to 20.518)	1	1.100 (-14.331 to 16.532)	1
Year 3	7.240 (-0.141 to 14.621)	.005	-0.640 (-18.526 to 17.246)	1	6.600 (-6.016 to 19.216)	.460
Year 4	-2.133 (-11.662 to 7.395)	1	-6.000 (-29.090 to 17.090)	1	-8.133 (-24.420 to 8.154)	.511
Year 5	-1.667 (-11.195 to 7.862)	1	22.750 (-0.340 to 45.840)	.054	21.083 (4.796 to 37.370)	.014*
Year 6	0.600 (-15.904 to 17.104)	1	-12.200 (-52.193 to 27.793)	1	-11.600 (-39.810 to 16.610)	.750
Day						
All	-5.867 (-31.789 to 20.55)	1	-11.092 (-36.993 to 14.810)	.758	-16.958 (-34.868 to 0.952)	.065
Female	2.000 (-39.843 to 43.834)	1	-21.670 (-62.615 to 19.275)	.479	-19.670 (-49.111 to 9.771)	.252
Male	-11.486 (-46.842 to 23.870)	1	-3.536 (-38.141 to 31.069)	1	-15.021 (-39.903 to 9.861)	.341
Year 3	-9.280 (-42.577 to 24.017)	1	-12.830 (-53.561 to 27.901)	1	-22.110 (-50.863 to 6.643)	.147
Year 4	-10.267 (-53.252 to 32.719)	1	-17.733 (-70.317 to 34.850)	1	-28.000 (-65.120 to 9.120)	.157
Year 5	23.933 (-19.052 to 66.919)	.395	-20.983 (-73.567 to 31.600)	.790	2.950 (-34.170 to 40.070)	1
Year 6	-65.000 (-139.453 to 9.453)	.090	47.200 (-43.877 to 138.277)	.470	-17.800 (-82.093 to 46.493)	1
Evening						
All	-0.817 (-14.801 to 13.168)	1	7.596 (-4.561 to 19.753)	.317	6.779 (-6.346 to 19.904)	.520
Female	1.880 (-21.022 to 24.782)	1	13.520 (-5.311 to 32.351)	.199	15.400 (-3.734 to 34.534)	.131
Male	-2.743 (-22.098 to 16.613)	1	3.364 (-12.551 to 19.279)	1	0.621 (-15.550 to 16.793)	1
Year 3	-10.160 (-25.956 to 5.636)	.265	16.670 (0.140 to 33.200)	.048*	6.510 (-15.435 to 28.455)	1
Year 4	6.200 (-14.193 to 26.593)	1	-6.417 (-27.756 to 14.923)	1	-0.217 (-28.547 to 28.114)	1
Year 5	16.400 (-3.993 to 36.793)	.125	2.217 (-19.123 to 23.556)	1	18.617 (-9.714 to 46.947)	.248
Year 6	-26.800 (-62.121 to 8.521)	.154	20.400 (-16.561 to 57.361)	.404	-6.400 (-55.470 to 42.670)	1
Weekday Moderate						
Morning						
All	1.750 (-3.354 to 6.854)	1	-3.004 (-10.053 to 4.045)	.764	-1.254 (-9.097 to 6.588)	1
Female	-2.240 (-9.223 to 4.743)	1	-3.380 (-15.028 to 8.268)	1	-5.620 (-17.505 to 6.265)	.614
Male	4.600 (-1.301 to 10.501)	.148	-2.736 (-12.580 to 7.108)	1	1.864 (-8.181 to 11.909)	1

Year 3	0.240 (-8.988 to 9.468)	1	-4.830 (-15.833 to 6.173)	.666	-4.590 (-17.666 to 8.486)	.962
Year 4	4.733 (-7.181 to 16.647)	.795	-1.033 (-15.238 to 13.172)	1	3.700 (-13.181 to 20.581)	1
Year 5	0.133 (-11.781 to 12.047)	1	2.467 (-11.738 to 16.672)	1	2.600 (-14.281 to 19.481)	1
Year 6	5.200 (-15.436 to 25.836)	1	-16.200 (-40.804 to 8.404)	.247	-11.000 (-40.239 to 18.239)	.868
Day						
All	8.633 (-9.935 to 27.201)	.650	-9.162 (-23.905 to 5.580)	.322	-0.529 (-16.805 to 15.747)	.650
Female	2.040 (-27.649 to 31.729)	1	-0.0600 (-22.754 to 21.554)	1	1.440 (-25.373 to 28.253)	1
Male	13.343 (-11.749 to 38.434)	.474	-15.279 (-34.002 to 3.445)	.124	-1.936 (-24.597 to 20.725)	1
Year 3	1.040 (-31.253 to 33.333)	1	-5.360 (-32.106 to 21.386)	1	-4.320 (-34.946 to 26.306)	1
Year 4	3.000 (-38.690 to 44.690)	1	-4.783 (-39.312 to 29.746)	1	-1.783 (-41.321 to 37.755)	1
Year 5	22.467 (-19.223 to 64.157)	.428	-19.667 (-54.196 to 14.862)	.373	2.800 (-36.738 to 42.338)	1
Year 6	22.000 (-50.209 to 94.209)	1	-9.800 (69.609 to 50.006)	1	12.200 (-56.282 to 80.682)	1
Evening						
All	-2.083 (-11.253 to 7.086)	1	3.608 (-10.362 to 17.579)	1	1.525 (-15.292 to 18.342)	1
Female	-9.560 (-21.847 to 2.727)	.149	9.340 (-12.736 to 31.416)	.758	-0.220 (-27.952 to 27.512)	1
Male	3.257 (-7.127 to 13.642)	1	-0.486 (-19.143 to 18.172)	1	2.771 (-20.666 to 26.209)	1
Year 3	-3.960 (-19.737 to 11.817)	1	7.700 (-17.315 to 32.715)	1	3.740 (-28.768 to 36.248)	1
Year 4	5.000 (-15.368 to 25.368)	1	-5.783 (-38.077 to 26.510)	1	-0.783 (-42.751 to 41.184)	1
Year 5	-2.200 (-22.568 to 18.168)	1	2.317 (-29.977 to 34.610)	1	0.117 (-41.851 to 42.084)	1
Year 6	-13.600 (-48.878 to 21.678)	.836	15.200 (-40.734 to 71.134)	1	1.600 (-71.090 to 74.290)	1
Weekday Vigorous						
Morning						
All	-0.167 (-0.552 to 0.219)	.745	-0.571 (-1.554 to 0.413)	.390	-0.737 (-1.807 to 0.332)	.332
Female	-0.200 (-0.836 to 0.436)	1	-0.790 (-2.395 to 0.815)	.565	-0.990 (-2.733 to 0.753)	.402
Male	-0.143 (-0.681 to 0.395)	1	-0.414 (-1.771 to 0.943)	1	-0.557 (-2.030 to -.916)	.909
Year 3	-0.280 (-0.921 to 0.361)	.673	-1.010 (-2.771 to 0.751)	.366	-1.290 (-3.218 to 0.638)	.235
Year 4	-0.400 (-1.228 to 0.428)	.549	0.117 (-2.157 to 2.391)	1	-0.283 (-2.772 to 2.205)	1
Year 5	0.200 (-0.628 to 1.028)	1	-0.583 (-2.857 to 1.691)	1	-0.383 (-2.872 to 2.105)	1
Year 6	-9.437 (-1.434 to 1.434)	1	-0.400 (-4.339 to 3.539)	1	-0.400 (-4.711 to 3.911)	1
Day						
All	4.400 (-0.057 to 8.857)	.053	2.546 (-3.491 to 8.583)	.778	6.946 (0.834 to 13.057)	.025*

Female	2.560 (-4.479 to 9.599)	.963	1.270 (-8.597 to 11.137)	1	3.830 (-5.573 to 13.233)	.809
Male	5.714 (-0.235 to 11.663)	.061	3.457 (-4.882 to 11.796)	.785	9.171 (1224 to 17.119)	.024
Year 3	0.960 (-6.167 to 8.087)	1	3.240 (-8.145 to 14.625)	1	4.200 (-6.849 to 15.249)	.854
Year 4	7.200 (-2.001 to 16.401)	.138	-0.167 (-14.865 to 14.531)	1	7.033 (-7.230 to 21.297)	.526
Year 5	6.000 (-3.201 to 15.201)	.254	4.350 (-10.348 to 19.048)	1	10.350 (-3.914 to 24.614)	.180
Year 6	8.400 (-7.536 to 24.336)	.452	1.800 (-23.657 to 27.257)	1	10.200 (-14.505 to 34.905)	.745-
Evening						
All	-0.383 (-2.043 to 1.276)	1	0.900 (-6.667 to 8.467)	1	0.517 (-6.846 to 7.880)	1
Female	-0.080 (-2.801 to 2.641)	1	0.010 (-12.458 to 12.478)	1	-0.070 (12.226 to 12.086)	1
Male	-0.600 (-2.899 to 1.699)	1	1.536 (-12.073 to 9.001)	1	0.936 (-9.338 to 11.209)	1
Year 3	-1.776 (-1.715 to 1.715)	1	-3.380 (-16.170 to 9.410)	1	-3.380 (-16.038 to 9.278)	1
Year 4	0.533 (-1.681 to 2.747)	1	0.217 (-16.295 to 16.728)	1	0.750 (-15.591 to 17.091)	1
Year 5	-0.133 (-2.347 to 2.081)	1	6.950 (-9.524 to 23.158)	.720	6.817 (-9.524 to 23.158)	.732
Year 6	-5.800 (-9.634 to -1966)	.006*	6.200 (-22.399 to 34.799)	1	0.400 (-27.904 to 28.704)	1
Weekday MV						
Morning						
All	1.583 (-3.488 to 6.655)	1	-3.575 (-10.991 to 3.841)	.604	-1.992 (-10.059 to 6.076)	1
Female	-2.440 (-9.330 to 4.450)	1	-4.170 (-16.413 to 8.073)	1	-6.610 (-18.769 to 5.549)	.449
Male	4.457 (-1.366 to 10.280)	.158	-3.150 (-13.497 to 7.197)	1	1.307 (-8.969 to 11.584)	1
Year 3	-0.040 (-9.253 to 9.173)	1	-5.840 (-17.588 to 5.908)	.517	-5.880 (-19.157 to 7.397)	.655
Year 4	4.333 (-7.560 to 16.227)	.911	-0.917 (-16.083 to 14.250)	1	3.417 (-13.723 to 20.557)	1
Year 5	0.333 (-11.560 to 12.227)	1	1.883 (-13.283 to 17.050)	1	2.217 (-14.923 to 19.357)	1
Year 6	5.200 (-15.400 to 25.800)	1	-16.600 (-42.869 to 9.669)	.279	-11.400 (-41.087 to 18.287)	.841
Day						
All	13.033 (-7.280 to 33.346)	.293	-6.617 (-23.849 to 10.615)	.906	6.417 (-9.872 to 22.705)	.871
Female	4.600 (-27.461 to 36.661)	1	0.670 (-26.478 to 27.818)	1	5.270 (-21.630 to 32.170)	1
Male	19.057 (-8.039 to 46.153)	.213	-11.821 (-34.766 to 11.123)	.510	7.236 (-15.499 to 29.971)	1
Year 3	2.000 (-32.385 to 36.385)	1	-2.120 (-34.427 to 30.187)	1	-0.120 (-29.493 to 29.253)	1
Year 4	10.200 (-34.191 to 54.591)	1	-4.950 (-46.658 to 36.758)	1	5.250 (-32.670 to 43.170)	1
Year 5	28.467 (-15.924 to 72.857)	.268	-15.317 (-57.024 to 26.391)	.901	13.150 (-24.770 to 51.070)	.979

Year 6	30.400 (-46.487 to 107.287)	.802	-8.000 (-80.240 to 64.240)	1	22.400 (-43.279 to 88.079)	1
Evening						
All	-2.467 (-11.906 to 7.027)	1	-4.900 (-14.972 to 24.772)	1	2.422 (-18.735 to 23.602)	1
Female	-9.640 (-22.823 to 3.543)	.187	10.290 (-21.940 to 42.520)	1	0.650 (-34.291 to 35.591)	1
Male	2.657 (-8.485 to 13.799)	1	1.050 (-26.190 to 28.290)	1	3.707 (-25.823 to 33.238)	1
Year 3	-3.960 (-19.085 to 11.165)	1	5.260 (-31.353 to 41.873)	1	1.300 (-39.586 to 42.186)	1
Year 4	5.533 (-13.992 to 25.059)	1	-5.567 (52.751 to 41.701)	1	-0.033 (-52.818 to 52.751)	1
Year 5	-2.333 (-21.859 to 17.192)	1	9.267 (-38.001 to 56.534)	1	6.933 (-45.851 to 59.718)	1
Year 6	-19.400 (-53.220 to 14.420)	.366	21.400 (-60.469 to 103.269)	1	2.000 (-89.425 to 93.425)	1

Weekend Table

	Baseline vs. Mid		Mid vs. End of term		Baseline vs. End of term	
	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value	Mean difference (95% CI)	p- value
Weekend Sedentary						
Day						
All	39.167 (-56.739 to 135.072)	.857	-36.967 (91.186 to 17.252)	.255	2.200 (-73.343 to 77.743)	1
Female	-28.125 (-143.588 to 87.338)	1	-14.562 (-88.290 to 59.165)	1	-42.687 (-138.911 to 53.536)	.734
Male	116.071 (-7.364 to 239.507)	.067	-62.571 (-141.390 to 16.247)	.145	53.500 (-49.368 to 156.368)	.531
Year 3	-24.333 (-182.896 to 134.229)	1	6.750 (-65.980 to 79.480)	1	-17.583 (-153.132 to 117.965)	1
Year 4	28.833 (-195.408 to 253.074)	1	-11.000 (-113.856 to 91.856)	1	17.833 (-173.861 to 209.528)	1
Year 5	106.600 (-67.096 to 280.296)	.334	-78.500 (-158.172 to 1.172)	.054	28.100 (-120.386 to 176.586)	1
Year 6	114.000 (-274.397 to 502.397)	1	-169.500 (-347.652 to 8.652)	.064	-55.500 (-387.525 to 276.525)	1
Evening						
All	0.821 (-25.361 to 27.004)	1	13.214 (-11.015 to 37.444)	.474	14.036 (-11.785 to 39.857)	.478
Female	-12.643 (-48.537 to 23.251)	1	19.643 (-23.251 to 48.537)	.445	7.000 (-30.634 to 44.634)	1
Male	14.286 (-21.608 to 50.180)	.871	6.786 (-28.570 to 42.142)	1	21.071 (-16.562 to 58.705)	.437
Year 3	-7.200 (-52.483 to 38.083)	1	26.400 (3.205 to 49.595)	.025*	19.200 (-27.967 to 66.367)	.809
Year 4	-23.000 (-81.460 to 35.460)	.856	47.833 (17.889 to 77.778)	.003*	24.833 (-36.059 to 85.726)	.807
Year 5	19.200 (-26.083 to 64.483)	.755	-7.700 (-30.895 to 15.495)	1	11.500 (-35.667 to 58.667)	1
Year 6	20.500 (-80.755 to 121.755)	1	-52.000 (-103.866 to -0.134)	.049*	-31.500 (-136.969 to 73.969)	1
Weekend Light						
Day						
All	-15.300 (-68.519 to 37.919)	1	16.000 (-16.596 to 48.596)	.610	0.700 (-46.858 to 48.258)	1
Female	23.375 (-39.705 to 86.455)	.982	16.438 (-30.359 to 63.234)	1	39.813 (-12.731 to 92.356)	.173
Male	-59.500 (-126.936 to 7.936)	.092	15.500 (-34.528 to 65.528)	1	-44.000 (-100.171 to 12.171)	.153
Year 3	-2.250 (-98.400 to 93.900)	1	1.833 (-52.592 to 56.259)	1	-0.417 (-87.928 to 87.094)	1
Year 4	-2.500 (-138.477 to 133.477)	1	1.000 (-77.969 to 75.969)	1	-1.500 (-125.259 to 122.259)	1
Year 5	-34.000 (-139.327 to 71.327)	1	32.100 (-27.520 to 91.720)	.471	-1.900 (-97.763 to 93.963)	1

Year 6	-38.500 (-274.019 to 197.019)	1	65.500 (-67.814 to 198.814)	.580	27.000 (-187.357 to 241.357)	1
Evening						
All	-8.750 (-25.386 to 7.886)	.517	-5.286 (-20.353 to 9.782)	1	-14.036 (-35.548 to 7.477)	.289
Female	-6.071 (-30.670 to 18.528)	1	-3.286 (-25.620 to 19.049)	1	-9.357 (-40.966 to 22.252)	1
Male	-11.429 (-36.028 to 13.170)	.663	-7.286 (-29.620 to 15.049)	1	-18.714 (-50.323 to 12.895)	.377
Year 3	-18.900 (-48.882 to 11.082)	.302	-13.700 (-32.853 to 5.453)	.202	-32.600 (-64.422 to -.778)	.044*
Year 4	-2.833 (-41.540 to 35.873)	1	-23.667 (-48.394 to 1.060)	.062	-26.500 (-67.581 to 14.581)	.282
Year 5	.500 (-29.482 to 30.482)	1	7.700 (-11.453 to 26.853)	.826	8.200 (-23.622 to 40.022)	1
Year 6	-22.000 (-89.042 to 45.042)	1	27.000 (-15.828 to 69.828)	.302	5.000 (-66.155 to 76.155)	1
Weekend Moderate						
Day						
All	-17.100 (-59.382 to 25.182)	.871	15.367 (-14.206 to 44.939)	.539	-1.733 (-33.621 to 30.154)	1
Female	7.00 (-47.435 to 61.435)	1	-6.125 (-41.177 to 28.927)	1	.875 (-44.815 to 46.565)	1
Male	-44.643 (-102.837 to 13.551)	.165	39.929 (2.457 to 77.400)	.035*	-4.714 (-53.559 to 44.130)	1
Year 3	17.750 (-48.573 to 84.073)	1	-6.250 (-46.528 to 34.028)	1	11.500 (-43.700 to 66.700)	1
Year 4	-19.833 (-113.682 to 73.962)	1	2.167 (-54.795 to 59.128)	1	-17.667 (-95.732 to 60.399)	1
Year 5	-47.500 (-120.153 to 25.152)	.277	33.100 (-11.022 to 77.222)	.174	-14.400 (-74.869 to 46.069)	1
Year 6	-66.000 (-228.458 to 94.458)	.829	-96.000 (-194.660 to 2.660)	.057	30.000 (-105.213 to 165.213)	1
Evening						
All	-7.750 (-18.871 to 3.371)	.234	-25.643 (-58.529 to 7.244)	.155	-33.393 (-61.946 to -4.839)	.020*
Female	1.429 (-11.459 to 14.316)	1	-44.000 (-88.351 to .351)	.052	-42.571 (-83.820 to -1.323)	.042*
Male	-16.929 (-29.816 to -4.041)	.010*	-7.286 (-51.637 to 37.065)	1	-24.214 (-65.462 to 17.034)	.386
Year 3	-4.200 (-25.587 to 17.187)	1	-41.800 (-94.153 to 10.553)	.135	-46.000 (-89.147 to -2.853)	.036*
Year 4	-7.667 (-35.277 to 19.944)	1	-56.500 (-124.088 to 11.088)	.112	-64.167 (-119.870 to 8.464)	.024*
Year 5	-12.500 (-33.887 to 8.887)	.373	.100 (-52.253 to 52.453)	1	-12.400 (-55.547 to 30.747)	1
Year 6	-2.00 (-49.823 to 45.823)	1	19.000 (-98.066 to 136.066)	1	17.000 (-79.480 to 113.480)	1
Weekend Vigorous						
Day						
All	-6.767 (-23.946 to 10.419)	.908	5.600 (-3.957 to 15.157)	.401	-1.167 (-15.179 to 12.846)	1
Female	-2.250 (-26.396 to 21.896)	1	4.250 (-9.388 to 17.888)	1	2.000 (-17.806 to 21.806)	1

Male	-11.929 (-37.742 to 13.885)	.680	7.143 (-7.437 to 21.722)	.605	-4.786 (-25.959 to 16.387)	1
Year 3	8.833 (-16.301 to 33.968)	1	-2.333 (-17.471 to 12.805)	1	6.500 (-17.159 to 30.159)	1
Year 4	-6.500 (-42.046 to 29.046)	1	7.833 (-13.575 to 29.242)	.973	1.333 (-32.126 to 34.792)	1
Year 5	-25.100 (-52.634 to 2.434)	.078	13.300 (-3.283 to 29.883)	.135	-11.800 (-37.717 to 14.117)	.667
Year 6	-9.500 (-71.067 to 52.067)	1	8.000 (-29.080 to 45.080)	1	-1.500 (-59.453 to 56.453)	1
Evening						
All	-2.286 (-6.669 to 2.098)	.527	-0.143 (-3.722 to 3.436)	1	-2.429 (-6.929 to 2.072)	.487
Female	-0.571 (-6.807 to 5.664)	1	-2.000 (-6.899 to 2.899)	.836	-2.571 (-9.275 to 4.132)	.922
Male	-4.000 (-10.235 to 2.235)	.300	1.714 (-3.184 to 6.613)	1	-2.286 (-8.989 to 4.418)	1
Year 3	.300 (-6.504 to 7.104)	1	-3.900 (-9.080 to 1.280)	.168	-3.600 (-10.356 to 3.156)	.472
Year 4	-2.167 (-10.950 to 6.617)	1	-0.500 (-7.188 to 6.188)	1	-2.667 (-11.389 to 6.056)	1
Year 5	-6.500 (-13.304 to .304)	.062	2.600 (-2.580 to 7.780)	.514	-3.900 (-10.656 to 2.856)	.386
Year 6	5.500 (-9.713 to 20.713)	.972	6.000 (-5.584 to 17.584)	.504	11.500 (-3.607 to 26.607)	.161
Weekend MV						
Day						
All	-19.200 (-73.441 to 35.041)	1	20.967 (-12.390 to 54.323)	.329	1.767 (-40.142 to 43.676)	1
Female						
Male						
Year 3	32.000 (-45.932 to 109.932)	.814	-8.583 (-52.361 to 35.195)	1	23.417 (-48.064 to 94.897)	1
Year 4	-13.833 (-124.047 to 96.380)	1	10.000 (-51.911 to 71.911)	1	-3.833 (-104.922 to 97.255)	1
Year 5	-72.600 (-157.971 to 12.771)	.106	46.400 (-1.566 to 94.356)	.059	-26.200 (-104.503 to 52.103)	1
Year 6	-75.500 (-266.395 to 115.395)	.865	104.000 (-3.233 to 211.233)	.058	28.500 (-146.590 to 203.590)	1
Evening						
All	-10.036 (-24.425 to 4.354)	.233	-25.786 (-60.178 to 8.607)	.180	-35.821 (-66.349 to -5.294)	.020*
Female	2.000 (-72.202 to 76.202)	1	-1.875 (-42.434 to 38.684)	1	0.125 (-60.017 to 60.267)	1
Male	-43.429 (-122.754 to 35.897)	.470	47.071 (-90.431 to -3.712)	.032*	3.643 (-60.652 to 67.938)	1
Year 3	32.000 (-45.932 to 109.932)	.814	-8.583 (-52.361 to 35.195)	1	23.417 (-48.064 to 94.897)	1
Year 4	-13.833 (-124.047 to 96.380)	1	10.000 (-51.911 to 71.911)	1	-3.833 (-104.922 to 97.255)	1
Year 5	-72.600 (0157,971 to 12.771)	.106	46.400 (-1.556 to 94.356)	.059	-26.200 (-104.503 to 52.103)	1
Year 6	-75.500 (-266.395 to 115.395)	.865	104.00 (-3.233 to 211.233)	.058	28.500 (-146.590 to 203.590)	1

Appendix J: Study three COREQ Checklist

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	109
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	107-108
Occupation	3	What was their occupation at the time of the study?	107
Gender	4	Was the researcher male or female?	107
Experience and training	5	What experience or training did the researcher have?	107
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	107-108
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	107-108
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	107-108
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	105
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	105-106
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	106
Sample size	12	How many participants were in the study?	105-106
Non-participation	13	How many people refused to participate or dropped out? Reasons?	105
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	108
Presence of nonparticipants	15	Was anyone else present besides the participants and researchers?	108
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	105-106 and 109
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	106
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	n/a
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	110
Field notes	20	Were field notes made during and/or after the interview or focus group?	110
Duration	21	What was the duration of the inter views or focus group?	110
Data saturation	22	Was data saturation discussed?	105 and 110

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	110
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	109
Description of the coding tree	25	Did authors provide a description of the coding tree?	Appendix N
Derivation of themes	26	Were themes identified in advance or derived from the data?	109
Software	27	What software, if applicable, was used to manage the data?	110
Participant checking	28	Did participants provide feedback on the findings?	111
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	113-117
Data and findings consistent	30	Was there consistency between the data presented and the findings?	113-117
Clarity of major themes	31	Were major themes clearly presented in the findings?	113-117
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	113-117

Appendix K: Teacher information and consent letter

MIDDLESEX UNIVERSITY

Physical Literacy and The Mayors Golden Kilometre

PARTICIPANT INFORMATION SHEET

SECTION 1

1. Study title

Physical Literacy and the Mayors Golden kilometre

2. Invitation paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

3. What is the purpose of the study?

To evaluate the effects on physical literacy components (height, weight, BMI, physical activity, fundamental movement skills competency, student behaviour and mental well-being) on primary school children who will run, walk or jog a km every day whilst at school. To explore the teacher's current knowledge and understanding of physical literacy and its assessment. To explore student perceptions of the daily kilometre and physical literacy.

4. Why have I been chosen?

It is important that we assess as many participants as possible, and you have indicated that you are interested in taking part in this study.

5. Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. If you do decide to withdraw from the study then please inform the researcher as soon as possible, and they will facilitate your withdrawal. If, for any reason, you wish to withdraw your data please contact the researcher within a month of your participation. After this data it may not be possible to withdraw your individual data as the results may have already been published. However, as all data are anonymised, your individual data will not be identifiable in any way.

6. What will I have to do?

One to one interviews will be conducted with a number of teaching staff to gain an understanding of your knowledge and understanding of physical literacy and what their current practises us. Interviews will be conducted in the school in a private room. A Dictaphone will be used to record the interviews for later transcription.

You may be invited to participate in an online interview using the video conference platform 'ZOOM' or Microsoft teams. You will be sent instructions on how to use the software and will require access to a laptop or computer with a microphone to participate. The online interview will be recorded by the lead researcher and saved directly on a password secure laptop. The interview will be password secure and locked once you and the researcher have joined.

Please note that in order to ensure quality assurance and equity this project may be selected for audit by a designated member of the committee. This means that the designated member can request to see signed consent forms. However, if this is the case your signed consent form will only be accessed by the designated auditor or member of the audit team.

7. Will I have to provide any bodily samples (i.e. blood/saliva/urine)?

No

8. What are the possible disadvantages and risks of taking part?

There are no potential risks of taking part

Appropriate risk assessments for all procedures have been conducted, and will be followed throughout the duration of the study.

9. What are the possible benefits of taking part?

We hope that participating in the study will help you. However, this cannot be guaranteed. The information we get from this study may help us to develop the concept of physical literacy and participants understanding, As well as develop the roll out of the Mayors Golden Km and therefore help to encourage the participation in physical activity.

9. Will my taking part in this study be kept confidential?

The research team has put a number of procedures in place to protect the confidentiality of participants. You will be allocated a participant code that will always be used to identify any data you provide. Your name or other personal details will not be associated with your data, for example, the consent form that you sign will be kept separate from your data. All paper records will be stored in a locked filing cabinet, accessible only to the research team, and all electronic data will be stored on a password protected computer. All information you provide will be treated in accordance with the UK Data Protection Act.

10. What will happen to the results of the research study?

The results of the research study will be used as part of an Postgraduate dissertation. The results may also be presented at conferences or in journal articles. However, the data will only be used by members of the research team and at no point will your personal information or data be revealed.

11. Who has reviewed the study?

The study has received full ethical clearance from the Research ethics committee who reviewed the study. The committee is the London Sport institute.

12. Contact for further information

If you require further information, have any questions or would like to withdraw your data then please contact:

Shannah Anico

S.Anico@mdx.ac.uk

Supervisor:

Dr Lizi Smith

L.Smith@mdx.ac.uk

Thank you for taking part in this study. You should keep this participant information sheet as it contains your participant code, important information and the research teams contact details

SECTION 2

Middlesex University Guide to Research Privacy Notices

Privacy notices need to be presented whenever data is collected and should be understandable and accessible. Privacy notices must explain the type and source of data that will be processed. They will also set out the processing purpose, data retention schedules and data sharing. Privacy notices must include details of the subject's rights and who the subject can complain to.

Middlesex University Privacy Notice for Research Participants

The General Data Protection Regulation (GDPR) protects the rights of individuals by setting out certain rules as to what organisation can and cannot do with information about people. A key element to this is the principle to process individuals' data lawfully and fairly. This means we need to provide information on how we process personal data.

The University takes its obligation under the GDPR very seriously and will always ensure personal data is collected, handled, stored and shared in a secure manner. The University's Data Protection Policy can be accessed here: https://www.mdx.ac.uk/__data/assets/pdf_file/0023/471326/Data-Protection-Policy-GPS4-v2.4.pdf.

The following statements will outline what personal data we collect, how we use it and who we share it with. It will also provide guidance on your individual rights and how to make a complaint to the Information Commissioner's Officer (ICO), the regulator for data protection in the UK.

Why are we collecting your personal data?

As a university we undertake research as part of our function and in our capacity as a teaching and research institution to advance education and learning. The specific purpose for data collection on this occasion is to evaluate the effects on weight status, physical activity, fundamental movement skills competency, student behaviour and mental well-being throughout participation in the mayors golden km, And additionally to explore student perceptions of the mayors golden km and physical literacy.

The legal basis for processing your personal data under GDPR on this occasion is Article 6(1a) consent of the data subject.

Transferring data outside Europe

In the majority of instances your data will be processed by Middlesex University researchers only or in collaboration with researchers at other UK or European institutions so will stay inside the EU and be protected by the requirements of the GDPR.

In any instances in which your data might be used as part of a collaboration with researchers based outside the EU all the necessary safeguards that are required under the GDPR for transferring data outside of the EU will be put in place. You will be informed if this is relevant for the specific study you are a participant of.

Your rights under data protection

Under the GDPR and the DPA you have the following rights:

- to obtain access to, and copies of, the personal data that we hold about you;
- to require that we cease processing your personal data if the processing is causing you damage or distress;
- to require us to correct the personal data we hold about you if it is incorrect;
- to require us to erase your personal data;
- to require us to restrict our data processing activities;
- to receive from us the personal data we hold about you which you have provided to us, in a reasonable format specified by you, including for the purpose of you transmitting that personal data to another data controller;
- to object, on grounds relating to your particular situation, to any of our particular processing activities where you feel this has a disproportionate impact on your rights.

Where Personal Information is processed as part of a research project, the extent to which these rights apply varies under the GDPR and the DPA. In particular, your rights to access, change, or move your information may be limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we may not be able to remove the information that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. The Participant Information Sheet will detail up to what point in the study data can be withdrawn.

If you submit a data protection rights request to the University, you will be informed of the decision within one month. If it is considered necessary to refuse to comply with any of your data protection rights, you also have the right to complain about our decision to the UK supervisory authority for data protection, the Information Commissioner's Office. None of the above precludes your right to withdraw consent from participating in the research study at any time.

Collecting and using personal data

Data will be collected following the tests stated above in section 1 part 8. All data will be coded to an ID Number per participant to anonymise the data

Data sharing

Your information will usually be shared within the research team conducting the project you are participating in, mainly so that they can identify you as a participant and contact you about the research project.

Responsible members of the University may also be given access to personal data used in a research project for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your records. All of these people have a duty to keep your information, as a research participant, strictly confidential.

If we are working with other organisations and information is shared about you, we will inform you in the Participant Information Sheet. Information shared will be on a 'need to know' basis relative to achieving the research project's objectives, and with all appropriate safeguards in place to ensure the security of your information.

Storage and security

The University takes a robust approach to protecting the information it holds with dedicated storage areas for research data with controlled access.

Alongside these technical measures there are comprehensive and effective policies and processes in place to ensure that users and administrators of University information are aware of their obligations and responsibilities for the data they have access to. By default, people are only granted access to the information they require to perform their duties. Training is provided to new staff joining the University and existing staff have training and expert advice available if needed.

Retention

Under the GDPR and DPA personal data collected for research purposes can be kept indefinitely, providing there is no impact to you outside the parameters of the study you have consented to take part in.

Having stated the above, the length of time for which we keep your data will depend on a number of factors including the importance of the data, the funding requirements, the nature of the study, and the requirements of the publisher. Details will be given in the information sheet for each project.

Contact us

The Principal Investigator leading this research is Shannah Anico

07521007963

S.Anico@mdx.ac.uk

The University's official contact details are:

Data Protection Officer

Middlesex University

The Burroughs

London

NW4 4BT

Tel: +44 (0)20 8411 5555
Email: dpaofficer@mdx.ac.uk

CONSENT FORM

Title of Project: Physical literacy and the Mayors Golden kilometre

Name of Researcher: Shannah Anico

Please initial in the box

1. I confirm that I have read and understand the information sheet dated .....……..…for the above study and have had the opportunity to ask questions. 1

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without penalty . 2

3. I agree that this form that bares my name and signature may be seen by a designated auditor. 3

4. I agree that my non-identifiable research data may be stored in National Archives and be used anonymously by others for future research. I am assured that the confidentiality of my data will be upheld through the removal of any personal identifiers. I understand that my interview/ focus group is taped and subsequently transcribed. 4

6. I agree to take part in the above study. 6

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Researcher	Date	Signature

Appendix L: Interview Thematic Table

Theme	Sub-theme	Supporting quotes
Fidelity and adherence	Frequency	**Once per day straight after play for 10 mins** - "Once a day… Around 7-10 mins for us" **Aiming for 4X but not always met** - "Err we be aiming for at least 4X the other reason we can do with all class is that we happen to have swimming in the afternoon but this is another way for them to be active so it counts as a kilometre even if it's a different type of activity. Erm We have been aiming but not always." **Completed 3 or 4 times per week** - "Err we try to most days but it can vary depending on number of people and times or if there's other clubs. It just depends. At the most is probably 3 or 4 times per week." **Number of times per week changes** - "I don't know. I guess the number of times we do it per week changes. We definitely try and the aim is to get a whole km. Actually, I'd say that's kind of a thing, sometimes we did it at the beginning during lunch time but because of the number of people we'd group it, so like these people first then these and so on." - "We'd try and get though. But then sometimes other groups were slower so we wouldn't get everyone done during one lunch time so then we'd have to miss out groups."
	Cheating	**Barnet's golden kilometre route – Children are responsible for counting the number of laps and distance covered** - "Participant 4- I think it is when other classes have gone in, just after playtime they are running back and forth running lengths or widths of the playground counting them as they ran. Researcher 1- Great, were the children in charge of counting themselves? Participant 4- Erm someone was leading it but I think the children were counting their own" **Some children go off route and climb of cut corners** - "…Because you can see in the playground, some of them start running behind the climbing frames, some of them you know in wiggle lines and some cutting through the middle. Even if I did it a few times with them, very often they somehow try to cut in the middle and make circles smaller. Especially with younger ones that would be beneficial."
	Variation in distance and/or pace	**Barnet's golden kilometre implementation – Those that can't run are encouraged to at least jog or walk** - "All of them do it, there might be a few exemptions if medical reasons but all of them are expected to take part and those that can't actually do the run for whatever reason we encourage them to at least jog or walk" **Teacher perspective – Focus on distance covered not intensity** - "…But I have been encouraging children to complete the actual distance even if they are walking slowly. As long as they are moving, they can have a little break and then continue jogging." **Build up to 1km distance** - "Erm when we started it off we did 10 laps but it became too much so we reduce the number of laps the first week then started to build back up to 10." **Self-select pace – Providing choice pupils enjoy it more**

		- "I think most of them Yeh most of them enjoy it. Erm I think some definitely they find or thought they wouldn't have to do it all the time. I think they were kind of thinking a kilometre isn't that long, which it's not for older people, but then they find it with small legs there like 'ah this is so long' so they find it a bit harder. It's just trying to make it fun in a way that you're just not running for running's sake erm like if I tell them to run they won't want to run. But if I say you can run, you can walk it, you can jog it but just need to get it done then they definitely enjoy it more"
	Why school opted to take part	**Inspire and encourage child's participation with adults. Maintain active habits.** - "Definitely and that's why we have been trying to inspire them to do it even outside of school too. So, we've been encouraging them to each do it each week, and if it's not suitable to do at school, try be active with the grown-ups on the weekend. Just to maintain the habits of being active and have the confidence to be healthy, and just to do it as a combination of physical activity, healthy lifestyle and you this lifelong habit." - "…And to maintain not just kind of a buzz for a couple days or weeks and then just you know it to be a lifestyle skill" - "…inspire them and encourage them to actually do after the data collection with the watches to continue to be active and understanding the importance to be physically active to be erm to improve their fitness and generally be aware of the importance" **PE lead** - "Researcher 1: Do you find that children take themselves off to get started with it being in the morning? Participant 5: Oh no its definitely me having to go 'come one lets go'" - "Researcher 1: Yeh great ideas. Just to go back to a previous point you made, you said in the past when you have done this in previous schools it was run by class teachers, is the golden kilometre run by just one team member here at the moment? Participant 3: At the moments it's just the PE lead who is responsible. He is out there every morning with the kids. I am not sure if any other sports staff are involved, they might be looking after the other kids but to be honest I don't know." **Head teacher** - "Researcher 1: Did you put yourself forward to help out? Participant 5: No, it was thrust upon me Researcher 1: Is that because of your PE lead position? Participant 5: Yeh it is" - "No one does anything other than me so Yeh a bit. I mean if I asked them to help I'm sure they would but I don't need any. Other than the headteacher saying 'PE lead, are you doing this?' and I go 'yep'"
Intervention suggestions	Not just running	**Running for running's sake- Make it fun for pupils so they're not just running** - "I think most of them Yeh most of them enjoy it. Erm I think some definitely they find or thought they wouldn't have to do it all the time. I think they were kind of thinking a kilometre isn't that long, which it's not for older people, but then they find it with small legs there like 'ah this is so long' so they find it a bit harder. It's just trying to make it fun in a way that you're just not running for running's sake erm like if I tell them to run they won't want to run. But if I say you can run, you can walk it, you can jog it but just need to get it done then they definitely enjoy it more" **Not just running but having things to do whilst running** - "I can't say mass therapy for kids halacha erm but I don't know whether you could not necessarily change it but have it in a way that it might, because obviously you coming in has made it more enjoyable it's kind of like not just running but having like doing things whilst running if that

		makes sense? So, like I'm not sure what you could do but I guess ideally, you'd have a kilometre and then you'd have it all laid out so they know where their running and when they get to a certain section like 200m in they run around some cones or jump over some hurdles or something. Because kids get so easily distracted like if you make them run where they need to they get distracted if there's nothing. I just think any little things you could do just to switch up the monogamy of running."
	Reward system	**Class chart with prizes** - "Participant 3: Erm Well they could pick up some reward system attached to it so some sort of reward stickers and things. They love things like getting house points and stickers so if there is a chart where they could tick off every day that they've done it or get half a sticker if they've only done half and then you know add it up at the end of the week. Researcher 1: Yeah great, would that be as a class or individual children? Participant 3: I think you could do it as a class like wall chart in each class room and everyone could just have their own. The could be some sort of prize at the end or sometime." **Tracking their run** - "So So actually, one thing maybe is is if children were able to track their run and keep record like today I've done this much and tomorrow I've been able to exceed that. Maybe if children were able to see and track how much they were doing it might motivate them all a little more. And it might make it more meaningful for them."
	Route	**Having a marked route with start and finish lines** - "Erm as I said already, perhaps those markings or little start and finish lines maybe as signs would defiantly be beneficial. Otherwise I cannot think of anything else!" **A guide to help children see the distance and direction** - "we may need to if possible, to set up like a little guide to help the children see the distance and the direction they need to run." **Playground space devoted** - "Researcher 1: Can you tell me on the other hand then anything that may make it easier to take part in this type of intervention? Participant 3: Well it depends, if all the children are doing it then you'll have the whole playground could be devoted to it. If only some are joining in then obviously they would be running around children in the playground so I imagine" **Make MGkm more inclusive – Run a short distance until stamina increase** - "Well perhaps they could run for shorter distance until their stamina increases."
Logistics	Time	**Curriculum organisation** **Lessons such as reading learning will suffer to fit Barnet's golden kilometre** - "Participant 3: Yeh it would have to be negotiated erm and some sort of comprise made. It's going to be eating into class time and things that always suffer for this type of this is their reading and guided learning times erm handwriting spelling tests sort of go out of the window. Researcher 1: Do you know why those sort particular topics do you think? Participant 3: Well because they are squeezed in anyway after their curricular maths and English between classes. There the first things to be lost." **Whole school can't do Barnet's golden kilometre at once** - "Erm not really, just that if we wanted to roll it out across more of the school it would be a timetabling challenge now that its cementable but it would be quiet challenging. We couldn't have the whole school doing it in the playground at once."

		Limited curriculum space –Barnet's golden kilometre loses reaching time - "Erm if we can schedule it into the curriculum and find 10mins to do it. I mean the curriculum is so packed your just loosing so much teaching time." **Lesson start 10m mins later because of Barnet's golden kilometre** - "It it it would have done slightly in as much as that lesson would be starting 10mins later" **Time during the day is precious** - "They are keen, they are really happy. If we get busy, they have reminded us this week and sometimes the time during the day is so precious so they remind us. But they are really keen and have been enjoying it because they started last week so they kind of know." **Optimum time of day** **Morning** - "Yeh I would think so. Because not necessarily with Barnet's golden kilometre but in general like PE when it's done later in the day you sometime get children saying 'oh I'm tired'. I guess if we did it at the end of the day I guess participation would be a lot lower and pupils wouldn't want to do it and you'd have people just faking illness or injury like always." **Afternoon** - "I think depending on what time of day you take them out. We do it straight after play time but I do know you know that it's a nice thing to do in the middle of your learning. Sometimes children need to have that run destress, burn off the energy and come back into class. So, it can positively impact their learning in class as well."
	Staff	**Staff awareness** - "Erm Yeh weather and maybe Yeh if they have different class teachers in the class on different days if they are not aware of the routine you know sometimes erm Yeh it happens to skip it." **Small class sizes so less teachers needed** - "We've got small class sizes so we do need fewer teachers to be involved. Our timetable can also be quite flexible so it wasn't too difficult to give them 10min to run their kilometre." **PE lead in charge** - "At the moments it's just the PE lead who is responsible. He is out there every morning with the kids. I am not sure if any other sports staff are involved, they might be looking after the other kids but to be honest I don't know." - "No, it was thrust upon me"
	Space/ Weather	**Space** **No room indoors** - "No room to do indoor Barnet's golden kilometre during wet play" **57 laps** - "I know the PE lead said something about the number of lengths of playground that the children had so complete and it was something ridiculous like 57 lengths to get to a km. In an ideal world, it would be very lovely if they could go out and run around the block but space/staffing for this is tricky" **Weather/ season** **If weather is miserable playground is dangerous**

		- "Erm dunno its just on the day to see. Sometime its more if the weather is miserable then we're inside. Its sometimes our playground is very quiet slippie so it can get quite dangerous. So, if it's too wet on the floor or icy we'll avoid. And other days with small numbers it's not worth it, they often loose interest if it's not with everyone else and they're like 'oh but my friend in the other year isn't doing it'. **Seasonal differences in participation** - "I think probably during winter time is going to pe challenges especially because of PE lessons being at the same time for other classes and if the teachers want to take children on quick break its basically not much space. Once it gets cold and wet it may be a disadvantage. We are looking to create a timetable for each class to do it."
	Simple to implement	**Children know what to do** - "Not really not. They just come in and they know what they're doing." **Do not need resources, only little space and outdoor area** - "The fact that we do not really need any resources you know. The fact you need a little bit of space, an outdoor area, we haven't tried inside but maybe you could do some forwards and backwards or little laps perhaps in the big hall. So, we don't really need anything to set up you know to make it. We don't need resources but we may need to if possible, to set up like a little guide to help the children see the distance and the direction they need to run." **Barnet's golden kilometre is pretty straight forward** - "Other than the space we have, I wouldn't say anything really. It's pretty straight forward I think"
Perceived experiences "Works for some but not others"	Interest in/ Lack of motivation	**Teacher perspective on enjoyment – They can't hate it so much** - "It's not something if we don't do it, they will remind be. So that means they can't hate it so much but I can't really be sure." **A km is self-motivating. If pupils have enjoyment first then motivation follows for the task** - "Erm I feel like just I guess if there I feel like it would be more self-motivated to do a kilometre. I guess if they enjoy it first there might be motivation but if their taking part just because everyone else is doing it stuff like that then maybe it is not so motivating. And the confidence hmm I guess they if they keep running and they get faster or feel fitter they might feel more confident then." **Initial enjoyment** **Pupils are keen and remind teacher to complete Barnet's golden kilometre** - "They are keen, they are really happy. If we get busy, they have reminded us this week and sometimes the time during the day is so precious so they remind us. But they are really keen and have been enjoying it because they started last week so they kind of know." **Information book, whole school assembly, launch date created buzz** - "Erm I mean it's you know, thanks to you (Researcher) we exchanged emails we had information book provided and we sent erm emails and information's throughout our school to parents and questionnaires and information. And you know, the fact we had a whole school assembly had a massive impact, the children were really keen and buzzing and you know it was and the fact that we had an official launching ceremony technically helped and you know the little flags, thing defiantly. We do this another time I would probably have a proper finish and start line you know. Something was planning but it didn't really get to be done on time". **Control pupils not taking part are envious** - "They appear to be quite jealous. We have one of the classrooms overlooking the playground so they were watching other children doing it and were quite envious that they were sitting down being expected to get on with their work whilst other people were outside running up and down"

		Children that do not complete Barnet's golden kilometre are distracted, detour or slower - "It's that they're distracted or you know so yeah, they'll find detours or are generally slow or go get a drink."
	Pupil ability	**Some kids find it tough and give up** - "Yeh I done this in another school some years ago but it was then up to the class teachers to take the children into the playground but then we had a much bigger playground so we could all run around it and it was easier to make everyone have a go. And again, some people were ok with it and some kids found it tough and would often give up"
	Pupil age differences	**Willingness to do it helped** - "Err I think I think it's just the willingness of people to do it has helped. I think they just seem to be quiet keen, if you say something to children they think 'oh yeah I'm gonna do that'. Whereas you get some, we have a few in older year groups that say 'oh I don't want to do it' and they make up excuses. The older ones get more of an attitude towards things but the younger ones are more like 'if you say something I want to do it'" **Age differences – different understanding and acceptance of participation** - "Erm that's a good question ha-ha. Probably because I just think I guess as you get older you can understand more about what you're doing. Whereas someone in year 3 will do something because you tell them to do it, they'll see as their being told to do it. Whereas if you spoke to someone in year 6 and you said 'you should do this' they'll kind of conceptualise it and they'll think 'oh why am I doing this? Not just because I've been told' they'd look at it more deeply or they might do what year 3 do ha-ha but you don't know."
	Gender differences in competition	**Differentiate between competition and taking park – Children focus on speed not distance** - "I don't think so. Even though I say it every time they go off sprinting. I say 'look you're going to be tired after a couple of laps' they go 'oh no no no' then two laps later they've got hands on their knees and puffing and I'm like 'told you it's not about how fast it's about just doing it' but they don't seem to get that." **Some boys are competitive and girls are sensible.** - "Erm maybe the first couple of days they will probably, some of them the boys you know are very competitive so in the begging they always sprint even if we explain they should be jogging and pacing themselves but anyway they sprint for 2/3 laps then they get really really tired. But I have been encouraging children to complete the actual distance even if they are walking slowly. As long as they are moving, they can have a little break and then continue jogging. Some girls are a little more sensible and some boys that have been jogging slowly and pushing themselves to maybe 5 or 6 laps which for their age and this time of year erm and after such a long period of time without being so active it's good to start with. This is a good starting point defiantly." **Run in you want – Children are competitive and to beat everyone** - "Researcher 1: So how Barnet's golden kilometre introduced in the school? Participant 5: It's just a general you can run if you want kind of thing but they just take it to the next level as they want to beat everyone around them"
	Taking part with friends	- "I don't think a huge deal but I can definitely pick out some that will just be doing it because their friends are. I feel like at that age a lot of them are just interested in friends like 'oh you're doing it, maybe I should as well'."

Perceived outcomes of participation	Physical related outcome	**Stamina** - "I don't think so. Even though I say it every time they go off sprinting. I say 'look you're going to be tired after a couple of laps' they go 'oh no no no' then two laps later they've got hands on their knees and puffing and I'm like 'told you it's not about how fast it's about just doing it' but they don't seem to get that." - "Well perhaps they could run for shorter distance until their stamina increases." **PC/ Movement pattern improvement** - "I think not just running it might help other skills just like movement of arms and legs and putting it all together. If you can run reasonably well you can do lots of other things."
	Concentration	**Concentration and healthiness** - "Just back to the same, concentration healthiness all those Yeh. The same things again really aren't it" **Being active will help pupils** - "Erm concentrations, you know I believe in the fact that as much as the children are active this will help with their concentration during the day, generally lifestyle and sleeping habits and just maintaining healthy lifestyle this will have a huge impact." **Improve understanding of how exercise works and help concentration** - "Glad to think it would increase their understanding of how exercise effects their bodies and should also help the concentration in the lessons and I would also say their mental health too."
	Healthy lifestyle	**Maintain lifestyle** - "And to maintain not just kind of a buzz for a couple days or weeks and then just you know it to be a lifestyle skill" **Tiers students out which is a bonus** - "Well it does tier them out in the morning ha-ha I have noticed that. I have quite a lively class so in a way that would be a bonus for me. It's hard to say as I don't really know how much they've done it so much this year and if they'll fit it in everyday or do it long enough to start seeing the benefits." **Mental health benefits** - "Participant 4: Glad to think it would increase their understanding of how exercise effects their bodies and should also help the concentration in the lessons and I would also say their mental health too. Researcher 1: Yeh, why mental health? Participant 4: Because any exercise definitely improves your mental health and I think that's kind of proven now isn't it."
	Understanding and knowledge	**Help with science-based learning and exercise boost the brain** - "Erm I guess it might help with some science-based things. I know some years groups work on muscles and movements. And I guess I dunno I just read somethings that said a little exercise can boost your I was gonna just your brain but you know get you going. And I guess especially because its early morning it might get them energised and ready. Also, it might calm them down because they do have a lot of energy. So, if you just get rid of most of that ha-ha they might actually learn something."
	Confidence and motivation	**Be able to see and engage in progression and stamina increase will help pupil's motivation and confidence**

		- " Well I think it would help their motivation and confidence in their own abilities to sort of run a set distance because they might initially start off by think a kilometre that's just miles I can possibly run that, then pretty soon they'll realise exactly how far it is and then suddenly realise too I did it today and it wasn't as hard as I thought, maybe I could run two kilometres by this time next week" **Children will be more motivated to take risks to try run** - "Well, definitely confidence of some children which are some are not very confidence in their subjects but they are really confident with their PE skills and they have really good knowledge in PE skills but this gives them confidence to shine in the school within this aspect. Some children will get more motivated and keener to take risks to try the run. This is definitely improving their confidence and knowledge." **Building running technique and confidence as no one is watching and pupils are in their own bubble** - "Their arms wouldn't move and then we've been able to sort of build that technique. And the run is quite good because there is no one is really looking at them. Everyone's sort of taking part and everyone's in their own little bubble and they're not, no one's looking at them. The focus isn't on them so their able to just sort of comfortably do it and I saw some I can definitely say some children did develop their confidence in this area." **Build confidence in terms of running but not sure on other forms of physical activity** - "Erm Yeh I think to an extend yes because it definitely does build their physical competence, even if it's just their stamina with running and being able to maintain that. And confidence in some cases yes because we do have a lot of children who are not very confident just runners in particular. I don't really know and can't really comment whether it affects their other sports but in other areas like PE but their confidence defiantly in terms of running. I've had a few children last week who weren't confidence runners who just simple things like they would run and their arms would just arm were quiet stationary." **Improve confidence and knowledge** - "Well, definitely confidence of some children which are some are not very confidence in their subjects but they are really confident with their PE skills and they have really good knowledge in PE skills but this gives them confidence to shine in the school within this aspect. Some children will get more motivated and keener to take risks to try the run. This is definitely improving their confidence and knowledge." **If pupils get fitter and faster it might help their confidence** - "Erm I feel like just I guess if there I feel like it would be more self-motivated to do a kilometre. I guess if they enjoy it first there might be motivation but if their taking part just because everyone else is doing it stuff like that then maybe it is not so motivating. And the confidence hmm I guess they if they keep running and they get faster or feel fitter they might feel more confident then."
	Perception of timing relating to behavioural outcomes	"I think depending on what time of day you take them out. We do it straight after play time but I do know you know that it's a nice thing to do in the middle of your learning. Sometimes children need to have that run destress, burn off the energy and come back into class. So, it can positively impact their learning in class as well."
	General physical activity benefits	**If you do anything for a year you see results** - "I think they definitely will. If they can do anything for a year you're bound to start seeing results and improvement."
Teacher attitudes	Teacher physical literacy	**Understanding** **Concept is simple** - "No this seems straight forward"

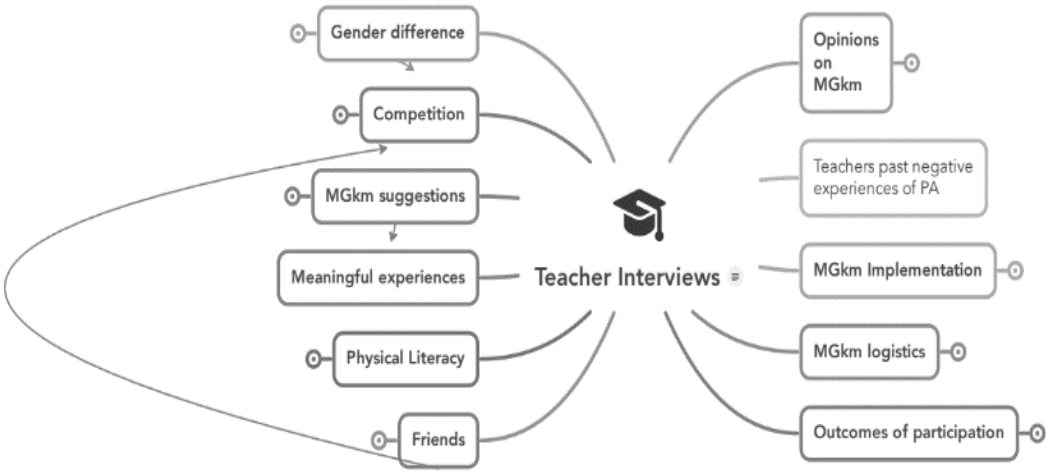
		- No questions on physical literacy **Definition** **Some physical literacy knowledge** - " Yes, as a PE leader I was familiar because during my PE subject leader courses we have discussed this and I know we have been, this is what we are trying to encourage you know every school and you know every people to be aware of the importance of physical literacy and you know it's a terminology which not everyone understands and when it comes to physical activity but I am aware of the fact that it's important to have the competence, confidence of the children and understanding of why we are aiming to be healthy and active and yes." **Never heard of physical literacy before**
	Teachers past negative experiences of physical activity	**Children being put off by Barnet's golden kilometre** - "I will think it could have one of two effects. It will either give them confidence that they can do it and they can achieve it but there is probably a very small number of children that always take longer and they will be put off by it." - "I think they'll be put off trying certain running activities because they are always the last and always the slowest… Speaking as someone who was always picked last for netball ha-ha" **PE as a kid was abusive & Not being fit enough children find it hard to keep going** - "Well you know just thinking about when I was a kid at school and just having to do something in PE that you don't want to do can kind of demoralise you a little bit and if you think you are not very good at it and perhaps not fit enough then you're going to find it hard to keep going. In the old days we didn't have teachers to encourage us ha-ha which obviously doesn't happen now ha-ha. Erm but you know a lot of PE in those days was kind of abusive and demoralising for kids so even now they can see other people doing it better than them so that can always set people back a little bit and impact their self- confidence."
	Punishment	**Children understand it's not punishment to run and articulate the benefits** - "Positively impact all their learning and just children's understanding that it's not a punishment to run but it's for your benefits and children can articulate what those benefits are". **Learning and understanding its not a punishment** - "Bigger picture could be that physical competence and it being able to positively impact all their learning and just children's understanding that it's not a punishment to run but it's for your benefits and children can articulate what those benefits are."

Appendix M: Interview Guides

Teachers: Interview guide		
Question	Probe	Checklist
What is your role in the school?		
How would you describe your role within the MGkm at your school?	Lead, support	
Why did you decide to sign your school up to the MGkm?	What was your motivation	
Describe the process of getting the school on board for this?	Challenges	
Completing the MGkm		
Can you tell me how the MGkm is currently running in your school?	Frequency, duration & implementation	
How do they pupils move when they do the MGkm?	Run, walk jog, skip	
Where/ when do you delivery the MGkm?	Space used and times	
Preparing		
What are the practical preparations that you had to do to deliver the MGkm?		
Can you tell me about any adaptions you had to make?		
Review		
Tell me about anything which has made it difficult to deliver the MGkm?	Pupils, teachers, school level issues	
Tell me about anything which has made it easier to deliver the MGkm?		
Physical literacy / outcome of MGkm		
We're now going to turn to discuss the outcomes you expect to see as a result of participating in the MGkm. As you know we're reviewing outcomes on the concept of PL….		
Firstly, before this research were you familiar with the term PL?		
If yes, what is your definition of PL?		
present IPLA definition	Questions?	
Can you tell me whether you think the MGkm will make any difference in pupils physical literacy? Or any other effects?	Classroom behaviour, motivation, confidence, physical activity	
Can you tell me whether you think the MGkm will change how well your pupils do in school? And why?		
Overall, what changes do you think the MGkm will have on your pupils?		
Pupil perceptions		
How do you pupils feel about the MGkm?	What do they like/ dislike?	
Have you or do you expect to experience any challenges with the MGkm? If so, what?		
Do you have any suggestions on how to develop the MGkm?		
Do you have anything else to add about your thoughts on the project in general?		

Appendix N: Interview Coding Trees

First Coding Tree



Final Coding Tree

Appendix O: Study four COREQ checklist

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	107-108
Occupation	3	What was their occupation at the time of the study?	107
Gender	4	Was the researcher male or female?	107
Experience and training	5	What experience or training did the researcher have?	107
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	128
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	107-108
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	107-108
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	105
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	126
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	64-65 and 126
Sample size	12	How many participants were in the study?	126
Non-participation	13	How many people refused to participate or dropped out? Reasons?	126
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	127
Presence of nonparticipants	15	Was anyone else present besides the participants and researchers?	127
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	126
Data collection			

Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	127
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	127
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	128
Field notes	20	Were field notes made during and/or after the inter view or focus group?	128
Duration	21	What was the duration of the inter views or focus group?	126
Data saturation	22	Was data saturation discussed?	105 and 110
Transcripts returned	23	Were transcripts returned to participants for comment and/or	128
Topic	**Item No.**	**Guide Questions/Description**	**Reported on Page No.**
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	128
Description of the coding tree	25	Did authors provide a description of the coding tree?	Appendix Q
Derivation of themes	26	Were themes identified in advance or derived from the data?	109
Software	27	What software, if applicable, was used to manage the data?	128
Participant checking	28	Did participants provide feedback on the findings?	128
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	129-138
Data and findings consistent	30	Was there consistency between the data presented and the findings?	129-138
Clarity of major themes	31	Were major themes clearly presented in the findings?	129-138
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	129-138

Appendix P: Focus Group Guides

Baseline

Children: Baseline focus groups guide		
Question	Probe	Checklist
Icebreaker		
Write down 5 words to describe physical activity to someone else	Provide post-it notes, paper and pencil	
Draw an environment where you are most likely to participate In physical activity	Done not in conjunction with other	
Completing the MGkm		
Could you please explain in your own words what you think MGKM is?	Or draw	
Why do you think your class is participating in MGKM?	Is it important to take part?	
Can you tell me what you thought about MGKM when you first heard about it?	Can you draw how it made you feel?	
Physical Literacy/ Outcome of MGkm		
Affective		
Can you tell me how feel about participating in MGkm? Do you think you will enjoy the MGkm? Will your classmates enjoy the MGkm?	Do you enjoy it? Does it feel challenging/difficult? Why? Why? What is about?	
Can you tell me how you feel before the MGkm? Do you look forward to doing it? Do you feel the same every time?	Motivated, confident Or do you think it changes according to the day/time?	
Can you tell me how you feel after the MGkm?	Motivated, confident	
Physical		
Can you tell me how you move when you complete the MGkm?	Walk, jog or run? Is this the same throughout? Why?	
Can you describe your drawings, what movement are you doing?	Use questionnaire images	
Cognitive		
How do you think the MGkm will impact you in the classroom? And your classmates?	Behaviour & focus?	
What do you think the benefits are of participating in the MGkm every day?	Cons? Health outcomes of participation?	
Pupils Perceptions		
If you could, how would you improve/ change the MGkm?	Is there anything you would change about it?	
Can you tell me if you think there will be any problem with the MGkm?	Suggestions for improvements?	

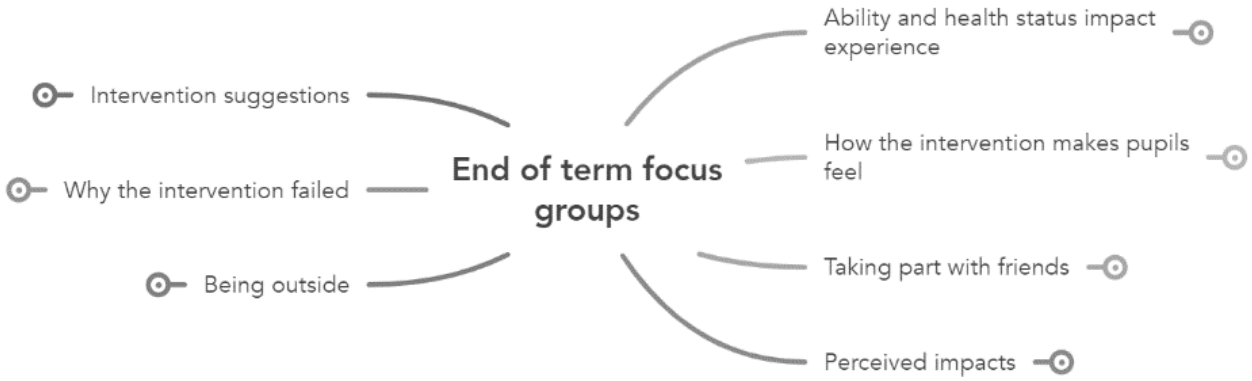
End of term

Children: Follow-up focus groups guide		
Question	Probe	Checklist
Icebreaker		
Write down 5 words to describe physical activity to someone else	Provide post-it notes, paper and pencil	
Draw an environment where you are most likely to participate In physical activity	Done not in conjunction with other	
Completing the MGkm		
Could you tell me what you first thought about MGkm? What do you think about it now?	What is good ad bad?	
What time of day and where do you do the MGKM?	Is this the best time and place?	
Physical Literacy/ Outcome of MGkm		
Affective		
Can you tell me how feel about participating in the mgkm, Do you enjoy MGkm? Do your class mates?	Does it feel challenging/difficult? Why? Why? What is about?	
Can you tell me how you feel before the MGkm?	Do you look forward to doing it? Do you feel the same every time?	
Can you tell me how you feel after the MGkm?	Has this changed over time?	
Physical		
Can you tell me how you move when you complete the MGkm?	Walk, jog or run? Is this the same throughout? Why?	
How has the MGkm influenced your physical ability to take part in sport? What about your class mates?	Have you learnt anything?	
What impact has the MGkm had on your PE skills or fitness?		
Cognitive		
Do you think the MGkm has had any difference on how you or the people in your class act in lesson?	Behaviour & focus? Is in making a difference?	
What impact has taking part in the MGkm had on your learning in school?		
Have you learnt anything whilst taking part in the MGKM?	Why? How?	
Pupils Perceptions		
Would you carry on MGkm?	Class mates?	

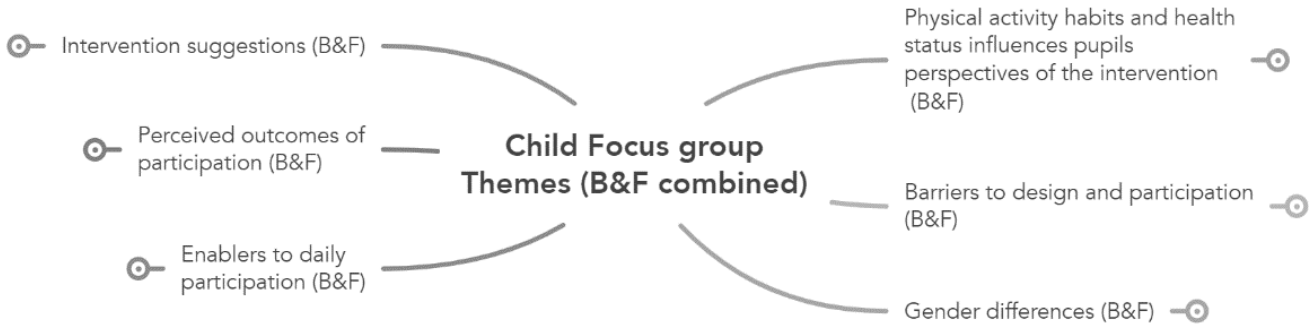
Appendix Q: Focus Group Coding Trees

Baseline coding tree

End of term coding tree



Final coding tree



Appendix R: Publication one

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PHYSICAL ACTIVITY, HEALTH AND EXERCISE

The effectiveness of school-based run/walk programmes to develop physical literacy and physical activity components in primary school children: A systematic review

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ABSTRACT

The objectives of this review were to systematically review the research on school-based run/walk programmes and their measurements of physical literacy (PL) and physical activity (PA)-related components and to assess the different intervention methods and their impact on encouraging PL and PA. To be included in the review, studies had to satisfy all inclusion criteria. An electronic search was conducted on six databases, the last date search was 25 April 2022. All outcome measures were grouped using the Shearer et al. (2021) PL checklist and additional PA related outcomes. Ten studies were included in the final review. Five different run/walk interventions were identified and six studies followed or referred to The Daily Mile (TDM) protocol. Outcomes relating to the physical domain were most commonly explored, and no studies explored the cognitive domain. Four studies reported significant differences in cardiovascular endurance measures. Positive findings were also reported for outcomes relating to motivation and self-perception/self-esteem in the affective domain. Overall, run/walk programmes appear to provide promising results in favour of physical and affective development in PL. However, further high-quality studies are needed to draw firm conclusions. This review highlights the popularity of TDM and its potential to contribute to PL development.

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KEYWORDS
School; intervention; physical literacy; physical activity

1 Introduction

Schools are identified as essential environments for contributing to children's daily physical activity (PA) levels (Jones et al., 2020; Naylor et al., 2015; Public Health England, G. U, 2020b; Shah et al., 2017; Taymoori & Lubans, 2008) and prove a popular environment to roll out PA-based initiatives as children spend a large portion of their day in school (Jones et al., 2020; Naylor et al., 2015; Shah et al., 2017). Children and young people should be engaging in an average of 60 minutes per day of moderate to vigorous physical activity (MVPA) across the week, and at least 30 of their 60 active minutes per day should be achieved during school time (UK Chief Medical Officer Physical Activity Guidelines, 2019;). However, with increasing timetable pressures on schools and physical education (PE), the opportunity for active play is often not prioritised (Norris et al., 2015; Youthsporttrust.org, 2018). School-based PA programmes are offered as an opportunity for pupils to be active throughout the school day outside of PE lessons, including during breaktime or in-class activities (Jones et al., 2020). These PA-focused initiatives are often introduced to combat rising childhood obesity and sedentary behaviours in young children by increasing daily PA at school (Chalkley et al., 2020b; Jones et al., 2020).

Existing systematic reviews and meta-analyses of school-based PA programmes have reported the effects of participation, including improved; PA and/or Sedentary behaviours (M. B. Owen et al., 2014; Dobbins et al., 2001; Hynynen et al., 2016; Jones et al., 2020; Kriemler et al., 2011), Motivation (Dobbins et al., 2013; Kelso et al., 2020), MVPA (Nathan et al., 2018), and academic outcomes (Watson et al., 2017). However, these findings are often inconsistent across reviews, and many components are inconclusive or only indicate small effects (Dobbins et al., 2013; Jones et al., 2020). One suggested limiting factor for these findings is the variation in intervention designs within reviews (Jones et al., 2020).

In recent years, school-based run/walk programmes have gained popularity (Chalkley et al., 2018b, 2020a) and involve walking, jogging, or running a route on school grounds for either a set distance or time (Chalkley et al., 2020b; Sherar et al., 2020). School-based running programmes are often also referred to at a policy level as "active mile initiatives", which typically entail running for approximately 15 minutes at a self-selected pace until a one-mile distance is covered (Chalkley et al., 2018a; Public Health England, G. U, 2020; The Daily Mile, 2022). Due to the self-select nature and variation in pace, the interventions are referred to in the present review as "run/walk" interventions rather than solely "running interventions". Several national and local policies feature school-based interventions with specific attention on run/walk programmes such as The Daily Mile™ (TDM; Public Health England, G. U, 2020; The Daily Mile, 2022). The United Kingdom (UK) Government Childhood obesity: A plan for action report, Chapter 2 (Department of Health and Social care, 2019) and the School Sport and Physical Activity Plan (Department for Education, Department for Digital, Culture, Media & Sport and Department of Health and Social Care, 2019) all promote the implementation of "active mile

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Appendix S: Publication two

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Research Article

OPEN ACCESS Check for updates

'Works for some but not others' A qualitative study on teachers' perspectives and perceived pupil experience of a North West London school-based run/walk programme

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ABSTRACT

Developing physical literacy (PL) in childhood is a key to develop lifelong physical activity. Teachers' play an important role in supporting children's PL and are at the forefront for continued participation in school-based interventions. This study aimed to discuss teacher-perceived pupils' experiences of a London-based run/walk intervention and explore its contribution to PL. Semi-structured interviews were developed to explore school delivery and teacher perceptions. Six themes developed: perceived experiences, perceived outcomes of participation, teacher attitudes, fidelity/adherence, logistics and intervention suggestions. A novel insight is that the intervention 'works for some but not others' and the importance of self-select pace.

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KEYWORDS
Physical literacy; teacher; physical activity; school

Introduction

Regular physical activity (PA) results in health-related outcomes (i.e. reduced risk of obesity and heart disease [Biddle et al. 2019]), improved cognitive function (e.g. attention and academic performance [de Greeff et al. 2018]) and general wellbeing (e.g. reduce depression/depressive symptoms [Biddle et al. 2019; Dale et al. 2019; de Greeff et al. 2018]) social and emotional wellbeing (Kliziene et al. 2021; Rodriguez-Ayllon et al. 2019). Developing health-related habits in childhood tracks into adolescence and adulthood (Hesketh, Lakshman, and van Sluijs 2017) making childhood (pre-adolescence) a popular focus for developing participation in PA. However, many children fail to meet the recommended PA guidelines (55.1%, [UK Chief Medical Officer Physical Activity Guidelines 2019; Physical Activity Data Tool: Statistical Commentary, March 2021. 2021]).

There is growing interest in the concept of physical literacy (PL) as a gateway to PA engagement (Edwards et al. 2017; Longmuir et al. 2015). PL is commonly defined as 'the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life' (IPLA 2017). Someone progressing within their PL journey is more likely to enjoy PA participation, understand the importance of engagement and participate in a range of activities across a variety of environments with others or alone (Whitehead 2019). Developing these core principals of PL is thought to be critical at childhood in order to develop lifelong participation (Belanger et al. 2018; Shearer et al. 2021).

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