Physical Literacy and South East Wales Primary School Children: The Role of Fundamental Movement Skills

Stuart Phillip Jarvis

A submission presented in partial fulfilment of the requirements Of the University of South Wales/Prifysgol De Cymru for the degree of Doctor of Philosophy

April, 2016

University of South Wales
Prifysgol De Cymru

Graduate Research Office
Swyddfa Ymchwil Graddedigion

R11

Certificate of Research

This is to certify that, except where specific reference is made, the work described in this thesis is the result of the candidate's research. Neither this thesis, nor any part of it, has been presented, or is currently submitted, in candidature for any degree at any other University.

Signed ....
Candidate

Date 25TH April 2016

Signed ....
Director of Studies

Date 25th April 2016.

Table of Contents

LIST OF APPENDICES

LIST OF TABLES

CHAPTER 5 (Study 3)

LIST OF FIGURES

PAGE

CHAPTER 4 (Study 2)

ACKNOWLEDGEMENTS

I would like to acknowledge the University of South Wales for providing the grant funding to commit to this project and the Central South Physical Education and Sport Consortium for allowing permission to approach the primary schools of the local education authority of South East Wales and their supplementary funding to support this research.

I would also like to thank the following people for the support and assistance during the course of this research.

Firstly, I would like to thank my director of studies Professor Richard Mullen for his considerable support and direction through the whole programme of research. His patience and encouragement has contributed to my development as a researcher, lecturer and applied practitioner.

I would also like to thank members of the School of Health, Sport and Professional Practice at the University of South Wales for their assistance. In particular, my supervisors Dr. Morgan Williams for his endless enthusiasm and assistance with the statistical analysis used in this thesis and Mr. Paul Rainer for promoting my involvement within specific research activities at the University of South Wales.

To all the head teachers, parents, and children of the many primary schools involved in this thesis, for without them there would be no research.

To my family and in particular thank you to my mum and dad, brother and sister. For your endless love, support and encouragement to persevere with my aspirations I will be eternally grateful.

To my partner Nicola, thank you for your support and encouragement along this journey, it has been immense.

Finally, to all my friends, thank you for your continued support and motivation throughout the duration of my PhD study.

Abstract

This thesis addressed the physical literacy attributes of primary school children in South East Wales with a specific focus on the relationships between FMS motor behaviour competency and other aspects of physical literacy. The aims of this thesis were to: (a) examine the factor structure of the Children and Youth Physical Self-Perception Profile (CY-PSPP), based on the validation work of Welk and Eklund (2005) for use as a valid measure of physical self-perceptions, with this population; (b) establish levels of FMS and associated measures of physical literacy in South East Wales primary school children; (c) utilise an alternative form of FMS classification (cluster analysis) and identify which associated variables of physical literacy discriminate between different classifications of FMS performance with this population; and (d) identify the impact of parental socialisation upon FMS performance. The thesis comprised of three studies and a summary report. In study 1 confirmatory factor analysis supported the hierarchical structure of the CY-PSPP as a valid and reliable measure to examine the nature and impact of physical self-perceptions on young children in this population and for its subsequent use in this thesis. Study 2 identified low levels of FMS proficiency in both genders of this population. The use of an alternative classification of FMS revealed several distinct group classification of FMS proficiency and identified specific skill differentiation between these group classifications in both genders. In addition, a number of significant relationships were identified between the multidimensional domains of physical literacy to discriminate the different group classifications of FMS performance. In Study 3 significant relationships between aspects of parental socialisation and children's FMS proficiency were revealed. Therefore, overall this thesis provides rich data that increases our knowledge of FMS proficiency and its classification in UK and in particular with Welsh primary school children and reports both theoretical and methodological strengths that make a significant contribution to the FMS and physical literacy research area.

Chapter 1

Introduction

Recent epidemiological reports indicate that youth are not as physically active as they should be and over the past quarter century the prevalence of overweight and obesity among children and adolescents has become a major public health concern (Ogden, Carroll, Kit, & Flegal, 2012). Worldwide obesity has more than doubled since 1980 and nearly 43 million children across the globe were overweight in 2010 (Goodway, Famelia, & Bakhitar, 2014). In the United Kingdom (UK), around 30% of children and young people are either classified as overweight or obese (Townsend et al., 2013) with Wales recording the highest rates of childhood obesity in the UK, with around 35 % of children and adolescents shown to be overweight or obese (Welsh Government, 2012). Additionally, in the distribution of obesity throughout the UK it was shown that five of the top six 'obesity hotspots' were in Wales (National Assembly for Wales [NAW], 2013). Compared to the obesity rates of other parts of the world (in 35 countries), Wales had the fifth highest rate (World Health Organisation [WHO], 2008) and it has been predicted to continue to rise in forthcoming years (NAW, 2013).

A distinct lack of physical activity and excessive sedentary behaviour are identified as major contributors to this obesity epidemic and there is a significant body of evidence demonstrating that childhood and adolescent physical activity levels across the globe are down (Goodway et al., 2014). In a study of 15 countries, Tremblay et al. (2014), reporting on identical measures of physical activity, found that levels were generally low or poor. Lifestyle changes and the emergence of sedentary technologies such as watching interactive television & DVDs, playing videogames, being on computers, the internet, and texting and interacting with mobile phones have been identified as major culprits. These have become the preferred mode of passive entertainment in daily living, particularly amongst young people (Bickham, Blood, Walls, Shrier, & Rich, 2013). This generation of children have been identified as being less active and more overweight than other generations of children (WHO, 2011a, 2011b, 2011c). Gopinath, Hardy, Baur, Burlutsky, and Mitchell (2012) suggest that children who engage in less physical activity also demonstrate reduced psychological well-being, poorer physical health, lower self-esteem, reduced life satisfaction, and poorer cognitive performance. Halfon, Verhoef, & Kuo (2012) have suggested that these positive and negative behaviours established during the growing years tend to carry over into adulthood. Therefore, in the long term, insufficient physical activity and sedentary behaviour have been identified as major, independent, modifiable risk factors for mortality and morbidity from many chronic, non-communicable and potentially preventable diseases (Gillis et al., 2013). Physical inactivity is now identified as the fourth leading risk factor for global mortality (WHO, 2012). The estimated economic cost of the health implications associated with physical inactivity and obesity in Wales alone is about £650 million a year (NAW, 2013).

Many developed countries, and global groups like the World Health Organisation, have highlighted the importance of systematic strategies to increase physical activity as a means to reduce childhood obesity and decrease chronic disease although increasing physical activity trends among children and adolescents is difficult as behaviour is influenced by several factors including personal factors, institutional, community, public policy, and the physical environment (Dobbins et al., 2013). The World Health Organisation (2012) recommends that "all sectors and all levels within governments, international partners, civil society, non-governmental organizations and the private sector have vital roles to play in shaping healthy environments and contributing to the promotion of physical activity". Reflecting this contention, a concept that is growing in importance worldwide in the promotion of physical activity is physical literacy (Pot, 2014). Nations such as the UK, Canada, Australia and New Zealand to name but a few, have all in recent years pioneered large-scale initiatives in education, community and public health settings to promote participation and performance in physical activity through the physical literacy concept (Keegan, Keegan, Daley, Ordway, & Edwards, 2013). Physical literacy is defined as a disposition acquired by individuals encompassing the motivation, confidence, physical competence, knowledge and understanding that establishes purposeful physical pursuits as an integral part of their lifestyle (Whitehead, 2010). The concept concentrates its focus on developing physical activity for health, targeting a wider audience opposed to more traditional approaches which mainly focus on attaining sporting prowess.

Given the investment and perceived importance of physical literacy for improving physical activity engagement, it is unfortunate that current models and initiatives used to operationalize this concept and dictate the structure of physical literacy programmes currently lack an accepted governing standard and vary in interpretation across the globe (Giblin, Collins, & Button, 2014). Giblin et al. (2014) also suggest that without comparative data to generate evidence for best-practice in developing physical literacy skills, policies can only offer vague guidelines. To improve the effectiveness of programme and policy development surrounding sustainable physical literacy interventions for children and adolescents, most experts in the field generally agree that additional study is needed (Gillis et al., 2013). To date, the research community has not been very successful at developing interventions for children and adolescents that bring about long-term and sustained change in health behaviours. In addition, little attention has been given to the importance of the demographic setting and establishing what works in what situation and with whom (Gillis et al., 2013). Keegan et al. (2013) suggest that without making best practice guidelines a specific goal of physical literacy programmes based on reliable evidence, future developments and funding decisions will remain dependent on anecdotal evidence.

Current programmes delivering physical literacy all operationalise the concept by emphasising the early development of fundamental movement skills (FMS). FMS are common motor activities comprised of an agreed series of observable movement patterns (such as throwing, kicking, catching and jumping; Gallahue & Donnelly, 2003) and are now considered an important pre-requisite to developing and enhancing participation in physical activity (Goodway et al., 2014; Stodden et al., 2008). Unfortunately, FMS trends of children attending primary school (between the ages of 7-11 in the UK) demonstrate FMS competency to be consistently low to moderate (Bryant, Duncan, & Birch, 2013; Foweather, 2010). Having insufficient FMS at this age is therefore seen to limit the development of children's physical literacy (Stodden et al., 2008). It has therefore been suggested by Lloyd, Colley, and Tremblay (2010) that we no longer measure FMS in isolation to predict/determine physical literacy outcomes. They suggest that physical literacy contains domains of physical fitness, motor skills competence, physical activity behaviours, psychological and socio-cultural factors. Although these domains are (theoretically and practically) distinct they do have interlinking constructs that have potential to impact on the physical literacy development of a child (Lloyd et al., 2010). It has been suggested by Giblin et al. (2014) that if the primary objective of physical literacy is life-long physical activity (facilitated by physical skills proficiency), then appropriate measurement of each physical literacy construct and integrated evaluation of these constructs should provide a more accurate assessment of an individual's physical literacy ability and inform appropriate direction for future physical literacy intervention and frameworks.

Purpose of this Thesis

The purpose of this research is to explore the physical literacy attributes of primary school children in South East Wales with a specific focus on the relationships between FMS motor behaviour competency and other aspects of physical literacy. To date, research has focused mainly on relationships among FMS and selective attributes of physical literacy. In addition, few of the studies have been conducted in the UK and very limited research has been used with primary school children in Wales. This thesis therefore intends to contribute to and challenge the existing literature by using an established measure of FMS competency but using an alternative classification system to determine current levels of FMS competency and examine its relationships with valid measures of physical literacy domains (physical fitness, physical activity behaviours, psychological and socio-cultural variables) for use with this population. The specific aims of this thesis are therefore to: (a) examine the factor structure of the Children and Youth Physical Self-Perception Profile (CY-PSPP), based on the validation work of Welk and Eklund (2005) for use as a valid measure of physical self-perceptions, which contributes to the psychological domain of physical literacy with this population; (b) establish levels of FMS and associated measures of physical literacy in South East Wales primary school children; (c) utilise an alternative form of FMS classification (cluster analysis) and identify which associated variables of physical literacy discriminate between different classifications of FMS performance with this population; and (d) identify the impact of parental socialisation upon FMS performance. The findings from this thesis will therefore aim to inform the body of literature within this field of expertise in the UK and in particular Wales.

Structure of this Thesis

The thesis comprises of six main chapters and consists of three studies. This introduction is followed by chapter 2, which provides a review of the physical literacy concept, its most critical domain (FMS) and its association with other domains of physical literacy (physical fitness, physical activity behaviour, psychology and socio-cultural) in primary school aged children.

Chapter 3 (Study 1) presents a validation study to directly test the factorial validity of Eklund, Whitehead, and Welk's (1997) Children and Youth Physical Self-Perception Profile (CY-PSPP) using confirmatory factor analysis with this population. The findings of this factorial validity study will determine its use as a measure of physical self-concept to provide an indication of the psychological component of physical literacy in subsequent chapters of this thesis.

Chapter 4 (Study 2). The study will address the absence of data specific to Wales and the UK by providing contextual information relating to FMS proficiency, physical activity, kinanthropometric, physical fitness, and psychological markers of physical literacy amongst Welsh primary school aged children. A secondary objective of this study will be to perform an exploratory analysis that classifies children into groups by their FMS ratings, and then compare kinanthropometric, physical fitness, physical activity and psychological scores to identify which of these variables have potential to discriminate FMS performance.

Chapter 5 (Study 3) will address the relationship between parental socialisation behaviours and the FMS performance of their child within this population. These socialization behaviours relate to the parents as the most proximal socialisation agents focusing on their family characteristics, behaviours, beliefs, knowledge and awareness of their child in relation to their FMS status.

Chapter 6 summarizes the overall findings of the research programme and discusses the conceptual issues derived from it. The chapter also discusses the major practical implications emanating from the findings and discusses the strengths and limitations of the research programme. Finally, areas of future research are considered, with an emphasis on how the FMS measurement model presented in Chapter 4 can be advanced to better assess a domain of physical literacy.

In addition to these chapters and due to the interest expressed in this thesis from the Welsh Government Central South Physical Education and Sports Consortium, primary school teachers, physical education practitioners and parents a summary report of findings has been produced highlighting the key outcomes (see Appendix J). The dissemination of this summary report to a wider audience may generate greater understanding and discussion of physical literacy, FMS competency and the appropriate direction for future physical literacy interventions and frameworks with children and young people.

Consideration in the Presentation of this Thesis

In order to ensure a consistent approach throughout the thesis, the following format was adopted for all six chapters: (1) American Psychological Association (APA) formatting (6th Edition), (2) Table and Figure numbering re-start with each new chapter, and (3) a single final reference list at the end of the general discussion (chapter 6). Appendices, including copies of the measures and questionnaires used in studies 1, 2 and 3, are provided following the reference list. The decision to use APA formatting was made on the basis of the author's research training. The supervisory team recommended that APA be used in preference to the University of South Wales Harvard system to ensure that the research training best prepared the author for a career publishing in specific journals that adopt this mode of presentation.

Chapter 2

Literature review

Introduction

The purpose of this chapter is to review the literature concerning the concept, interpretation and delivery of physical literacy. The chapter will also discuss the importance of fundamental movement skills (FMS), and its relationship with the associated physical literacy variables of physical fitness, physical activity behaviour, psychology, and socio-cultural markers.

Physical Literacy

The purpose of this section is to (a) outline the concept of physical literacy and why it might be important, (b) identify current physical literacy initiatives, their financial investments, and the proposed impact of these models and frameworks, (c) discuss the current issues with physical literacy interpretation, (d) establish why there is a need to develop it with children, and (e) identify what’s needed to operationalise physical literacy with this cohort.

What is it and why physical literacy? There have been numerous references to physical literacy in the literature over the years, and also many philosophical and physiological debates, mainly by physical educators, over its importance throughout the human life span (Ford et al., 2011). Lundvall (2015) suggests that amongst scholars, Margaret Whitehead is seen as “the” scholar who has placed physical literacy on the agenda within the past decade, persistently exploring the concept for a conceptualization that is philosophically and theoretically sound and operationally feasible. Although the work of Whitehead has become prominent, the term physical literacy is not entirely a new concept. Definitions have existed for well over four decades. One of the first written definitions was provided by Morrison, 1969 (cited in Wall & Murray, 1994):

> To be physically literate, one should be creative, imaginative, and clear in expressive movement, competent and efficient in utilitarian movement and inventive, versatile,

> and skilful in objective movement. The body is the means by which ideas and aims are carried out and, therefore, it must become both sensitive and deft. (p. 5)

With respect to such early definitions of physical literacy, Mandigo, Francis, and Lodewyk (2007) suggest that Whitehead (2001) was most probably the first to develop the concept in any meaningful way by proposing a definition, and questioning traditional methods of physical education to promote physical literacy throughout the life course. Originally, Whitehead (2001) defined a physically literate person as one who moves with poise, economy and confidence in a wide variety of physically challenging situations; and, is perceptive in 'reading' all aspects of the physical environment, anticipating movement needs or possibilities and responding appropriately to these, with intelligence and imagination. However, Whitehead (2007) updated the definition to take into consideration criticisms that her initial definition excluded the social and cultural contexts of movement (Wright & Burrows, 2006). This revised definition included concepts such as motivation, quality of life, imagination and self-esteem. Mandigo et al. (2007) suggested therefore that the reworking of the definition was also consistent with other scholars in this area for example Penney and Chandler (2000) who suggest physical literacy should be:

> Focused upon the knowledge, skills and understanding that are associated with bodily awareness, development and expression, and that underpin participation, development of performance and enjoyment in and of the wide array of physical activities that feature in modern societies. There is a need to emphasize that the knowledge, skills and understanding that we refer to are not only physical in nature. The focus of attention is on physical development, but the complexity of that development is acknowledged. (pp. 80-81)

Hayden-Davies (2008), in an international survey with experts trying to provide a definitive definition of physical literacy, supports the revised interpretation of physical literacy by suggesting that to become physically literate, “a child needs to be able to perform basic movement competencies (within their own physical capacity), apply these in a variety of situations and activities, understand how they can learn further, independently and have the internal motivation to do so.” (p.19). Mandigo, Francis, Lodewyk, and Lopez (2009) have therefore suggested that it would seem that the definition of physical literacy has come full circle. The initial definition of physical literacy proposed by Morrison in 1969 adopted a more holistic perspective by acknowledging that physical literate individuals not only move efficiently, but they also move creatively, competently and with enthusiasm. Whitehead’s revised working definition of physical literacy has adopted this perspective, and also further expanded the definition to include elements of social responsibility. Most recently, Whitehead (2010) refined the concept of physical literacy as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life with sufficient opportunity afforded for every child to be able to develop and reach his or her physical potential to lead a healthy lifestyle.

Keegan, Keegan, Daley, Ordway, and Edwards (2013) suggested that Whitehead’s intention for introducing the concept of physical literacy was to change educationalists’ views on the priority of physical education. It was perceived that physical education was becoming increasingly unsophisticated and unimportant compared to other curricular subjects, with the importance of movement development and physical activity being neglected due to the emphasis on cognitive capacities such as literacy and numeracy (Higgs, 2010; Whitehead, 2010). Physical education is the subject area that has historically been responsible for delivering curricula that cover physical activity, FMS, physical fitness, healthy eating, and other developmentally appropriate health education (Lloyd & Tremblay, 2011). Whitehead (2005) suggested that physical education was for the most part being influenced by a “Cartesian, dualist view of being which casts the body as a mere mechanism” (p.2). Kirk

(2010) suggests that this approach demonstrates that physical education is taught in a way that is abstracted from its natural context through an authoritarian pedagogy of command response with opportunities for thinking in and through physical movement thus being diminished as de-contextualized, repetitive drills aimed at maturing movement that have created a pedagogical paradigm of "physical education as sports techniques" (p.42). Whitehead (2007, 2005, 2001) has interpreted the concept of physical literacy through a monist view and suggested that instead of teaching children a limited number of skills in a set of narrowly defined activities or sports, movement capacities should be explored and understood in interaction with the environment in which they are executed (i.e., being able to read and understand the environment and being able to respond to it in an efficient and confident way) thus capitalising on their potential. In addition, Whitehead (2010) suggested that these competencies with emphasis on the interaction with the environment could be divided into four stages for the developing child: movement vocabulary (e.g., rolling and walking), movement capacities (e.g., running and jumping), movement patterns (e.g., throwing and catching) and movement patterns specialised for specific activity (e.g., various sporting past times). Extending this bank of movement competencies will allow the individual to interact, anticipate and respond in a way that is automatic in any given environment.

Physical literacy is therefore not an ideology or a curriculum but an ideological tool through which to build a pedagogical model (i.e., a framework or reference point). Roetert and Jefferies (2014) suggest that the debate on physical literacy has progressed significantly in the past five to ten years and Lundvall (2015), advocates that scholars have been attempting to clarify the extent to which physical ability is recognised, conceptualised, socially configured, nurtured and embodied as constructed in physical literacy in and through the practices of physical education and recreational activity. Lloyd and Tremblay (2011) suggest that many have not taken the same philosophical approach as Whitehead in her definition, or have gone into as much detail, but all have furthered the profile of physical literacy bringing it to the attention of a wider international audience.

Investment in physical literacy. Reflecting the increased attention afforded to physical literacy, many governments around the world have introduced large scale initiatives in education, community and public health settings to promote participation and performance in physical activities through physical literacy. Governments have come to understand the concept of literacy. Through the use of the term physical literacy, many stakeholders have identified that children and youth need a repertoire of physical skills or physical literacy that will enable them to become more physically active and therefore develop into healthier adults (Higgs, 2010), and in many countries physical literacy is now used as a philosophy that influences pedagogical models in physical education and sports policy. The considerable expense of implementing such models seems justified when the potential return on investment into health and future well-being is considered (Giblin, Collins, & Burton, 2014). For example, the estimated cost per annum of physical inactivity to worldwide economies is estimated to be $75 billion in the USA, $15.8 billion in Australia and £8.2 billion in the UK (Keegan et al., 2013).

Keegan et al. (2013) highlighted the approximate spends on physical literacy and physical activity projects in some of the leading nations worldwide. They suggested that Canada has demonstrated probably the most comprehensive adoption of physical literacy and has incorporated the concept into schools, national governing bodies and its long term athlete development programmes. Although exact figures of financial investment remain undisclosed, the total is thought to be substantial, for example the regional government of Quebec invests approximately $20 million per annum in its programmes for physical literacy. In New Zealand, Government and regional funding towards physical literacy projects is estimated to be $22.4 million since 2009 with a further $13.8 million being granted from additional partners (e.g., community sport, national sporting bodies, organisations and charities). In the United States, funding is determined by individual states and not the federal government; therefore, amounts of funding remain unclear, although it is thought to be substantial. In the United Kingdom, which has some of the largest selection of physical literacy frameworks in the world, there has been significant investment with separate programmes being developed in England, Scotland, Northern Ireland and Wales. Keegan et al. (2013) identified that since 2006, Sport Northern Ireland has invested £16.6 million, with a further 15% of this total having been potentially generated via programme sponsorship. In Scotland, an estimated £20 million funding with a further £6 million is being granted for the professional development of the physical literacy programme. In England, the Youth Sports Trust has received £128 million in funding from several sources (e.g., Government, National Lottery, and multinational company sponsorship) to deliver high quality physical literacy, physical education and sports programmes to its young people. In addition, within the UK as part of the 2012 London Olympic legacy, £150 million has been earmarked for investment in school sport.

Specific to Wales, the Welsh Government set up a taskforce in 2012 to look at how to develop the roles of its schools in increasing the levels of physical activity in children and young people. This taskforce concluded that physical education in Wales needed to be supported by a national physical literacy framework which would include a suite of measures to enhance and evaluate the progress of its young people by professionals in education, health, sport and by parents (Welsh Government, 2013). Therefore, in 2014, the Welsh Government introduced the Physical Literacy Programme for Schools (PLPS) to support young people on their physical literacy journey. A total of £1.78 million has initially being spent with a further £2.35 million agreed to in principal to develop a draft physical literacy framework. The Welsh Government (2013) estimates a further £5 million per annum will need to be set aside for the PLPS programme. The outcome of this investment it is hoped will change the lives of the next generation with Wales leading the way in the UK and beyond as a physically literate, healthy and active nation (Welsh Government, 2013). In summary, these prominent, developed nations have all committed substantial funding towards physical literacy models and frameworks. This investment will be justified if a wide range of anticipated benefits, such as significant future savings to healthcare and improved well-being (i.e., physical literacy) can be met.

Disappointingly, scientific evidence showing the efficacy of such physical literacy interventions to successfully meet these expectations is limited. Further still, despite investment, physical activity guidelines for both children and adults are frequently not achieved (Giblin et al., 2014). Whitehead (2001) originally suggested that the intention for introducing the concept of physical literacy was to enhance debate on the content and delivery of physical education. Although the widespread global adoption of the term physical literacy has since been espoused or implied, Lounsbery and McKenzie (2015) could not find physical literacy explicitly identified as the target goal of physical education (i.e., producing physically literate individuals) in the national physical education standards of any country other than the United States of America. Therefore, despite inward investment and the continued exposure to developing physical literacy in the school setting, Keegan et al. (2013) suggest that in reality this funding and resource to support primary schools, teachers and children remains unclear. Early years' physical education is, by necessity, often delivered by teachers with limited training in physical education, limited access to trained physical education professionals, and has severe constraints in terms of time and resources (Rainer, Cropley, Jarvis, & Griffiths, 2012). It has been suggested by Lundvall (2015) that in the world of physical education and sport, physical literacy has been adapted to purposes beyond

Whitehead's (2001) original interpretation. There has been a tendency for many governments and national governing bodies to construct their own conceptualisation of physical literacy, often resulting in alternative and ambiguous terminology and definitions being circulated in the public domain.

Issues with physical literacy interpretation. The variations in physical literacy interpretation across the globe provide no assurances that current models and frameworks are benefiting children (Keegan et al., 2013). In the majority of physical literacy models and frameworks, the outcome is to develop a physically literate young person who has the skills, knowledge, habits, confidence, and desire to continue participation in physical activity throughout the lifespan. Whilst developing these models and frameworks, physical literacy, sport and physical activity are often considered synonymous by many (Pot, 2014), for example, Coaching Ireland's Long-term Involvement in Sport and Physical Activity framework and the Canadian Sport Centre's Long Term Athlete Development model. Both these frameworks are based on Balyi and Hamilton's (2004) Long Term Athlete Development Model (LTAD) whereby physical literacy has been considered an integral component. Such models draw on Higgs and colleagues' (2008) narrow definition of physical literacy which define physical literacy as "the development of FMS and fundamental sport skills that permit a child to move confidently and with control, in a wide range of physical activity, rhythmic (dance) and sports situations" (p. 5). Similarly, in the UK, programmes such as TOP Sportability, aimed at supporting high quality physical education and sports programmes for all young people, also contain strong links to the LTAD model. In the Netherlands, the use of physical literacy is most noticeable in the policies of the national sport federation and its different sport associations who all employ the LTAD model (Pot & Hilvoorde, 2013).

The LTAD model is fundamentally based upon physiological principles to develop athletic potential alongside biological growth and focuses on critical periods which are proposed as windows of opportunity or periods of accelerated adaptation. The model proposes that failure to develop relevant capacities (i.e., FMS) during these critical periods will forever undermine a child's capacity to develop athletic competency. Ford et al. (2011) suggested that there are a number of problems with this theoretical model that are not necessarily evident to coaches and physical education practitioners who adopt it. Ford et al. highlight that the model is only one-dimensional, has a lack of empirical evidence upon which it is based, its interpretation is questionable or restricted due to it being based on questionable assumptions and erroneous methodologies and it is a generic model rather than an individualised plan for physical and sporting development.

In Canada and in Ontario's Revised Health and Physical Education framework (2010, p. 3) they use Mandigo and colleagues' (2009) definition of physical literacy in an effort to bridge the gap between the needs and philosophies of sport and those of physical health education:

> Individuals who are physically literate move with competence in a wide variety of physical activities that benefit the development of the whole person. Physically literate individuals consistently develop the motivation and ability to understand, communicate, apply, and analyze different forms of movement. They are able to demonstrate a variety of movements confidently, competently, creatively, and strategically across a wide range of health-related physical activities. These skills enable individuals to make healthy, active choices throughout their life span that are both beneficial to and respectful of themselves, others, and their environment. (p. 28)

The interpretation of physical literacy models and frameworks as described here has therefore resulted in several alternative approaches considered as best practice in which to promote and develop physical literacy. Many of these programmes and frameworks operationalise physical literacy as the early development of FMS and exposure to sport (Keegan et al., 2013). The question to consider, therefore, is are we promoting physical literacy specifically aimed at sport participation and performance over and above active lifestyles, health and quality of life? Keegan et al. (2013) highlighted that:

> The repeated pattern of physical literacy frameworks becoming 'sport for life' projects may serve as a warning to those yet to develop a model and the cultural tendency to conflate activity and movement with sport and athleticism is extremely strong, but possibly quite damaging. (p. 13)

Within the concept of physical literacy little emphasis is put on sport, as the physical activity engagement that is a central goal of physical literacy extends far beyond the sport context (Whitehead, 2010). In addition, sport is often associated with competition between children and/or adolescents, whereas physical literacy is aimed at personal development and realising an individual's potential (Lundvall, 2015). Many models, especially the LTAD model (stages 1, 2 and 3), identify physical literacy as the development of FMS on a pathway to developing the athlete for sporting performance; in addition, in many sport and education policies and praxis physical literacy is also often interpreted as FMS. Lundvall (2015) suggests that the narrowing of physical literacy to focus solely on FMS development in such frameworks has resulted in physical literacy becoming synonymous with FMS development. Although FMS are identified as the building blocks for physical literacy (Whitehead, 2010), physical literacy should not be confused as solely being FMS. To focus all attention on developing FMS without paying due diligence to their interaction in certain contexts with other domains of the physical environment (as proposed as part of Whiteheads physical literacy philosophy) leads to too narrow a focus (i.e., sport skill specific), and alienates large groups of children in physical pursuits, preventing the development of physical literacy itself.

Physical literacy is aimed at participation for all in different kinds of physical activity pursuits, in which everybody can reach his or her own potential, regardless of their level compared to others. Physical literacy is the result of a lifelong process in which the mind and body continuously adapt to changes that come as a result of the human development and ageing cycle (Whitehead, 2001). It is therefore imperative that physical literacy should not be being promoted as a pathway for young children into sport, talent identification and long term athlete development programmes. Physical literacy is supposed to develop “a lifelong habit of taking up options in one or more areas of physical activity” (Whitehead, 2007, p. 295), in which being physically active does not necessarily have to mean being competitive in order to promote a healthy lifestyle. We may therefore be overlooking the opportunity to reach out to every child during their initial experiences at school and are unintentionally continuing to preach to the more able and talented.

Physical literacy as a concept is the “new kid on the block” and provides a renewed emphasis in promoting physical opportunities to every individual for future sustainable health. Pot (2014) suggests that although Whitehead in her interpretation of physical literacy explicitly wants to avoid a characterisation of physical literacy as sport education, it seems inevitable that the field of sport is the dominant context in which physical literacy becomes concrete and meaningful, especially for children and adolescents. Roetert and Jefferies (2014) highlight further that there still remains a subtle move towards high level performance as the principal focus of physical literacy in what Shilling (2008) describes as an era of “performative” sport. In addition, the building block metaphor of motor competence assumes that movements can be stacked from movement vocabulary to movement capacities, movement patterns and ultimately patterns specialised for specific activity, such as sports (Whitehead, 2010, p.45). Therefore, this metaphor of movement that is the cornerstone in the conceptualisation of physical literacy has potential for misinterpretation and manipulation when they are considered in light of meaningful (sport) context (Pot, 2014).

The picture that emerges then is one of physical literacy being a contested concept that is not consistently applied and without comparative data to generate evidence for best-practice in developing physical literacy, policies can only offer vague guidelines (Bellew, Bauman, & Brown, 2010). Whether described in philosophical (Whitehead, 2001; 2007; 2013) or practical (Balyi, Way, Norris, Cardinal, & Higgs, 2005) terms, Higgs (2010) advocates that whichever approach is developed, the aim should always be to develop the individual who is sufficiently physically skilled to use their fully developed capacity for movement to achieve their personal goals in healthy physical activity or sporting excellence. Therefore, Higgs (2010) suggests that there are two approaches (philosophical and practical) but there is only one concept of physical literacy.

In an attempt to draw together the different approaches to physical literacy and specifically aim at enhancing physical activity for health promotion, Keegan et al. (2013) have developed a working model (Game Plan) that recognises models with a focus on LTAD may be incomplete due to an over reliance on sport and talent identification. Therefore, Keegan et al. introduced a taxonomy of factors that contribute to physical literacy that when taken together can be considered an exploratory theoretical framework to generate the positive outcomes specified in physical literacy theory with no better time to promote it than in childhood.

Why develop physical literacy with children? Given the paucity of research on physical literacy, few limitations have been identified. However, one potential limitation is that self-actualization of physical literacy is elusive (Whitehead, 2007). Although the underlying belief is that physical literacy is a learned behaviour that is sustainable and consistent, individuals are continually faced with health related decisions. The onslaught of negative advertisement and ease of access to unhealthy choices might make physical literacy susceptible to relapse or germination of negative behaviour change especially with children and adolescents who are the most pervasively influenced (American Academy of Pediatrics, 2006). As these positive and negative behaviours established during the growing years (i.e., childhood and adolescence) tend to track or carryover into adulthood, it is important to identify those most vulnerable to developing a negative spiral (i.e., sedentary youth) into adulthood. If we miss this critical window of opportunity during the growing years, the decline and disinterest in physical activity that seems to be on the increase begins to evolve (Stodden et al., 2008). Faigenbaum, Stracciolini, and Myer (2011) have suggested that by middle childhood, children more acutely compare their physical prowess to others, and their perception of competence that can influence their persistence in a task or activity can become permanent. By age ten, some children already know that they are not as good as their peers and consequently choose to engage in sedentary ‘safe’ activities rather than display low levels of physical competence in front of their friends and family. Therefore, targeting this population is extremely important for any physical literacy framework.

Children will spend a large proportion of their early life in compulsory education, therefore maximizing school-based opportunities for all children to develop competencies in physical literacy is strongly encouraged (Parry, 2013). According to Castelli, Centeio, Beighle, Carson, and Nicksic (2014), it is also important that physical literacy becomes the frame of reference for achievement resulting from participation in quality physical education and school-wide physical activity programming. Schools are popular settings for interventions as large numbers of children can be accessed simultaneously and school infrastructures are in place which can facilitate delivery of the intervention and cost-effectiveness (Stone, McKenzie, Welk, & Booth, 1998). Ultimately a physical literacy focus here may reach more children, alienate fewer and thus ensure that more children are exposed to developing a positive physical health attitude (Keegan et al., 2013).

Coates (2011) recommended that concepts surrounding physical literacy outcomes need to be factored more forcefully into the physical education curriculum and embraced by schools. The existence of developmental critical periods in childhood (i.e., enhanced neural and muscular adaptations) is seen as an ideal window of opportunity to expose, train and develop long lasting physical literacy behaviours (Lubans, Morgan, Cliff, Barnett, & Okely, 2010). Whilst adults and older adults should not be overlooked, programmes to promote physical activity in these groups will take a very different shape with a different message (perhaps less focussed on sport and games and greater emphasis on individual pursuits), and different delivery mechanisms (perhaps mass media and health professionals, as school is no longer an option). Therefore, in order to target children and adolescents effectively and ensure physical literacy moves forward from an array of interpretation it must become operationalized and measurable to enable practitioners to teach, evaluate, deliver positive outcomes and gain credibility from its critics (Tremblay & Lloyd, 2010).

Operationalizing physical literacy. Physical literacy is far from a neutral or simple concept with tension between measurement, assessment and the intentions behind the concept (Lundvall, 2015). Tremblay and Lloyd (2010) make the case for more robust and comprehensive assessment of physical literacy. They argue that such assessments are as important as numeracy and literacy and “as a means to elevate the importance of physical education, increase the robustness of physical education assessment, improve monitoring and evaluation of physical education curricula, and provide important surveillance evidence needed to assist with resource allocation by decision makers” (p. 26). Therefore, to allow for this possibility, physical literacy must be defined in a way that guides its measurement. They suggest that:

> Physical literacy is a construct which captures the essence of what a quality physical education or a quality community sport / activity programme aims to achieve. It is the foundation of characteristics, attributes, behaviours, awareness, knowledge and understanding related to healthy active living and the promotion of physical recreation opportunities. (p. 28)

Physical literacy is the foundation of skills or tools - social/cognitive, behavioural, and fitness related - that children need to possess or develop in order to receive the inherent benefits of taking part in physical activity and sport for life-long enjoyment and success (Lloyd, Colley, & Tremblay, 2010). Although new frameworks of physical literacy emerge frequently, a very simplified and practical approach has been suggested by Lloyd et al. (2010) who consider physical literacy to have four inter-related core domains: (a) physical fitness (cardio-respiratory, muscular strength and flexibility), (b) motor behaviour (FMS proficiency), (c) physical activity behaviours (directly measured daily activity), and (d) psycho-social/cognitive factors (attitudes, knowledge, and feelings).

Being mindful of the philosophical underpinnings of the physical literacy journey suggested previously by Whitehead (2010, 2007, 2005, 2001) this pragmatic approach suggested by Lloyd et al. (2010) does resonate with the author as these core domains transcend physical education, sport and recreation and are important in understanding and practically measuring physical literacy in children. Looking at physical literacy through these domains in this simplified and practical approach is feasible. The literature has demonstrated that FMS are related to physical activity (Fisher et al., 2005; Okely, Booth, & Patterson, 2001; Saakslahti et al., 1999; Williams et al., 2008), physical activity is related to physical fitness (Boreham & Riddoch, 2001; Physical Activity Guidelines Advisory Committee, 2008; Ruiz et al., 2006), and motor skills are likewise related to physical fitness (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2008a; Haga, 2008; Okely et al., 2001). Knowledge is a critical component of skilled motor performance (Bouffard, Watkinson, Thompson, Causgrove, & Romanow, 1996; Wall, 2004; Wall, Reid, & Harvey, 2007), physical activity participation (Aldinger et al., 2008; Harvey et al., 2009; Tse & Yuen, 2009) and physical fitness (Young, Haskell, Taylor, & Fortmann, 1996). Consequently, when Lloyd et al. (2010) suggest that a truly physical literate child would develop competence in each of these core domains and be able to apply these skills in multiple contexts it does resonate. It is also possible though, that this definition could be criticised for not having the resounding themes borrowed from the "literacy" literature but, it does make physical literacy a more practical concept where curricula and measurement can be focussed. These four domains capture common major themes in physical education curricular and are identified by the National Association for Sport and Physical Education (motor skills competency, knowledge, physical activity and physical fitness; Tremblay & Lloyd, 2010).

Clearly, the behavioural, psychological and physical components of physical literacy are (theoretically and practically) distinct but interlinking constructs. Integrating evaluation of the constructs should provide a more accurate assessment of an individual's physical literacy ability (Giblin et al., 2014). All these domains have a vital role to play in an individual's physical literacy development pathway although Stodden et al. (2008) has suggested that developing proficiency in the motor behaviour domain (i.e., FMS) has the greatest role in contributing to children's physical, cognitive and social development and is thought to provide the foundation for an active lifestyle. The physiological, psychological and behavioural development of children, improved physical literacy and long term active lifestyles are often attributed to FMS proficiency (Stodden, Langendorfer, & Roberton, 2009). The focus on physicality is a feature of Whitehead's (2001) original ideas of physical literacy. Whitehead (2010) framed the FMS metaphor as a "bank of movement competences" (p. 53). Accordingly, the more one has in the bank, the more one will respond to a wide variety of situations in a way that is automatic to the individual. A physically literate individual who throws a ball within a game, for example, no longer has to stop and think to perform the movement, rather the motile act of "throwing" exists within a repertoire of movement possibilities. Whitehead (2010) refers to such movement patterns as one's vocabulary and relates the process of becoming fluent in such action to the Piagetian notion of assimilation and accommodation (Lloyd, 2011). It is therefore recognised that there must be a foundation (i.e., development of movement competencies) upon which lifelong participation in activity is based to develop physical literacy (Tremblay & Lloyd, 2010). It has, however, increasingly been reported that young children lack FMS (Fisher et al., 2005; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006) and crucially this occurs at critical periods during their physical development.

Fundamental Movement Skills

The purpose of this section of the literature review chapter is to: (a) define FMS, (b) discuss the importance of FMS, (c) identify their origins and development, (d) identify common tests and FMS assessment procedures for these skills, (e) identify issues with these assessment and current limitations and (f) describe the current prevalence of proficiency in children.

Definition of fundamental movement skills. Fundamental movement skills are common motor activities that comprise an agreed series of observable movement patterns (such as throwing, kicking, catching and jumping) that involve different body parts such as feet, legs, trunk, hands, arms and head and in most instances involve the combination of movement patterns of two or more of these body segments (Gallahue & Donnelly, 2003). FMS can be broken down into three categories of locomotor skills, object control skills (manipulative skills) or stability skills. Gallahue and Ozmun (2006) define locomotor skills as those that involve projection of the body into an external space by altering its location relative to fixed points on the surface. Activities, such as walking, running, jumping, hopping, skipping, galloping, sliding, leaping, and climbing are representative examples of locomotor movement skills. Object control or manipulative skills include either gross motor or fine motor movements. Gross motor manipulative skills involve movements that give force to objects or receive force from objects (Gallahue & Ozmun, 2006). Throwing, catching, kicking, trapping, striking, volleying, bouncing, rolling, and punting are examples of fundamental gross motor manipulative skills. Fine motor manipulative skills refer to small object-handling activities that emphasize motor control, precision, and accuracy of movement. Gallahue and Ozmun (2006) define stability skills as fundamental to all movement and involve "the ability to maintain one's relationship to the force of gravity" (p. 216). More specifically Westcott, Lowes, and Richardson (1997) defined stability skills as “the ability to maintain a posture, such as balancing in a standing or sitting position”, and dynamic stability as “the ability to maintain postural control during other movements, such as reaching for an object or walking across a lawn” (p. 630). According to Gallahue and Donnelly (2003), axial movements, such as bending, stretching, twisting, turning, swinging, body inversion, body rolling and landing/stopping are all considered as stability skills.

The importance of fundamental movement skills. One of the most critical skill sets children need to begin to acquire in early childhood is competence in FMS (Gallahue, Ozmun, & Goodway, 2012). They are seen as the building blocks to future physical activities and sport and are the movement equivalent to the ABCs in reading literacy. The mastery of FMS has been suggested as contributing to children’s physical, cognitive and social development and is thought to provide the foundation for an active lifestyle (Cliff, Okely, & Magarey, 2011; Ford et al., 2011). Frequent physical activity participation relies on proficiency in FMS and in turn allows exposure to characteristics of physical literacy (Tompsett et al., 2014). FMS correspond to one level in the continuum of skill development

(Walkley, Holland, Treloar, & Probyn- Smith, 1993). The FMS stage of development follows a period of infant motor development and is a prerequisite to the learning and mature performance of specialised sport skills in late childhood (Gallahue & Donnelly, 2003). Therefore, proficiency in a range of FMS (i.e., running, jumping, catching, throwing, kicking and striking) is a precursor to successful application to a range of sport-specific contexts (Gallahue & Ozmun, 2006). Miller (2006) suggests that for example the FMS of the overhand throw is applicable (and transferable) to sport specific skills such as the javelin throw, the overhead slam of badminton, the volleyball spike and the tennis serve; therefore, all FMS can be applied to a range of physical sporting contexts.

In the promotion of health related activity, it has been proposed by the Physical Activity Guidelines for Children (2008) that developmentally appropriate activities (e.g., tennis, basketball, football, hopscotch, etc.) should be encouraged. Such activities require a certain degree of proficiency in FMS (e.g., kicking, throwing and jumping) for successful participation but unfortunately, many youths do not attain adequate proficiency in FMS to successfully participate in such activities (Hardy, Reinten-Reynolds, Espinel, Zask, & Okely, 2012; Okely & Booth, 2004). Therefore, Stodden, Gao, Goodway, and Langendorfer (2014) contend that this lack of proficiency in FMS may severely hinder youth participation in many diverse types of leisure physical activities, games and sports. Consequently, if children are unable to run, jump, catch, kick and throw, the resultant outcome will be a reduced number of opportunities for engagement in physical activity later in their lives as they will not have the pre-requisite skills to be active (Stodden et al, 2008). Research would therefore suggest that we should include as many opportunities whereby children have the potential to develop their FMS (McKenzie, 2007) and whilst children may naturally develop a rudimentary form of fundamental movement pattern, a mature form of FMS proficiency is more likely to be achieved with appropriate practice, encouragement, feedback and instruction (Clark & Metcalfe, 2002; Gallahue & Ozmun, 2006).

Moreover, young children will require an appropriate level of FMS competence before they can learn sport specific skills and participate in sport and physical activity. Consequently, children who fail to master competency in FMS are more likely to experience a failure in the motor domain and less likely to participate in sport and games during childhood and adolescence (Hardy, King, Farrell, Macniven, & Howlett, 2010). Children who possess inadequate FMS are often relegated to a life of exclusion from organised and free play experiences of their peers, and subsequently, to a lifetime of inactivity because of their frustrations in early movement behaviour (Seefeldt, 1980). Gallahue et al. (2012) suggests that it is critically important for children to experience and acquire a wide variety of FMS of locomotion, object control and stability before moving onto levels of combined skills and finally sport specific skills. If children do not acquire a good repertoire of FMS, they confront a proficiency barrier that makes it difficult to be successful at higher levels of skill acquisition (Branta, 2010). Often this will lead to young children facing 'proficiency barriers' as they progress through key transitions during their lives, such as moving from primary to secondary school, where the focus of physical education changes (Gallahue et al., 2012). As such, Gallahue et al. (2012) recommends that young children need to be competent in FMS to provide 'transitional skills' that will allow them to apply fundamental movement patterns in a somewhat more complex and specific form (specialised movement skills) in sport and recreational settings. Unfortunately, the end result is often that young children progress without the key skills that will allow them to participate fully in physical education and this has a significant effect on their commitment and their motivation to engage in future physical activity (Caspersen, Powell, & Christenson, 1985).

Development of fundamental movement skills. It has been emphasised by Haywood and Getchell (2009) that FMS must be taught, and practiced as they do not develop naturally. It is important to focus on the development of FMS early in life because of the high degree of plasticity in neuromuscular development during preadolescence, which provides an optimal window to train and develop long lasting movement skills and desired behaviours (Lubans et al., 2010). The development of FMS starts at birth and traditionally continues to be developed until around 11–12 years of age, depending on the complexity of the skill (Gabbard, 1992). Prior to adolescence, boys and girls are very similar physically with little difference in biological characteristics, including body type, body composition, strength and limb length (Malina, Bouchard, & Bar Or, 2004) and are therefore expected to develop FMS at similar rates. Hardy, King, Farrell, et al. (2010) suggests that on a continuum of FMS skill development, the locomotor movement skills are mastered prior to more complex manipulative skills (manipulative actions require greater multi joint co-ordination, stability of the trunk and object manipulation in order to master the skill). Gallahue and Ozmun (2006) advocate that most children are developmentally able to master most of the less complex FMS, including sprint run, vertical jump, and catch by ages 7-8 years and several of the more complex FMS including the leap and kick by the ages 9-10 years. In terms of literature findings, researchers now argue that a critical period for the development of these skills is early childhood between 2-8 years of age (Gallahue & Donelly, 2003).

A number of prominent models of motor development (The Mountain of Motor Development Model, Clark & Metcalfe, 2002; The Hour Glass Model of Motor Development, Gallahue & Ozmun, 2006; The Sequential Model of Motor Development, Seefeldt, 1980) suggest that it is critical during this age phase for FMS to be given maximum attention. All these models highlight that failure to do so could either limit or hinder the individual's ability to perform more complex tasks and physical activities later on and throughout the life course.

When observing children in traditional physical education classes or in general play it may seem as though all children perform FMS in the same manner (e.g., running, jumping and throwing). Although on closer inspection, Gallahue et al. (2012) suggest that it will almost certainly reveal that children of the same age do look very different in the way they perform FMS. In an example of children performing the same skill (e.g., the over arm throw), Goodway et al. (2014) suggested that several performance variants are most likely to be observed. These include a child demonstrating a stationary "chop throw", while another child steps and throws with the same hand and foot, and another throws forcefully with wind-up of the arm, and arm-leg in opposition. Therefore, as Barnett et al. (2008a) suggest, although there is general consensus in the period of when FMS should be developed, there will be considerable variation of individual skill proficiency in children of similar age due to a number of constraints. These constraints will result from the interaction between organism, environment and task and they will all influence an individual's aptitude to develop motor skills (Gallahue & Donnelly, 2003). In addition, Hardy, King, Farrell, et al. (2010) suggests that FMS development is contingent upon multiple internal and external factors (e.g., biological, social, psychological, motivational, environmental, etc.), which will define developmental opportunities at each point in the lifespan. Therefore, as children develop motor skill competence at different rates, it is important to accurately assess each child for monitoring purposes, such as identifying those at risk of developmental delay, and to examine relationships between FMS and health outcomes (Foweather, 2010).

Assessment of fundamental movement skills. Hands (2002) suggests that there are several different ways to measure children's performance of FMS and the decision on how to measure children's FMS performance will be guided by the purpose of assessment. Burton and Miller, (1998) advocate that the purpose may be to appropriately group a class of children, to identify those at risk, to plan intervention or education programmes, to monitor change over time, to provide feedback to the performer or to predict performance in the future.

Too often, the focus of FMS assessment is on the product, rather than on the process (Cools, DeMartelaer, Samaey, & Andries, 2009; Ulrich, 2000). A multitude of clinical motor skill assessments have been designed and integrated, with the primary focus on the outcome of what the individual can achieve but seldom on the process of performance within specific movements (O'Brien, 2013). Assessment approaches measuring the product or outcome of the performance have been used due to their high level of reliability over time and ease of use without an extensive understanding of movement competencies. In a product-oriented measurement tool only the outcome of the movement is assessed. For example, product assessments include measures of the distance in centimetres thrown or jumped, or time taken in seconds to sprint 100m, or the number of successful bounce and catches in so many seconds, or simple "Yes/No" checklists based on whether a desired outcome is achieved (Foweather, 2010; Hands, 2002). Unfortunately, these test outcomes do not provide direct information about the proficiency of the performance (Branta, Haubenstricker, & Seefeldt, 1984) and product measures do not examine the movement process that produced the performance outcome, and scores can be unrelated to the child's motor development (Stodden et al., 2008). Product-oriented assessments therefore provide limited information to guide interventions about the technical aspects of performance that need to be improved. When children are still mastering motor skills, their movement patterns are often extremely variable. The information gathered through product measurement techniques is not able to discern between the levels of variability in movement patterns (Hands, 2002). Hence there is little agreement on what might be expected in relation to children's FMS development (Haywood & Getchell, 2009).

The most popular product oriented tests being used in the assessment of FMS include the Movement Assessment Battery for Children (MABC)-2 (Henderson, Sugden, & Barnett, 2007) and the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2; Bruininks & Bruininks, 2005). The MABC-2 Test is a standardised assessment tool that requires children and adolescents to perform a range of motor tasks in order to acquire an objective measure of motor impairment (Henderson et al., 2007). The Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) is used to assess fine and gross movement skill abilities (Cools et al., 2009). Similar to the Movement ABC-2, the BOT-2 also identifies participants with mild to moderate motor coordination deficits. The BOT-2 is targeted by practitioners and researchers as a discriminative and evaluative measure to describe motor performance, with particular emphasis on fine manual control, manual coordination, body coordination, and strength and agility (Deitz, Katrin, & Kopp, 2007). Such movement assessment batteries were originally designed for use in clinical settings as a discriminative measure to characterise motor deficiency (Giblin et al., 2014).

Based on a need to provide a more effective evaluation of motor skill performance in recent years, most frequently used FMS assessment tools with children have employed process measures that focus on the form or technique of the movement; in other words, how the skill is performed (Hands, 2002). Knudson and Morrison (2002) define process assessment as "the systematic observation and introspective judgement of the quality of human movement for the purpose of providing the most appropriate intervention to improve performance." (p. 4), In order to implement effective movement programmes, it is imperative to gather process information about the FMS level of the child and move away from the outcome or product, criterion referenced tests that compare the participants' performance to predetermined criteria (Hands, 2002). Unlike the product mode of assessment, process oriented assessments of FMS are more accurate in identifying specific topographical aspects of the movement (Hands, 2002). Consequently, researchers have advocated process-oriented measures, as "there is a need to focus on the process or mechanics of movement prior to the product, or performance aspects of movement skill development" (Gallahue & Donnelly, 2003, p. 53). Wickstrom (1983) also stated that FMS have definable characteristics that are observable and which serve to underlie the unique characteristics of the skills. Therefore, a process approach to assessment seeks to measure whether observed characteristics were demonstrated during a performance and emphasises measurement of the quality of movement and technique; focusing on the way a skill is performed rather than the end result.

Several process oriented tools to assess FMS proficiency during childhood are available, with many aimed at a specific target group and hence, have specific content. Hands (2002) highlights that observation records or checklists for each FMS are usually generated to facilitate this approach to FMS assessment and there are several schools of thought about how these observation records are structured, with each approach stemming from a different theoretical approach to motor development. Branta et al. (1984) and Seefeldt and Haubenstricker, (1982) have suggested that the Global or Whole Body approach, where the levels or stages for skill development are universal in that the movement of the lower and upper body extremities (i.e., legs, arms and torso) are described for each stage. Seefeldt and Haubenstriker (1982) suggest that all body components progress in unison towards greater levels of efficiency with an observation record based on this approach to include descriptors for each body part for each defined stage of learning. Roberton (1977) has developed the Component Stage Theory and suggested that components of the body develop at their own rate and therefore should be assessed independently of each other with skill performance described within phases of performance such as the preparation phase, propulsion phase and follow through phase. Roberton views developmental change as occurring within different parts of the body at different stages from 1 (least proficient) to 3 (most proficient). In the development of the overhand throw, for example, Roberton has shown that the arm action will develop independently of the leg and trunk actions and that the patterns will vary between children. Even within a body component, such as the arm, individual patterns for the upper and lower arm have been shown. Hands (2002) advocated that research findings have identified component stages for a number of FMS which have significantly contributed to our understanding of FMS but in the meantime have also made assessment more complicated.

Stodden et al. (2008) stated that the main problem with studies that have used these process approaches to measuring motor skill competence are that none have related the movement description to a developmental continuum. Therefore, Hands (2002) has suggested a less complex approach to assessment using the component stage theory. That being the 'mastery' or 'proficiency criteria' model that describes the key actions of the main body parts for the proficient form of the action, rather than patterns that may be observed during the learning of the skill. These criteria do not represent a developmental sequence nor fully describe an instructional sequence but comprise certain key aspects for a proficient performance. A popular process measurement tool considered valid and reliable therefore is the Test of Gross Motor Development 2 (TGMD-2; Ulrich, 2000); however, this is only designed for children aged between 3 and 10 years old. In addition, a shortcoming of TGMD-2 may be the absence of a stability subtest (Gallahue & Ozmun, 2006; Haywood & Getchell, 2009) and for use with a European population the test battery is not free from cultural differences (Cools et al., 2009).

A number of studies (Booth, Denney-Wilson, Okely, & Hardy, 2005; Booth, Macaskill, Phongsavan, McLellan, & Okely, 1998; Okely & Booth, 2004; Salmon et al., 2005; Van Beurden, Zask, Barnett, & Dietrich, 2002) have used process measures based on the "Get Skilled Get Active" Australian resource (Department of Education and Training, New South Wales, 2000). This process-oriented FMS instrument consists of 12 FMS; a unique strength of the ‘Get Skilled: Get Active’ resource is that all categories of FMS are included within this assessment protocol (locomotor, object-control and stability; Gallahue & Ozmun, 2006; Haywood & Getchell, 2009). Both Hands and Larkin (2001) and Walkley et al. (1993) used the item-response theory to locate motor ability (Hands & Larkin) and skill components (Walkley) on a scale of difficulty. Walkley et al. (1993) created a developmental continuum for the sequence of mastery of the skill components based on a child's age, which was then tabulated for the movement skills. These 12 skills (run, balance, vertical jump, catch, hop, side gallop, skip, overhand throw, leap, kick, two-handed strike and dodge) were selected because collectively, they represent a platform for the development of specialised skills, enabling students to participate in a wide range of physical activities (Department of Education and Training, NSW, 2000).

All 12 FMS are composed of observable behavioural components that together constitute a mature performance of the skill (Okely & Booth, 2004). Each individual FMS has been broken down into individual components that are pre-ordered on level of complexity with the assessor recording which components of the skill are being demonstrated by the performer from a checklist (Department of Education and Training, NSW, 2000). For example, do the arms move in opposition to the legs while running; is the head stable, are the knees lifting high? Mastery was defined as the demonstration of all, or all but one, of the skill criteria. It does not focus on the areas of motor development that highlight dysfunctions, inefficient movement behaviours, motor impairment and motor deficits. In fact, this assessment protocol represents the only process oriented measurement tool that is appropriate for use in children and adolescents - an important factor for experimental researchers who may wish to conduct a long term follow up of participants. A substantial amount of evidence highlights that the ‘Get Skilled: Get Active’ FMS assessment protocol is an appropriate, reliable, culturally acceptable and valid instrument for measuring levels of gross motor skill proficiency amongst children and adolescents (Hardy, Barnett, Espinel, & Okely, 2013; Foweather, 2010) and the number of studies including FMS assessments based on this resource suggests this is a sound instrument appropriate for the measurement of skill proficiency in scientific study (Foweather, 2010).

As established, there are a great variety of assessment tools available for measuring FMS competency, particularly during childhood (Cools et al., 2009). The levels of FMS proficiency emerging from interventions using such measurement tools amongst children aged 5 to 12 years old is only low to moderate (Booth et al., 1999; Hardy, King, Espinel, Cosgrove, & Bauman, 2010; Mitchell et al., 2013; Okely and Booth, 2004). This consistently low FMS proficiency emerging worldwide in the literature may raise several questions in the use of these models. Questions such as, in the first instance, are we utilising the most relevant FMS assessment measure for use with this cohort? Secondly, is it possible to provide an alternative interpretation of FMS proficiency and identify a more effective classification of skills? For example, it has been suggested by Tremblay et al. (2014) that in order to consistently assess the movement skill competency of children and young people, a standardised methodology should be employed. That being a movement skill competency assessment battery based on locomotor (sprint run, vertical jump, side gallop and leap) and object control (catch, overhand throw, kick and two-handed strike) skills, using the Get Skilled Get Active process oriented checklist (Department of Education and Training, NSW, 2000), administered by trained staff with boys and girls examined separately.

Limitations of fundamental movement skills assessment. An accurate interpretation of FMS proficiency is critical for assessing and shaping pedagogical decisions for physical literacy in children. Researchers have attempted to address the need for standardisation and clarification of FMS measurement scores that report the same objective but which, confusingly, may provide different information (Logan, Robinson, Rudisill, Wadsworth, & Morera, 2012). FMS assessment tools involving observation records vary in complexity and number of skill criteria for any one skill. McIntyre (2000) analysed performance measures of three different assessment tools to assess FMS and noted that each tool had different skill criteria and used different assessment protocols. For example, on a single skill, one assessment tool had four skill components; another package had six components and the later eight components to assess the same FMS. For each assessment tool skill proficiency was decided if the component was demonstrated in 2 out of 2 trials, 4 out of 6 trials, or 3 out of 3 trials. Consequently, it is evident that greater complexity in the number of components in the records increases the potential for disagreement between observers, reduces reliability, the chances of being rated as proficient and prevents national comparisons between children (Hands, 2002).

The experience and skill level of the observer must also increase and a compromise between complexity and depth of information and simplicity needs to be found. Barnett, VanBeurden, Morgan, Brooks, and Beard (2009) highlighted that inter-rater reliability assessment of the motor skills using the 'Get Skilled Get Active' skill measurement protocol; the hop had a particularly low reliability compared to the other five skills. This may indicate that some locomotor skills are hard to assess (at least with this instrument), which would have limited the ability to accurately confirm a certain standard of proficiency. If there was measurement error involved in the locomotor skill assessment this may have biased the study away from identifying a relationship between childhood locomotor ability and subsequent behaviour.

Most FMS studies categorize a total score for each individual skill (i.e., mastery if all skill components are demonstrated, near mastery if only one component was not demonstrated and poor if two or more components are not demonstrated). This scoring bandwidth may discriminate against children not achieving mastery on a particular skill as they may not all demonstrate the same missing skill components. Therefore, the impact of not taking into consideration the relative difficulty of a missing component is unknown. Performances rated as near mastery may vary significantly from child to child. For example, the overhand throw of a child who is not demonstrating a hip-shoulder rotation is more proficient than that of a child who is not stepping forward. Miller (2002) found that performance variation was greater for some skill components both within and between children on several FMS. The motor skill instrument 'Get Skilled Get Active' whilst process oriented is not developmental. Each skill has features that are considered introductory features, yet it is possible that near mastery may be reached by achieving a combination of skill features that does not include an introductory feature. Therefore, this may result in ineffective support and intervention strategies based on this outcome (Larkin & Hoare, 1991). For example, as children grow and develop, they are more likely to be proficient in an FMS, or even excel at it, but the child who "excels" at the more demanding skill features may score the same as a child who simply displays proficiency in the core skill components (Morgan, Barnett, et al., 2013). Therefore, Cools et al. (2009) suggests that when FMS tests assess components of each skill, caution needs to be applied when judging a child solely on these results. The reason a child performed that way maybe overlooked in the results and interventions may therefore only focus on a weak skill criterion of a particular FMS.

The reporting of FMS has also used a selection of distinct categories such as locomotor and object control proficiency outcomes to aggregate FMS scores (Barnett, Morgan, Van Beurden, Ball, & Lubans, 2011; Williams et al., 2008). All studies reporting Get Skilled: Get Active have identified the overall mastery for each skill; some have grouped mastery and near mastery together to form advanced skills. Others have standardised scores for the skills, which are added together to create an index of skill proficiency. Scores are then separately rank ordered for boys and girls and classified into quintiles. In other studies, scores have been standardized for the locomotor and object control skills for use in analysis. The selection of these distinct categories such as a locomotor and an object control proficiency outcome and the pooling of scores into these distinct categories may discriminate against individual skill performance. It may therefore be questioned that an individual's FMS proficiency cannot be presented with sufficient certainty. For example, based on their exposure to different skills, dribbling a soccer ball may be more important than dribbling a basketball or kicking a football. However, as noted motor skill assessments often aggregate components together in an unweighted total; i.e., each factor is treated as important as the next, even though some components are measured more often and, therefore, make a bigger contribution. In addition, the focus on children with optimal movement abilities and not those with less than optimal movement abilities could go unnoticed. Moreno-Briseño, Diaz, Campos-Romo, & Fernandez-Ruiz (2010) highlight that the current interpretations maybe discriminating the future developmental-specific differences within FMS interventions. It therefore could be questioned that careful refinement of FMS ability maybe required which provides a more in-depth assessment of FMS scoring outcome and classification of these skills. In support, Giblin et al. (2014) suggests that more research is required to establish appropriate procedures for testing movement ability that provide empirical monitoring on micro (individual) or macro (intervention) levels, which in turn, should generate valid, reliable measures without compromising the quality of data measured.

Prevalence of fundamental movement skill proficiency in children. Due to the array of test measures used to assess FMS proficiency, both process and product related, it is not easy to establish whether FMS, motor abilities, fitness or a combination of these factors are being assessed at a glance (Holfelder & Schott, 2014). Therefore, comparisons across studies should be made with caution due to the variation in methodologies employed to assess FMS, and differences in populations studied (Foweather, 2010). The focus of this part of the review is therefore based on studies that have adopted the ‘Get Skilled: Get Active’ resource (Department of Education and Training, NSW, 2000). This resource has been extensively used to assess FMS proficiency mainly with Australian children, with Australia currently being the only country to undertake regular population monitoring of children’s FMS (Hardy et al., 2012). FMS proficiency in Get Skilled: Get Active is described as the prevalence of mastery, near-mastery or advanced skills (i.e., mastered all components of the skill, all but one, or combining mastery and near mastery respectively) among children and adolescents (Booth et al., 2006; Hume et al., 2008; Okely & Booth, 2004; Van Beurden et al., 2002). As the Get Skilled: Get Active assessment tool adopts such terminology subsequent reporting of children’s FMS ability in studies using this measure will follow this format although the author suggests the term proficiency may be a better choice as the term mastery may suggest a ceiling effect is possible in skill development.

One of the first studies to adopt the ‘Get Skilled: Get Active’ resource was by Van Beurden et al. (2002). Their sample of Australian primary school children (n = 1045, aged 8-10 years old) to define FMS proficiency of eight FMS (balance, throw, catch, sprint, hop, kick, side gallop and jump) found that less than half of all children tested were rated at mastery (21.3%) or near mastery (25.7%) level; therefore, a low prevalence of FMS mastery was determined for this cohort. Another Australian study by Okely and Booth (2004) found that for both boys and girls (n = 1288, ages 6-8 years old) the proportion of children who displayed mastery of a skill did not exceed 35% for any of the FMS, with overall FMS proficiency also being described as low to moderate. The last state-wide survey in Australia (New South Wales Sport Physical Activity and Nutrition Survey [NSW SPANS], 2010) which assessed seven FMS (sprint run, vertical jump, side gallop, leap, kick, overhand throw and catch) that were deemed most popular amongst primary school aged children (e.g., due to use in ball games, dance and gymnastics) documented that children attending years 4, 6, 8 and 10 (n = 8058, approximate ages 9.3, 11.3, 13.3 and 15.3 years of age respectively) were found to possess low levels of FMS mastery across the seven FMS skills. Following a thirteen year trend of the SPANS surveys (1997, 2004, and 2010) and FMS competency in children and adolescents (n = 13,752, ages 9-15 years), Hardy et al. (2013) identified that for five FMS (sprint run, vertical jump, catch, kick, and over arm throw), competency was low, with prevalence rarely above 50%. The kick and over arm throw in girls were highlighted as being particularly poor. Hardy et al. (2012) suggested that approximately two-thirds of year 6 children (ages 11-12) in NSW, Australia were not proficient at locomotor skills (e.g., running, jumping and hopping) and two-thirds of girls and one quarter of boys had low object control skill proficiency (e.g., ball handling skills, such as throwing and kicking).

There is limited data (i.e., within the past decade) on the prevalence of proficiency at FMS in primary school aged children in the UK, and descriptive research is urgently needed (Bryant, Duncan, & Birch, 2013; Foweather, 2010). There have been some small studies with small sample sizes conducted within the UK and in particular England using the same 'Get Skilled: Get Active' (Department of Education and Training, NSW, 2000) resource. The Active City of Liverpool, Active Schools and SportsLinx Project (A-Class) with primary school children (n = 152, ages 9-10 years old) looked at the prevalence of FMS proficiency in eight FMS. It was shown that FMS proficiency did not exceed 60% for any of the skills except for the over arm throw with results revealing low to moderate levels of FMS proficiency (Foweather, 2010). In another study conducted by Foweather (2010) on English primary school children (n = 140, ages 10-11 years old) that examined six FMS (hop, vertical jump, sprint run, catch, kick, and over arm throw), levels of FMS proficiency did not exceed 60% mastery or proficiency in five out of six skills in boys. Prevalence of proficiency was low in the sprint run (8%) and vertical jump (30%), moderate in the hop (38%), kick (41%), and throw (59%), and high in the catch (77%). In girls, prevalence of proficiency did not exceed 25% in five skills; hop (25%), vertical jump (16%), sprint run (16%), throw (13%), kick (13%), and catch (48%). Therefore, overall proficiency was classified as low. The most recent UK study to use this resource to the authors knowledge was by Bryant et al. (2013) in a sample of English primary school children (n = 281, ages 6-11 years old) on eight FMS (run, hop, gallop, jump, balance, kick, throw and catch). Only the catch and balance FMS achieved near mastery. The mastered skills with the lowest percentages were the three lococmotor skills: sprint (3.3%), gallop (12.8%) and hop (3.9%). The least mastered skill was the hop with 79.1% of children showing non mastery of this skill. The highest mastered skill was the catch with 37.1% of children demonstrating mastery. Therefore, overall the FMS proficiency of the children in the study was deemed as being low.

The evidence would suggest that while levels of FMS vary from country to country, performance levels remain consistently low across the spectrum with the majority of children and adolescents failing to surpass 50% mastery in most skills (O'Brien, 2013). Therefore, many children are entering adolescence having not mastered these basic movement skills (Hardy, King, Farrell, et al., 2010). Globally, there appears a need to improve the skill proficiency levels of both children and adolescents (Hardy, King, Farrell, et al., 2010; Lubans et al., 2010; Stodden et al., 2008; Van Beurden et al., 2002) It is not enough to simply be able to perform the skill; children need to master a skill to incur the benefits associated with skill proficiency (Seefeldt, 1980). Stodden et al. (2008) emphasised that mastering FMS is essential for enhancing and embracing future physical activity behaviours. The available evidence however, is less clear about the underlying causes contributing to the low levels of skill proficiency observed in school children (Tompsett et al., 2014). Giblin et al. (2014) suggested that the behavioural, psychological and physical components of physical literacy are (theoretically and practically) distinct but interlinking constructs and have suggested that evaluating how these constructs relate to FMS could therefore provide a more rounded understanding of an individual's physical literacy.

Domains of Physical Literacy and Fundamental Movement Skills

Frequent physical activity participation relies on proficiency in FMS and in turn allows exposure to characteristics of physical literacy (Ford et al., 2011). Although evidence suggests that FMS are a prerequisite to future physical activity, concentrating solely on FMS may be narrowing the focus of physical literacy and ignoring the wider characteristics of the concept (Tompsett et al., 2014). As previously suggested, we should no longer measure elements of children's physical attributes in isolation. Instead, we should adopt a multifaceted approach to evaluate a child's competence defined as physical literacy (Lloyd et al., 2010). Understanding the importance of these perceived variables and their relationship with FMS may help understand their impact on physical literacy among youth. The purpose of this section of the literature review chapter is therefore to identify and highlight, through reference to the literature, the relationship between: (a) physical fitness (body composition, cardio- respiratory fitness and musculoskeletal strength) components, (b) physical activity behaviours (objectively measured activity recall), (c) psychological / cognitive factors, and (d) socio-cultural factors (due to the wide scope of this area the focus of attention here will specifically relate to parental behaviours and beliefs) and FMS.

Physical fitness. Physical fitness may be subdivided into health-related fitness and performance-related fitness. Cardio-respiratory endurance, muscular strength and endurance, and body composition are often referred to as health-related fitness (Haga, 2008) and are usually associated with disease prevention and health promotion (Powell, Casperson, Koplan, & Ford, 1989). Balance, coordination, speed, agility and power are often described as performance related fitness, reflecting the performance aspect of physical fitness (Haga, 2008). It is the health-related components of fitness that we will discuss here.

Body composition and fundamental movement skills. Body composition refers to the percentage of body fat, or the percentage of total weight made up of fat mass. Body composition is multifaceted and does not just affect the aesthetics of an individual; it has many long-term implications and is the cause of many other physiological diseases, such as hypertension, type II diabetes, coronary heart disease and strokes (Graf et al., 2008). Understanding the relationship between body composition and children's FMS status may be particularly important in developing strategies to develop physical literacy and/or reduce obesity (Bryant et al., 2013). To date, it has consistently been reported that low to moderate negative correlations exist in the relationship between measures of body composition and motor skill performance in childhood and early adolescence (D'Hondt et al., 2013). D'Hondt et al. (2013) further highlighted that in general overweight and particularly obese children display markedly poorer FMS performance and are less competent in motor tasks requiring support, propulsion or movement of a great proportion of body mass compared with normal-weight peers. Additionally, Lubans et al. (2010), in a comprehensive review of FMS studies, highlighted that in five studies increased weight status had negative effects on FMS mastery. On the contrary, Hume et al. (2008) found no relationship between body composition measures and FMS proficiency of both locomotor and object control skills (n = 248, ages 9-12 years old).

Most apparent in significant studies is the seemingly negative relationship between body composition and locomotor FMS (e.g., run, hop, side gallop). For example, Southall, Okely, and Steele (2004) found that overweight children, as classified by BMI, demonstrated lower competence in locomotor FMS than their non-overweight peers but no difference was found for object-control skills. Okely, Booth, and Chey (2004) also found that non-overweight boys and girls were two to three times more likely to possess more advanced locomotor FMS than overweight boys and girls, though object-control skills were virtually unrelated to body composition. Locomotor skills may be more related to body composition than object-control skills for several reasons. Okely et al. (2004) suggested that overweight children are more likely to perform poorly in certain locomotor skills such as the sprint run due to the requirement of the movement of whole body mass to perform the task. In children with elevated levels of BMI, components of the sprint run will be harder to perform. For example, having an increased BMI will make the leg heavier to lift up for propulsion, having increased adiposity around the joint will restrict it to limited degrees of freedom, making it harder for that child to perform that criterion and decrease mastery of that skill. In addition, obesity is often associated with orthopaedic conditions such as flat-footedness and increased plantar pressure at the forefoot, which may cause pain or discomfort during physical activities and cause locomotor movement complications (Dowling, Steele, & Baur, 2001).

Despite these prior studies having examined FMS and body composition, they were conducted with Australian and American children; therefore, comparisons with children in the UK should be treated with caution. Within the UK, there is sparse data available on FMS mastery and weight status (Bryant et al., 2013). Of those that exist, Foweather (2010) using a dual-energy x-ray absorptiometry (DXA) to assess body composition and FMS performance in UK children (n = 152, ages 9-10 years old) found a weak to moderate association of the hop and dodge with body composition with skill competence being a significant predictor of body composition. In the most recent UK study with a specific focus on the relationship between weight status and FMS proficiency in children, Bryant et al. (2013) demonstrated that body mass index (BMI) had a negative effect on the FMS of sprint run in 281 children aged between 6-11 years old.

Okely and colleagues (2004) hypothesized that the relationship between skill competence and the propensity to be overweight maybe reciprocal. Thus, children who are overweight participate in less physical activity, and so have less opportunity to practice and develop proficiency in motor skills, or children who are less skilled have fewer opportunities to engage in physical activity and gain less enjoyment from participation, which may lead to an unhealthy increase in weight status. The negative relationship between body composition and locomotor skills elucidates a potential implication for the attainment of physical literacy. Bryant et al. (2013) suggested that further data are needed to confirm these suggestions, especially for children in the UK. Given the premise that FMS may actually reduce obesity because better mastery of FMS is more likely to increase habitual physical activity, it is perhaps crucial that researchers investigate and identify children with low levels of FMS and elevated body composition.

Cardio-respiratory fitness and fundamental movement skills. Cardio-respiratory fitness, which is also sometimes referred to as aerobic fitness or maximal aerobic power, is the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity. Cardio-respiratory fitness is in part genetically determined but it can be greatly influenced by environmental and behavioural factors (Bouchard, Shephard, & Stephens, 1994). Cardio-respiratory fitness is therefore considered a physiological state, not a behaviour, and can be conceptualised as an attribute of physical activity (Sallis & Owen, 1999). Using data on over 25 million 9-17 year olds from 28 countries since 1964, it has been conclusively shown that young people's aerobic fitness has declined worldwide since about 1975 (Ekelund, Tomkinson, & Armstrong, 2011). To make matters worse, it is likely that the largest declines have occurred in young people with the lowest fitness. To date, there have been few empirical studies of the relationship between measured physical fitness and FMS in children. A better understanding of the nature of this relationship could be usefully applied to maintaining and developing both sufficient physical fitness and FMS in children as they are potentially important contributors to a child's health and well-being (Haga, 2008).

In a review of FMS studies, Lubans et al. (2010) found four studies examining the relationship between FMS competency and cardio-respiratory fitness. All four found a positive relationship between skill ability and fitness level (Barnett, et al., 2008a; Marshall & Bouffard, 1997; Okely et al., 2001; Reeves, Broeder, Kennedy-Honeycutt, East, & Matney, 1999). More recently Hardy et al. (2012) investigated a sample of 6917 children and adolescents (ages 9 -15) from the New South Wales Fitness and Physical Activity Survey (2010). Seven skills (sprint run, vertical jump, side gallop, leap, catch, over-arm throw and kick) were assessed, whilst cardio-respiratory endurance (i.e., fitness) was indirectly assessed using the multi-stage fitness test. Results showed that there was a clear and consistent association between low competency in FMS and inadequate cardio-respiratory fitness. Hardy et al. (2012) identified that boys with low FMS competency were between three to seven times and girls two to six times more likely to be unfit, with findings consistent across individual object control and locomotor skills.

Conclusions drawn from this small evidence base suggest that proficiency of FMS is important in cardio-respiratory fitness. High levels of motor skill competence and increased physical fitness allow individuals to persist and succeed in activities that require greater levels of motor competency and provide more opportunities to further develop these skills. Stodden et al. (2014) advocate that as improvement in FMS or health related fitness may be reciprocal during childhood and adolescence, promoting the development of both FMS and fitness would seem to be mutually beneficial. Although one could argue that physical activity is the key issue in this relationship; the amount and intensity of physical activity both impact upon many aspects of fitness (Gutin, Yin, Humphries, & Barbeau, 2005) and motor competence (Marshall & Bouffard, 1997). Further research is therefore required to clarify the importance of this relationship to children's health and well-being (Haga, 2008).

Musculoskeletal strength and fundamental movement skills. It has been speculated that muscular strength is critical for successful FMS development (Behringer, Vom Heede, Matthews, & Mester, 2011). Stodden, True, Langendorfer, and Gao (2013) suggest that the development of ballistic FMS, which involves multi segmented movements, places an increased demand on the neuromuscular system to generate and transfer energy optimally through the kinetic link system (i.e., optimizing control and co-ordination). In order for individuals to practice and perform FMS in leisure and sporting activities they must develop and repeatedly produce adequate levels of muscular strength and coordination to effectively manipulate their body mass in a gravity-based environment, which promotes increased muscular endurance. Lloyd and Oliver (2012) cited early research indicating that muscular strength (in addition to stature) could account for up to 70% of the variability in a range of motor skills including throwing, jumping, and sprinting in 7- to 12-year-old boys.

During the pre-pubertal years, boys and girls will follow similar rates of development in growth and maturation, and despite consistent sex differences, strength, speed, power, endurance, and coordination will develop at similar rates for both sexes throughout childhood (Beunen & Malina, 2005). Boys generally have greater muscle mass than girls in childhood with sex differences not becoming apparent until the adolescent growth spurt (Eklund, Tomkinson, & Armstrong, 2011). Consequently, from a developmental perspective, both boys and girls can follow similar health development programmes during the pre-pubertal years. Lloyd and Oliver (2012) suggest that during these years the development of the neuromuscular system naturally accelerates and as a result of this neural plasticity strength development could be targeted. Barnett et al. (2013) therefore suggest that programmes that enhance muscular strength and FMS performance early in life appear to build the foundation for an active lifestyle later in life.

Neuromuscular performance (i.e., muscular strength and motor fitness) appears to be declining in UK children (Cohen et al., 2011). With the development of muscle strength and motor skills previously suggested as an important goal for sparking an active lifestyle, Faigenbaum, Chu, Paterno, and Myer (2013) has suggested that the first step in encouraging children and youth should be to increase their physical strength and perceived confidence to perform a variety of low-tech FMS. These basic movements, activities and exercises that are found in physical education are a much needed opportunity for children and youth to enhance muscular fitness (e.g., muscular strength, muscular power, and local muscular endurance) and master FMS.

Previous studies on the relationship between musculoskeletal strength and FMS development are limited. In a study on Belgian boys, Beunen et al. (1988) reported that strength measures and motor skill performance showed a moderate correlation. Malina and Bouchard (1991) also generally found low correlations. Behringer et al. (2011) identified that structured resistance training programmes significantly improve running, jumping and throwing performance in children and adolescents, although these skills were tested for sporting performance opposed to health related development. In a review of FMS and its associated health benefits in children and adolescents, Lubans et al. (2010) revealed that due to an inadequate number of studies that looked at the relationship between FMS competency and muscular fitness it could only be classified as uncertain with more research needed in this area.

Physical activity behaviour. It has been suggested by O’Brien (2013) that the meaning of physical activity has remained consistent amongst public health professionals over the last two decades and a standardised physical activity definition has become accepted as any bodily movement produced by the skeletal muscles that results in a substantial increase over resting energy expenditure (Bouchard, Blair, & Haskell, 2007; Caspersen et al., 1985; Woods, Tannerhill, Quinlan, Moyna, & Walsh, 2010). Under this broad and diverse definition, physical activity can either be classified as structured or incidental. Structured activity or exercise is planned, purposeful activity undertaken to promote health and fitness benefits (Caspersen et al., 1985). Incidental physical activity is not planned and usually is the result of daily activities at school, work, and home or during transport (Strath et al., 2013).

Physical activity recommendations. Most recent physical activity guidelines have been issued to children and young people within the UK by the UK Department of Health Chief Medical Officer (2011) on the amount and type of physical activity needed for health benefits. The recommended guidelines for physical activity from the UK Department of Health (2011) state that:

> All children and young people should engage in moderate to vigorous intensity physical activity for at least 60 minutes and up to several hours every day. On at least three of these days a week this should include activities to improve musculoskeletal health (activities that strengthen muscle and bone) and flexibility. All children should minimise the amount of time spent being sedentary for extended periods. (p. 26)

The activities to enhance musculoskeletal health may include hopping, skipping and jumping and the chief medical officer (Department of Health, 2011) defines moderate activities as those that will cause children to get warmer and breathe harder and their hearts to beat faster, but they should still be able to hold a conversation. Such activities have been highlighted to include games that require catching and throwing, such as rounders and other playground activity. Vigorous intensity physical activities will cause children to get warmer, breathe harder, and increase heart rate rapidly. Examples will include physically active play and games involving running and chasing and the participation in several types of sporting activities. Foweather (2010) suggests that moderate to vigorous physical activity (MVPA) is the term most commonly used to characterise physical activity in paediatric research and represents all physical activity at or above moderate intensity. These guidelines bring together different aspects of physical activity (e.g., fitness, motor development, psychological wellbeing and socialisation) in a life course approach (i.e., physical literacy), which provides the flexibility to promote sustained and good health.

Physical activity trends and future risks. Despite repeated recommendations for physical activity during the past decade, lifestyle changes in industrialised countries have resulted in the decline of people engaging in physical activity (Bouchard et al., 2007). In particular, there is an escalating prevalence of youth physical inactivity and obesity (Currie et al., 2012). The exact reasons why some youth are more physically active than others remain unclear (Stodden et al., 2008; Stodden & Holfelder, 2013). A study of 10-12 year-old European children reported that 83% of boys and 95% of girls did not meet recommended physical activity guidelines (Verloigne et al., 2012). More recently, Townsend, Wickramasinghe, Williams, Bhatnagar, and Rayner (2015), showed that of the UK countries, Scotland demonstrated the highest proportion of 11 year old children reporting that they conducted vigorous physical activity for two or more hours a week (55%), with lower participation figures experienced in both England (49%) and Wales (46%). Within this study the mean of the 43 countries surveyed within Europe and North America was 49%. The figure provided for Wales is clearly below this mean. It has previously been suggested by Jackson et al. (2003) that as children get older their participation in levels of moderate to vigorous physical activity declines. This reduction in moderate to vigorous physical activity is highlighted further in the fact that young children spend much of their daytime (often as much as 80%) in sedentary behaviours that typically require very low energy expenditure and very little (as little as 3%) of their day in health-enhancing moderate to vigorous physical activity (Pate, McIver, Dowda, Brown, & Addy, 2008; Reilly, 2010). Townsend et al. (2013) have shown that the percentage of children and young people who persist in sedentary activity (e.g., television viewing) for more than two hours on weekdays in England, Scotland and Wales was higher than for the United States of America, Ireland and many other European countries.

It is estimated that physical inactivity contributes to almost one in ten premature deaths (based on life expectancy estimates for world regions) from coronary heart disease (CHD) and one in six deaths from any cause. Although children and young people don't usually experience such chronic diseases, it is clearly evident that factors which contribute to these such as low physical activity have the potential to become established during childhood and adolescence (British Heart Foundation, 2013). Townsend et al. also reported that as well as the health burden in the UK, physical inactivity has a significant financial burden with the direct financial cost of physical inactivity in the UK estimated to be greater than £900 million in 2009/10.

Measuring physical activity. Physical activity is an infinitely unstable variable with complex behaviour, which is therefore extremely difficult to measure (Harro & Riddoch, 2000). Physical activity is assessed using subjective self-report (e.g., questionnaires or diaries), objective measures (e.g., accelerometers, pedometers, heart rate monitoring, indirect calorimetry) or combined multiple measurement parameters (e.g., heart rate monitoring with accelerometer). At present, with more than 30 different instruments developed to assess the dimensions of physical activity, there is little information available to guide the selection of a single physical activity assessment method that is appropriate for the wide variety of potential applications. In providing a comprehensive analysis of both subjective and objective measures, their advantages and disadvantages, and an assessment matrix to determine physical activity measurement, the reader is strongly recommended to read the work of Strath et al. (2013).

At present, self-report applications are the most widely used measurement method in UK studies involving young people and physical activity (Townsend et al., 2015). In a review of subjective self-reported physical activity recall questionnaires for use with young people for population surveillance Biddle, Gorely, Pearson, and Bull (2011) suggested three instruments that are valid for use. One of the instruments recommended for use with young people was the Physical Activity Questionnaire for Children/Adolescents (PAQ-C/PAQ-A). This instrument was also recommended by the Assessing Levels of Physical Activity and Fitness at population level working group (ALPHA) for use with European samples of young people although they do advise caution in its use due to physical activity recall bias in young people (Ruiz et al., 2010). More specifically, Corder and Ekelund (2008) identify concerns over the ability of young people being able to accurately recall and self-report their physical activity levels. They suggest that as their physical activity levels are likely to be highly sporadic (i.e., interspersed with periods of intense, moderate and low activity), they become less measurable, are subject to misinterpretation and also become susceptible to response bias. In support of the measure, Ruiz et al. (2010) suggest that due to their ease of administration, brevity, and ability to generate information on both the type and context of physical activity (i.e., an understanding of what physical activity children do alongside how much) ensures they are acceptable and important in the design of effective interventions.

Physical activity behaviour and fundamental movement skills. The documenting of scientific evidence about the importance of regular physical activity participation among youth and continued refinement of physical activity guidelines is of little value if the target population cannot practically apply this behaviour to their lives (O'Brien, 2013). Many children have other physical literacy challenges (i.e., physical, mental, emotional), therefore, specific types of activities may require adaptation to an individual's needs and abilities for these children's sustained participation in physical activity and optimal health. Based on the existing low levels of youth physical activity worldwide (Currie et al., 2012), researchers and practitioners are particularly interested in identifying which factors are the most modifiable and responsive to intervention to increase physical activity (Kenyon, Kubik, Davey, Sirard, & Fulkerson, 2012). O'Brien (2013) suggests that one particular correlate that requires additional examination in the literature are the levels of FMS proficiency amongst young people, and its association with physical activity and it therefore seems logical to hypothesise that:

> Since FMS are considered a prerequisite to, or foundation of, the specific skills used in popular forms of adult physical activity, it is reasonable to assume that there may be a relationship between an individual's participation in physical activity and his/her mastery of FMS. (Okely et al., 2001, p.1899)

Faigenbaum et al. (2013) suggest that the decline and disinterest in physical activity seems to be a modern-day corollary of low FMS proficiency and appears to decline steadily after age six. Lopes, Rodriguez, Maia, and Malina (2011) examined the determinants of physical activity participation levels in Portuguese youth, and suggested that motor skill proficiency in children six to ten years of age was a significant predictor. That is, children with high levels of motor competency at age six years showed negligible changes in levels of physical activity over the next three years compared with children with low and moderate levels of motor competency who significantly reduced their physical activity over the same period. These findings support the work of Seefeldt (1980), who observed that youth who do not develop the prerequisite skills to engage in a variety of physical activities early in life may not be able to break through a hypothetical proficiency barrier later in life that would allow them to participate regularly in recreational physical activities and sports with energy and vigour. It is therefore suggested that in addition to considering the “dose response” of physical activity, the importance of the “quality response” of developmentally appropriate movements should also be appreciated, with effective and genuine interest in helping children gain competence and confidence in their abilities to be physically active (Bryant et al., 2013; Faignebaum et al., 2013; Stodden et al., 2009).

It has been suggested by Barnett, Van Beurden, Morgan, Brookes, and Beard, (2008b) that there are very few longitudinal studies that have assessed the relationship between childhood FMS and future physical activity levels. Of these studies, several showed that enhancing proficiency levels in FMS longitudinally led to an increased level of physical activity being observed (Jaakkola & Washington, 2013; Okely et al., 2001). In contrast, McKenzie et al. (2002) did not identify a relationship between childhood FMS and future physical activity levels, whilst others have suggested that it is the influence of physical activity which dominates the development of FMS and not vice versa (Bürgi et al., 2011). In the most recent review of FMS and physical activity by Holfelder and Schott (2014), it was suggested that the focus of previous works was mainly on general associations without presenting and discussing results about relationships specific to skill and gender, although they do emphasise that a skill-specific analysis was proposed by Lubans et al. (2010) as a future direction. Therefore, Holfelder and Schott (2014) and Hume et al. (2008) amongst several others, suggest that a cause and effect relationship between FMS and physical activity is suspected but has yet to be demonstrated and further research is needed.

Psychological / Cognitive factors. The proficiency of FMS has been advocated as a potential strategy for increasing perceived physical competence with concomitant positive effects on physical literacy (Foweather, 2010). As FMS development progresses over time, children’s physical activity levels may be partially attributed to their actual FMS competence and related choice of activities, which are also linked to their levels of self-esteem, perceptions of competence, success, and intrinsic motivation to participate (Barnett et al., 2008b; Stodden et al., 2008). Therefore, children who have stronger beliefs about their physical competence are more likely to enjoy, persist and remain physically active than children who report lower physical competence (Fox, 2000). This section of the literature review will seek to explain the mechanisms for this important relationship and begin by focussing on the theoretical underpinnings of physical self-concept, including descriptions and definitions of the physical self. The research evidence will be reviewed, including studies that have assessed physical self-perceptions with children and those examining the relationships between physical self-perceptions and FMS. Summaries of the evidence will be provided and limitations in the research will be highlighted, which will provide the rationale for the thesis.

Physical self-concept. Physical self-concept has been found to be an important determinant of exercise behaviour (Fox, Corbin, & Couldry, 1985; Klint & Weiss, 1987), self-esteem (Fox, 1992; Sonstroem & Morgan, 1989) and other life adjustment variables (Sonstroem & Potts, 1996). Self-esteem is frequently used interchangeably with the term self-concept. Self-concept can be defined as "a person's self-description of whom and what they are" (Whitehead, 1995, p. 132). There has been an increase in the study of self-concept (Harter, 1990), coinciding with an increase in the general awareness by individuals of their own self-perceptions, their mental well-being and motivational state having significant relevance to life in general and in particular their own physical activity behaviours (Fox, 1990; Sonstroem & Morgan, 1989; Whitehead, 1995). Physical self-concept is evaluative in nature, and this evaluation is based on self-perceptions in different aspects of the self, known as domains (Shavelson, Hubner, & Stanton, 1976). These self-perceptions are influenced by the dominant culture, beliefs and values held by the individual (Fox, 2010).

Measuring physical self-concept. The work of Shavelson et al. (1976) showed that although several self-concept instruments contained items relating to physical skills and physical appearance, none were a precise measure of physical self-concept and of little value in relation to sport, exercise and physical health. Marsh and Cheng (2012) summarized that although multidimensional self-concept instruments based on the works of Shavelson et al.'s (1976) model provided good support for the construct validity of the physical ability and appearance scales they left unanswered questions. Subsequent to the work of Shavelson et al. (1976), physical self-concept instruments have been developed specifically to address the issue of the multidimensionality of physical self-concept. Such constructs have included the Physical Self-Perception Profile (PSPP; Fox, 1990; Fox & Corbin, 1989), the Physical self-description Questionnaire (Marsh, Richards, Johnson, Roche, & Tremayne, 1994) and the Physical Self-Concept (PSC) scale (Marsh, 1997).

Regarding these specific models, the PSPP (Fox, 1990; Fox & Corbin, 1989) has attracted the most attention. Fox and Corbin (1989) developed the PSPP for measuring physical self-perception as a subscale of global self-worth. Physical self-perceptions have shown to be important determinants of self-worth and exercise behaviour (Welk, Corbin, Dowell, & Harris, 1997). In this model, physical self-concept is captured through four independent dimensions. These include sports competence (SC), which represents an individual's perceptions regarding their sport and athletic ability, their ability to learn new sport and motor skills, and how confident they feel in sport environments. Physical condition (PC), which represents the individual's perceptions regarding the level of their physical condition, physical fitness, stamina, their ability to maintain exercise and state how confident they feel in the exercise and fitness setting. Body attractiveness (BA), representing the individual's feelings regarding the attractiveness of their bodies and how confident they feel about their appearance and physical strength (PS) representing the individual's perceptions regarding their strength and muscle development, and how confident they feel when they are involved in strength demanding tasks. These four domains are hierarchically related to more global physical self-perceptions of worth (PSW) and global self-esteem or global self-worth (GSW) located at the pinnacle of this hierarchical model. The factorial validity and psychometric properties of the PSPP were originally demonstrated with college students (Fox & Corbin, 1989) with subsequent work supporting the utility of the model among young adults (Sonstroem, Harlow, & Joseph, 1994; Sonstroem, Speliotis, & Fava, 1992), and older adolescents (Welk, Corbin, & Lewis, 1995). In addition, support for a hierarchical structure was evidenced by global physical self-worth mediating the relationship between global perceptions of self-esteem and lower levels such as sub-domains or situation specific perceptions of competence (Fox & Corbin, 1989).

The Children and Youth Physical Self-Perception Profile (CY-PSPP). Harter (Harter & Pike, 1984) found that young children (4-7 years) are capable of making reliable judgements about different aspects of the self; however, at these ages, children have difficulty differentiating between particular aspects of the self (i.e., domains), and are not able to make overall judgements of self-worth. In middle childhood (ages 8-12), children can make an overall evaluation of global self-worth, and make a distinction between different aspects of these self domains (Harter, 1985b). In an attempt to expand the model for use with a younger population, Whitehead (1995) produced an adapted version of the PSPP for use with children and adolescents (C-PSPP). This version was based on the original work of the PSPP by Fox and Corbin (1989), although it contained only three subscales from the original PSPP (PC, BA and PS) with amendments to the wording. The C-PSPP also contained Harter's (1982) validated sport competence subscale; a global PSW subscale (Whitehead & Corbin, 1991) and a general GSW subscale (Harter, 1982). The initial exploratory and CFA of this revised model by Whitehead (1995) with American students (n = 505, aged 12-14 years) found support for the four factor PSPP subscale structure, and the hierarchical framework, with sub-domains accounting for 64% and 70% of the variance in physical self-worth for boys and girls, respectively. The model successfully discriminated between high and low scoring children (as perceived by PE teachers) to provide evidence of construct validity. Eklund, Whitehead, and Welk (1997) conducted a further CFA on a large sample of 13 to 15-year-old adolescents which provided additional support for the factor structure of this revised measurement tool.

In order to distinguish it from the earlier model, after changes were made to the instrument subscales and to enhance its use with children and adolescents who were used in the revised model, Eklund et al. (1997) called the questionnaire the Children and Youth Physical Self-Perception Profile (CY-PSPP). Subsequent work by Welk and Eklund (2005) in validating the CY-PSPP among eight to twelve-year-old children found that it demonstrated factorial validity and hierarchical structure. The CY-PSPP has also been validated with adolescents (Jones, Polman, & Peters, 2009), and younger children of ages nine and ten (Welk et al., 1997; Welk & Eklund, 2005). However, with this younger age group some minor cross-loadings of items between scales have been observed (Welk et al., 1997). The CY-PSPP instrument has also developed cross cultural support with translation into several different languages for use with a range of children and youth from Britain, Hong Kong, Russia, Sweden and Greece (Asci, Eklund, Whitehead, Kirazci, & Koca, 2005; Kolovelonis, Mousouraki, Goudas, & Michalopoulou, 2013; Raustorp, Mattson, Svensson, & Stahle, 2006; Raustorp, Stahle, Gudasic, Kinnunen, & Mattsson, 2005). The CY-PSPP has been used most extensively by researchers (Fox, 1997), particularly in studies of children and young people but to the authors knowledge not extensively in the UK.

Physical self-perceptions and fundamental movement skills. Late childhood (8-11 years) is the period immediately preceding physical maturation for most children and also a time of important cognitive and social development. Cognitively, children at this age are focused on developing competency in particular learning and skill areas (e.g., FMS, Spiller, 2009). They also develop skills in reflection and evaluation; therefore, late childhood is an important period of processes and experiences (Eccles, Wigfield, Harold, & Blumenfeld, 1993). Spiller (2009) also suggests that late childhood:

> Contains peaks in physical activity participation and is a time of improving physical abilities and increasing cognitive functioning, including the ability to self-reflect. It is also a time of increased awareness of others, including the social status to be gained by excelling in particular areas and involves ongoing early identity development. (p. 8)

Welk and Eklund (2005) have called for greater individual and societal understanding of the factors influencing physical self-concept in young people. It has been convincingly shown (Harter, 1985a; Marsh & Shavelson, 1985; Soule, Drummond, & McIntire, 1981) that from the age of seven or eight years, children are increasingly able to judge themselves differently according to the domain of their lives being addressed. Therefore, a positive self-concept is valued as a desirable outcome in sport, exercise and health psychology as well as in many other disciplines (Marsh & Cheng, 2012). Recent revisions to physical literacy theory suggest that we must give children the confidence and motivation to move as well as a solid understanding of the importance of moving frequently and proficiently (Keegan et al., 2013). Young children have high perceptions of their own competence but as they approach adolescence this changes and they become more aware of their ability, which has implications for their feelings and motivation (Harter, 1987, 2003). For this reason, learning to move proficiently in the early years is essential.

The importance of perceived sport competence is supported by a systematic review that shows there is a consistent association between perceived sports competence and motor skill proficiency (Lubans et al., 2010). Perceived competence may be central to self-esteem. Harter's model proposes that actual competence precedes perceived competence with perceived competence more directly effecting motivation than actual competence (Harter, 1978). Barnett et al. (2008b) could locate no previous studies that investigate whether physical self-perception mediated between childhood motor skill proficiency and subsequent physical activity behaviour. In their study, Barnett and colleagues followed up six years later on 276 adolescents who originally performed a study on FMS proficiency and physical self-perceptions in childhood. They found that a positive perception of sports competence was a key predictor of physical activity and fitness and is influenced by motor skill proficiency as a child. More specifically, it was influenced by being able to perform object control skills (such as catching, throwing and kicking) competently in childhood. The direct relationship between childhood object control proficiency and perceived sports competence was strong in both physical activity ($\beta = .37$) and fitness models ($\beta = .43$), signifying that adolescent perceived sports competence may be based on childhood object control ability. Although the authors do state that this is feasible because perceptions of sports competence were measured again on the sample during adolescence, therefore, perceptions of sports competence reflect a self-concept based on current skill ability and not exclusively on past childhood skill ability, which may have been influenced by improved object control skills since the original measurement.

Stodden et al. (2008) suggest that as FMS development progresses over time, children's physical activity levels may be partially attributed to their actual FMS competence and related choice of activities, which are also linked to their perceptions of competence, success, and intrinsic motivation to participate. Stodden and colleagues (2008) therefore contend that motor competence precedes perceived competence and is the key determinant of an active lifestyle. Mastering FMS is thought to increase perceptions of competence and, in turn, competency beliefs influence children's motivation to be physically active (Weiss, 2000).

The only study identified in Lubans et al.'s (2010) review that assessed the relationship between FMS performance and specific global self-concept by Martinek, Chetters, and Zaichkowsky (1978) in a sample of 344 children showed the relationship to be non-significant. Raudsepp and Liblik (2002) therefore suggest that although there is some evidence that children's FMS competence and perceived competence are related, there is scant evidence of skill development programmes successfully increasing competence beliefs. Lubans et al. (2010) suggested that due to an inadequate number of studies, the relationship between FMS competency and global self-concept and perceived physical competence were classified as uncertain. They recommend that more longitudinal and intervention research examining the relationship between FMS competency and potential psychological outcomes in children and adolescents is required. More specifically, and in relation to the UK, Foweather (2010) advocates that evidence documenting the FMS skill mastery and psychological health of its children aged 9-11 years is too sparse to draw any conclusions from.

Social factors. As established throughout this chapter, there are many facets of physical literacy that may impact on FMS and subsequent physical activity. In addition to these reciprocally interacting domains proposed by Tremblay and Lloyd (2010), there is substantial evidence that different social factors can have a profound ability to impact on a child's physical literacy journey and health (Armenakis & Kiefer, 2007). Social factors are things which affect lifestyle and distinguish major differences between groups of people in society such as religion, race, family, wealth, education and environment. With such a wide range of these social factors being beyond the scope of this review it is intended to focus on the socialising effects and interrelatedness of variables within the family context towards children's physical well-being (e.g., parental behaviours and beliefs). Children and young people are influenced by their parents, peers, and siblings (Fitzgibbon et al., 2013; Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007; Van Sluijs, McMinn, & Griffin, 2007) as they have the potential to encourage or discourage certain motor behaviours through various socialising processes (Cools, DeMartelaer, Samaey, & Andries, 2011). It has been suggested by O'Brien (2013) and Ferreia (2007) that more attention should be paid to different types of correlates of behaviour such as the social influence from parents during the development of interventions to improve children's physical activity trends. The remainder of this chapter will therefore discuss the influence of this social factor on children's FMS and identify previous research in this area.

The family context and fundamental movement skills. Biographical data suggests that social influence on physical activity participation is generated in childhood with post-childhood experiences having lower potential to influence these differences (Wheeler, 2011). Regarding the wider context of social influences (e.g., religion, race, family, wealth, education and environment) it is family influence and in particular parental influence which principally determine or influence a child's enduring propensity towards physical activity or sports participation (Birchwood, Roberts, & Pollock, 2008; Van der Horst, Chinapaw, Twisk, & Van Mechelen, 2007). Active children are socialised into active lifestyles by encouraging, supportive parents (Parry, 2013). It is widely thought that parental and family influences are crucial to early childhood development of physical skills and abilities. By having varied and extensive early experiences of physical activity, children develop basic physical literacy made up of FMS (Whitehead, 2001, 2010). Parents introduce and guide children through developmental stages of movement skills, they are important agents who monitor movement skills and encourage children to engage in activities that promote movement skill performance and competence (Williams et al., 2008). Bois, Sarrazin, Brustad, Trouilloud, and

Cury (2005) highlighted that as a starting point, socialization within the family (i.e., parents and siblings) should be a fundamental form of influence on motor skill development. This is because the family constitutes an important initial element of socialization influence for children with the majority of children's free time prior to adolescence being spent within the context of the family. Therefore, the family context has been identified as an important medium to provide opportunities for children to be physically active and to develop their FMS (Gallahue & Ozmun, 2006).

A useful theoretical model to explain parental influence is the expectancy-value model of Eccles and Harrold (1991). Welk (1999) suggests that this model has clear application to physical activity in that socialization behaviours are thought to be influenced jointly by parental expectation for the child's success in a given area and the value parents place on this success. In the model, Eccles and Harold suggest that there are various ways that parents can socialize their children to be physically active. These variables include parental encouragement (e.g., play outside, limit TV viewing, transfer of knowledge), parental involvement (playing or practicing skills), parental facilitation (access to facilities, programmes, equipment) and parental role modelling (efforts to model an active lifestyle and be physically active). Eccles and colleagues (Eccles, Wigfield, & Schiefele, 1998; Fredericks & Eccles, 2004) also suggest that the beliefs that parents hold for their children influence their patterns of interaction with the child, such as extent of encouragement and the provision of opportunities and experiences that, in turn, affect their child's motivation. Lee (2014) further suggests that within socialization theory, parents deliberately engage in certain practices that they feel will help to protect their children from and overcome the risks in their environment and hopefully lead to positive development. Therefore, the family process, parental styles, role-modelling and social capital all highlight ways that parents' behaviour and practices can mediate the relationship between physical activity outcomes. Together, they will serve to guide the conceptualization of how behaviours and practices of parents link disadvantage in childhood/adolescence to physical activity outcomes in adolescences and in the transition into young adulthood (Lee, 2014).

Previous studies have mainly focused on the relationship between physical activity and socialising situations such as the family context. There has been limited research focusing more specifically on the relationship between primary school children's FMS performance and specific influences from within the family and parental context. Of the limited research in a study of preschool children in Belgium (n = 846, ages 4-6 years old), Cools et al. (2011) highlighted several critical positive and negative family correlates for preschool children's FMS performance. Positive correlates included father's physical activity, transport to school and parental importance rating on their child's physical activity. Negative correlates included, parental emphasis on winning and performance of their child's physical activity and parental inquiry with the preschool teacher on their child's motor development. Further, the study recommended that preschool children may benefit from family interventions that emphasize the importance of providing sufficient opportunities to be physically active to support the child's overall development. The work of Cools et al. (2011) clearly identified associations between several family correlates and preschool children's FMS performance. It has been suggested by Gabbard (1992), that the development of FMS starts at birth and traditionally continues to be developed until around 11–12 years of age. Therefore, it seems valid to suggest that such family correlates investigated by Cools et al. may have an association with the FMS performance in children not just at preschool ages but with children throughout this development period (i.e., with primary school children). Further investigation of the relationships of these family correlates with the FMS ability of primary school children is clearly warranted in addition to the previously identified physical literacy attributes.

Summary of Literature Review

Overall, it is clear that countries are facing similar problems of poor physical activity levels and obesity within their populations and are responding with significant investment in promoting physical literacy among children. They are using increasingly sophisticated programmes in an attempt to meet the specific needs of their demographics. Within several of these physical literacy programmes such as the Canadian Sport for Life (CS4L), Physical Education Health Education Canada (PEHE), TOP Sportsability (England), Basic Moves (Scotland), KiwiSport (New Zealand) and Utah Sport for Life Model (United States), it is recognised that there must be a foundation (i.e., development of fundamental movement skills) upon which lifelong participation in activity is based to develop physical literacy (Tremblay & Lloyd, 2010). It has, however, increasingly been reported that young children lack FMS (Fisher et al., 2005; Wrotniak et al., 2006) and crucially this occurs at critical periods during their physical development. At present there is a dearth of data and literature in relation to FMS proficiency worldwide; although in Wales, as far as the author is aware, there is a noticeable absence of data in relation to children's FMS proficiency clearly indicating a gap within the literature.

Of greater significance is the interpretation and subsequent profiling of FMS proficiency, which varies with each assessment tool adopted in the many studies conducted across the world (Cools et al., 2009). It has been highlighted in this review that many approaches to FMS assessment result in inappropriate measurement or classification which have the potential to limit or hinder children's FMS development. Further, Giblin, Collins, and Button (2014), and Foweather (2010) have suggested that more research is required to establish a more valid measure of FMS proficiency without compromising the quality of data measured. Consequently, given such concerns and the importance placed on FMS towards physical literacy, a novel and innovative classification of FMS proficiency is clearly warranted for further investigation.

In addition, the concept of physical literacy is conceived to be the result of the multidimensional interaction between FMS and several other domains (physical fitness, physical activity, psychology and socialization) to facilitate lifelong healthy active living behaviours in children and youth (Lloyd & Tremblay, 2011). The relationship of these domains and FMS has shown it possible to trace causal chains. Hitherto, the research on physical literacy is still in its infancy and has focused mainly on relationships among FMS and selective markers of physical literacy. Therefore, to understand best practice a gap in the literature exists to collectively examine several physical literacy domains and their potential to discriminate FMS performance in primary school aged children. At present, evidence within the UK and with primary school children is currently limited therefore there is scope to inform the body of literature within this field of expertise and to support future policy direction. It has been suggested by Keegan et al. (2013) that without making best practice guidelines a specific goal of physical literacy programmes based on reliable research and evidence, future developments and funding decisions will remain dependent on anecdotal evidence.

Chapter 3

Validation of the Children and Youth Physical Self-Perceptions Profile for South East Wales primary school children

Abstract

Purpose: The Children and Youth Physical Self-Perception Profile (CY-PSPP) is widely used to study children's physical self-perceptions. The purpose of this study was to directly test the validity of the CY-PSPP for use with a sample of Welsh primary school children. *Methods:* A total of 585 children, aged 9-12 years, completed the CY-PSPP. Confirmatory factor analysis was conducted to assess the hierarchical six-factor measurement model of the CY-PSPP. Equivalence of measurement across gender was conducted using measurement invariance via sequential multi group covariance analyses. *Results:* Confirmatory factor analysis supported the hierarchical structure of the CY-PSPP model and revealed no invariance between genders. Correlations between CY-PSPP domains were moderate to strong and exhibited the expected pattern of relationships. All factor loadings in all analysis of the measurement model were significant ($p < 0.001$) and yielded a clean factor structure. Inter correlations amongst the CY-PSPP sub domains demonstrated no cross loadings among the factors. *Conclusions:* The CY-PSPP instrument is a valid and reliable measure to examine the nature and impact of physical self-perceptions of young children in this population.

Keywords: Children; self-perceptions; self-concept

Introduction

Late childhood (8-11 years) has been identified as the period immediately preceding physical maturation for most children and is a time of important cognitive and social development. Cognitively, children at this age are focused on developing competency in particular learning and skills (Spiller, 2009). They also develop skills in reflection and evaluation; therefore, late childhood is an important period of processes and experiences especially when considered for the promotion of good physical health. Spiller (2009) suggests that late childhood:

> Contains peaks in physical activity participation and is a time of improving physical abilities and increasing cognitive functioning, including the ability to self reflect. It is also a time of increased awareness of others, including the social status to be gained by excelling in particular areas and ongoing early identity development. (p. 8)

In support of such suggestions, Stein, Fisher, Berkey, and Colditz (2007) showed that those children who increased participation in physical activity during late childhood felt more competent in their athletic ability. In addition, they also perceived themselves to be more socially accepted by their peers. Therefore, with the increasing incidence of obesity, inadequate physical activity levels and body dissatisfaction of children in late childhood, Welk and Eklund (2005) have called for greater individual and societal understanding of the factors influencing physical self-concept in young people.

Physical self-concept has been found to be an important determinant of exercise behaviour (Fox, Corbin, & Couldry, 1985; Klint & Weiss, 1987), self-esteem (Fox, 1992; Sonstroem & Morgan, 1989) and other life adjustment variables (Sonstroem & Potts, 1996). Researchers have generally stated that young children have fairly undifferentiated perceptions of their physical self (Biddle et al., 1993; Fox, 1992). It has been convincingly shown (Harter, 1985a; Marsh & Shavelson, 1985; Soule, Drummond, & McIntire, 1981) that from the age of

7 or 8 years, children are increasingly able to judge themselves differently according to the domain of their lives being addressed. Therefore, a positive self-concept is valued as a desirable outcome in sport, exercise and health psychology as well as in many other disciplines (Marsh & Cheng, 2012).

As a result, there has been an increase in the study of self-perceptions (Harter, 1990), coinciding with an increase in the general awareness by individuals of their own self-perceptions, their mental well-being and motivational state having significant relevance to life in general and in particular their own physical activity behaviours (Fox, 1990; Sonstroem & Morgan, 1989; Whitehead, 1995). Unfortunately, this heightened interest may have resulted in the definition of different self-perceptions becoming blurred or interchangeable and confusion has thus resulted (Whitehead, 1995).

The work of Shavelson, Hubner, and Stanton (1976) showed that although several self-concept instruments contained items relating to physical skills and physical appearance, none were a precise measure of physical self-concept and of little value in relation to sport and exercise. Marsh and Cheng (2012) noted that although multidimensional self-concept instruments based on the works of Shavelson et al. (1976) model provided good support for the construct validity of the physical ability and appearance scales, they left unanswered questions. Subsequent physical self-concept (PSC) instruments have been developed specifically to address the issue of the multidimensionality of PSC, including the Physical Self-Perception Profile (PSPP; Fox, 1990; Fox & Corbin, 1989), the Physical Self-Description Questionnaire (Marsh, Richards, Johnson, Roche, & Tremayne, 1994) and the Physical Self-Concept (PSC) scale (Marsh, 1997). Welk and Eklund (2005) have subsequently described all three of these related measurement models as being multidimensional and hierarchical in nature, due in part to the broad self-concept framework previously advanced by Shavelson et al. (1976).

Of these instruments, the PSPP has attracted the most attention. Fox and Corbin (1989) developed the PSPP for measuring physical self-perception as a subscale of global self-worth. Physical self-perceptions have shown to be important determinants of self-worth and exercise behaviour (Welk, Corbin, Dowell, & Harris, 1997). In this model, physical self-concept is captured through four independent dimensions. The first of which is sports competence (SC), which signifies an individual's perceptions regarding their sport and athletic ability, their ability to learn new sport and motor skills, and how confident they feel in sport environments. The second dimension is physical condition (PC), which represents the individual's perceptions regarding the level of their physical condition, physical fitness, stamina, their ability to maintain exercise and state how confident they feel in the exercise and fitness setting. Body attractiveness (BA), the third dimension, represents the individual's feelings regarding the attractiveness of their bodies and how confident they feel about their appearance and the final dimension, physical strength (PS) characterizes the individual's perceptions regarding their strength and muscle development, and how confident they feel when they are involved in strength demanding tasks. These four domains are hierarchically related to more global physical self-perceptions of worth (PSW) and global self-esteem or global self-worth (GSW), located at the pinnacle of this hierarchical model.

In this initial model, each domain was represented by six items in a 30 item inventory, except for the GSW dimension. In order to measure the GSW dimension in this initial PSPP model it was recommended by Fox (1990) that the 10-item Rosenberg Self-Esteem Scale (Rosenberg, 1965) be used alongside the main instrument. This GSW scale was designed to reflect the advances made by Harter (1985a) and Shavelson et al. (1976) in identifying the physical self as an important construct to measure in its own right and to reflect the hierarchical, multidimensional nature of the physical self (Marsh & Cheng, 2012). The PSPP demonstrated good reliability (coefficient alpha of .80 - .95; Fox, 1990; Page, Fox, Biddle, &

Asmord, 1993; Sonstroem, Speliotis, & Fava, 1992), good test-retest stability over the short term (rs of .74 - .89; Fox, 1990) and a well-defined, replicable factor structure, demonstrated with the use of confirmatory factor analysis (CFA; Fox & Corbin, 1989; Sonstroem, Harlow, & Josephs, 1994).

The factorial validity and psychometric properties of the PSPP were originally demonstrated with college students (Fox & Corbin, 1989) with subsequent work supporting the utility of the model among young adults (Sonstroem et al., 1992; Sonstroem et al., 1994), and older adolescents (Welk, Corbin, & Lewis, 1995).The instrument has also been found be valid with use in several countries such as Canada (Crocker, Eklund, & Kowalski, 2000), Russia (Hagger, Ashford, & Stambulova, 1998) and in the United Kingdom (Biddle et al., 1993). However, Marsh et al. (1994) found that correlations among the PSPP scales were consistently high (.65 - .89 when disattenuated for measurement error), which detracted from the instrument's ability to differentiate among the different PSC factors it purports to measure.

In an attempt to expand the model for use with a younger population, Whitehead (1995) produced an adapted version of the PSPP for use with children and adolescents (C-PSPP). This version was based on the original work of the PSPP by Fox and Corbin (1989) although it contained only 3 subscales from the original PSPP (PC, BA and PS), with amendments to the wording. It also contained Harter's (1982) validated sport competence subscale; a global PSW subscale (Whitehead and Corbin, 1991) and a general GSW subscale (Harter, 1982). Initial exploratory and CFA of this revised model supported the construct and concurrent validity of the C-PSPP. However, a number of cross loadings emerged from the findings (Welk et al., 1995).

Eklund, Whitehead, and Welk (1997) conducted a further CFA on a large sample of 13 to 15-year-old adolescents, which provided additional support for the factor structure of the revised measurement tool. The CFA supported the instrument's factor structure, with both the comparative fit index (CFI) and the non-normed fit index (NNFI) exceeding the .90 criterion for good model fit (Eklund et al., 1997). In order to distinguish it from the earlier model, after changes were made to the instrument subscales and to enhance its use with children and adolescents who were used in the revised model, Eklund et al. (1997) called the questionnaire the Children and Youth Physical Self-Perception Profile (CY-PSPP). The final version of the CY-PSPP is based on the idea of multidimensional self-concept in the physical domain (Kowalski, Crocker, Kowalski, Chad, & Hubert, 2003). The CY-PSPP assesses these physical perceptions of SC, PC, PS and BA. Perceptions in these sub-domains then influence one's PSW (Welk et al., 1995), which is at the domain level, allowing for multidimensionality within the physical domain. Global self-worth will then be influenced by the amount of importance one places on their physical self (Eyre, 2008). Marsh and Shavelson (1985) advocate that one's GSW at the apex of the hierarchical construct, is a relatively stable trait. As one descends the hierarchy, self-concept becomes less stable and more situation-specific. Therefore, the CY-PSPP is both hierarchical and multidimensional.

Subsequent work by Welk and Eklund (2005) in validating the CY-PSPP among eight to twelve-year-old children found that it demonstrated factorial validity via CFA and hierarchical structure. The CY-PSPP has in addition been validated with adolescents (Jones, Polman, & Peters, 2009), younger children (Welk et al., 1997) and cross culturally with translation into several different languages for use with a range of populations (Asci, Eklund, Whitehead, Kirazci, & Koca, 2005; Raustorp, Stähle, Gudasic, Kinnunen, & Mattsson, 2005; Raustorp, Mattsson, Svensson, & Stähle, 2006). Despite this support, the results with younger, primary school aged children have been less clear. As noted above, Welk et al. (1997) claimed that the CY-PSPP could be used with children as young as nine years of age; however, the debate as to its limitations has centred on the structure and complexity of the alternative response format with this age group. The CY-PSPP uses a non-standardized response format based on the work of Harter (1985a). That is, children have to decide which of two statements relating to how they feel in specific situations are most relevant to them, and then to indicate whether the statement they selected was "really true for me" or "sort of true for me". Higher scores reflect greater levels of physical self-perception. The use of this response format is designed to reduce the influence of social desirability, although Marsh et al. (1994) identified potential method effects associated with this non standardized response scale. This format therefore may be somewhat confusing, particularly for children if clear and adequate instruction is not presented (Eiser, Eiser, & Havermans, 1995).

In support of the structured alternative response format of the CY-PSPP, Welk et al. (1997) have suggested that it has clear advantages in psychometric properties over the alternative standard Likert scale format. However, Welk et al. (1997) did show cross loadings among several factors since exploratory factor analysis were employed rather than confirmatory techniques. In addition, they highlighted that cross loadings would be expected for this sample due to a less differentiated physical fitness profile at this age but they also acknowledged that the cross loadings may occur because of the inability of young children to distinguish between the different dimensions of the physical self. They further highlighted that the nature of children's activities may also have accounted for some differences in how children perceive and respond to the items.

Lindwall, Asci, Palmeira, Fox, and Hagger (2011) have published a revised version of the PSPP (PSP-R) and acknowledged that the idiosyncratic alternative response format was difficult to understand for some participants. They dropped the format and replaced it with a 4-point Likert response using only positive worded items and demonstrated its use with 1831 participants from several countries. However, they did not indicate whether the PSPP-R supersedes the PSPP or is merely an alternative to it nor did they discuss the implications for other instruments such as the CY-PSPP (Marsh & Chang, 2012).

Fox (2000) has suggested that the validation process of a questionnaire instrument requires ongoing work and the psychometric properties of the CY-PSPP using different populations should be further scrutinized. In recent validation of the instrument, Welk and Eklund (2005) confirmed the utility of the CY-PSPP model down to fourth grade children (9-10 years), and their study efforts were consistent with the recommendations by Marsh (1997) who called for continued refinement of physical self-concept instruments using CFAs to evaluate the a priori dimensionality and design. Recent research by Kolovelonis, Mousouraki, Goudas, & Michalopoulou, (2013) with a non-English speaking sample found support for the CY-PSPP hierarchical structure, its internal consistency, and criterion validity. This work therefore supports the previous theoretical and empirical evidence across cultures regarding the multidimensional and hierarchical structure of physical self-perceptions (Eklund et al., 1997; Fox, 2000; Fox & Corbin, 1989; Hagger, Biddle, & Wang, 2005; Welk et al., 1995; Welk & Eklund., 2005; Whitehead, 1995). Other work to validate the CY-PSPP with different populations was either not fully supportive of the hypothesized hierarchical factor structure (Asci et al., 2005; Hagger, et al., 1998) or did not examine its factorial and structural validity (Raudstrop et al., 2005). It is therefore generally accepted that establishing the validity of such a psychometric instrument is an ongoing process (Kaplan & Sacuzzo, 2012; Schutz & Gessaroli, 1993). In addition, Kolovelonis et al. (2013) suggest that the cross-cultural validation of the CY-PSPP should be continued using populations with diverse characteristics from different cultures in order to expand the validity evidence base for this measure.

The purpose of the present study was to directly test the utility of the CY-PSPP model among a sample of Welsh primary school aged children. The study employed CFA techniques to specifically evaluate the utility of the measurement model for this population. It was hypothesised that the CY-PSPP would have a hierarchical structure with four-factors (i.e., SC, PC, PS and BA) in the sub domain level, the PSW factor in the domain level, and the GSW at the apex level. These analyses included an invariance analysis to identify if the relationships differed by gender. We predicted that responses to the CY-PSPP would be explained by the factors and its hierarchical structure. Specifically, it was predicted that each item would have a no zero loading on the self-concept factor it was designed to measure and zero loadings on all other factors, there would be no differences in model fit between genders and that measurement error terms would be uncorrelated.

Method

Participants and Settings

Following approval by the University's Human Research Ethics Committee, and permission granted by the Welsh Government Central South Physical Education and Sport Consortium, primary schools in South East Wales were approached to participate in the study.

A total of twenty-seven primary schools were invited to participate in the study, of which eighteen returned consent (see Appendix A). Schools were briefed on the study and only those children returning signed parental consent (see Appendix B) and child assent forms (see Appendix C) were allowed to participate in the study. A total of 640 completed consent packs were returned from all participating schools. Subsequently, each school attended the test centre at the University of South Wales on separate dates. All data were collected during normal school hours. A total of 591 children, aged 9-12 years old attended the test centre. Of these attendees, a total of 585 complete data sets were recorded for 313 males (*M* age = 10.9 years, *SD* = 0.62), and 272 females (*M* age = 10.7 years, *SD* = 0.64).

Instruments

The Children and Youth Physical Self-Perception Profile (CY-PSPP). The CY-PSPP (see Appendix F) includes scales to address one's perceptions of Global Self-Worth (GSW), Physical Self-Worth and its sub-domains of Sports Competence (SC), Physical Conditioning (PC), Body Attractiveness (BA) and Physical Strength (PS) in children and adolescents. Each scale is assessed with six items scored on a four-point scale with the average score used to represent the value for the scale. Higher scores reflected greater levels of physical self-perceptions. All of the items use a structured alternative format to reduce the tendencies for socially desirable responses (Harter, 1982) and half of the items were reverse coded to keep the instrument more interesting for participants. Previous work by (Welk et al., 1997) on a similarly aged sample revealed high alpha reliability for the scales in this instrument (range; 0.77 - 0.91). Additionally, in Welk and Eklund's (2005) study no substantial areas of concern were revealed in the measurement model for the total sample (range 0.41 - 0.82), for boys (range 0.32 - 0.85) and for girls (range 0.43 - 0.83), suggesting an adequate fit for the CY-PSPP measurement model and reasonable psychometric attributes.

Procedures

An assurance of full confidentiality was emphasized by the use of an identification number system issued at registration, which precluded the use of names on the questionnaires. The CY-PSPP self-report instrument was administered in a pre-designated classroom by the lead investigator and supported by several research assistants and the school support assistant or teacher. To make the participants feel more comfortable and avoid potential distraction, they were assigned to small groups (no greater than 6) of the same gender, where possible. The children were first explained the purpose of the survey and were reminded that we were interested in their personal opinions and ratings (i.e., that there were no right or wrong answers) and asked to answer each question as best they could by choosing the statement that best described them. Example items were provided and demonstrated to the group based on Whitehead's (1995) recommendation for use with the structured alternative format. Each of the items in the survey was read to the children and the research assistants circulated throughout the room to provide extra assistance.

Statistical Analysis

Several sets of analysis were conducted with these data including descriptive, correlational, and structural equation modelling. Descriptive statistics were calculated for self-perception profiles for the group and between gender differences to allow comparisons with similar studies.

The structural equation modelling analyses were conducted on data from the total sample, and male and female subsamples using Mplus (Muthen & Muthen, 2010). Confirmatory factor analysis (CFA) of the hypothesized six-factor measurement model of the CY-PSPP as proposed by Fox and Corbin (1989) was conducted. The CFA models were fitted for each group separately to test for this configurable invariance. Global model fit indices were examined at each stage of CFA, along with detailed assessment of the completely standardized factor loadings, the standardized residuals, and the modification indices. Specifically, items were uniquely loaded on each appropriate factor; the scale of each latent factor was defined by fixing the factor loading of an indicator to 1.0 with zero loadings on all other factors. Factors were allowed to correlate, and measurement errors were not allowed to correlate.

Data were screened for multivariate normality and missing data, and all confirmatory factor analyses were conducted using the robust maximum likelihood estimation procedure with a Satorra–correction (S-Bχ2; Bentler, 2002; Satorra & Bentler, 1994; West, Finch, & Curran, 1995) and fit indices corrected for robust estimation. These fit indices, in addition to the normed chi-square test (χ^2), included the chi-square to degrees of freedom ratio (χ^2/df)

(Wheaton, Muthen, Alwin, & Summers, 1977), the Comparative Fit Index (CFI; Bentler, 1990), the Tucker-Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990) and the Standardized root mean square residual (SRMR; Bollen, 1989). In the statistical literature a χ^2/df ratio of 3:1 or less indicates good fit (Carmines & McIver, 1981), a value of > .90 for the CFI was originally considered acceptable (Bentler, 1990); however, Hu and Bentler (1999) proposed a better cut-off value close to .95. Values for the TLI should meet the above CFI guidelines to be considered acceptable, since the TLI is a variant of the CFI (Byrne, 2006). It is generally accepted that an adequate fit between data and a hypothesised model is indicated by RMSEA values of around .06 (Hu & Bentler, 1999). The RMSEA 90% confidence intervals are also provided to assist in interpreting this point estimate. SRMR values are suggested to be lower than .10 (Hu & Bentler, 1999). These fit indices, however, are not immune to misspecification (Heene, Hilbert, Draxler, Ziegler, & Bühner, 2011; Marsh, Hau, & Wen, 2004). As a result, the aforementioned criteria for fit indices were treated as guides rather than absolute values in the present study.

To examine whether the CY-PSPP displayed equivalence of measures across different groups a measurement invariance approach was employed via multi-group confirmatory factor analysis. A checklist for testing measurement invariance by Schoot, Lugtig, and Hox (2012) was consulted. The demographic variables used were gender; male (n = 313), female (n = 272) and group (n = 585). Measurement invariance assessed invariance of construct, factor loading, item intercepts and error variances in a hierarchical ordering with increased constraints from one model to the next. As a result, a model is only tested if the previous model in the hierarchical ordering has been shown to be equivalent across groups. The multiple fit indices as previously described in addition to the Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) theoretic indices were selected to indicate how well the empirical data 'fit' the proposed theoretical model. A lower AIC/BIC value indicates a better trade-off between fit and complexity (Schoot et al., 2012).

Results

Descriptive statistics for the CY-PSPP of the full group, boys' subgroup and girls' subgroup are shown in Table 1 with sub variable and total score values presented.

Table 1. Descriptive statistics of the CY-PSPP variables for the full group, boys and girls sub groups

	Full Group (n = 585)		Boys (n = 313)		Girls (n = 272)	
CY-PSPP Sub scale	Mean	SD	Mean	SD	Mean	SD
SC	3.05	0.66	3.14	0.66	2.96	0.65
PC	3.05	0.65	3.12	0.64	2.97	0.65
BA	2.87	0.75	2.93	0.75	2.80	0.74
PS	2.82	0.68	2.89	0.70	2.75	0.64
PSW	3.18	.062	3.26	0.58	3.09	0.61
GSW	3.42	0.55	3.46	0.51	3.39	0.55
CY-PSPP	110.36	18.86	112.72	18.78	107.64	18.61

Note. CY-PSPP=Children and Youth Physical Self-Perception Profile; SC: Sports competence; PC: Physical condition; BA: Body attractiveness; PS: Physical strength; PSW: Physical self-worth; GSW: Global self-worth

The results of analysis conducted to evaluate CY-PSPP measurement model fit are presented in Table 2. A χ^2/df ratio of 3:1 or less is successfully demonstrated in each model. The CFI indexes exceeded the 0.90 criterion in all instances thus indicating an adequate overall fit of the model to the data in each analysis. All RMSEA values were below .06, which also suggested an adequate fit of the model to the data. In addition, SRMR values were also below the suggested .10 value. These values indicate that the six factor model of the CY-PSPP was supported in all groups.

Table 2. Measurement model fit of Confirmatory Factor Analysis for the full group, boys and girls sub groups

Model	*n*	SB-χ^2	χ^2	*df*	*P* <	CFI	TLI	RMSEA (90% CI)	SRMR
Full	585	1362.507	2.35	579	0.001	0.950	0.898	0.048 (0.043-0.052)	0.038
Boys	313	920.885	1.59	579	0.001	0.906	0.898	0.047 (0.042-0.52)	0.059
Girls	272	1128.288	1.94	579	0.001	0.934	0.928	0.055 (0.050-0.061)	0.044

Note. CY-PSPP=Children and Youth Physical Self-Perception Profile; **SB-χ^2**: Satorra-Bentler scaled goodness of fit chi-square statistic; *df*: degrees of freedom for chi-square statistic; CFI: comparative fit index; TLI: Tucker-Lewis Index; RMSEA: Root mean squared error of approximation; 90% CI: 90% confidence interval of the point estimate; SRMR: Standardized root mean square residual.

Factor loadings in the measurement model (Table 3) revealed no substantial areas of concern. All questionnaire items loaded onto their designated factors with non-zero loadings. Median loadings for the full group, boys subsample and girls subsample were 0.76 (range = 0.59 – 0.92), 0.75 (range = 0.61 – 0.92) and 0.75 (range = 0.55 – 0.95) respectively. These findings suggest an adequate fit for the CY-PSPP measurement model to these data and reasonable psychometric properties.

Inter correlations amongst sub domains (Table 4) signified zero cross loadings on all other factors. In general, the correlations among the sub domains (SC, PC, BA, and PS) were moderate to strong across the full group (r = 0.57 - 0.93), boys sub group (r = 0.56 - 0.96), and girls sub group (r = 0.51 - 0.93). As expected, the sub domains demonstrated stronger associations with PSW than with GSW in all groups. The correlations between GSW and PSW were higher than the correlations between GSW and the other CY-PSPP sub domains for all groups.

Measurement invariance across boys and girls sub groups to evaluate the CY-PSPP factor structure for gender sensitivity is shown in Table 5. An excellent fit of the independent factor structure has earlier been established; therefore, one could expect that configurable invariance would be supported. The fit indexes in Table 5 confirm this; Model 1 provides excellent multiple fit indices to the data (χ^2/df, CFI index, RMSEA, SRMR, AIC/BIC value) indicating that the factorial structure of the construct is equal across groups. As configural invariance was supported, coefficients were then constrained to be equal to test for metric invariance. Model 2 has good fit indices; therefore, constraining the factor loading to be the same across the groups. The scalar invariance model (Model 3) provided a good fit to the data as did the error variance invariance model (Model 4). The overall goodness of fit indices and the tests of differences in fit between adjacent models therefore support measurement invariance.

Table 3. Scale content and corresponding factor loadings of the CY-PSPP for the full group, boys and girls sub groups

Sub Scale	Item no.	Group (n = 585) Factor Loading	Group T-values	Boys (n = 313) Factor Loading	Boys T-values	Girls (n = 272) Factor Loading	Girls T-values
SC	1	0.83	39.41	0.85	32.18	0.82	26.26
	7	0.80	35.79	0.75	20.04	0.84	31.00
	13	0.65	19.40	0.65	13.29	0.62	12.11
	19	0.61	14.58	0.63	10.91	0.61	10.51
	25	0.80	34.70	0.82	28.62	0.75	17.49
	31	0.67	19.99	0.69	15.32	0.66	13.09
PC	2	0.59	14.85	0.64	12.46	0.58	10.49
	8	0.81	37.53	0.82	26.92	0.79	25.99
	14	0.80	29.40	0.82	25.96	0.77	17.28
	20	0.60	14.59	0.61	10.96	0.55	8.57
	26	0.79	28.07	0.77	19.79	0.81	17.86
	32	0.83	34.89	0.81	25.44	0.87	33.96
BA	3	0.80	35.26	0.77	21.69	0.79	23.55
	9	0.71	23.24	0.76	19.96	0.67	14.12
	15	0.84	40.71	0.84	28.84	0.84	28.94
	21	0.76	24.96	0.76	18.83	0.73	15.23
	27	0.92	71.15	0.92	49.41	0.91	43.39
	33	0.83	32.64	0.79	20.04	0.87	30.78
PS	4	0.68	19.02	0.71	15.32	0.62	10.06
	10	0.85	40.50	0.85	33.22	0.84	24.14
	16	0.62	16.07	0.69	15.14	0.59	9.70
	22	0.77	25.11	0.78	18.97	0.77	16.63
	28	0.74	23.17	0.73	16.75	0.75	17.42
	34	0.91	47.43	0.90	32.42	0.95	47.36
PSW	5	0.72	22.36	0.67	13.03	0.73	16.80
	11	0.74	24.28	0.73	17.18	0.72	14.58
	17	0.74	23.86	0.69	15.09	0.80	22.55
	23	0.74	23.50	0.75	19.22	0.68	12.19
	29	0.77	27.02	0.78	20.54	0.73	14.66
	35	0.77	29.23	0.70	16.71	0.83	31.16
GSW	6	0.71	23.35	0.71	17.77	0.73	17.96
	12	0.73	19.96	0.68	11.96	0.81	19.92
	18	0.71	22.34	0.72	18.46	0.69	11.97
	24	0.82	30.88	0.76	16.52	0.82	23.19
	30	0.82	29.11	0.80	18.16	0.82	20.22
	36	0.77	25.18	0.81	25.17	0.70	11.48

Note. CY-PSPP=Children and Youth Physical Self-Perception Profile; SC: Sports competence; PC: Physical condition; BA: Body attractiveness; PS: Physical strength; PSW: Physical self-worth; GSW: Global self –worth

Table 4. Correlations among CY-PSPP sub domains for the full group, boys and girls sub groups.

Factor	SC	PC	BA	PS	PSW	GSW
Total group (*n* =585)						
SC	-					
PC	0.84	-				
BA	0.72	0.66	-			
PS	0.76	0.69	0.57	-		
PSW	0.88	0.77	0.89	0.69	-	
GSW	0.77	0.65	0.81	0.57	0.93	-
Boys (*n* =313)						
SC	-					
PC	0.84	-				
BA	0.71	0.66	-			
PS	0.79	0.72	0.56	-		
PSW	0.84	0.79	0.86	0.72	-	
GSW	0.72	0.64	0.82	0.55	0.96	-
Girls (*n* =272)						
SC	-					
PC	0.82	-				
BA	0.68	0.65	-			
PS	0.65	0.60	0.51	-		
PSW	0.89	0.74	0.93	0.63	-	
GSW	0.77	0.63	0.78	0.54	0.90	-

Note. CY-PSPP=Children and Youth Physical Self-Perception Profile; SC: Sports competence; PC: Physical condition; BA: Body attractiveness; PS: Physical strength; PSW: Physical self-worth; GSW: Global self-worth. All correlations significant at the $p < .01$ level

Support for scalar invariance in Table 5 indicates that the latent means can be meaningfully compared across groups. Support for error variance invariance indicates that the four observed variables are invariant across groups, having no measurement bias. Therefore, this analysis supports the measurement invariance of the factor structure across the gender groups. In summary, the data provide supportive evidence for the use of the CY-PSPP with this population demonstrating adequate fit of the CY-PSPP measurement model and its subsequent psychometric properties.

Table 5. Measurement invariance of the CY-PSPP factor structure

Model	SB-χ^2	χ^2	*df*	*P* <	CFI	TLI	RMSEA	SRMR	BIC	AIC
1	1297.741	-	579	0.001	0.900	0.892	0.046	0.051	46801.951	46264.242
2	2084.538	797.74	1188	0.001	0.882	0.875	0.051	0.066	47198.541	46254.273
3	2130.261	752.42	1218	0.001	0.880	0.876	0.051	0.067	47051.415	46238.295
4	2256.413	717.38	1274	0.001	0.801	0.867	0.050	0.065	4694.312	46198.654

Note. CY-PSPP=Children and Youth Physical Self-Perception Profile; **SB-χ^2**: Satorra-Bentler scaled goodness of fit chi-square statistic; *df*: degrees of freedom for chi-square statistic; CFI: comparative fit index; TLI: Tucker-Lewis Index; RMSEA: Root mean squared error of approximation; SRMR: Standardized root mean square residual; BIC: Bayesian Information Criterion; AIC: Akaike Information Criterion. Model 1: testing equivalence of measurement model across gender; Model 2: CFA analysis for Boys and Girls with measurement invariance of factor loadings; Model 3: CFA analysis for Boys and Girls of factor loadings and intercepts; Model 4: CFA analysis for Boys and Girls with measurement of factor loadings, intercepts and residuals.

Discussion

The aim of this study was to directly test the utility of the CY-PSPP model for use in a sample of Welsh primary school aged children. More specifically, to evaluate the hierarchical structure of the CY-PSPP, its ability to measure the self-perception sub-scales without cross loading and to examine gender invariance to determine if the model fit differed between genders. The study confirmed the hierarchical six factor structure of the CY-PSPP as well as the hypothesized factor loadings on the appropriate subscales. There is also evidence to support the structural invariance of physical self-perceptions across gender with measurement error terms being uncorrelated. Therefore, the CY-PSPP demonstrates valid psychometric properties for use in future research with this population.

The CFA models fitted to test for configurable invariance, the global model fit indices examined at each stage of CFA, and the detailed assessments of the completely standardized factor loadings, the standardized residuals, and the modification indices all confirmed support for the utility of the CY-PSPP model with this population. All model fit indices for the full group, boys' subsample, and girls' subsample suggested an adequate fit in each instance. All factor loadings in all analyses of the measurement model were significant ($p < 0.001$) and yielded a clean factor structure (i.e., a no zero loading on each of these self-concept factors) and inter correlations amongst the CY-PSPP sub domains showed no cross loadings amongst the factors. The six factor structure in this study and in particular the sub domain correlation scores of sports competence, physical condition, strength and body attractiveness, confirmed that young children hold independent perceptions for each of these domains and these are all hierarchically related to more global perceptions of physical self-worth and global self-worth located at the pinnacle of the model. These findings support previous work by Marsh and Shavelson (1985) who noted that the hierarchical structure of physical self-concept holds with children in late childhood and does not become more differentiated, as seen with adolescents. Late childhood involves early identity development, and importantly, it is a time when young people will continue to persevere even in the face of failure and hold independent perceptions of sport competence, physical conditioning, strength and body attractiveness (Spiller, 2009). Hagger et al. (2005) proposed that older children (i.e., adolescents) may have a more differentiated notion of self-concept that could not easily be explained by a global self-concept construct alone. Adolescents are abler to think in more complex and abstract ways, consider multiple aspects of problems, acquire and learn more complex information and generalise their physical activity experiences therefore, self-concept and physical self-concept may differ with age (Spiller, 2009). The findings demonstrated here are therefore consistent with the theoretical and empirical evidence regarding the hierarchical structure of the CY-PSPP (Eklund et al., 1997; Fox, 2000; Fox & Corbin, 1989; Hagger et al., 2005; Kolovelonis et al., 2013; Welk et al., 1995; Welk & Eklund, 2005; Whitehead, 1995). In addition, it shows support for the construct validity for use of the questionnaire with younger children of primary school age 9-10 years to measure self-perceptions (Welk et al., 1997; Welk & Eklund, 2005). Although it must be noted that due to the complexity of the alternative response type questions and to avoid confusion and socially desirable responses with young children, the author reiterates the suggestions of Marsh and colleagues (1994) that detailed and adequate instruction must be provided when administering the CY-PSPP profile questionnaire with this age group.

In addition to supporting the construct validity of the CY-PSPP, Welk and Eklund (2005) highlight Fox's (1990) recommendation that in order to facilitate the use of the CY-PSPP with other variables such as physical health for example it is important to separate perceptions by gender sensitivity for any such comparisons. It has also been suggested by Hagger et al. (2005) that given the support for the invariance of model structure, researchers can be confident that any variance in the model intercept and factor means are not therefore confounded by structural discrepancies. The measurement invariance approach via multi-group confirmatory factor analysis of the CY-PSPP model in this study displayed equivalence of measures across different groups with no measurement bias. These findings therefore support previous findings of structural invariance of physical self-perceptions across gender in children (Welk & Eklund, 2005; Hagger et al., 2005).

Of interest, the descriptive data in this study showed that boys scored higher than girls across all domains of physical self-perceptions and global self-concept. This supports the typical trend shown in self-concept research with the use of the CY-PSPP model with suggestions that girls tend to view their self-concept less favourably than boys even at this young age (Hagger et al., 2005; Marsh, Barnes, Cairns, & Tidman, 1984; Welk & Eklund, 2005; Wilgenbusch & Merrell, 1999). The reasons for these gender differences are unclear, although Hagger et al. (2005) suggested that differences at the domain and sub domain levels of physical self-concept might occur because many of the self-concept constructs at this level focus on specific abilities and competencies (e.g., sports competence, physical conditioning, and physical strength) in which boys are typically viewed as being more competent than girls. However, Welk and Eklund (2005) have suggested that gender differences are most likely to occur as a result of sociological, cultural and behavioural factors (e.g., sporting expectations, physical activity behaviours, and parental encouragement). Further, Mullan, Albinson, and Markland, (1997) advocate that it may simply be that girls are more modest and realistic about their physical self than boys who tend to exaggerate their physical competence at this age. It is also conceptually plausible that maturity status may also influence physical self-perceptions, especially among girls with physical self-perceptions becoming less positive with advancing maturity status (Fairclough & Ridgers, 2010). However, Cumming, Standage, Gillison, and Malina (2008) suggest that it is most likely a combination of social, psychological, and physical changes that are responsible for the differences in physical self-perceptions between the sexes. To date, research has focused mainly on selective relationships between the CY-PSPP, physical activity and gender differences. In addition, few of the studies have been conducted in the UK and very limited research has been used with primary school children. Therefore, as a consequence of the CY-PSPP validation with this population its subsequent use to investigate such relationships may be further warranted.

Despite the support presented here, the present study was not without limitations. The sample size was relatively small to examine the structural invariance across gender; therefore, to enhance this and promote other significant findings in this area, further research with a larger sample would be of benefit. In addition, the study did not measure the invariance of the CY-PSPP factor structure across separate school year groups, thus, again, future research using a larger cohort may consider this approach.

Conclusion

The author therefore concludes that the outcome of this study demonstrates that the CY-PSPP is a valid measurement tool for use with UK and in particular Welsh primary school children. The validation work on the structural validity of the CY-PSPP with this cohort support the recommendations of Fox (2000) and Marsh (1997), who suggest that in order to maintain its effectiveness, the continued refinement of physical self-concept instruments using CFA to evaluate the a priori dimensionality and design of the instrument should be ongoing. Kolovelonis et al. (2013) further suggests that the use of the CY-PSPP should be continued using populations with diverse characteristics from different cultures in order to expand the validity evidence base for this measure. The present study contributes to this call for further evidence.

Chapter 4

Fundamental movement skill competency and measures of physical literacy: Their impact on primary school children in South East Wales.

Abstract

Purpose: The aim of this research was to identify levels of fundamental movement skills (FMS) proficiency in a cohort of UK primary school children and to identify markers of physical literacy which significantly discriminate levels of FMS proficiency. *Methods:* In total 553 primary school children were recruited to the study, 294 boys (*M* age = 10.9 years, *SD* = 0.62) and 259 girls (*M* age = 10.7 years, *SD* = 0.64). Participants were assessed across eight different FMS. Physical literacy measures of physical fitness, physical activity recall behaviour and physical self-perceptions were measured objectively. Hierarchical cluster analysis was used to classify groups of boys and girls separately based on their similarity of FMS proficiency. Discriminant analysis was then used to predict FMS proficiency based upon the physical literacy behaviours. *Results:* Distinct groups of varying FMS skill proficiency were established for boys and girls. Overall, FMS proficiency across all groups in boys and girls was low. The vertical jump, overhand throw and the leap were the FMS tasks that best differentiated the boys FMS groups and the static balance the best that differentiated the girls FMS groups. For both boys and girls ($p < .05$, $r > .40$), several measures of physical fitness were significant predictors of FMS proficiency. In addition, the physical behaviour recall measure was a prominent predictor in girls whereas for boys, the physical competence sub scale of the physical self-perception profile was significant. *Conclusions:* The low levels of FMS proficiency, the distinct categorization of FMS and identification of specific skill differentiation found in both genders of this study may enhance our understanding of FMS proficiency in UK primary school children. In addition, the number of significant relationships identified between the multidimensional domains of physical literacy to discriminate between children's FMS performance may warrant further research in this area.

Keywords: Fundamental movement skills, physical literacy, physical fitness, physical activity, perception, children

Introduction

During the past decade, lifestyle changes to people in industrialised countries have resulted in the decline of people engaging in physical activity (Bouchard, Shephard, & Stephens, 2007); in particular, there is an escalating prevalence of youth physical inactivity and obesity (Currie et al., 2012). The exact reasons why some youth are more physically active than others remain unclear (Stodden et al., 2008; Stodden & Holfelder, 2013), and we continue to be made aware that there is now strong evidence demonstrating that the physical fitness and health status of children and adolescent youth are substantially enhanced by regular physical activity (Dobbins, Husson, DeCorby, & LaRocca, 2013). Keegan, Keegan, Daley, Ordway, and Edwards (2013) have proposed that to simply accept the inevitability of sedentary lifestyles would be to sign the death warrant of an entire future generation. It is therefore imperative that researchers and practitioners continue to identify factors that are the most modifiable and responsive to intervention to increase physical activity and health related fitness (Kenyon, Kubik, Davey, Sirad, & Fulkerson, 2012).

In response, the concept of physical literacy has emerged in the contemporary sport development vernacular, both in policy and practice (Lloyd, Colley, & Tremblay, 2010). Whitehead (2010) defined physical literacy as a disposition acquired by human individuals encompassing the motivation, confidence, physical competence, knowledge and understanding that establishes purposeful physical pursuits as an integral part of their lifestyle. Several governments such as the United Kingdom, Canada, and New Zealand are pioneering large-scale initiatives in education, community and public health settings to promote participation and performance in physical activities through physical literacy (Giblin, Collins, & Button, 2014). The United Kingdom in particular has one of the largest selections of physical literacy models in the world, with separate programmes developed in England, Scotland, Northern Ireland and Wales (Keegan et al., 2013). Wales incidentally has the highest rate of childhood obesity in the UK that is predicted to continue to rise in forthcoming years (NAW, 2013). In general, governments have come to understand that children and youth need a repertoire of physical skills or physical literacy that will enable them to become physically active and adopting use of the term physical literacy makes the importance of this work more easily recognizable to others in the fields of education, recreation, health and human development (Higgs, 2010). However, Giblin et al. (2014) suggest that given the perceived importance of developing physical literacy for sustained physical activity and health, the current models used to operationalise it currently lack an accepted governing standard, due in part to the varying philosophical and physiological interpretations of physical literacy around the world. Therefore, Bellew, Bauman, and Brown (2010) suggested that without comparative data to generate evidence for best-practice in developing physical literacy skills, policies at present can only offer vague guidelines.

Although lacking an accepted governing standard, physical literacy in current models tends to be operationalised with the early development of fundamental movement skills (FMS; Keegan et al., 2013). Cliff, Okely, Smith, and McKeen (2009) suggest that FMS are the building blocks for more complex motor skills and movement patterns and represent the underlying performance competency required for adequate participation in many forms of current and future physical activity for children, adolescents and adults. FMS are common motor activities that comprise of an agreed series of observable movement patterns and consist of locomotor skills (e.g., run, hop and jump), manipulative skills (e.g., catch, throw and kick), and stability skills (e.g., static and dynamic balance; Gallahue & Donelly, 2003). Furthermore, the mastery of FMS during childhood has been suggested as a vital component contributing to children's physical, cognitive and social development, i.e., physical literacy (Malina, 2009; Vandorpe et al., 2011). Consequently, FMS are now an integral component of primary school (7-11 years) physical education curricula in the United Kingdom, Canada, New Zealand and several other developed nations of the world. However, despite this heightened focus on developing FMS as a core contributor to physical literacy, an overall decline in children's motor skill performance and physical activity is still being observed (Hardy, Barnett, Espinel, & Okely, 2013). It is less clear as to the underlying causes contributing to the decline in the motor skill proficiency observed in school children (Tompsett, Burkett, & McKean, 2014).

A potential contributing factor into the decline of FMS proficiency maybe our interpretation of the FMS performance scores. An accurate interpretation of FMS proficiency is critical for assessing and shaping pedagogical decisions for physical literacy in children. Researchers have attempted to address the need for standardisation and clarification of FMS measurement scores that report the same objective but which, confusingly, may provide different information (Logan, Robinson, Rudisill, Wadsworth, & Morera, 2012). Most FMS studies categorize a total score for each individual skill (i.e., mastery if all skill components are demonstrated, near mastery if only one component was not demonstrated and poor if two or more components are not demonstrated) from a set number of trials which correctly identify a number of pre-ordered performance components (usually 5 or 6) based on their level of complexity. This scoring bandwidth may discriminate against children not achieving mastery on a particular skill (i.e., only one or two components missing). In addition they may not all demonstrate the same missing skill components. Therefore, such narrow assessment criteria and subsequent classification of FMS may be limiting our interpretation of FMS proficiency and hampering our ability to provide effective support. The reporting of FMS has also used a selection of distinct categories such as locomotor and object control proficiency outcomes to aggregate FMS scores (Barnett, Morgan, VanBeurden, Ball, & Lubans, 2011; Williams et al., 2008). This pooling of scores into distinct categories may discriminate against individual skill performance and therefore cannot be presented with sufficient certainty. For example, catching and throwing, are summarized as an object control score and presented as a common result. It has therefore been suggested by Giblin et al. (2014) that more research is required to refine the procedures for assessing movement ability (i.e., FMS scoring outcome and classification of skills) that will generate valid and reliable results without compromising the quality of data measured.

In addition to the influence of the FMS scoring mechanism on FMS proficiency ratings, it is also important to identify how other aspects of physical literacy have the potential to impact FMS proficiency. There has been a plethora of research that has examined these potential associations. It has been suggested that a significant inverse association exists between FMS proficiency and weight status (Cliff, Okely, & Magarey, 2011; Lopes, Stodden, Bianchi, Maia, & Rodrigues, 2011). In addition, it has also extensively been reported that there is a consistent and clear association between low competency in FMS and inadequate levels of cardio-respiratory fitness (Barnett, VanBeurden, Morgan, Brooks, & Beard, 2008a; Hardy et al., 2013; Stodden et al., 2008). It has also been speculated that muscular strength is critical for successful FMS development and performance (Behringer, VomHeede, Matthews, & Mester, 2011), with Lloyd and Oliver (2012) citing early research indicating that muscular strength (in addition to stature) could account for up to 70% of the variability in a range of motor skills including throwing, jumping, and sprinting in 7 to 12 year-old children. Within the scope of the physical literacy concept, psychological characteristics are also likely to be associated with FMS. It has also been suggested by Stodden et al. (2008) and Barnett, VanBeurden, Morgan, Brooks, and Beard (2008b) that children's physical activity behaviour may also be partially attributed to their actual FMS competence and related choice of activities, which are also linked to their perceptions of competence, success, and intrinsic motivation to participate. Giblin et al. (2014) highlight that if the primary objective of physical literacy is lifelong physical activity facilitated by physical skills proficiency (i.e., FMS), then appropriate measurement of each physical literacy construct and integrated evaluation of these constructs is needed. This in turn, should provide a more accurate assessment of an individual's physical literacy ability and inform appropriate directions for future physical literacy interventions and frameworks.

In light of these issues and the ever increasing focus on physical literacy, the purpose of the present study is to investigate FMS performance, its measurement and relationship with associated behaviours of physical literacy in a cohort of UK primary school children. A primary objective of this study will be to investigate the use of an alternative method of classifying FMS performance, which is based upon cluster analysis and decision tree induction. Cluster analysis is a classification tool that retains all of the available information and categorises individuals that display similar characteristics across the full range of factors, in this case FMS ability, rather than rely on median splits, arbitrary classifications, or groupings of mastery, near-mastery and poor, issues with which have previously been highlighted here and are described in greater detail elsewhere (Cools, DeMartelaer, Samaey, & Andries, 2009). Decision tree induction will then be used to best describe the defining features of each of these FMS group profiles in relation to their ability to perform individual FMS tasks. In addition, these profiles will then be used to examine which aspects of physical literacy (anthropometry, physical fitness, physical activity and self-esteem) best differentiate the groups in this population. It is hypothesised that children with more proficient FMS profiles will demonstrate higher markers of the associated physical literacy variables.

Method

Participants and Settings

Following approval by the University's Human Research Ethics Committee, and permission granted from the Welsh Government Central South Physical Education and Sport

Consortium, primary schools in South East Wales were approached to participate in the study.

A total of twenty-seven primary schools were invited to participate in the study of which eighteen provided consent (see Appendix A). Schools were briefed on the study; only those children returning signed parental consent forms (see Appendix B),confirming assent (see Appendix C), and completed exercise and physical activity readiness assessment questionnaires (see Appendix D) were allowed to participate in the study. A total of 844 children were invited to the study and 640 completed consent packs were returned from all participating schools. Subsequently, each school attended the test centre at the University of South Wales on separate dates. All data were collected during normal school operating hours. A total of 591 children, aged 9-12 years old attended the test centre. Of these attendees a total of 553 complete data sets were recorded on 294 males (*M* age = 10.9 years, *SD* = 0.62), and 259 females (*M* age = 10.7 years, *SD* = 0.64). The majority of children in the sample were of white British ethnicity. Schools invited to participate in the study were located within practical travel distance of the test venue and therefore from local unitary authorities of Wales classified with high deprivation (Welsh Government, 2014).

Instruments and Measures

Fundamental movement skills. Assessment of FMS behaviour was conducted using the process orient checklists taken from the Australian resource 'Get Skilled: Get Active' (Department of Education and Training, NSW, 2000). This process-oriented instrument has been used in several large scale studies (Booth, Denney-Wilson, Okely, & Hardy, 2005; Hardy, King, Espinel, Cosgrove, & Bauman, 2010; VanBeurden et al., 2002). The 'Get Skilled: Get Active' assessment protocol is an appropriate, reliable, culturally acceptable and a valid instrument for measuring levels of gross motor skill proficiency amongst children and adolescents (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2010; Hardy et al., 2013).

The checklist for this study (see Appendix H) comprised eight FMS, including four locomotor skills (run, vertical jump, side gallop, leap), three manipulative skills (catch, overhand throw, kick), and one stability skill (static balance). Each skill was broken down into either five or six components (e.g., over arm throw is broken down into six components; 1: eyes focused on target area throughout the throw, 2: stands side on to target area, 3: throwing arm moves in a downward and backward arc, 4: steps toward target area with foot opposite throwing arm, 5: hips then shoulders rotate forward, 6: throwing arm follows through down and across the body).

Physical fitness. Physical fitness assessments were conducted with the ALPHA (Assessing Levels of Physical Activity and Fitness) Health-Related Fitness Test Battery for Children and Adolescents Test Manual (Ruiz et al., 2010). The ALPHA study is a European Union-funded project providing a set of instruments for assessing levels of physical fitness in children and adolescents in a comparable way within the European Union. The High Priority battery of tests (see Appendix I) were selected for use from the manual, which included assessments of cardio-respiratory fitness (20m shuttle run test), musculoskeletal fitness (handgrip strength, standing long jump) and body composition (weight, height, BMI, waist circumference). A detailed description of the ALPHA study has been published elsewhere (Meusel et al., 2007), with the reliability and criterion-related validity of the various field-based test items included in the test battery to be found in the work by Castro-Pinero, Artero, et al. (2010), España-Romero et al. (2010) and Ruiz et al. (2010). In addition to this battery of fitness tests, the present study included a separate measure of motor fitness (20-metre sprint). This measure has shown to help identify and prevent the potential risks to skeletal health (Castro-Piñero, Gonzalez-Montesinos, et al., 2010), and has been reported to be a reliable and valid measure in childhood (Morrow, Jackson, Disch, & Mood, 2005). We did not use the motor fitness measure proposed as part of the extended ALPHA test battery as the test manual predicts the measure as having low health and criterion related validity and has been shown to be time consuming to conduct with large groups (Ruiz et al., 2010).

Physical activity. The Physical Activity Questionnaire for Children (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997) was used as an indicator of the children's typical level of physical activity (see Appendix G). The instrument uses nine questions to assess a child's physical activity in a variety of situations and times (e.g., school break, lunchtime, after school, evening, weekend etc.). The items in the instrument specifically probe how often the child was physically active (before school, at recess etc.) for the past 7 days and the responses generally range from 1 (never) to 5 (almost every day). The instrument is scored by computing the average score across the nine items. A score of 1 indicates low physical activity, whereas a score of 5 indicates high physical activity. The PAQ-C has been shown to have adequate test-retest reliability (range: $r = 0.75 - 0.82$) and reasonable validity (range: $r = 0.45 - 0.53$) when compared against other objective measures of physical activity (Crocker et al., 1997). Welk and Eklund (2005) suggest that while the questionnaire items assess activity over the past week it is generally used to reflect 'typical' physical activity patterns.

Physical self-perceptions. The Children and Youth Physical Self-Perception Profile (CY-PSPP; Eklund, Whitehead, & Welk, 1997) includes scales to address one's perceptions of Global Self-Worth (GSW), Physical Self-Worth (PSW), and its sub-domains of Sports Competence (SC), Physical Conditioning (PC), Body Attractiveness (BA) and Physical Strength (PS) in children and adolescents (see Appendix F). Each scale is assessed with six items scored on a four-point scale with the average score used to represent the value for the scale. Higher scores reflected greater levels of physical self-perceptions. All of the items use a structured alternative format to reduce the tendencies for socially desirable responses (Harter, 1982) and half of the items were reverse coded to keep the instrument more interesting for participants. Previous work by (Welk et al., 1997) on a similarly aged sample revealed high alpha reliability for the scales in this instrument (range; 0.77 - 0.91). Additionally, in Welk and Eklund's (2005) study no substantial areas of concern were revealed in the measurement model for the total sample (range 0.41 - 0.82), for boys (range 0.32 - 0.85) and for girls (range 0.43 - 0.83), suggesting an adequate fit for the CY-PSPP measurement model and reasonable psychometric attributes. Alpha reliability for the scales of this instrument used in this study (previously reported in chapter 3) demonstrated no substantial areas of concern in the measurement model for the total sample (range 0.59 - 0.92), boys (range 0.61 - 0.92) and girls (range 0.55 - 0.95). Cronbach's alpha was also reported (chapter 3) at 0.89 (total sample), 0.88 (Males) and 0.89 (Females), therefore demonstrating a high level of internal consistency.

Procedures

Data was collected by a team of research assistants trained to administer the tests. The training was facilitated by the author and an experienced practitioner, who had previously trained teachers and informed national government on motor skill assessment.

To make the participants feel more comfortable and to avoid potential distraction, they were assigned to small groups (max = 6) of same gender and of mixed ability. Fundamental movement and physical fitness tests were conducted in a partitioned and screened sports hall to minimise distraction and test bias. Anthropometric measures were collected in a separate room and screened off from exterior view. Testing of FMS was followed by administration of the CY-PSPP, PAQ-C and physical fitness measures, allowing adequate recovery from physical exertion to enhance accuracy of the data collection.

Prior to each FMS assessment, the field assistant provided a verbal description, and a single demonstration of the skill to the participants, with no coaching points between attempts in accordance with 'Get Skilled: Get Active' (Department of Education and Training, NSW,

2000) guidelines. Participants were then required to perform five trials of each skill with no feedback provided. When performing the skills, the participants in each group were rotated to avoid being first or last for each consecutive trial. The performance of each FMS was video recorded at 50 frames per second (Sony Video Camera, Sony, UK). Skills were recorded on the sagittal and coronal planes in accordance with 'Get Skilled: Get Active' and the recommendations of Knudson and Morrison's (2002) qualitative analysis of human movement. Data was transferred in real time from videotape to a Mac Book Pro (Apple Inc., Cupertino, CA, USA) and subsequently analysed using Studio Code performance analysis software (Studio Code, Warriewood, NSW, Australia). The process oriented checklist was used to determine the total number of components performed correctly for each skill attempt and was analysed by the author. If there was any uncertainty about whether a feature was consistently present or not, it was checked as absent. The number of skill components rated as present or correct were summed for each skill for each participant using 'Get Skilled: Get Active' guidelines.

The self-report instruments of the CY-PSPP and the PAQ-C were administered in a classroom by the author of the project supported by several research assistants and the school support assistant or teacher. The children were first explained the purpose of the measure and were reminded that there were no right or wrong answers and asked to answer each question as best they could by choosing the statement that best described them. With the CY-PSPP, example items were provided based on Whitehead's (1995) recommendation for use with the structured alternative format. Each of the items in the measure were read to the children and the research assistants circulated throughout the room to provide extra assistance.

Physical fitness assessments and data collection followed the procedures described in the ALPHA Health-Related Fitness Test Battery for Children and Adolescents Test Manual (2010). In addition, 20 metre sprint efforts followed the procedures outlined by Oliver and

Meyers (2009) and were recorded with Smart Speed dual beam electronic timing gates (Fusion Sport, Coopers Plains, Queensland, Australia). For each sprint effort, participants began each sprint 30 cm behind the start line, in order to trigger the first gate. Participants used a standing start for each sprint test, placing their preferred foot in the forward position. If participants rocked backwards, hesitated, or slipped prior to starting the speed trials, the trial was disregarded, and another attempt was allowed after the recovery period. Once ready, participants were allowed to start in their own time, and were instructed to run maximally once they initiated their sprint run. Two sprint attempts were permitted with approximately two minutes' rest allocated between each maximal sprint effort. Speed was measured to the nearest 0.01 second, with the best sprint effort from the two trials recorded for analysis. Pearson's correlation coefficient was undertaken between the several measures of body composition previously identified. There were significant relationships between all of these variables, therefore, to avoid multicoliniarity and allow comparisons with similar studies body mass index (BMI) was adopted as the selected measure of body composition.

Statistical Analysis

For reliability of the FMS assessment, a sample of 50 completed skill sets were randomly selected from the study. Intra-rater reliability was determined by the author who assessed the video footage containing the 50 participants performing the skill sets twice. The second assessment of the skill sets was performed two weeks after the first. Inter-rater reliability was obtained by a comparison of a second operator, previously identified, who independently reviewed the same sample footage of the completed skill set used to establish intra-tester reliability. The qualitative level of agreement for retest reliability and inter-rater reliability were determined and reported using a linear weighted Kappa statistic (Fleiss, Levin, & Paik, 2003). The thresholds used to describe reliability were < 0.2 poor, < 0.4 fair,

< 0.6 moderate, < 0.80 good and > 0.81 very good (Altman, 1991). Med Calc version 14.12.0 (Med Calc Software, Ostend, Belgium) was used for this analysis.

Data were split by gender due to well-established differences (Malina, Bouchard, & Bar-Or, 2004) and after preliminary analysis confirmed these differences in this population (see Table 1). Therefore, descriptive statistics are reported for male and female participants and based on FMS group classification for all variables of physical fitness, physical activity recall behaviour and psychological markers. Pearson's correlation coefficients are also reported between these markers for male and female cohorts. All FMS competencies based on group classification in males and females were reported as frequency distributions.

Table 1. Overall differences between boys (*n* = 294) and girls (*n* = 259) on FMS and physical literacy variables with Mann-Whitney U test and one-way MANOVA

FMS variables	*U*	*Z*	*p*	Physical literacy variables	*df*	*F*	*p*
Static Balance	29632	-4.651	.000	BMI	1	4.995	.026
Run	34307	-2.076	.038	SLJ (cm)	1	49.162	.000
Vertical Jump	31306	-3.703	.000	DHG (Kg)	1	22.705	.000
Side Gallop	30353	-4.237	.000	MSFT (m)	1	46.548	.000
Leap	24056	-7.683	.000	SPRINT (sec)	1	38.574	.000
Catch	35778	-1.253	.210	PAQ-C	1	14.926	.000
Overhand Throw	15549	-12.460	.000	CY-PSPP	1	12.805	.000
Kick	15096	-12.480	.000				

Note. FMS = Fundamental movement skills; BMI = Body mass index; SLJ = Standing long jump; DHG = Dominant handgrip; MSFT = Multistage fitness test; PAQ-C = Physical activity questionnaire children; CY-PSPP =Children and youth physical self-perception profile. Significant value ($p < 0.05$).

Group classification by FMS task scores. Wards two-way hierarchical cluster analysis was used to classify groups based on all the FMS task scores. Separate analyses were conducted for males and females. The benefit of such analysis is that it is a multivariate approach to group categorisation that retains all information and groups individuals that display similar characteristics across the full range of tasks. Moreover, it does not rely on a sum of scores or an arbitrary threshold as previously used (e.g., Okely, Booth, & Patterson, 2001) that may contain very different individuals who scored a similar aggregate score (Parsonage, Williams, Rainer, McKeown, & Williams, 2014). Once the cluster analysis was performed, the scree plot of the distances was then used to visually identify the number of clusters (i.e., the point at which the scree plot plateaus) and confirmed using the values. Frequency distribution of the FMS task scores were then reported by cluster group. To describe the features that best described the clusters a decision tree induction (DTI) method was used. The application of DTIs to reduce a rich dataset into a more parsimonious and manageable framework has been described in detail elsewhere (e.g., Morgan, Williams, & Barnes, 2013). The DTI was split then pruned to retain the r^2 without over fitting. Once completed, column contributions and the rules were summarised to show the defining features of each group in relation to their ability to perform the FMS tasks. Finally, the validity of the model was assessed via inspection of the ROC curve, area under the curve and also the corresponding confusion matrix (Morgan, Williams, et al., 2013). The analysis was conducted using JMP Statistical Discovery version 10.02 (SAS Institute, Marlow, Buckinghamshire, United Kingdom).

Discriminant analysis. Following group classification, discriminant analysis was performed to examine which physical literacy variables best discriminated between the FMS groups. The analysis was conducted using SPSS version 21 (SPSS Inc., IBM Corp., Armonk, NY, USA). Initial screening of dependent variables revealed non-normal distributions. The identified outlying cases were modified using Tabachnick and Fidell's (2007) recommendation of assigning the outlying case(s) a raw score that was one unit larger (or smaller) than the next most extreme score in the distribution. The analysis was then reassessed to confirm the assumptions corresponding to linearity, normality, multicollinearity and heterogeneity of variance-covariance matrices. Discriminant analysis was then performed to identify discriminant functions, their significance ($p < .05$) and the correlation of each predictor variable with the discriminant functions. Loadings > 0.4 were used based on Stevens' (1992) conservative recommendation. A classification matrix was constructed to assess the predictive accuracy of the discriminant functions using a proportional chance criterion of > 56% (Hair, Anderson, Tatham, & Black, 1998). Finally, to determine the predictive ability of the discriminant function, classification accuracy was examined using Press's Q statistic, compared to the $\chi 2$ critical value of > 6.63 and alpha = 0.05 was used with this analysis and all other analysis previously unspecified.

Results

Retest and inter-tester reliability for all FMS are reported in Table 2. All FMS displayed a level of agreement that was good or above.

Table 2. Intra-rater and inter-rater reliability for total group, boys' and girls' fundamental movement skills

	Intra-rater reliability (*n* = 50)			Inter-rater reliability (*n* = 50)		
FMS	Group Kw (SE)	Boys Kw (SE)	Girls Kw (SE)	Group Kw (SE)	Boys Kw (SE)	Girls Kw (SE)
Static balance	0.73 (.06)	0.75 (.09)	0.68 (.08)	0.66 (.07)	0.61 (.10)	0.71 (.11)
Run	0.81 (.09)	0.85 (.06)	0.78 (.08)	0.74 (.06)	0.74 (.08)	0.73 (.08)
Vertical jump	0.85 (.05)	0.89 (.05)	0.82 (.09)	0.62 (.08)	0.64 (.10)	0.61 (.12)
Side gallop	0.88 (.05)	0.85 (.08)	0.90 (.06)	0.79 (.04)	0.81 (.06)	0.73 (.07)
Leap	0.89 (.04)	0.86 (.06)	0.93 (.05)	0.65 (.06)	0.66 (.08)	0.62 (.09)
Catch	0.89 (.04)	0.89 (.05)	0.89 (.06)	0.73 (.06)	0.73 (.01)	0.72 (.09)
O.H. Throw	0.93 (.03)	0.92 (.04)	0.91 (.06)	0.68 (.07)	0.62 (.01)	0.68 (.11)
Kick	0.89 (.04)	0.93 (.04)	0.77 (.10)	0.70 (.06)	0.70 (.01)	0.69 (.13)

Note. FMS = Fundamental movement skills; Kw = Weighted Kappa; SE = Standard error of measurement.

FMS Group Classification and Proficiency

Boys. From the total sample of boys with complete FMS data sets (*N* = 294), three groups were identified from cluster analysis. These groups were identified as the Low Group

(n = 31), Intermediate Group (n = 187), and the High Group (n = 76) FMS groups. Figure 1 shows the frequency distribution of FMS performance of the cluster groups on each FMS. Despite this labelling of cluster groups (Low, Intermediate and High) it is important to note that overall skill mastery (i.e., correctly demonstrating all components of the skill) is relatively low in each of the cluster groups across all FMS with no group achieving greater than 20% competence in any FMS. The leap is the least proficient skill across all the FMS groups in boys.

The final DTI model (Figure 2) had a total of seven splits (r^2 = 0.45). From the column contributions (Table 3), vertical jump, overhand throw and leap were the FMS tasks that best differentiated the boys cluster groups (refer to the frequency distributions in Figure 1). The FMS with the largest difference between the cluster groups was vertical jump followed by the overhand throw, then leap. Of note, side gallop, static balance and the catch also featured, but to a lesser extent. The FMS of run and kick made no contribution between the groups. The subsequent decision tree model rules for the probability of cluster group membership are listed in Table 4. Of interest, the high cluster group demonstrated strongest performances for the splits on vertical jump; overhand throw, static balance, catch and side gallop. The low group were poor in the vertical jump and also poorest in the splits of side gallop and the leap. The intermediate group demonstrated lower performance than the high group but better performance than the low group across all splits except for the catch. In summary whether the child scored high or not on vertical jump (first split) subsequent skills identified the high cluster group as being the most proficient of the cluster groups across the identified splits. Finally, the accompanying Receiver Operator Characteristics (ROC) curves shown in Figure 5, and the confusion matrix (Table 7), both confirm the validity of the model to distinguish FMS classification between cluster groups in boys.

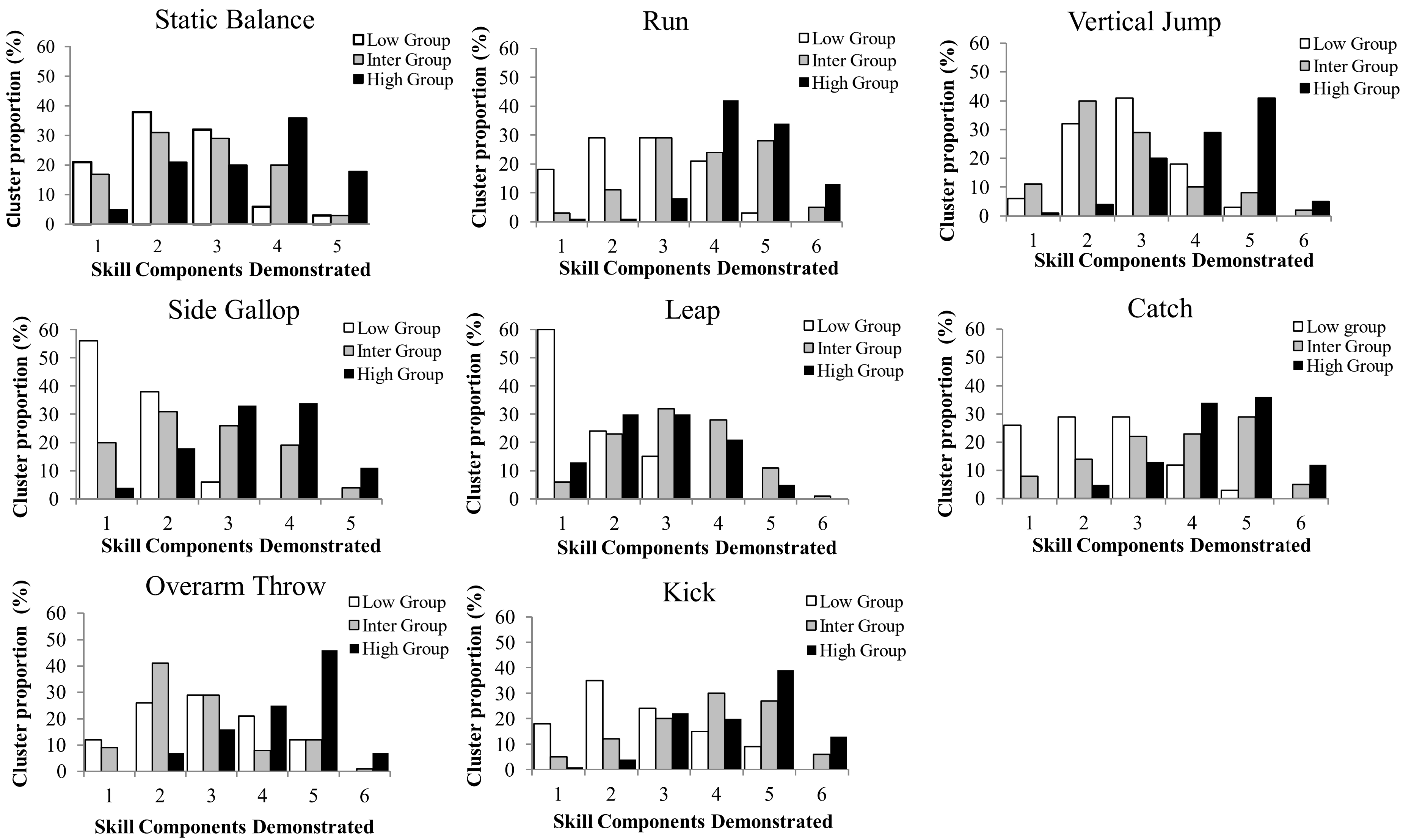

Figure1. Frequency distribution of boys FMS skill components present via group classification on each FMS.

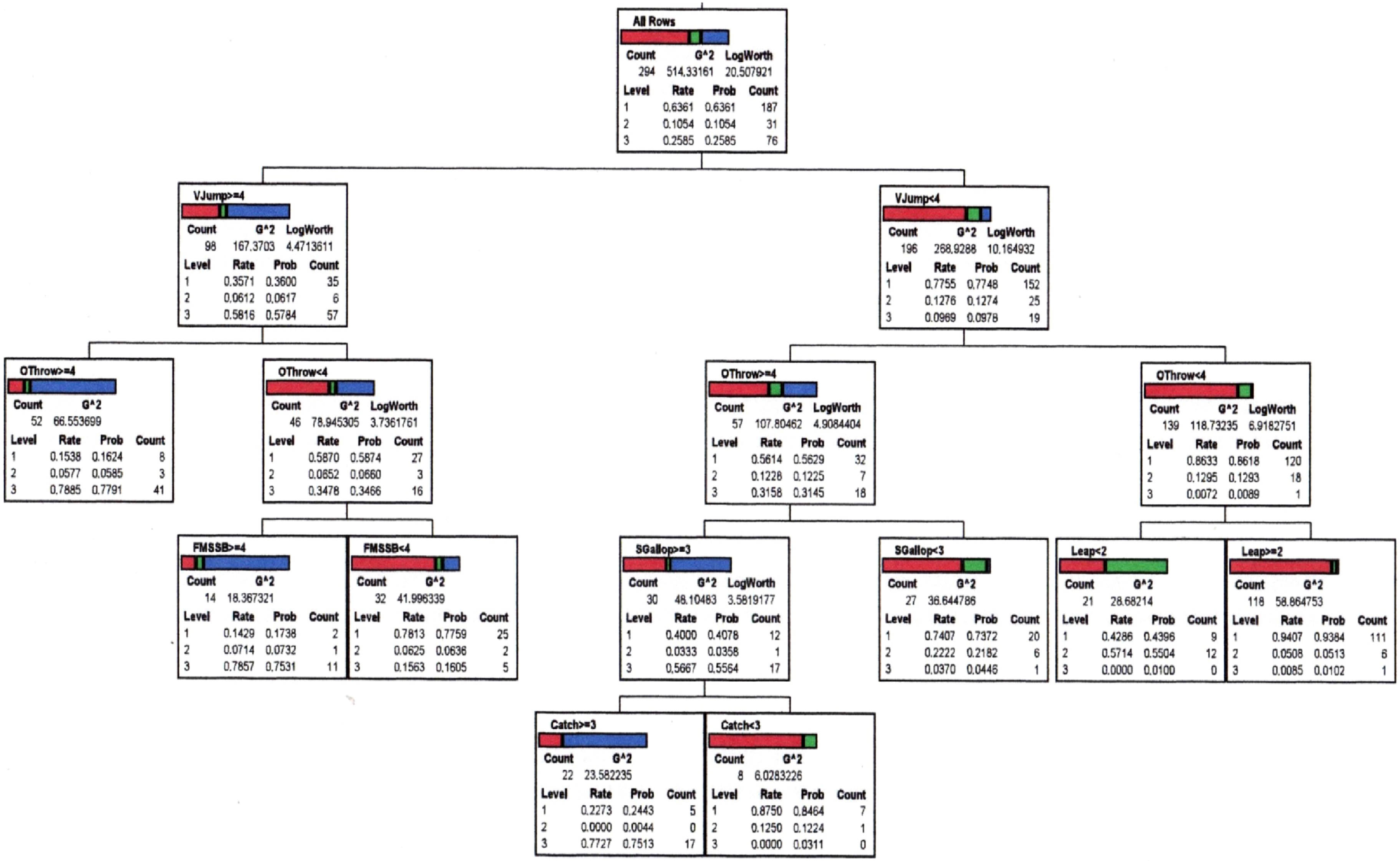

Figure 2. Final decision tree including the 7 splits for boys FMS groups. Level 1= Intermediate group; Level 2= Low group; Level 3= High group

Table 3. Column contributions for boys FMS

FMS	Number of splits	G^2
Static balance	1	18.58
Run	0	0.00
Vertical jump	1	78.03
Side gallop	1	23.06
Leap	1	31.19
Catch	1	18.49
Over arm throw	2	64.26
Kick	0	0.00

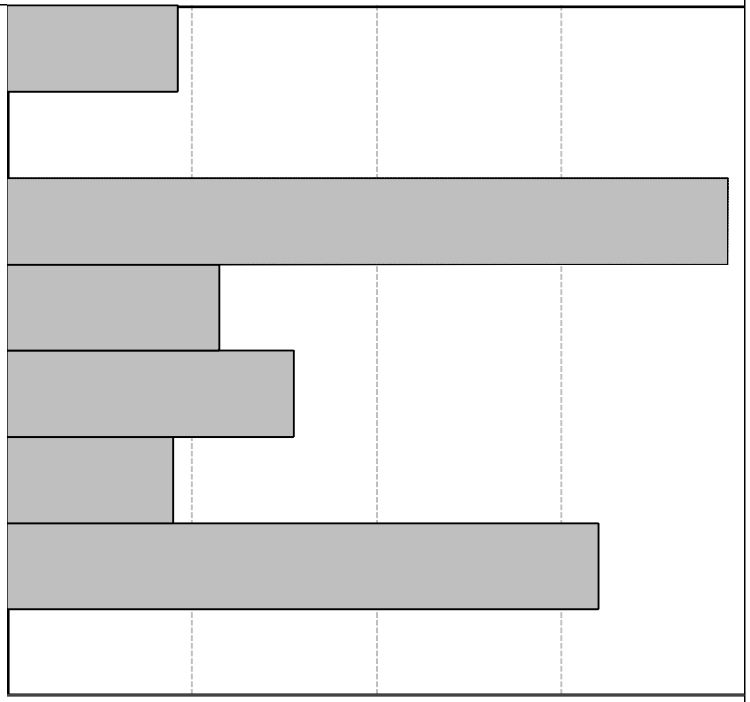

Table 4. The resultant decision tree rules for boys FMS groups

Rule 1	**If** the vertical jump is > 4 and the over hand throw is > 4 **then** probability is 78% are in the high group, 16% are in the intermediate group and 6% are in the low group.
Rule 2	**If** the vertical jump is > 4, the overhand throw is < 4 and the static balance is > 4 **then** probability is 75% are in the high group, 17% are in the intermediate group and 7% are in the low group.
Rule 3	**If** the vertical jump is > 4, the overhand throw is < 4 and the static balance is < 4 **then** probability is 78% are in the intermediate group, 16% are in the high group and 6% are in the low group.
Rule 4	**If** the vertical jump is < 4, the overhand throw is > 4, the side gallop is > 3 and the catch is > 3 **then** probability is 75% are in the high group, 24% are in the intermediate group and <1% are in the low group.
Rule 5	**If** the vertical jump is < 4, the overhand throw is > 4, the side gallop is > 3 and the catch < 3 **then** probability is 85% are in the intermediate group, 12% are in the low group and 3% are in the high group.
Rule 6	**If** the vertical jump is < 4, the overhand throw is > 4 and the side gallop is < 3 **then** probability is 74% are in the intermediate group, 22% are in the low group and 4% are in the high group.
Rule 7	**If** the vertical jump is < 4, the overhand throw is < 4 and the leap is < 2 **then** probability is 55% are in the low group, 44% are in the intermediate group and 1% are in the high group.
Rule 8	**If** the vertical jump is < 4, the overhand throw is < 4 and the leap is > 2 **then** probability is 94% are in the intermediate group, 5% are in the low group and 1% are in the high group.

Girls. From the total sample of girls with complete FMS data sets ($N = 259$) two groups were identified from the cluster analysis. These groups were identified as the Low FMS Group ($n = 102$) and the High FMS Group ($n = 157$). Figure 3 shows the frequency distribution of FMS performance scores of the low and high cluster groups on each FMS. Comparisons between the groups showed the high group were the most proficient across all FMS compared to the low group. Despite this difference it is important to note that skill mastery is low in each of the cluster groups across all FMS with neither group achieving greater than 15% competence in any FMS. The overhand throw and kick are the least proficient skills performed by both the FMS groups in girls.

The final girls' DTI model (Figure 4) had five splits ($r^2 = 0.48$) that differentiated between the two cluster groups. Static balance was the FMS variable with the largest contribution to the model (Table 5), and the differences in frequency distribution are shown in Figure 3. The catch, vertical jump and leap followed but their impact was much smaller. Whereas run, side gallop, kick and overhand throw made no contribution and did not feature in the final model. The subsequent decision tree model rules for the probability of cluster group membership are listed in Table 6. Of interest, girls who scored higher on the static balance and the vertical jump demonstrated higher probability of being in the high cluster group. Girls who scored lower on the static balance but higher on the catch, static balance and the leap splits also demonstrated higher probability of being in the high cluster group. In contrast, the low cluster group demonstrated poorer skill proficiency across all splits. In summary, whether good performance was observed in static balance (first split), subsequent skills identified the high cluster group as being the most proficient of the cluster groups. The accompanying Receiver Operator Characteristics (ROC) curves (Figure 5), and the confusion matrix (Table 7), both confirm the validity of the model to distinguish FMS classification between cluster groups in girls.

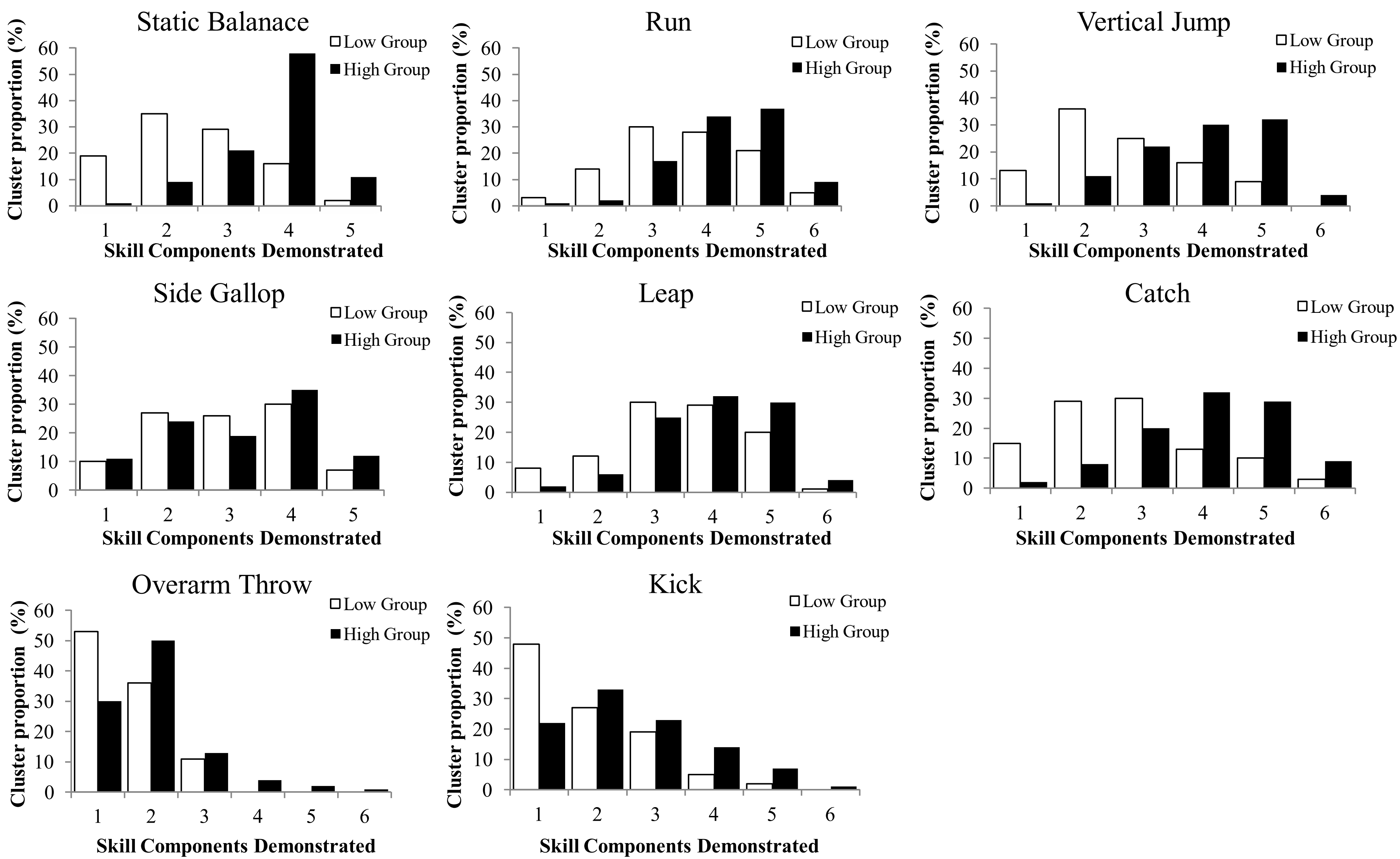

Figure 3. Frequency distribution of girls FMS skill components present via group classification on each FMS.

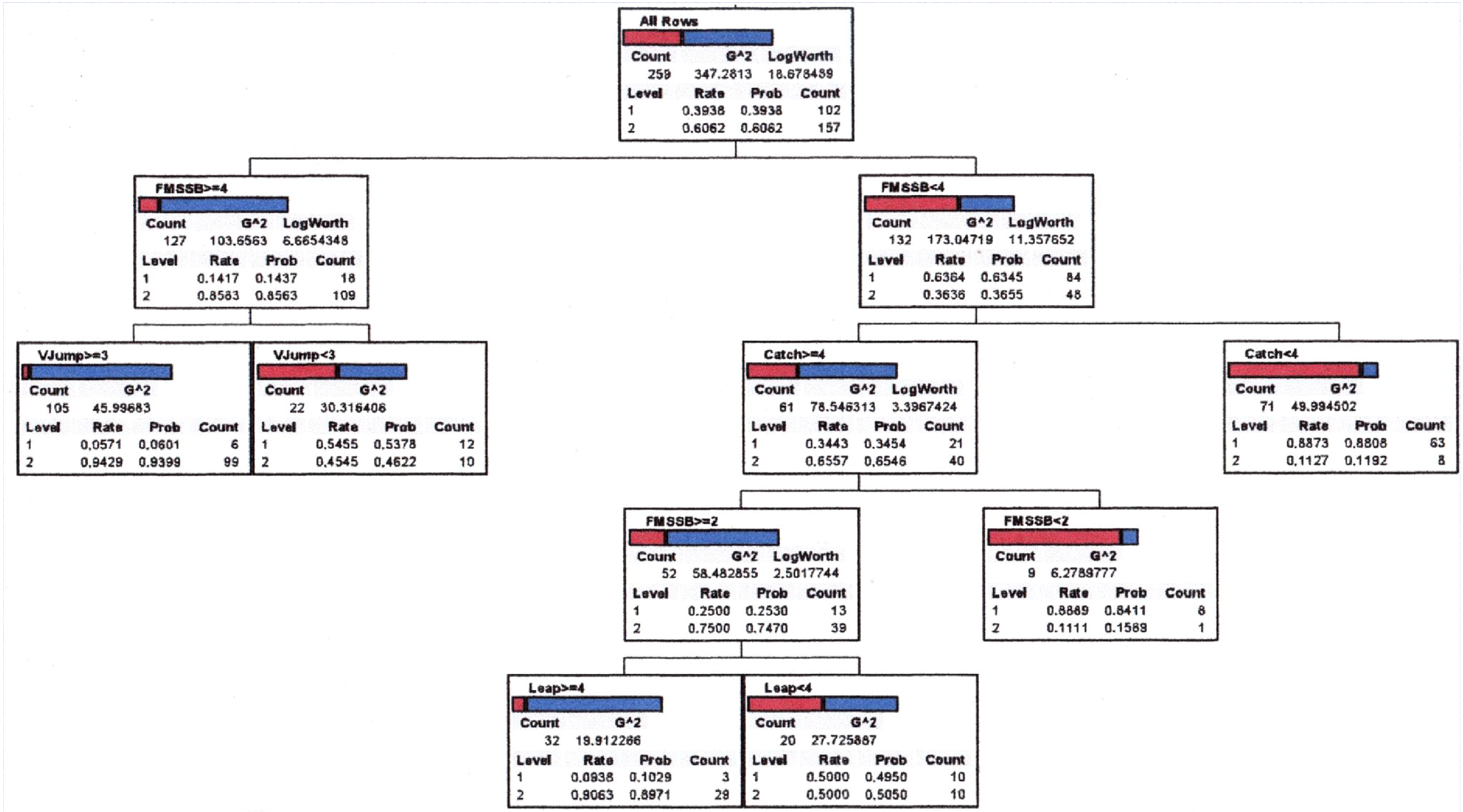

Figure 4. Final decision tree including the 5 splits for girls FMS groups. Level 1= Low group; Level 2= High group

Table 5. Column contributions for girls FMS

FMS	Number of Splits	G^2
Static balance	2	84.36
Run	0	0.00
Vertical jump	1	27.34
Side gallop	0	0.00
Leap	1	10.84
Catch	1	44.51
Overhand throw	0	0.00
Kick	0	0.00

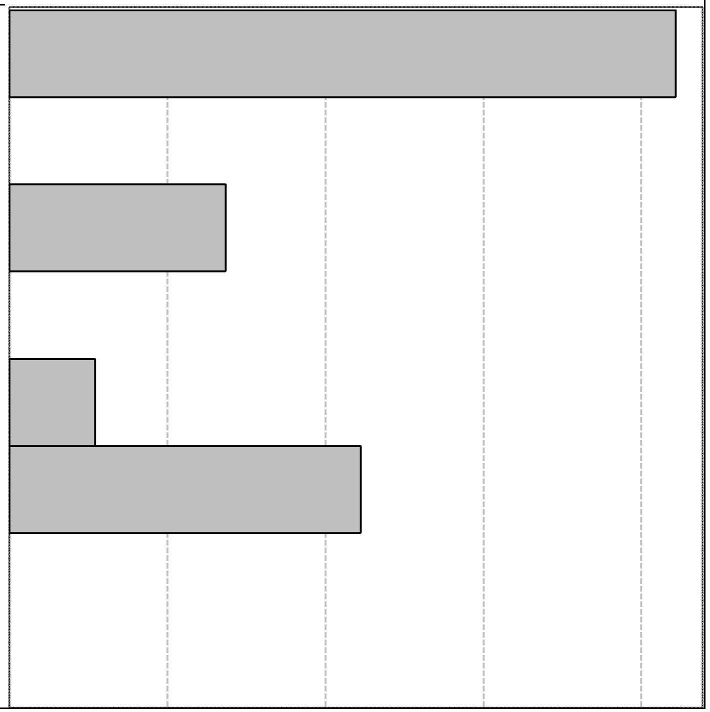

Table 6. The resultant decision tree rules for girls FMS groups

Rule 1	**If** the static balance is > 4 and the vertical jump is > 3 **then** probability is 94% are in the high group and 6% are in the low group.
Rule 2	**If** the static balance is > 4 and the vertical jump is < 3 **then** the probability is 54% are in the low group and 46% are in the high group.
Rule 3	**If** the static balance is < 4, the catch is > 4, the static balance is > 2 and the leap is > 4 **then** the probability is 90% are in the high group and 10% are in the low group.
Rule 4	**If** the static balance is < 4, the catch is > 4, the static balance is > 2 and the leap is < 4 **then** the probability is 50% are in the low group and 50% are in the high group.
Rule 5	**If** the static balance is < 4, the catch is > 4 and the static balance is < 2 **then** the probability is 84% are in the low group and 16% are in the high group.
Rule 6	**If** the static balance is < 4 and the catch is < 4 **then** the probability is 88% are in the low group and 12% are in the high group.

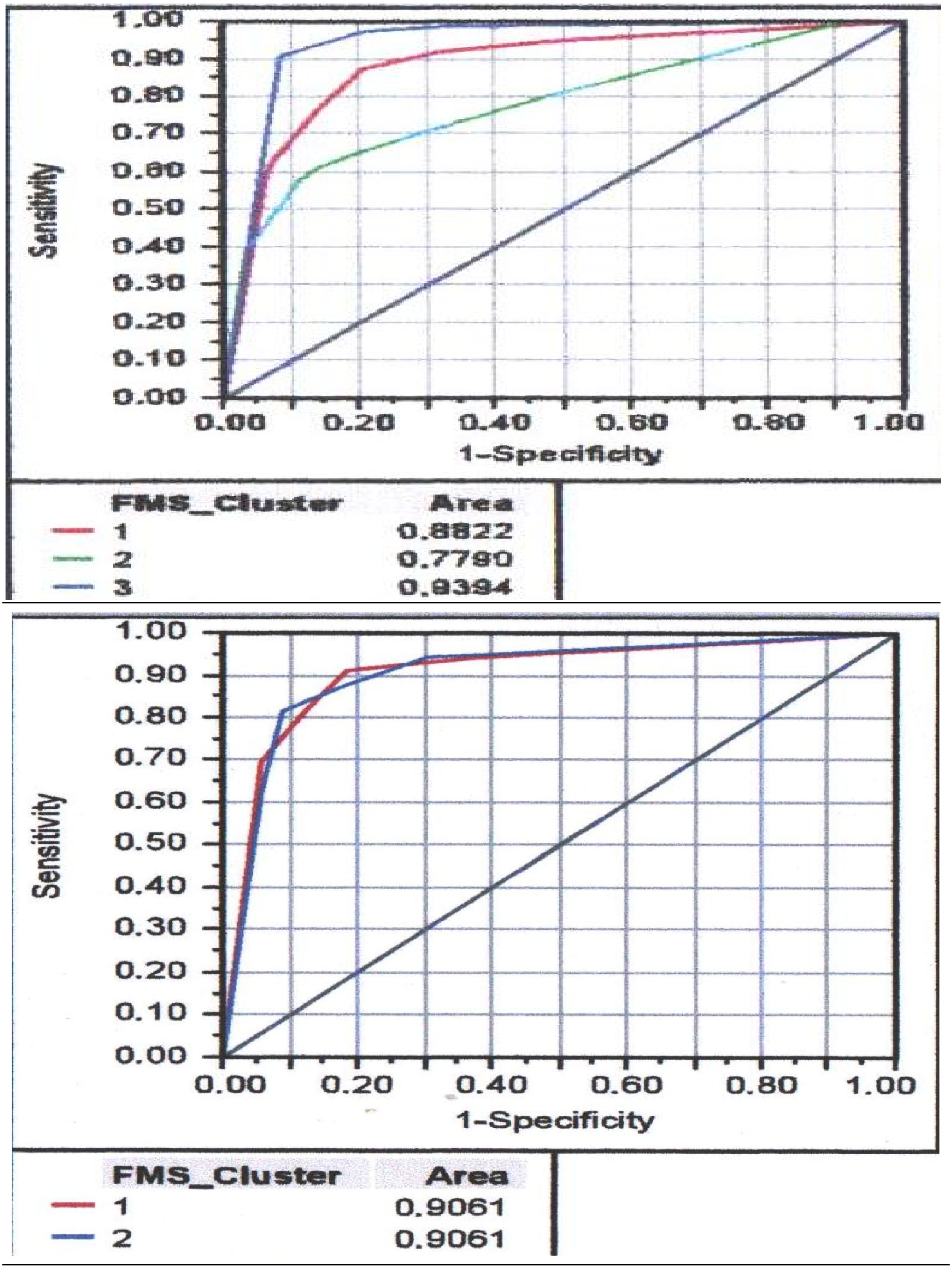

Figure 5. Receiver Operating Characteristics (ROC) for boys FMS cluster groups (Top) and girls FMS cluster groups (Bottom). In boys, FMS cluster 1 = Intermediate group; FMS cluster 2= Low group; FMS cluster 3= High group. For girls, FMS cluster 1= Low group; FMS cluster 2= High group

Table 7. Confusion matrix for boys' and girls' FMS cluster groups

Boys	Actual	Predicted			**Girls**	Actual	Predicted	
	Group	Low	Inter	High		Group	Low	High
	Low	12	15	4		Low	83	19
	Inter	9	163	15		High	19	138
	High	7	0	69				

Physical Fitness, Physical Activity Recall Behaviour and Physical Self-Perception Descriptive Statistics by FMS Group

Boys. Descriptive statistics for boys FMS groups on physical fitness, physical activity recall behaviour and physical self-perception are reported in Table 8. The high group demonstrated better performance measures of physical fitness, activity recall behaviour and physical self-perception than the intermediate group or the low group. The low group demonstrated the lowest performance scores across all these measures.

Girls. Physical characteristics and performance data for the girls FMS groups are reported in Table 8. The high group demonstrated better performance measures of physical fitness, activity recall behaviour and physical self-perception than the low group.

Discriminant Analysis

Boys. Analysis revealed two discriminant functions. The first function explained 86.7% of the variance, canonical $R^2 = 0.26$, whereas the second function explained only 13.3%, canonical $R^2 = 0.05$. In combination, these discriminant functions significantly differentiated the cluster groups, $\Lambda = 0.70$, $\chi2\ (24) = 102.73$, $p < .001$; although removing the first function indicated that the second function did not significantly differentiate the groups, $\Lambda = 0.95$, $\chi^2\ (11) = 15.27$, $p = 0.17$. Closer analysis of the discriminant loadings in Table 9, using loadings $\geq \pm\ 0.40$ (Stevens, 1992), reveals that Sprint ($r = -0.834$), MSFT ($r = 0.754$), SLJ ($r = 0.581$), and CY-PSPP Condition sub scale ($r = 0.461$) exceeded the criterion on the first function. The discriminant function plot showed that the first function discriminated the high group from the intermediate group and the low group. Classification results showed that 67.3% of the original grouped cases were correctly classified. The intermediate group were 87.2% correctly classified, the high group were 34.2% and the low group were 29%. In testing for classification accuracy, given that Press's Q = 17.69 (> 6.63), it can be concluded that the classification results exceed the classification accuracy expected by chance at a statistically significant level ($p < .05$). The classification ratio exceeds the proportional chance criterion of 56 % demonstrating predictive accuracy of the discriminant function (Hair et al., 1998).

Girls. A single discriminant function which explained all of the variance was identified, canonical $R^2 = 0.14$. This discriminant function significantly differentiated the cluster groups, $\Lambda = 0.86$, $\chi2$ (12) = 36.65, $p < .001$. Closer analysis of the discriminant loadings in Table 9 revealed that Sprint ($r = -0.748$), SLJ ($r = 0.718$), HG ($r = 0.598$), PAQ-C ($r = 0.522$) and MSFT ($r = 0.497$) were significant predictors of group membership (> .40). The associated sub scales of the CY-PSPP and BMI were below the criterion cut off. Functions at group centroids identified the group centroid for cluster 1 to be -0.490 whereas the group centroid for cluster 2 was 0.318. Therefore, it can be determined that the low group differs from the high group in obtaining poorer mean values across all significant predictor variables. Classification results showed that 69.5 % of original grouped cases were correctly classified. The low group was identified at 47.1% as correctly classified with the high group at 84.1%. In testing for classification accuracy, given that Press's Q = 39.39 (> 6.63), it can be concluded that the classification results exceed the classification accuracy expected by chance at a statistically significant level ($p < .05$). The classification ratio exceeds the proportional chance criterion of 56 % demonstrating predictive accuracy of the discriminant function (Hair, et al., 1998).

Table 8. Means and standard deviations of physical characteristics and performance measures for boys and girls FMS group classification

	Descriptive group data (mean ± SD)						
	Boys				**Girls**		
Variables	Total Group (n = 294)	Low Group (n = 31)	Inter. Group (n = 187)	High Group (n = 76)	Total Group (n = 259)	Low Group (n = 102)	High Group (n = 157)
BMI	18.5 ± 2.9	19.5 ± 4.9	18.4 ± 2.7	18.2 ± 2.3	19.1 ± 3.1	19.07 ± 3.43	19.03 ± 2.81
SLJ (cm)	143 ± 22	129 ± 20.7	141 ± 20.4	153 ± 19.9	131 ± 18	125 ± 17.17	135 ± 18.13
DHG (Kg)	18.5 ± 3.4	17.7 ± 3.1	18.1 ± 3.4	19.8 ± 3.3	17.1 ± 3.3	16.17 ± 3.57	17.74 ± 3.01
MSFT (m)	821 ± 400	506 ± 339	773 ± 360	1066 ± 389	612 ± 304	539 ± 263	659 ± 320
SPRINT (sec)	4.14 ± 0.33	4.50 ± 0.41	4.15 ± 0.28	3.96 ± 0.29	4.31 ± 0.34	4.44 ± 0.37	4.24 ± 0.30
PAQ-C	3.44 ± 0.65	3.06 ± 0.71	3.46 ± 0.64	3.53 ± 0.58	3.22 ± 0..65	3.06 ± .065	3.33 ± 0.63
CY-PSPP	18.91 ± 3.03	17.32 ± 3.38	18.90 ± 2.94	19.60 ± 2.88	18.0 ± 3.11	17.49 ± 3.00	18.29 ± 3.14
CY-SC	3.16 ± 0.65	2.85 ± 0.78	3.14 ± 0.64	3.31 ± 0.54	2.97 ± 0.65	2.85 ± 0.63	3.04 ± 0.65
CY-PC	3.14 ± 0.63	2.76 ± 0.70	3.11 ± 0.60	3.36 ± 0.70	2.98 ± 0.65	2.86 ± 0.64	3.06 ± 0.65
CY-BA	2.95 ± 0.75	2.72 ± 0.89	2.97 ± 0.76	2.99 ± 0.74	2.79 ± 0.75	2.73 ± 0.74	2.82 ± 0.75
CY-PS	2.91 ± 0.68	2.71 ± 0.71	2.89 ± 0.68	3.04 ± 0.65	2.75 ± 0.65	2.68 ± 0.61	2.80 ± 0.67
CY-PSW	3.27 ± 0.57	2.98 ± 0.60	3.29 ± 0.56	3.37 ± 0.54	3.10 ± 0.62	3.02 ± 0.66	3.15 ± 0.59
CY-GSW	3.50 ± 0.50	3.31 ± 0.64	3.50 ± 0.48	3.53 ± 0.49	3.39 ± 0.55	3.34 ± 0.55	3.42 ± 0.55

Note. BMI = Body mass index; SLJ = Standing long jump; DHG = Dominant handgrip; MSFT = Multistage fitness test; PAQ-C = Physical activity questionnaire children; CY-PSPP =Children and youth physical self-perception profile ; CY-PSPP- SC = Sport competence subscale; CY-PSPP – PC = Physical condition subscale; CY-PSPP –BA =Body attractiveness subscale; CY-PSPP –PS = Physical strength subscale; CY-PSPP –PSW = Physical self worth subscale; CY-PSPP –GSW = Global self worth subscale

Table 9. Zero order correlations, internal consistency reliability coefficients and discriminant function analysis loadings on FMS performance for boys and girls

							Boys (*n* = 294)							
Variables	BMI	SLJ	DHG	MSFT	SPR	PAQ-C	CY-PSPP	CY-SC	CY-PC	CY-BA	CY-PS	CY-PSW	α	DFA
BMI	-													-.18
SLJ (cm)	-.34**	-												.58*
DHG (Kg)	-.38**	.28**	-											.35
MSFT (m)	-.37**	.47**	.16**	-										.75*
SPRT (sec)	.34**	-.60**	-.31**	.55**	-									-.83*
PAQ-C	-.01	.14	.11	.22**	-.22*	-								.31
CY-PSPP	.27**	.39**	.13*	.43**	-.44**	.41**	-							-
CY - SC	.19**	.37**	.13*	.39**	-.38**	.51**	.84**	-					0.73	.33
CY - PC	-.25**	.42**	.15*	-.51**	-.45**	.42**	.79**	.66**	-				0.74	.46*
CY - BA	.38**	.30**	-.02	.33**	-.34**	.20**	.81**	.57**	.50**	-			0.80	.15
CY - PS	.05	.28**	.31**	.26**	-.26**	.29**	.73**	.60**	.55**	.42**	-		0.77	.23
CY - PSW	-.26**	.29**	.05	.34**	-.37**	.32**	.87**	.65**	.60**	.71**	.52**	-	0.72	.30
CY - GSW	-.27**	.21**	-.01	.25**	-.30**	.22**	.78**	.56**	.48**	.68**	.38**	.75**	0.75	.19
							Girls (*n* = 259)							
BMI	-													-.02
SLJ (cm)	-.32*	-												.72*
DHG (Kg)	.26**	.35**	-											.60*
MSFT (m)	-.40**	.51**	.14*	-										.50*
SPRT (sec)	.25**	-.66*	-.48**	-.50**	-									-.75*
PAQ-C	-.10	.22**	.11	17**	-.18**	-								.52*
CY-PSPP	-.27**	31**	.13*	.41**	-.33**	.39**	-							-
CY - SC	-.19**	.30**	.18**	.37**	-.32**	.42**	.83**	-					0.72	.36
CY - PC	-.22**	.36**	.16**	.48**	-.39**	.37**	.80**	.67**	-				0.73	.39
CY - BA	-.40**	.25**	-.03	.30**	-.22**	.23**	.82**	.53**	.55*	-			0.80	.15
CY - PS	.07	.18**	.26**	.22**	-.24**	.31**	.71**	.56**	.49**	.42**	-		0.75	.23
CY - PSW	-.31**	.22**	.01	.34**	-.24**	.35**	.89**	.69**	.62**	.78*	.51**	-	0.75	.25
CY - GSW	-.20**	.18**	.04	.26**	-.20**	.19**	.78**	.57**	.50**	.63**	.43**	.72**	0.76	.17

Note. BMI = Body mass index; SLJ = Standing long jump; DHG = Dominant handgrip; MSFT = Multistage fitness test; Sprt = Sprint; PAQ-C = Physical activity questionnaire children; CY-PSPP = Children and youth physical self-perception profile; CY-PSPP- SC = Sport competence subscale; CY-PSPP –PC = Physical condition subscale; CY-PSPP –BA =Body attractiveness subscale; CY-PSPP –PS = Physical strength subscale; CY-PSPP –PSW = Physical self-worth subscale; CY-PSPP –GSW = Global self-worth subscale. Pearson's zero order correlations:* Significant value ($p < 0.05$); ** Significant value ($p < 0.01$) (two-tailed); DFA = Discriminant function analysis loadings; *Significant loadings (≥ ± 0.40; Stevens, 1992).

Discussion

The purpose of the study was to examine FMS performance and its relationship with associated aspects of physical literacy in a cohort of UK primary school children. Groups of varying FMS skill proficiency were established for males and females. In addition, several physical literacy variables discriminated between the FMS performance groups in both gender.

O'Brien (2013) identified that whilst levels of FMS vary from country to country, performance levels remain consistently low across the spectrum, with the majority of children and adolescents failing to achieve mastery in most FMS skills. The findings from this study support this claim, with the prevalence of FMS competency demonstrated by both boys and girls identified as low. Across both genders, FMS performance failed to surpass twenty percent mastery in any of the skill categories. These findings are also consistent with FMS proficiency levels demonstrated in similar studies (e.g., Hardy, Reinten-Reynolds, Espinel, Zask, & Okely, 2012; Okely, Booth, & Chey, 2004). Hardy, King, Farrell, Macniven, and Howlett (2010) have suggested that the majority of children should have mastered FMS by ages 9-10 years of age and it seems logical that all basic movement patterns be mastered by early adolescence (12 years old).

The classification of FMS used in this study identified three distinct groups in boys and two in girls, with a clear identification of FMS that differentiated between the ability groups in each gender. Cools et al. (2009) have previously been critical of how FMS are interpreted and reported, suggesting that many interpretations of FMS assessment focus on the skill criterion of a bank of motor competencies such as the total score, or as locomotor and manipulative skills totals. They suggest that it could be seen that children with less than adequate proficiency levels who require more attention in individual skills have been classified as proficient under these pre-determined banks of motor competencies. As a consequence of such classifications it could be seen that children are propelled towards more complex tasks that require a combination of these skills (e.g., catching and throwing manipulative skills) during active play or organised activities. Such activity may break down due to the inadequacies in specific individual skills which require greater focus but may still continue to go unnoticed (Tompsett et al., 2014). It has been further suggested by O'Brien (2013) that the primary focus still remains on the development of combinations of sport specific skills and on the outcome of what the individual can achieve. Graf et al. (2005) points to the fact that seldom is it on the process of performance with specific movements encouraging holistic movement for all children. It is therefore simply not enough to be able to perform a series of skills; children need to master a skill to incur the benefits associated with skill proficiency (Seefeldt, 1980) At present children maybe progressing to a point where they are limited by their movement abilities but through no fault of their own.

The alternative classification of FMS proficiency developed in this study of groups of children displaying similar characteristics across a range of FMS, and having the provision to identify specific skill differentials between these groups may therefore allow practitioners to identify a clearer strategy to tailor specific skill development and enhance FMS proficiency in primary school aged children. For example, the decision tree induction method used in this study identified several FMS that differentiated in ability between the boys FMS groups (vertical jump, overhand throw and leap) and also the girls groups (static balance and catch). Other FMS were also identified in both genders but to a lesser extent and several FMS demonstrated no differences in ability between the FMS groups in boys (run and kick) and girls (run, side gallop, kick and overhand throw). Based on these findings practitioners would be able to identify specific FMS, plan and target their development (i.e., appropriate developing, consolidating and challenging phase tasks) with a class or group of children classified at various levels of skill competency. Additionally, it would be possible to identify those FMS which worryingly lack proficiency and require greater focus of attention across the board.

In addition to FMS assessment, it is also important to identify how associated variables of physical literacy relate to the FMS performance of children at what has been suggested to be a critical developmental age. Stodden and colleagues' spiral model of engagement-disengagement in physical activity (Stodden et al., 2008) points towards a dynamic and reciprocal relationship between FMS competence and physical activity behaviours at mid childhood and onwards towards adolescence. In addition, they advocate that it is important to substantiate which variables of health related physical activity (i.e., physical literacy) have the potential to impact FMS performance with this age group as any future intervention to promote and sustain health outcomes must have a clear strategy in the combining of these elements. In this study, the discriminant analysis revealed that for both boys and girls, measures of physical fitness were significant predictors of FMS proficiency. These findings are in line with the growing body of evidence that substantiates the link between FMS performance and physical fitness components (Hands, Larkin, Parker, Stranker, & Perry, 2009; Stodden, Langendorfer, & Roberton, 2009). More specifically, it was shown that upper body strength in girls and lower body strength in boys and girls discriminated between the FMS groups. It has been suggested by Enoka (2008) that acquiring higher levels of FMS demands more effective manipulation of an individual's entire body mass against gravity and will therefore require higher strength and power outputs. In addition, Barnett et al. (2013) suggest that programmes that enhance muscular strength and FMS performance early in life appear to build the foundation for an active lifestyle later in life. Developing physical strength with children had proven controversial in recent years due to the lack of evidence of its benefits, issues with maturation and the type of resistance training being introduced (Lillegard, Brown, Wilson, Henderson, & Lewis, 1997; Lloyd &

Oliver, 2012). Baker (1996) proposed that strength development of the lower extremities with children through the squat may transfer to skills such as the vertical jump (an FMS particularly relevant to differentiating between the FMS groups of both gender in this study). Vaseghi, Jaberzadeh, Kalantari, and Naimi (2013) identified press ups as the optimal strength training movement required for most upper body FMS (i.e., overhand throw and strike) and Behringer et al. (2011) identified that structured resistance training programmes significantly improved running, jumping and throwing with children and adolescents. In a systematic review, Lubans, Morgan, Cliff, Barnett, and Okely (2010) classified the association of FMS with strength training as uncertain, highlighting that more research is needed in this area. Although, a recent position statement on children and youth resistance training by Lloyd et al. (2014) has suggested that the use of practical and safe basic bodyweight exercise techniques (e.g., squatting, lunging, pressing and pulling movements) should be utilized to enrich the motor skills learning environment for children, initiate adaptation, and help children with low motor competence catch up with their peers.

The physical fitness variables of the sprint run and cardio respiratory fitness were also found to significantly discriminate between the FMS groups in both genders. A positive relationship between FMS ability and cardio respiratory fitness levels has previously been demonstrated (Barnett et al., 2008a; Okely et al., 2001) and most recently, Hardy et al. (2012) confirmed, that there was a clear and consistent association between low competency in FMS and inadequate cardio-respiratory fitness in children. Mahon, Corral, Howe, Duncan, and Ray (1996) and Okely et al. (2001) identified that locomotor FMS and in particular, the sprint run and the vertical jump were the most significantly related to cardio respiratory fitness in children. Although there is clear evidence supporting this relationship it is unclear which direction has the most significant impact (i.e., whether higher FMS competency increases a child's cardio respiratory fitness or vice versa). Cohen, Morgan, Plotnikoff, Barnett, and

Lubans (2015) have suggested that improvements in overall FMS competency in children may act as a causal mechanism for physical activity behaviour change and subsequent improvements in cardio respiratory fitness. Despite the uncertainty concerning the direction of this relationship, it is clearly evident from this study and the supporting literature that developing FMS and cardio respiratory fitness in children is of significant importance. A point reiterated by Stodden, Gao, Goodway, and Langendorfer (2014) who suggested that as improvements in FMS or health related fitness may reciprocally influence each other during childhood and adolescence, promoting the development of both FMS and cardio respiratory fitness would seem to be mutually beneficial in developing physical literacy.

It is important to note here that the physical fitness variable of BMI failed to discriminate the FMS performance in either boys or girls and is consistent with the studies of Castelli and Valley (2007) and Hume et al. (2008) who also found no relationship between BMI and FMS proficiency in children aged 9 - 12 years. Conversely, these findings contrast with several studies who have reported that an elevated BMI has a negative effect on FMS performance (Cliff et al., 2009; Okely et al., 2004; Southall, Okely, & Steele, 2004). Most apparent in these studies is the seemingly negative relationship between BMI and locomotor FMS (e.g., run, hop, side gallop). Locomotor skills may be more related to BMI than object control skills as these skills require more 'whole body' movement and transfer of body weight, and so are more difficult to perform given overweight and obese children's increased overall mass (Okely et al., 2004). Okely and colleagues (2004) hypothesize that the relationship between skill competence and being overweight maybe reciprocal. Thus, children who are overweight participate in less physical activity, and so have less opportunity to practice and develop proficiency in motor skills, or children who are less skilled have fewer opportunities to engage in physical activity and gain less enjoyment from participation which may cause overweight and diminished physical literacy. Therefore, although BMI might be important in terms of health and physical activity its relationship with FMS and children remains unclear and further investigation is clearly warranted.

It has been suggested by O'Brien (2013) that levels of FMS proficiency among young people and their association with physical activity behaviours /trends requires additional examination. In this study it was shown that for girls only, the physical activity behaviour measure significantly discriminated the FMS groups. Typically, research has found an association between FMS proficiency and physical activity behaviour (Bryant et al., 2014; Cohen et al., 2015; Lopes et al., 2011). Parry (2013) suggests that it is children who are more physically active in organised physical activity outside of school who develop FMS earlier are abler and thus more likely to have enhanced levels of physical activity. More specifically, Okely et al. (2001) and Raudsepp and Pall (2006) found a relationship between FMS and time in organised physical activity was stronger for girls than boys outside of the school environment. Therefore, it may be seen that encouraging and offering quality physical activity in an organised environment outside of the school curriculum that provides an alternative experience may provide a more stimulating opportunity to develop FMS in children. A clear distinction between organised and non-organised activity did not form part of this study therefore caution must be taken in interpreting the findings here.

Physical condition (PC) represents the individual's perceptions regarding the level of their physical condition, physical fitness, stamina, their ability to maintain exercise and state how confident they feel in the exercise and fitness setting. This sub scale of the physical self-perception profile significantly discriminated between FMS groups in boys. Spiller (2009) suggests that through participation many boys learn that the optimal functionality and performance of their bodies (i.e., physical condition) is more important than other facets such as appearance and participation in physical activity typically providing a better 'fit' for the development of males' identity and skill acquisition. Foweather (2010) suggests that with advancing age children are more able to make informed judgements about their levels of physical conditioning and so it is likely that the relationship between physical activity and motor competence will strengthen in those with advanced levels of physical conditioning. In addition, Barnett et al. (2008b), has suggested that the levels of physical self-perception and feelings of competence whilst performing motor tasks are important factors that explain why children decide to participate in or avoid future physical activity. Therefore, it may be mindful to consider when developing physical components of physical literacy (i.e., physical fitness and FMS) the significant contribution certain self-perceptions such as physical condition could have in promoting their success.

Although no other CY-PSPP variables discriminated between the FMS performance groups in boys and girls in this study, they should not be completely overlooked as they may still have the potential to influence FMS development and physical literacy. The 0.40 cut off value used in this study was based on Stevens' (1992) suggestion although it has been suggested by Tabachnick & Fidell, (2007) that the choice of the cut off value for reporting is a matter of researcher preference. They advocated that the correlation should be a minimum of 0.30 or greater since anything lower would suggest a weak relationship between the variables. Hair, Anderson, Tatham, and Black (1998) also recommends that cut off values greater than 0.30 be considered to meet the minimum level but suggests loadings of 0.40 are to be considered more important. Typically, Field (2013) reported that researchers tend to take a cut off value of more than 0.30 to be important. Therefore, of note, if this study had followed similar reporting at the minimal 0.30 cut off value several additional variables in boys (DHG, PAQ, CY-SC, CY-PSW) and girls (CY-SC, CY-PC) would have contributed to the discriminant function, although notably, BMI would still not have contributed to the discriminant function. Despite the conservative nature of the selected .40 cut-off point, the author believes its use is justified as it identifies only those key variables that contribute most significantly to the discriminating function.

The present study holds several limitations. The primary schools used in the study were a selection of schools within South East Wales that were in close proximity to the test venue, therefore restricting the generalisation to the wider primary school population in the region. Due in part to the cultural, environmental and assessment differences, and more specifically due to the unique nature of the analysis used in this study caution must be exercised when comparing data from this study with study findings from other countries (i.e., Australia and the USA), where substantial research in FMS performance has taken place. It is also important to note that when measuring and comparing FMS competencies, researchers must be cautious of making direct inferences due to such a diverse range of methodologies. It is not easy to comprehend at a glance when assessing FMS if ability, competency, proficiency, fitness or a combination of these factors are being assessed. The use of the PAQ-C to measure physical activity behaviour was used due to its low cost and ease of administration. The PAQ-C is only appropriate for use during the school year, therefore the PAQ-C only assess general levels of physical activity for individuals in the school system. It does not provide an estimate of frequency, time and intensity nor does it differentiate between organised and non-organised activity. To heighten the strength and accuracy of physical activity behaviour in future work Chinapaw, Mokkink, Van Poppel, Van Mechelen, and Terwee (2010) suggested that a combination of self-report and accelerometry may be a sensible approach.

Conclusion

In conclusion, a low level of FMS proficiency in both genders was found, suggesting that there is potential to improve these skills across the board. Distinct groups of varying FMS skill proficiency were established for males (3 groups) and females (2 groups). It was shown that the vertical jump, overhand throw and the leap were the FMS tasks that best differentiated the boys FMS groups and the static balance, catch, vertical jump and the leap the FMS task that best differentiated between the girls FMS groups. This distinct categorization of groups in both genders, displaying varying levels of motor competence, and the identification of specific skills that differentiate the groups may allow a more detailed focus on specific developmental needs. In addition, the physical literacy variables of physical fitness (cardio-respiratory fitness, sprint run, lower body strength for both genders in addition to upper body strength in girls) significantly discriminated between both boys' and girls' FMS groups. It may therefore be suggested that appropriate strength building and cardiovascular development exercise could be promoted and incorporated more into children's physical education programmes to specifically enhance FMS and physical literacy. Physical activity behaviour was significantly different between girls FMS group's therefore girls with poorer FMS proficiency may benefit from greater opportunities to participate in range of activities to develop FMS. The result of the significant physical competence component of the physical self-perception profile in boys ensures it is mindful to note that when teaching and delivering FMS, it is important to consider the impact on learning from psychological and cognitive factors and not just the physical components typically promoted to develop FMS.

The outcome of this study has demonstrated low levels of FMS proficiency, a distinct categorization of FMS and identification of specific skill differentiation in both genders. In addition, the number of significant relationships identified between the multidimensional domains of physical literacy to discriminate between children's FMS performance may therefore warrant further research in this area to truly develop the physically literate person.

Chapter 5

Parental behaviours and their relationship with fundamental movement skill proficiency of South East Wales primary school children.

Abstract

Purpose: The aim of this study was to investigate the relationship between parental physical activity behaviour and beliefs and the fundamental movement skills of primary school children. *Methods:* A total of 484 primary school children were recruited to the study, 255 boys (*M* age =10.9 years, *SD* = 0.62) and 229 girls (*M* age= 10.7 years, *SD* = 0.64). Children were assessed on eight different FMS. Self-reported parental behaviour questionnaires were completed and matched to participants in the study. *Results:* For boys, the findings highlighted significant relationships between aspects of parental behaviours, parental beliefs and parent's knowledge/awareness and FMS proficiency. More specifically these relationships were shown to be on the variables of parent-child interaction in video gaming, the importance of social development, motor development and participation beliefs towards children's physical activity, parental awareness of extracurricular participation in community sports clubs and awareness of child's physical activity preferences. For girls, the findings highlighted significant relationships between aspects of parental behaviours, parental beliefs and family characteristics and FMS proficiency. These relationships were specifically shown to be on the variables of the extended family in pre and after school childcare provision, parental employment status, mother's physical activity participation, and the value of social function and learning rules to physical activity participation. *Conclusions:* Different parental processes have the potential to influence children's FMS performance and their impact could be given greater consideration in interventions to improve children's FMS.

Keywords: Fundamental movement skills, physical activity, socializing agents, parents, primary school children.

Introduction

Evidence suggests that regular participation in physical activity is associated with important health benefits both in the short and long term and is especially important for children and adolescents (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2008a). Despite this evidence, within the United Kingdom, Bryant, James, Birch, and Duncan (2014) have reported that only thirty-two percent of boys and twenty-four percent of girls aged 2-15 years are meeting the recommended physical activity guidelines. Indeed, Bryant et al. (2014) highlight that these statistics are likely to be linked to childhood obesity trends, which in the past sixteen years has seen an increase of twenty-two percent in boys and thirty-two percent in girls (Public Health England, 2014).

The development of fundamental movement skills (FMS) has been suggested as a key factor in promoting lifelong physical activity and reversing the increase in childhood obesity, with the early development of FMS in children being a primary underlying mechanism that promotes engagement in physical activity and contributes to children's psychosocial development (Stodden et al., 2008). Furthermore, recent studies suggest that previous research has failed to consider the dynamic role that FMS competence plays in the initiation and maintenance of physical activity (Breslin, Murphy, McKee, Delaney, & Dempster, 2012; Stodden et al., 2008) and it may also explain why children decide to participate in or avoid physical activity (Barnett, VanBeurden, Morgan, Brooks, & Beard, 2008b). As a result, researchers and practitioners therefore continue to examine factors that positively relate to FMS and are the most modifiable and responsive to interventions to increase physical activity (Kenyon, Kubik, Davey, Sirad, & Fulkerson, 2012).

Schools have been identified as essential providers of physical activity and are being called upon to give greater attention to their physical education programmes and in particular the development of FMS (Naylor & McKay, 2009; Pate, Almeida, McIver, Pfeiffer, &

Dowda, 2006). Consequently, FMS are now an integral component of physical education curricula in the United Kingdom (UK), Canada, New Zealand and several other countries. Indeed, school is where children spend a large proportion of their day and a health education infrastructure exists throughout the formal physical education lessons and informal extracurricular sports or physical activity programme curriculum to promote physical activity in the UK (Ridgers, Stratton, & Fairclough, 2006). However, although the school environment is seen as the most effective place to develop, enhance and promote FMS and physical activity for future health, it is recognised that children's motor skill performance and their physical activity has declined and obesity rates continue to increase amongst children worldwide (Hardy, Barnett, Espinel, & Okely, 2013).

Within the UK, physical education doesn't achieve the same recognition or priority as other academic subjects and therefore is viewed by several head teachers as an additional burden to an already overcrowded curriculum (Rainer, Cropley, Jarvis, & Griffiths, 2012). Many issues and problems remain such as policy development, finance and appropriate staff provision and training with a distinct lack of specialist physical education teachers in primary schools (Morgan & Hansen, 2008; Rainer et al., 2012). Further, Callea, Spittle, O'Meara, and Casey (2008) suggest that many primary school teachers could be relying on their ability to recall their own primary physical education and sporting experiences to guide decisions regarding programme development and teaching of FMS which could have either a positive or negative influence in their approach. Therefore, it is less clear as to the underlying causes contributing to the decline in the motor skill proficiency observed in school children (Tompsett, Burkett, & McKean, 2014).

Alternative influences for FMS development may therefore be necessary in order for children to reach levels of motor proficiency that will allow them to engage in and sustain physical activity. Furthermore, Ferreira et al. (2007) have suggested there is a need to examine other environmental influences on children and youth physical activity at different levels (e.g., home and neighbourhood) and not just at school to better inform the development of interventions attempting to improve physical activity levels. Indeed, Rudd (2015) has suggested that the best chance of improving children's FMS therefore lies with parents and immediate family members. Unfortunately, as Faigenbaum, Chu, Paterno, and Myer (2013) highlight, many parents assume that their child takes part in enough physical activity through school and also assumes that their young child is competent in movement. Despite this, Welk (1999) has reiterated that for a child to develop active patterns of living, it is important for them to receive activity-promoting messages and experiences at home. Therefore, children who are encouraged and supported to be physically active outside school develop FMS earlier, and are abler and thus more likely to do well at and enjoy formalised sport and physical activity (Kirk, 2005; Van der Horst, Chinapaw, Twisk, & Van Mechelen, 2007). In contrast, children who receive minimal encouragement and support are least likely to be active outside of the school, develop negative experiences of school sport and physical education and are most likely to become disengaged from physical activity (Van der Horst et al., 2007).

Significantly, Barnett et al. (2013) suggested that children should ideally develop FMS proficiency during childhood through a range of opportunities, which include unstructured play, interactions with parents, siblings and caregivers to coincide with quality school sport and community based programmes. Moreover, it is family culture that principally determines an individual's enduring propensity to play sport and provide those initial interactions that allow engagement (Birchwood, Roberts, & Pollock, 2008). Therefore, parents are critical in introducing and guiding children through the development stages of movement skills. Further, they are significant agents who monitor movement skills and encourage children to engage in activities that promote future movement skill performance and competence that contributes to lifelong physical activity (Williams et al., 2008). As a result, it has been suggested by Bois, Sarrazin, Brustad, Trouilloud, and Cury (2005) that as a starting point, socialization within the family (i.e., parents and siblings) should be a fundamental form of influence because the family constitutes an important initial element of socialization influence for children and because the majority of children's free time prior to adolescence is spent within the context of the family.

A useful theoretical model to explain parental influence on physical activity is the expectancy-value model of Eccles and Harrold (1991). Welk (1999) suggests that this model has clear application to sport and physical activity in that socialization behaviours are thought to be influenced jointly by parental expectation for the child's success in a given area and the value parents place on this success. In the model, Eccles and Harold suggest that there are various ways that parents can socialize their children to be physically active. These variables include parental encouragement (e.g., play outside, limit TV viewing, transfer of knowledge), parental involvement (playing or practicing skills), parental facilitation (access to facilities, programmes, equipment) and parental role modelling (efforts to model an active lifestyle and be physically active). Eccles and colleagues (Eccles, Wigfield, & Schiefele, 1998; Fredericks & Eccles, 2004) also suggest that the beliefs that parents hold for their children influence their patterns of interaction with the child, such as extent of encouragement and the provision of opportunities and experiences that, in turn, affect their child's motivation. Lee (2014) further suggests that within socialization theory, parents deliberately engage in certain practices that they feel will help to protect their children from and overcome the risks in their environment and hopefully lead to positive development, although this in turn can unintentionally prove to be detrimental. Alternatively, because socialization theory identifies parents as role models, parents who are inactive and/or obese may serve to reduce or impede physical activity in their children (Fogelholm, Nuuttinen, Pasanen, Myohanen, & Saatela, 1999). If a child lives with parents who fail to exercise and consistently engage in sedentary type behaviour, youth are likely to mimic the lifestyles they see and retain these habits into adulthood (McGuire, Neumark-Sztainer, & Story, 2002).

A study by Cools, Martelaer, Samaey, and Andries (2011) that examined the FMS performance of preschool children in relation to the family context suggested that the socialization process, including individuals who are influential in the process, is one of the major environmental mechanisms constraining children's movement skill performance. In addition, Cools et al. highlighted several critical positive and negative family correlates for preschool children's FMS performance. Positive correlates included father's physical activity, transport to school and parental importance rating on their child's physical activity. Negative correlates included, parental emphasis on winning and performance of their child's physical activity and parental inquiry on their child's motor development with the primary school class teacher. Further, the study recommended that preschool children may benefit from family interventions that emphasize the importance of providing sufficient opportunities to be physically active to support the child's overall development.

This previous work has clearly identified associations between family correlates and preschool children's FMS performance. The development of FMS starts at birth and traditionally continues to be developed until around 11–12 years of age (Gabbard, 1992) therefore, it seems valid to investigate which family correlates maybe associated with the FMS performance in children of school age (i.e., primary school). The author hypothesizes that these same parental behaviours and beliefs will be instrumental in primary school aged children's FMS proficiency. The findings may therefore have the potential to impact on a child's FMS development and significantly impact upon any future participation in physical activity pursuits. Following the similar focus of Cools et al. (2011) and Bois et al. (2005) in this area, this study includes a broad perspective of factors representing parental behaviours in relation to FMS and physical activity. These behaviours as discussed relate to the child's parents as the most proximal socialisation agents' focusing on their family characteristics, behaviours, beliefs, knowledge and awareness of their child in relation to FMS development and physical activity.

Method

Participants and Setting

Following approval by the University's Human Research Ethics Committee, and permission granted from the Welsh Government Central South Physical Education and Sport Consortium primary schools in South East Wales were approached to participate in the study. The primary schools response rate, consent and assent procedures, and subsequent participant attendance in the study have previously been described in-depth in Chapter 4 (pp. 97-98). Of the attendees a total of 553 complete FMS data sets were recorded. The Parental Behaviour Questionnaire was returned by 502 parents and subsequently matched to their child in the study. A total of 484 fully completed questionnaires (response rate 76%) were used in the study on 255 boys (*M* age = 10.9 years, *SD* = 0.62), 53% of sample, and 229 girls (*M* age = 10.7 years, *SD* = 0.64), 47% of sample. The majority of children in the sample were of white British ethnicity. Schools invited to participate in the study were located within practical travel distance of the test venue and located in the local unitary authorities of Wales classified with high multiple deprivation (Welsh Government, 2014).

Instruments and Measures

Fundamental movement skills. FMS behaviour was assessed using the process orient checklists taken from the Australian resource 'Get Skilled: Get Active' (NSW Department of Education and Training, 2000). The inclusion of this instrument for use in this study has previously been described in-depth in Chapter 4 (pp. 98-99).

Parental behaviour questionnaire. This questionnaire concentrated on parental socialization factors in specific relation to FMS development. The questionnaire was first developed and used by Cools et al. (2011) in a study of Flemish preschool children (aged 2.5 – 6 years old). Permission to translate and use the questionnaire was requested and granted (personal communication Cools, August 2011). The development of the questionnaire by Cools et al. underwent several stages to ensure content validity. The questions were based on a review of literature from Eccles et al.'s (1998) model of parental influences on children's motivation and achievement. The Spearman Brown reliability statistics were used by Cools et al. to examine test-retest agreement of scaled answer questions and alpha reliability coefficients of nominal answer questions. Reliability estimates for this initial questionnaire showed high reliability coefficients (> 0.80) for reports on family characteristics, physical activity participation, use of transport, and importance rating of developmental aspects. Parental reports on more subjective aspects such as appreciation of social development and characteristics of the child's equipment, physical activity and play showed moderate stability coefficients, which ranged between 0.50 and 0.78. Consequently, Cools et al. (2011) reported that all of these coefficients provided support for the reliability of parental reporting in this questionnaire.

The questionnaire used in the present study was adapted for use with the specific population (see Appendix E). The questions relating to physical environment, educational attainment and provision of equipment were not included here due to their potentially invasive nature, which a pilot study highlighted as problematic. Parents therefore responded to questions relating to family characteristics, parental behaviour, parental beliefs and parental awareness/knowledge. The first group of variables included those related to family characteristics such as parental employment status, workload and family situation. Parental employment status was subdivided into: (a) active (i.e. active duty) and (b) passive (i.e., non-active duty). Workload was categorised as (a) full-time working, (b) part-time working, and (c) not working. Family situation included questions on the composition of the family (i.e., one parent, two parent or other care givers), provision of care to child before and after school, duration of care provision, and number of siblings living at home. The second group of variables were parental behaviours, which included the parents' involvement in the child's play activities, transport habits to and from school, communication with the school teacher related to the child's FMS, parents' own physical activity behaviours, frequency of conducting various leisure activities with their child and the frequency/likelihood of performing physical activity together. The third group of variables included parental beliefs and the parental importance afforded to developmental and rearing aspects and physical activity characteristics of their child. Parental awareness and knowledge of the child's physical activity formed the final group of variables and included the questions related to after school sports participation, frequency of play, play with contemporaries, and knowledge of child's play activities.

Statistical Analysis

The statistical software packages used for all analysis were SPSS version 21 (SPSS Inc., IBM Corp., Armonk, NY, USA), JMP Statistical Discovery version 10.02 (SAS Institute, Marlow, Buckinghamshire, United Kingdom) and MedCalc for Windows, version 14.12.0 (MedCalc Software, Ostend, Belgium). The procedures for the reliability of the FMS assessment and the classification of boys and girls FMS groups based on the FMS task scores have been previously described in-depth in Chapter 4 (pp. 103-105).

The classification of FMS groups identified three groups from the total sample of boys' FMS data sets ($N = 255$). Groups were classified as High ($n = 66$), Intermediate ($n = 160$), and Low ($n = 29$) FMS groups. From the total sample of girls FMS data sets ($N = 229$)

two groups were identified. These groups were identified as Low (n = 92) and High (n = 137) FMS groups.

Based on these FMS group classifications the Kruskal-Wallis H test was used to identify differences between the FMS groups in boys. P-values < 0.05 were used as the cut-off for statistical significance. Post hoc examination of significant effects were run and interpreted with pairwise comparisons based on Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted p-values are presented in addition to effect sizes based on Rosenthal's (1991) equation. Cut off values used to interpret effect sizes were small > 0.1, medium > 0.3, and large > 0.5 (Cohen, 1988). Results are reported as mean ranks, accompanied by their respective chi-square statistic, degrees of freedom and p values. The Mann-Whitney U test was used to examine differences between the FMS groups in girls. Asymptotic p-values < 0.05 were considered statistically significant based on Dineen and Blakeley's (1973) recommendation for different sample group sizes. Mean ranks were used for further examination of significant effects and effect sizes reported.

Responses to categorical questionnaire variables across FMS groups were assessed by Pearson's chi square test for association for both genders. To meet assumptions of expected frequencies the variables were inspected and several required collapsing of data across the variables. These variables related specifically to questions on pre and after school care, parents' knowledge of their child's activity preferences and family composition. All subsequent expected counts were greater than 1 and no more than 20% of expected counts were less than 5 (Field, 2013). Fisher's exact test statistic was run to identify chi square (p < 0.05). Where contingency assumptions are met the Likelihood ratio chi square value is provided. Phi and Cramer's V is used to express effect size dependent on contingency output.

Results

The qualitative level of agreement for retest reliability and inter-rater reliability of FMS was returned at between 0.73 and 0.93 and between 0.61 and 0.79 respectively. All FMS therefore displayed a level of agreement that was good or above.

Family Characteristics

There were no significant findings ($p < .05$) for the boys' on any of the questions relating to family characteristics as shown in Table 1. In girls, the grandparent and family variables on the provision of care before and after school identified significant differences between FMS groups (see Table 1). For both variables, higher mean rank score values were demonstrated by the high FMS group over the low FMS group. On the question of parental employment status, Pearson's chi square analysis (see Table 5) revealed that both fathers and mothers had significant associations with girls' FMS. On closer examination of father in active or passive employment, it was shown that there were a higher proportion of fathers in active employment in the High FMS group (81%) compared to those in the low FMS group (65.2%). For mothers, there were more mothers in passive employment in the high FMS group (72.3%) compared to the low FMS group (57.6%). No other questions relating to family characteristics were significant for girls.

Parental Behaviour

A significant difference between the boys' FMS groups was identified on the question relating to the type of activity the parent and child conducted together. In particular, this was shown for the variable relating to computer gaming (see Table 2). The low FMS group demonstrated the highest mean rank score across all the FMS groups here. A post hoc pairwise comparison revealed no further significant differences between any of the FMS group combinations. No other questions relating to parental behaviour were found to be significant in boys. For girls, a significant difference between the FMS groups was identified on the question relating to the frequency of parental physical activity per week. In particular, this was significant with the mother (see Table 2). A higher mean rank score was demonstrated for girls in the high FMS group over the low FMS group. No other questions relating to parental behaviour were significant for girls.

Table 1. Parental responses to Family characteristic questions of the PBQ for boys and girls FMS groups using Kruskall-Wallis and Mann-Whitney statistical analysis

Boys	FMS group mean rank			Kruskall-Wallis (*H*)	
Family characteristics question	Low (n = 29)	Inter (n = 160)	High (n = 66)	χ^2	*p-value*
Care of child prior / after school					
Father	114.59	126.30	138.01	2.605	.272
Mother	131.03	128.91	124.45	.450	.798
Grandparent	125.81	130.69	122.45	.743	.690
Other family	128.97	128.11	127.31	.022	.989
Babysitter	120.00	128.72	129.78	2.234	.327
School	138.67	128.13	123.00	2.231	.321

Girls	FMS group mean rank		Mann-Whitney (*U*)			
Family characteristics question	Low (n = 92)	High (n = 137)	*U*	Z	*p-value*	*r*
Care of child prior / after school						
Father	116.47	114.01	6156.50	-.290	.772	
Mother	121.63	110.55	5692.00	-1.878	.060	
Grandparent	103.76	122.55	7336.50	2.321	.020*	0.15
Other family	102.68	123.27	7435.00	3.217	.001*	0.21
Babysitter	114.20	115.54	6375.50	.360	.719	
School	111.16	117.58	6655.00	1.177	.239	

Note: PBQ = Parental Behaviour Questionnaire. * $P < 0.05$

Table 2. Parental responses to Parental Behaviour characteristic questions of the PBQ for boys and girls FMS groups using Kruskall-Wallis and Mann-Whitney statistical analysis

	Boys FMS group mean rank			Kruskall-Wallis (*H*)		Girls FMS group mean rank		Mann-Whitney (*U*)			
Parental behaviour questions	Low (*n* = 29)	Inter (*n* = 160)	High (*n* = 66)	χ^2	*p-value*	Low (*n* = 92)	High (*n* = 137)	*U*	z	*p-value*	*r*
Transport to/from school											
Public transport	126.88	131.56	119.86	4.019	.134	112.95	116.38	6491.00	.588	.557	
Bicycle	126.48	126.76	131.67	1.638	.441	118.19	112.86	6008.50	-1.612	.107	
On foot	130.44	125.99	131.81	.351	.839	120.93	111.01	5756.00	-1.168	.243	
Motorised	123.36	125.40	136.33	1.254	.534	110.68	117.90	6699.00	.843	.399	
School PA discussion with class teacher											
Father	127.03	127.93	128.60	.011	.995	109.76	118.52	6784.50	1.055	.292	
Mother	130.95	127.58	127.73	.057	.972	120.66	111.20	5781.00	-1.109	.268	
Parental involvement in child's play activities											
Calm play	146.53	128.63	118.33	3.566	.168	115.05	114.97	6297.50	-.010	.992	
Active play	130.95	128.24	126.13	.097	.953	116.26	114.15	6186.00	-.244	.807	
Creative play	140.38	126.11	127.15	1.071	.585	118.60	112.58	5971.00	-.703	.482	
Gaming	143.45	132.18	111.07	6.423	.040*	113.09	116.28	6478.00	.386	.699	
TV-viewing	143.26	127.63	122.18	1.785	.410	120.78	111.12	5770.50	-1.130	.259	
Books	146.17	122.41	133.58	3.310	.191	122.62	109.88	5601.00	-1.492	.136	
Dance activities	148.66	124.52	127.37	3.402	.182	118.04	112.96	6022.00	-.590	.555	

Table 2. Continued

Parental behaviour questions	Boys FMS group mean rank Low (*n* = 29)	Inter (*n* = 160)	High (*n* = 66)	Kruskall-Wallis (*H*) χ^2	*p-value*	Girls FMS group mean rank Low (*n* = 92)	High (*n* = 137)	Mann-Whitney (*U*) *U*	z	*p-value*	*r*
PA of parent and child together											
Spontaneous	137.24	126.83	126.77	.553	.759	110.88	117.77	6681.00	.805	.421	
At child's request	124.67	126.50	133.09	.485	.785	115.89	114.40	6220.00	-.174	.861	
Parent requirement	136.66	124.68	132.25	1.014	.602	117.65	113.22	6058.50	-.512	.608	
Frequency of parent PA											
Father	149.67	122.34	132.20	3.931	.140	109.96	118.39	6766.00	.973	.331	
Mother	141.74	122.62	134.99	2.603	.272	106.45	127.73	5131.00	2.479	.013*	0.16
Frequency to conduct activity with child											
Playground	138.45	129.97	118.64	1.988	.370	114.10	115.61	6385.00	.190	.849	
Forest	115.47	127.91	133.73	1.286	.526	119.17	112.20	5918.50	-.799	.424	
Park	134.02	129.18	122.51	.690	.708	115.40	114.73	6265.00	-.092	.926	
Walking pets	120.36	125.41	137.63	2.022	.364	121.13	110.88	5738.00	-1.288	.198	
Cinema/theatre	121.64	126.17	135.23	1.004	.605	110.18	118.23	6745.00	.926	.355	
Museum	135.03	127.47	126.20	.336	.845	112.66	116.57	6517.00	.455	.649	
Shops	119.28	132.48	120.98	2.405	.300	111.65	117.25	6610.50	1.056	.291	

Note: PBQ = Parental Behaviour Questionnaire; PA = Physical activity. *$P < 0.05$

Parental Beliefs

The question relating to the importance of developmental features to the child identified significant differences between boys' FMS groups on the variables of motor development, social development and participation in physical activity (see Table 3). Post hoc analysis revealed that for motor development, significant differences were observed between the low and both the intermediate and high FMS groups, $p = .023$, $r = .19$, and $p = .013$, $r = .29$, respectively. For social development, significant differences were again revealed between the low and both the intermediate and high FMS groups $p =.003$, $r = .23$, and $p = .010$, $r = -.30$, respectively. Finally, the physical activity variable revealed significant differences between the low FMS group and both the intermediate and high FMS groups respectively $p = .022$, $r = .20$, $p = .008$, $r = -.30$. No other questions relating to parental beliefs were significant in boys.

For girls, a significant difference between the FMS groups was identified on the question relating to the importance parents placed on the characteristics most salient to physical activity participation. In particular, significant differences were shown between the girls FMS groups on the social function and learning rules characteristics (see Table 3). For both variables a higher mean rank score value is observed for the high FMS group over the low FMS group. No other questions relating to parental beliefs were significant in girls.

Parental Awareness and Knowledge

A significant difference was identified between boys' FMS groups on the question relating to parent's awareness of their child's participation in after school physical activity. In particular, the frequency of participation in community sports clubs variable was significantly different between boys' FMS groups (see Table 4). The high FMS group demonstrated the highest mean rank score across all the FMS groups here.

Table 3. Parental responses to Parental Beliefs characteristic questions of the PBQ for boys and girls FMS groups using Kruskall-Wallis and Mann-Whitney statistical analysis

	Boys					Girls					
	FMS group mean rank			Kruskall-Wallis (*H*)		FMS group mean rank		Mann-Whitney (*U*)			
Parental belief questions	Low ($n = 29$)	Inter ($n = 160$)	High ($n = 66$)	χ^2	*p-value*	Low ($n = 92$)	High ($n = 137$)	*U*	z	*p-value*	*r*
Developmental aspects											
Cognitive development	111.29	132.27	124.98	3.519	.172	112.24	116.85	6556.00	.667	.505	
Social development	95.71	130.34	136.52	8.709	.013*	113.54	115.98	6436.50	.306	.760	
Motor development	95.26	132.26	132.06	11.100	.004*	108.27	119.52	6921.00	1.644	.100	
Participation in PA	97.83	129.64	137.27	9.414	.009*	109.64	118.60	6795.00	1.153	.249	
Healthy nutrition	127.78	129.05	125.55	.125	.939	115.68	114.54	6239.00	-.140	.889	
Sufficient sleep	110.50	132.04	125.89	3.277	.194	109.93	118.40	6768.00	1.246	.213	
Physical activity characteristics											
Enjoyment	127.62	126.77	131.15	.400	.819	113.66	116.38	6480.00	.588	.556	
Support motor development	126.53	127.87	128.96	.028	.986	114.59	115.27	6339.00	.085	.932	
Experiencing success	130.52	122.99	139.03	2.499	.287	113.90	115.74	6403.00	.215	.829	
Social function	112.84	127.47	135.95	3.017	.221	106.01	121.04	7129.00	2.012	.044*	0.13
Learning rules	114.53	132.69	122.54	3.198	.202	104.30	122.18	7286.00	2.376	.017*	0.16
Sport specific PA goals	120.84	124.60	139.39	2.526	.283	105.82	121.17	7147.00	1.859	.063	
Offering a variety of PA	124.14	122.96	141.92	3.849	.146	107.36	120.13	7005.00	1.580	.114	
High performance-winning	126.67	128.09	128.36	.013	.994	115.50	114.66	6256.00	-.098	.922	

Note: PBQ = Parental Behaviour Questionnaire; PA = Physical activity. * $P < 0.05$

Table 4. Parental responses to Knowledge and Awareness characteristic questions of the PBQ for boys and girls FMS groups using Kruskall-Wallis and Mann-Whitney statistical analysis

Knowledge/Awareness questions	Boys FMS group mean rank Low (n = 29)	Inter (n =160)	High (n = 66)	Kruskall-Wallis (H) χ^2	*p-value*	Girls FMS group mean rank Low (n = 92)	High (n = 137)	Mann-Whitney (U) U	z	*p-value*	*r*
Frequency of child's activity											
Calm play	157.45	124.32	123.99	5.919	.052	119.43	112.02	5894.00	-.876	.381	
Active play	106.86	127.59	138.27	4.599	.100	112.84	116.45	6501.00	.425	.671	
Creative play	145.38	125.32	126.86	2.005	.367	118.90	112.38	5943.50	-.757	.449	
Gaming	112.14	129.26	131.91	1.727	.422	114.37	115.42	6360.00	.121	.903	
TV-viewing	130.97	132.05	116.88	2.298	.317	116.38	114.07	6175.00	-.271	.786	
Books	123.88	125.38	136.15	1.163	.559	123.90	109.02	5483.00	-1.735	.083	
Dance activities	134.34	126.15	129.70	.411	.814	115.21	114.86	6283.00	-.040	.968	
Frequency of child play											
Indoors	119.83	133.67	117.85	3.314	.191	114.38	115.42	6359.00	.130	.897	
Outdoors	107.24	127.48	138.39	4.626	.099	115.67	114.55	6240.00	-.140	.889	
Frequency of child's play with contemporaries											
Indoors	121.02	131.41	122.81	1.032	.597	119.11	112.24	5923.50	-.809	.418	
Outdoors	104.19	131.09	130.97	4.163	.125	113.77	115.82	6415.00	.249	.803	
After school PA participation											
After school sport club	105.36	130.18	132.66	3.790	.150	110.25	118.19	6739.00	.946	.344	
Swimming club	129.71	121.17	143.80	4.942	.085	108.33	119.48	6915.50	1.310	.190	
Sports camps	123.84	123.82	139.95	3.256	.196	108.62	119.28	6885.50	1.530	.126	
Community sport clubs	95.48	127.97	142.37	9.411	.009*	111.99	117.02	6579.00	.625	.532	
Other	119.34	126.94	134.38	1.297	.523	114.96	115.03	6306.00	.009	.992	

Note: PBQ = Parental Behaviour Questionnaire.; KA = Knowledge and awareness; PA = Physical activity. * $P < 0.05$

Post hoc analysis revealed a significant difference between the low FMS and the high FMS groups, $p = .006$, $r = -.31$, but not between any other group combination. Also in boys, parental knowledge of the child's activity preference revealed a significant association between FMS groups (see Table 5). Comparisons between these groups revealed that parents of boys in the high FMS group had greater awareness of their child's physical activity preferences (97%) compared to the intermediate group (90.6%), and the low group (75.9%). In girls, no parental awareness and knowledge questions were found to be significant (Table 4).

Discussion

The purpose of this study was to investigate the potential associations between parental behaviours and levels of FMS proficiency in primary school children in South East Wales. For boys and girls, the findings highlighted significant relationships between some aspects of parental behaviours and beliefs and FMS proficiency. The different levels of FMS ability were also related to features of parental knowledge/awareness in boys and family characteristics in girls. These parental physical activity behaviours and beliefs therefore have the potential to impact on children's future FMS proficiency and subsequent engagement in lifelong physical activity.

The influence from family and in particular the provision of care afforded by grandparents and other family members prior to and after school were significantly associated with girls' FMS performance. In both instances, the parents of girls in the high FMS proficiency group indicated that their daughters spent more time with grandparents and other family members during these periods. These findings support the previous work of Brustad (1996), and Weigand, Carr, Petherick, and Taylor (2001), who suggested that a variety of other family members apart from parents are profoundly influential in shaping goal orientations of physical activity with children.

Table 5. Categorical PBQ responses of parents for boys and girls using Pearson's chi-square statistic

	Boys				Girls			
PBQ questions	χ^2	*df*	*p-value*	φ	χ^2	*df*	*p-value*	φ
Family characteristics questions								
Duration of childcare								
Pre-school	.710	2	.952		.208	1	.929	
After-school	1.004	2	.915		3.693	1	.164	
Other siblings residing at home								
Older brothers	2.584	2	.287		2.743	1	.105	
Younger brothers	1.444	2	.491		.361	1	.564	
Older sisters	1.339	2	.524		.301	1	.661	
Younger sisters	.772	2	.711		.019	1	.501	
Family structure at home	2.800	2	.582		.316	1	.889	
Parent employment status								
Father	.100	2	.979		7.116	1	.008*	.178
Mother	.126	2	.979		5.254	1	.023*	-.152
Contract of employment status								
Father	1.106	2	.913		5.286	1	.075	
Mother	9.091	2	.057		4.795	1	.090	
Knowledge/awareness questions								
Awareness of child's PA Preferences	9.368	2	.008*	.203	.533	1	.517	

Note: PBQ = Parental Behaviour Questionnaire.; PA = Physical activity; * $P < 0.05$

As a function of cognitive development children rely most heavily on parental and significant other family adult feedback to judge personal competency and during childhood a significant proportion of time is spent within this family context. In addition, the child has not yet developed firm social contacts outside the family unit and therefore, family are the biggest influence on the child's effort, enjoyment and interest for physical activity (Carr, Weigand, & Jones, 2000). For various reasons beyond the scope of this discussion, many parents rely on the support of grandparents and other family members to assist with the upbringing of their child prior to and after the school day. Therefore, providing the appropriate and supportive environments from grandparents and other family members during this time may be profound in enhancing FMS proficiency and physical activity within girls. This maybe particularly relevant for girls as parenting goals, strategies and practices related to physical activity are very much gender stereotyped (Wheeler, 2012). Several studies (Brustad, 1993; Fredericks & Eccles, 2004) have observed that the support afforded towards physical activity from family members tends to favour boys' physical activity participation. It is perceived that boys' are more able and willing in physical pursuits and therefore there is a greater desirability for supporting boys' participation in physical activity rather than girls.

The significant association between parents' occupational status with girls' FMS ability in this study supports findings reported by Gottileb and Chen (1985), who found that fathers' occupation status was significantly related to physical activity levels in children. In addition, Yang, Telama, and Laakso (1996) demonstrated a significant association between levels of parental employment status (with either parent) and sustained physical activity levels of girls aged 9-12 years. In contrast, Cools et al. (2011) and Krombholz (2006) found no significant associations between parental occupation status and children's movement skill performance, albeit with younger school children. Further analysis of these significant variables in this study revealed that the fathers of girls with high FMS ability demonstrated a higher active employment rate than fathers of girls with low FMS ability. Therefore, a potential explanation for this proficiency difference may be that less actively employed fathers through the economic hardships of daily life (e.g., low income and unstable work) may experience additional economic pressures, become consumed by their economic problems, have less financial resource to engage their child in organised physical activity and therefore become less involved in their children's daily activities (Lee, 2009). Of interest, the participants in this study were from unitary authorities of South East Wales where 72% of its area falls within the most deprived half of Wales (Welsh Government, 2014). The domains included in this multiple deprivation index included those of income, employment, health, education, access to services, community safety, physical environment and housing. Although it must be noted that caution is needed here as an examination of several of these socioeconomic factors did not form part of this study and therefore no further comparisons can be drawn.

In contrast, in this study, the mothers of girls with high FMS ability demonstrated a higher passive employment rate than mothers of girls with low FMS ability. The higher FMS ability of children with passive mothers may be helped somewhat due to these mothers being salient socialization agents for their children at this age range, perhaps because they are most likely to be involved in the day-to-day activity choices of their children (Brustad, 1996; Fredericks & Eccles, 2004). Conversely, the busy working patterns of many mothers may result in them not having the time to engage with their children in physical activity, monitor their child's inactivity or make arrangements for the child to be able to engage in organised physical activity (Lee, 2009).

Specific parental behaviours and their potential to influence a child's FMS development are also evident in this study. In particular, the amount of computer gaming activity conducted by the parent and child together each week was significantly related to boys' FMS proficiency. Boys with low FMS proficiency spent the most time in this type of sedentary activity with the parent and those with high FMS proficiency the least, although follow up analysis failed to distinguish specific differences between the groups. Nevertheless, it has been suggested by Cools et al. (2011) and Kohl and Hobbs (1998) that greater involvement in sedentary activities such as TV-viewing, playing computer games and reading books may limit a child's FMS performance. Indeed, such evidence suggests that this might plausibly reflect the effect of missing the opportunities to adequately engage in and develop FMS and therefore potentially hinders their subsequent ability to adequately perform various types of physical activity. Significantly, Hardy et al. (2010) highlighted that on weekend days, eighty percent of primary school children spend more than two hours on small screen recreation with this prevalence consistently higher among boys. In addition, approximately half of parents of primary school aged children were not aware of the recommended guideline for children's screen time. Consequently, the increasing prevalence of this type of sedentary activity, the continued willingness of parents to frequently interact and encourage this type of behaviour with their child could develop a social norm where children consider this type of sedentary behaviour as acceptable. Critically, this could be most detrimental to the development of FMS and a young child's initial and future engagement in physical activity.

The present study identified that the frequency of physical activity behaviour undertaken by mothers on a weekly basis and girls' FMS was significant. It was clearly shown that the mothers of girls with high FMS levels reported a higher mean rank score here, which therefore suggests that the mothers of these children participate in more physical activity each week. In support of this finding, Aarnio, Winter, Kujala, and Kaprio (1997) found a significant difference between very active mothers and inactive mothers and their daughters' physical activity level (i.e., very active mothers were more likely to have active daughters) and more recently Bailey, Cope, and Parnell, (2015) highlight that children with active mothers have been found to be twice as likely to be active when compared with children of inactive mothers. Additionally, it appears that mother's physical activity behaviours may have a more pronounced influence and support on their daughter's physical activity than on their sons at this age (Gustafson & Rhodes, 2006). Furthermore, children who perceive their mother and/or father to be physically active (i.e., role models) are more likely to engage in physical activity and develop FMS themselves (Edwardson & Gorely, 2010). Therefore, the study would suggest that to facilitate physical activity and enhance movement competency for children aged 6–11 years, particularly girls; mothers may need to be more directly involved in participation themselves.

It is evident in this study that the beliefs and importance parents attached to certain developmental aspects in rearing children significantly impact on FMS proficiency. In boys, the variables of motor development, social development and participation in physical activity were significant. The parents of boys in the high FMS group presented higher values for each of these aspects. This evidence supports the work of Cools et al. (2011), who suggested that the importance parents place on key developmental aspects in childhood may impact on their child's FMS performance. Indeed, Faigenbaum et al. (2013) further highlighted that many parents of inactive children or children with low motor competence either wrongly believe, or are unaware of, specific recommendations for developing physical activity and healthy lifestyles. In girls, the importance parents placed on variables of social function and learning rules were found to be significantly associated with FMS competency. In each instance the girls with high FMS competency demonstrated the highest values. Jago, Page, and Coopers (2012) suggested that having a sound social support network for girls in physical activity was associated with higher levels of physical activity. Bailey et al. (2015) advocate further that providing opportunities to be with friends, developing close relationships and gaining recognition and social status seem to be motivations associated with this heightened physical activity trend. In addition to enhancing social support the other significant variable of importance in girls was the focus of attention parents placed on the learning of games and sports rules. It has been suggested by Green (2004), that if girls are afforded the opportunity to grasp a basic understanding of sports games and how activity is supposed to be played opposed to the focus on the competitive element more commonly promoted it may, in turn, develop greater confidence to participate in physical activity, enhance social function and develop their FMS.

Parents can play a significant role in a child's FMS development by having an awareness of the type of physical activity that their child engages in, the resources they have access to and an understanding of their importance (Welk, Wood, & Morss, 2003). Within this study awareness by parents of the frequency of participation in extracurricular activity was of significance in boys. In particular, there were significant differences between the boys FMS proficiency groups and their attendance at community sports clubs with boys in the high FMS group demonstrating a higher frequency of attendance. Parry (2013) suggests that children who are encouraged and supported to be physically active outside school develop better skill competence (i.e., FMS), gain enhanced confidence in their ability and develop healthy sporting habits. In addition, much of the existing literature suggests that parents are solely responsible for influencing children's physical activity participation outside of the school environment, often through enrolling them in sports clubs, or influencing their decision to start participating (Light, Harvey, & Memmert, 2013). It has therefore been suggested by Bailey et al. (2015) that the parents of such children may have developed an understanding and awareness of the importance participation in such extracurricular activity brings. It was also shown in this study that parents' knowledge and awareness on the type of sport or activity preferred by their child was significant in boys. The parents of boys with high and intermediate FMS proficiency demonstrated greater knowledge of which sports or games activities their child liked to play than those of low FMS proficiency**.** In order to develop a child's FMS and maintain their interest in physical activity it may therefore be seen that a key factor for parents would be to develop an understanding of which physical activity pursuits their child particularly enjoys doing and is most suited to, as opposed to a sense of their own and the community's perceptions of which activities are most suitable, valuable and acceptable (Bailey et al., 2015).

The present study had several limitations. Primarily, it is possible that the data may be affected by recall bias and social desirability responses; consequently, some effects might be undetected and others might be exaggerated. Secondly, questionnaire responses are from only one parent in each household. Fathers and mothers might not share similar appraisals of their child's aptitudes and abilities and it is likely that one parent might be more influential in shaping the child's achievement-related beliefs than the other. A related limitation pertains to the fact that it may be possible that on some occasions the mother and father may have completed the questionnaire together. Thirdly, the relationship between parental variables and children's FMS performance represents only one step in understanding how parental behaviour influences primary school children's FMS. For example, factors other than those considered in the present study (i.e., socioeconomic status and environmental characteristics) could be involved in the relationship between parental behaviours and beliefs on children's FMS proficiency. Finally, it is important to note that due to sample size some of the questions generated small sub groups for comparisons.

Conclusion

As is evident, parents have significant potential to influence the development of their child's FMS. It is important that parents develop a heightened awareness of the potential impact their actions and behaviours may have in developing either positive or negative aspects of FMS and physical activity with their child. Therefore, in boys, it may be important to educate parents on specific guidelines, particularly those of sedentary pursuits such as TV/gaming. In addition, parental education highlighting the benefits and importance of developing a bank of motor competencies (i.e., FMS) and the social aspects of physical activity participation (i.e., enjoyment, being with friends) as opposed to the competitive element, which is more commonly promoted (Green, 2004). Parents of children with lower FMS may also be encouraged to enhance and provide wider opportunities for their child to experience physical activity through increased community sports club participation with the child being central to the decision on activity choice. In girls, the role of the extended family is seen as an important component in supporting beliefs and behaviours of physical activity within the child's overall development. In addition, mothers as role models are important in effectively demonstrating frequent physical activity behaviour especially with daughter and ensuring time is spent by either parent on frequent interaction in a variety of physical activity together. Also, the parents of girls with low FMS may provide enhanced opportunities for their child to develop greater social interaction with friends and other family in semi/structured and structured physical activity to encourage sustained participation.

It is important to bear in mind that identifying those children with poorer FMS and their parents who may require support is critical. Wheeler (2012) highlights that many current measures to promote physical activity participation are most likely (if not restricted) to impact upon the section of the population in possession of some form of sporting predisposition, and highly unlikely to impact upon the section without. Therefore, identifying, educating and encouraging these children and their parents to enhance their awareness, attitudes and behaviour towards FMS and physical activity could positively impact on future physical activity trends. In conclusion, the outcome of this study demonstrates that different parental processes have the potential to influence children's FMS performance and their impact could be given greater consideration in interventions to improve children's FMS.

Chapter 6

Summary and concluding comments

Introduction

The purpose of this final chapter is to synthesise the findings of the thesis. The chapter is divided into five sections: (a) a synopsis of the aims and major findings of the research programme, (b) a discussion of the major findings and conceptual issues that emanated from each study and the overall thesis, (c) the practical implications derived from the research, (d) the strengths and limitations of the research programme, and (e) recommendations for future research.

Synopsis of the Aims and Major Findings of the Thesis

The purpose of this research was to explore the physical literacy attributes of primary school children in South East Wales with a specific focus on their relationship with fundamental movement skills (FMS) motor behaviour competency. At present there is a dearth of sufficient data and literature in relation to FMS proficiency worldwide; although in Wales, as far as the author is aware, there is a noticeable absence of data in relation to children's FMS proficiency clearly indicating a gap within the literature. Of greater significance was the interpretation and subsequent profiling of FMS proficiency, which varies with each assessment tool adopted in the many studies conducted across the world. It has been suggested that the development of FMS is a key factor in the promotion of lifelong physical literacy; therefore, due to its importance, a more precise classification of FMS proficiency has been called for in the literature. Physical literacy is conceived to be the result of the multidimensional interaction between FMS and several other domains (physical fitness, physical activity, psychology and socialization) to facilitate lifelong healthy active living behaviours in children and youth (Lloyd & Tremblay, 2011). Thus far, the research on physical literacy is still in its infancy and has focused mainly on relationships among FMS and selective markers of physical literacy. To understand best practice for developing physical literacy a gap in the literature exists to examine which physical literacy domains have the potential to discriminate FMS performance in primary school aged children. Therefore, the aims of this thesis were to: (a) examine the factor structure of the Children and Youth Physical Self Perception Profile based on the validation work of Welk and Eklund (2005) to determine its use as a valid measure of physical self-perceptions and as a psychometric marker of physical literacy with this population and for subsequent use in this thesis; (b) establish the current levels of FMS proficiency (i.e., locomotor, manipulative and stability skills) and associated measures of physical literacy (i.e., physical fitness measures, physical activity behaviour recall, psychological perceptions and parental socialisation) in South East Wales primary school children; (c) utilise cluster analysis to group participants based on their FMS performance as an alternative to the typical sum of scores classification and also to utilise the decision tree induction method to identify the defining features of each FMS that clearly distinguished FMS group memberships; (d) identify which of the associated measures of physical literacy discriminate between these FMS groups and discuss their possible implications, (e) identify the relationship between parental socialisation behaviours (i.e., family characteristics, parental behaviours, beliefs, knowledge and awareness) and their child's FMS performance. These aims and the major findings were established in three empirical studies and are therefore discussed in further detail below.

Study 1

The first study of this thesis set out to directly test the factorial validity of Eklund, Whitehead, and Welk's (1997) Children and Youth Physical Self Perception Profile (CY-PSPP) for use with a cohort of primary school children in South East Wales. Research has highlighted that the CY-PSPP is an established measurement tool for use with children and adolescents although it has been suggested that the validation process of a questionnaire requires ongoing work (Crocker, Eklund, & Kowalski, 2000). In particular, the psychometric properties of the CY-PSPP using different populations, such as those in this thesis, should be further scrutinized to expand the validity evidence base for the measure (Crocker et al, 2000; Fox, 2000). In addition, consistent with the recommendations of others (Fox, 1990; Eklund et al., 1997), it is advisable to validate the psychometric properties of the CY-PSPP by gender. Further, the validation of the CY-PSPP with this population will hopefully expand its application in the examination of children's and youth's self-perceptions for physical health and identify potential correlations of self-perceptions with other physical literacy outcomes such as physical activity, physical fitness and psychological well-being (Kolovelonis, Mousouraki, Goudas, & Michalopoulou, 2013). Therefore, confirmatory factor analysis was employed to specifically evaluate the utility of the hierarchical factor structure of the measurement model for this population. In addition, invariance analysis was included to identify if the model fit differed between genders.

The results from the study confirmed the validity of the CY-PSPP for use with this population. In particular, the confirmatory factor analysis supported the hierarchical structure of the CY-PSPP model and revealed no invariance between genders. Correlations between CY-PSPP domains were moderate to strong and exhibited the expected pattern of relationships. All factor loadings in all analysis of the measurement model were significant ($p < 0.001$) and yielded a clean factor structure. Inter correlations amongst the CY-PSPP sub domains demonstrated no cross loadings among the factors. Therefore, in conclusion, the CY-PSPP demonstrated valid psychometric properties for use in future research with both genders in this population and in particular as a valid measure for the psychometric domain of physical literacy for use in the subsequent chapters of this thesis.

Study 2

The purpose of the second study in this thesis was to identify selected physical literacy attributes and FMS motor behaviour competency of primary school children in South East Wales with a specific focus on the relationship of the physical literacy variables with

FMS motor behaviour competency. The early development of FMS is considered a key determinant of physical literacy, which in turn may influence a future physically active lifestyle (Whitehead, 2007). Of note, the measurement and interpretation of these FMS has been inconsistent among studies that have been conducted to date, making comparisons between studies difficult. Many (e.g., Barnett, Morgan, Van Beurden, Ball, & Lubans, 2011; Cohen, Morgan, Plotnikoff, Barnett, & Lubans, 2015; Williams et al., 2008) classify FMS performance on the grouping of individual skills into distinct categories (i.e., locomotor and object control skills scores), or provide an overall FMS competency score for each individual. The pooling of scores into these distinct categories may therefore be limiting our knowledge of an individual's skill performance. As such, Cools, De Martelaer, Samey, and Andries (2009) suggested that caution needs to be applied when interpreting a child's FMS performance based on these results as individual skill variation is being overlooked and is potentially thwarting future developmental-specific differences within FMS interventions. In an attempt to address these limitations, an alternative method of classifying FMS proficiency based upon cluster analysis was adopted for use in this study. It was hypothesised that cluster analysis would provide a distinct categorization of groups, specific to gender, who displayed similar characteristics across all the FMS task scores. In addition, specific FMS that differentiated between these groups would also be identifiable through the use of the decision tree induction method.

Along with FMS, the domains of physical fitness, physical activity behaviours, psychological perceptions and socio-cultural factors are considered important to physical literacy (Loitz, 2013). Although these domains are (theoretically and practically) distinct they do have interlinking constructs that have the potential to impact on FMS and on the physical literacy development of a child (Lloyd, Colley, & Tremblay, 2010). A key focus of this study was therefore on the relationship between FMS proficiency and these related physical literacy variables. More specifically, the study sought to establish which aspects of physical literacy best differentiated the FMS groups in this population.

The findings from study 2 highlighted that the prevalence of FMS proficiency among 9-12-year-old Welsh primary school children was low in both boys and girls. Generally, children demonstrating higher levels of FMS proficiency also demonstrated better performance across all of the associated physical literacy measures. Distinct groups of varying FMS skill proficiency were established for boys (3 groups) and girls (2 groups). It was identified that the vertical jump, overhand throw and the leap were the FMS tasks that best differentiated the boys FMS groups. In girls, the static balance was the FMS task that best differentiated between these FMS groups along with the FMS of catch, vertical jump and leap although these contributions were much smaller. It was shown that several physical literacy variables significantly discriminated between these FMS performance groups in both genders ($p < .05$, $r > .40$). In particular, physical literacy measures of physical fitness were significant predictors of FMS proficiency in both genders. This included cardio-respiratory fitness and lower body musculoskeletal strength in boys and girls in addition to upper body musculoskeletal strength in girls. Other significant physical literacy variables included physical activity behaviour as a prominent predictor for girls whereas for boys, the physical competence subscale of the CY-PSPP was prominent.

Study 3

The third study investigated the potential associations between the socio-cultural behaviours of parents and levels of FMS proficiency in primary school children in South East Wales. These socio-cultural behaviours relate to the parents as being the most proximal socialisation agents in relation to FMS development and physical activity. It has been suggested by Rudd (2015) that the best chance of improving children's FMS lies with parents and care-givers as they introduce and guide children through development stages of movement skills. The focus of attention in this study was therefore on the family characteristics and parental behaviours, beliefs, and knowledge and awareness of their child, in relation to their child's FMS development. Parents self-reported on their parental behaviours and these responses were matched to their child's FMS group classification which had been pre-established based on their FMS task scores in study 2.

The findings from study 3 highlighted significant relationships between some aspects of parental behaviours and beliefs and FMS proficiency in both boys and girls. The different levels of FMS ability were also related to features of parental knowledge/awareness in boys and family characteristics in girls. Such parental socialisation behaviours may therefore have the potential to impact on children's FMS proficiency and their future physical activity trends.

Discussion of Major Findings

The following section will discuss the main conceptual and theoretical issues that emerged from the research programme. These include (a) the importance of a validated physical self-perception profile for use with this population (b), the identification and prevalence of FMS differentials in this population utilising a more appropriate method to classify FMS groups, (c) the ability of physical literacy variables to discriminate between FMS performance groups in both genders, and, (d) the impact of parental behaviours and beliefs on FMS performance.

The validation of the CY-PSPP as a comprehensive measure of the psychometric properties of physical literacy is highly important to this thesis. In order to develop an accurate assessment of physical literacy it is essential that the potential domains (e.g., psychometric) have precise and accurate measures in place. In this thesis the participant's ages ranged from nine years upwards; therefore, it was important to establish a measure that was valid with young children. Although the CY-PSPP measure has previously been validated and extensively used in research with children as young as nine years old (Welk & Eklund, 2005) there have been some mixed results with different cultural populations (Biddle et al., 1993; Hagger, Ashford, & Stambulova, 1998). It has been suggested by Fox (2000), and Kolovelonis et al. (2013), that the validation process of the questionnaire instrument requires ongoing work and the psychometric properties of the CY-PSPP, using different populations especially young children, should continue to be scrutinized to expand the validity evidence base for this measure.

In particular, the debate on the validity of the instrument has centred on the structure and complexity of the alternative response format questionnaire for use with young children (i.e., children as young as nine years of age). The CY-PSPP uses a non-standardized response format based on the work of Harter (1985). The use of this response format is designed to reduce the influence of social desirability. Previously, Eiser, Eiser, and Haversmans (1995), and Lindwall, Asci, Palmeira, Fox, and Hagger (2011) have raised concerns over this format suggesting that the reading ability and cognitive maturity of younger children makes it difficult for them to fully interpret and understand this questionnaire and therefore affects the validity of the instrument. In addition, debate has centred on the inability of young children to distinguish between the different dimensions of physical self-perceptions of the CY-PSPP at this age. As a result, Welk et al. (1997) has suggested that there is potential for cross loadings on these CY-PSPP dimensions with children of this age therefore limiting its use.

The validation work in study 1 has explicitly addressed such concerns and the recommendations of Fox (2000) and Kolovelonis et al. (2013) on the validity of the CY-PSPP prior to its use with different populations. The confirmatory factor analysis clearly supported the hierarchical structure of the CY-PSPP and yielded a clean factor structure for this model. This in turn clearly demonstrated understanding of the CY-PSPP non-standard response scale with the younger children in this population. To ensure its effectiveness, the author suggests following Marsh, Barnes, Cairns, and Tidman's (1994) recommendation of providing detailed and adequate instruction when administering the CY-PSPP profile questionnaire with younger children. The study also demonstrated inter-correlations amongst the CY-PSPP sub domains showed no cross loadings amongst the factors. It clearly shows that children from this population (i.e., Welsh primary school children) are able to judge themselves differently according to the physical domains of their lives being addressed (Harter, 1985; Marsh et al., 1984) and are hierarchically related to more global perceptions of physical self-worth and global self-worth. As the CY-PSPP was to be used to compare relationships with other variables later in this thesis it was important to separate perceptions by gender for comparisons. Welk and colleagues (2005) highlight that in order to facilitate the use of the CY-PSPP with other variables (i.e., domains of physical literacy in this thesis) it is important to separate perceptions by gender sensitivity for any such comparisons. It has also been suggested by Hagger, Biddle, and Wang (2005) that given the support for the invariance of model structure, researchers can be confident that any variance in the model intercept and factor means are not therefore confounded by structural discrepancies. The measurement invariance approach via multi-group confirmatory factor analysis of the CY-PSPP model in the study displayed equivalence of measures across different groups with no measurement bias, therefore supporting its use of physical self-perceptions across gender in this population. This validation work presented in study 1 clearly confirms the use of the CY-PSPP as a reliable measure of the psychometric properties of physical literacy with Welsh primary school children and for use in examining relationships with other physical literacy variables in subsequent chapters of this thesis.

It has been suggested by Hardy, King, Espinel, Cosgrove, and Bauman (2010) that the majority of children should have mastered the less complex FMS (i.e., sprint run, vertical jump, catch, side gallop and over-arm throw) by age nine and more complex FMS (i.e., leap and kick) by age ten. It therefore seems logical to suggest that all basic movement patterns be mastered by early adolescence (12 years old) and on transition to secondary school where traditionally more complex skill combinations (i.e., sport specific) are being promoted (O'Brien, Belton, & Issartel, 2015). In study 2, the overall levels of FMS competency demonstrated by both boys and girls was identified as low and is not dissimilar to levels demonstrated in other UK based studies with primary school aged children (Bryant, Duncan, & Birch, 2013; Foweather, 2010). This low prevalence of skill proficiency is worrying given the importance of FMS role in enhancing physical literacy and promoting health. There is therefore significant potential to improve FMS among children of primary school age in the UK and Wales.

As FMS provide the foundation to physical literacy, children of early to mid-primary school age need to be provided with sufficient exposure and opportunities for practice and instruction of FMS. It is a common misconception that children just naturally acquire FMS as a normal function of play and getting older therefore the development of a child's movement skill must be taught and practiced with appropriate attention to detail (Goodway, Ozmun, Dieringer, & Lee, 2013). More specifically, as children develop these movement skills at different rates, it is important to accurately assess each child and identify those at risk of developmental delay in individual skills. The use of an alternative classification of FMS in this thesis provided a distinct categorization of groups in both genders displaying varying levels of motor competence. In addition, specific FMS that differentiated between these groups were identified. In boys, three cluster groups were established with the FMS of vertical jump, overhand throw and leap identified as the FMS that best differentiated the groups. The FMS of the side gallop; static balance and catch also featured but to a lesser extent. The FMS of the run and kick made no contribution between the groups. Across the contributing FMS, the high cluster group were shown to be the most proficient FMS group with the intermediate group demonstrating lower performance than the high group but better performance than the low group. In girls, two cluster groups were established with the FMS of static balance being the most significant skill to differentiate the groups. The FMS of the catch, vertical jump and leap also featured but their impact was to a lesser extent. The FMS of the run, side gallop, kick and overhand throw made no contribution between the groups. Across the contributing FMS, the high cluster group were shown to be the most proficient FMS group.

Adopting hierarchical cluster analysis and subsequent decision tree induction to establish FMS proficiency as adopted in this study may provide a more comprehensive framework for future FMS classification. To be more specific, utilising a multivariate approach (i.e., cluster analysis) to group children specific to gender and based on their FMS proficiency scores across the full range of FMS tasks in this study ensured all the information was retained. As a result, individuals who displayed similar characteristics across the range of FMS tasks were appropriately clustered together to form definitive groups. Further, the use of decision tree induction allowed for closer analysis of these FMS cluster groups to identify the defining features on each FMS that clearly distinguished FMS group memberships. A significant advantage in the use of decision tree induction is its ability to establish a hierarchical solution to classification of large data sets with many attributes (Morgan, Williams, & Barnes, 2013). This novel and innovative form of FMS classification clearly provides precise evidence of FMS proficiency in primary school children with specific reference to individual skill differentials. Therefore, in practice, this may provide practitioners with sufficient information to ensure children are exposed to the appropriate teaching of skill development (i.e., developing, consolidating and challenging phases) for enhancing their FMS proficiency. In addition, targeting individual FMS with specificity to gender may also assist this development process. Many different tools to assess FMS proficiency are available during childhood and vary in the way they report FMS proficiency. Cools et al. (2009) have suggested that many focus too heavily on the sum of scores based on distinct categories of motor competencies (e.g., locomotor skills, manipulative skills and both these categories combined). They suggest that as a consequence, children with less than adequate proficiency levels in certain individual skills may have been misclassified as proficient under these pre-determined categories of motor competencies. As a consequence of such classifications it could be seen that children are propelled towards more complex individual FMS tasks or those that require a combination of these skills (e.g., catching and throwing manipulative skills) during active play or organised activities. Such activity may therefore break down due to the inadequacies in specific individual skills that require greater focus but may still continue to go unnoticed (Tompsett, Burkett, & McKean, 2014). A more precise interpretation of FMS proficiency as proposed in this study is therefore critical for assessing and shaping any future pedagogical decisions for physical literacy in children.

Enhancing physical health has been identified as a complex interaction of multiple factors with mounting evidence to suggest that the domains of physical literacy are related to each other underpinned by FMS ability (Lloyd et al., 2010; Ford et al., 2011). If the primary objective of physical literacy is lifelong physical activity (i.e., a positive trajectory of physical health) facilitated by physical skills proficiency (i.e., FMS), then being able to identify which physical literacy constructs discriminate children's FMS performance is key. The discriminant analysis of the FMS proficiency groups in this study established that several measures of physical fitness were significant predictors of FMS proficiency in boys' (MSFT, SLJ, and Sprint) and girls' groups (MSFT, SLJ, HG, and Sprint). For girls only, the physical behaviour recall measure was also significant predictor of FMS performance. For boys, analysis of the physical self-perception profile identified the physical condition sub scale to be a significant predictor. It has been suggested by Longmuir et al. (2015) and Tremblay and

Lloyd (2010) that the collective development of a number of identifiable physical literacy components is crucial if physical literacy is to become a key outcome of children's physical activity experiences. Stodden, Gao, Goodway, and Langendorfer (2014) further suggest that developing higher levels of FMS require the development of higher levels of physical fitness components (i.e., cardiovascular fitness and musculoskeletal strength), which in turn increases motivation and confidence to participate in various physical activity and may promote either a positive or negative trajectory of physical health of children over time.

Lloyd and Oliver (2012) suggest that during childhood many components of physical literacy (i.e., FMS and physical fitness) are trainable simultaneously and should not be restricted to specific windows at various stages of development (e.g., LTAD). Kriemler et al. (2011) also highlight that single component approaches to developing physical literacy are less effective than multi-component interventions. At present, several national governing bodies and national sports development policies within the UK and globally, interpret physical literacy with children as to what is contained within the LTAD framework and subsequently constrained to the sole development of FMS by a predetermined age (i.e., adolescence). This narrows the focus to nothing more than the regurgitation of a number of sport specific technical drills and tactical skills that impact on the development of children's FMS and does not necessarily lead to a positive trajectory in the development of physical literacy. Future interventions should therefore consider identifying specific components of physical literacy that discriminate FMS performance in children and target their improvement alongside FMS. This in turn may promote a more rounded appreciation towards the developing of physical literacy, appeal to children of varying physical abilities (not just those of sporting disposition) and possibly promote a more positive trajectory of physical health.

Of interest, BMI (classified as part of physical fitness/ health-related fitness in this thesis) failed to discriminate the FMS performance in either gender. This finding is consistent with the works of Freitas et al. (2015) and Hume et al. (2008) who also failed to find an association between BMI and FMS proficiency in children. On the contrary, it has widely been noted that elevated BMI has a negative impact on FMS performance in children (D'Hondt et al., 2011; Gentier et al., 2013; Lopes, Stodden, Bianchi, Maia, & Rodrigues, 2011). Within the UK comparable evidence is sparse and many significant studies have been conducted with children in Australia and America who have cultural, environmental and curriculum differences. In addition, due to the variation in FMS assessment tools used in such studies (i.e., either product or process based outcomes) the impact of BMI on FMS proficiency remains uncertain.

The interaction of BMI and FMS is probably more relevant in process based assessments, which are based on promoting developmental aspects of FMS, rather than focusing on outcome scores (e.g., time, distance, successful strikes). Unfortunately, of those studies to have focused on the developmental aspects of FMS with BMI several have tended to utilise a limited selection of FMS for comparison and have included a significant proportion of locomotor skills (e.g., sprint run, leap, side gallop). These FMS require greater whole body coordination and are generally harder to master than other FMS (e.g., manipulative skills of throwing, catching etc.) in overweight children (Lopes et al., 2011). To further understand the impact of BMI on FMS proficiency a more representative sample of locomotor and manipulative FMS is therefore proposed for use in any future intervention. In addition, and most recently, Freitas et al. (2015) have suggested that FMS proficiency is probably more dependent on neuromuscular development and motor coordination independent of body mass. Freitas et al. further suggest that the negligible contribution of BMI to variance in FMS proficiency implies important roles for other factors affecting movement development and proficiency. These likely factors involve neuromuscular development, maturation, environmental conditions related to home, habits of outdoor play and physical activity and specific instruction and practice in school PE and sport (Malina, 2012). Therefore, although BMI failed to discriminate FMS performance in this thesis, its continued scrutiny with physical health suggests it will continue to play an important role in developing physical literacy throughout the life course.

There is a considerable amount of scholarly work that considers physical activity behaviours to be largely constrained by social and cultural structures of the family (Evans & Davies, 2012; Green, 2012). In this thesis, these aspects were related to features of family characteristics, parental behaviours, parental beliefs and knowledge and awareness. The findings from study 3 highlighted significant relationships between some aspects of these constructs and FMS proficiency in both boys and girls. In each of these significant outcomes the children of parents surveyed with low FMS proficiency scored most poorly.

Relating to features of family characteristics the influence from family and in particular the provision of care afforded by grandparents and other family members prior to and after school were significantly associated with girls FMS performance. It has been suggested by Bailey, Cope, and Parnell (2015) that adult beliefs (e.g., of grandparents and other significant family members) often express cultural norms and prejudices that may be strictly delineated according to gender and therefore such norms may significantly influence the child's goal orientation, effort, enjoyment and interest for physical activity. Further, Hively and El-Alayli, (2014) suggest that children, and in particular girls, who experience such gender biased expectations tend to underperform at physical tasks (e.g., FMS) especially when they are reminded of negative performance expectations of their gender (e.g., "throw like a girl") from significant others. It must be noted that societal stereotypes regarding lower expectations for female athleticism continue to be salient, thus impacting on their physical performance (Hively & El-Alayli, 2014). Therefore, although there are many benefits to the provision of daily childcare from grandparents and other family members, this care provision may unknowingly be impeding the child's physical development.

Specific parental behaviours such as the frequency of physical activity conducted on a weekly basis by mothers was shown to be significant with girls FMS proficiency. It was clearly identified that the mothers of girls with high FMS levels reported a higher frequency of physical activity participation on a weekly basis. The importance parents place on physical activity through their own involvement has been found to significantly influence the involvement of their child (Mattocks et al., 2008). Mattocks et al. (2008) further suggest that even if this interaction in physical activity is seen in one or both parents then children are more likely to be physically active themselves and that relationship seems to be linear (the more active the parents, the more active the child). To facilitate motor competence in children aged 6-11 years, parents may need to be directly involved in the participation of these types of activities themselves (Edwardson & Gorely, 2010). Although the study demonstrated a positive relationship between parental behaviours and FMS proficiency, the findings also demonstrated a potential negative impact.

Other specific parental behaviours and their potential to influence a child's FMS development were also evident in the study. In particular, the amount of computer gaming activity conducted by the parent and child together each week was significantly related to boys' FMS proficiency. Boys with low FMS proficiency spent the most time in this type of sedentary activity with the parent and those with high FMS proficiency the least. Halfon, Verhoef, and Kuo (2012) have suggested that these negative behaviours established during the growing years tend to carry over into adulthood and time spent playing computer games or watching television is time not spent engaging in social interactions, developing movement competencies (e.g., FMS) and testing the limits of one's cognitive capabilities (Gopinath, Hardy, Baur, Burlutsky, & Mitchell, 2012). The relationship between the parent and child activity engagement together is particularly strong in children up to 11-12 years of age (Mattocks et al., 2008). Therefore, parental behaviours promoted during this period can have both a positive and negative impact in strengthening a young person's physical perceptions, ability, identity and any future physical literacy. It seems that the most efficacious level of parental involvement is something of a balancing act between under and over involvement (Gould, Lauer, Rolo, James, & Pennisi, 2008); however, it seems reasonable to suggest that parents have a significant role to play in promoting positive behaviours and developing children's movement competencies (Bailey et al., 2015).

Parents can impact upon their child's FMS and physical activity in direct and indirect ways, for example, their beliefs about what they interpret as being in the best interests for their child's physical development. Parental beliefs were significant in study 3 on the importance placed on particular developmental aspects relating to physical activity in boys (social development, motor development and participation in physical activity) and the importance placed on physical activity characteristics (social function and learning rules) in girls. For both gender children in high FMS groups demonstrated better performance scores. Parental beliefs about their child's physical competence are shaped from their own perceptions of competence and perceptions about the relative value of physical activity in the child's overall development (Bois, Sarrazin, Brustad, Trouilloud, & Curry, 2005). The beliefs that parents hold for their child's physical development influence their patterns of interaction with the child and range from the extent of encouragement to the provision of opportunities and experiences that, in turn, affect their child's motivation to develop their physical proficiency (Bois et al, 2005). Such beliefs of parents may be more important as they are associated with positive socio-emotional development of the child. High levels of positive beliefs about physical activity displayed by parents can become just as important to promote

FMS and physical activity through pathways that may not be directly aimed at the physical level such as enhancing self-efficacy.

These beliefs can also be attributed to parent's knowledge and awareness of the importance of physical development. Parry (2013) suggests that children who are encouraged and supported to be physically active outside school by parents develop better skill competence (i.e., FMS), gain enhanced confidence in their ability and develop healthy sporting habits. In study 3 the frequency of participation in sports clubs was significant in boys. The boys group that demonstrated the highest level of FMS proficiency attended these sports clubs most frequently. Much of the existing literature suggests that parents are solely responsible for influencing children's physical activity participation outside of the school environment, often through enrolling them in sports clubs, or influencing their decision to start participating (Light, Harvey, & Memmert, 2013). It has therefore been suggested by Bailey et al. (2015) that the parents of such children may have developed an understanding and awareness of the importance participation in such extracurricular activity brings. On the reverse many parents of children who are inactive and generally have poor motor skill proficiency wrongly believe their children meet or exceed physical activity recommendations each day (Faigenbaum, Chu, Paterno, & Myer, 2013). Therefore, Faigenbaum et al. (2013) further suggests that these parents need to be targeted, educated and informed of specific recommendations for achieving physical goals and making healthy lifestyle choices for their children. With Bailey et al. (2015) suggesting this knowledge and awareness needing to be built on parents wishing to promote their child's sporting and physical activity involvement would be well advised to focus on building their physical competence and a sense of competence in movement domains. If not Bauer, Nelson, Boutelle, and Neumark-Sztainer (2008) predict these children will tend to adopt the beliefs and more likely to mimic the lifestyles of parents who fail to exercise and engage in sedentary behaviour and retain these habits into adulthood.

In summary, the major findings from this thesis clearly address the concerns and recommendations of the validity of the CY-PSPP for use with different populations (i.e., Welsh primary school children) and its subsequent use as a reliable measure of the psychometric properties of physical literacy with this population. As FMS provide the foundation to physical literacy the use of a more appropriate method to classify FMS here clearly provides a more detailed analysis on the specific FMS credentials of children from this population and generates valid discussion. In addition, the ability to identify physical literacy variables which discriminate between FMS performance in both genders and the issues surrounding their potential to impact on physical literacy warrants further investigation. Further, the influence of socio-cultural factors and in particular the impact of parental behaviours and beliefs on FMS performance also highlight that there are several potential issues to consider here.

Applied Implications

The low levels of FMS proficiency, health related fitness (i.e., cardio-respiratory and musculoskeletal) and physical activity behaviours in both boys and girls demonstrated in this thesis are a cause for concern. It is well established that acquiring proficiency in FMS during childhood has the greatest significance in contributing towards an active lifestyle (Cliff, Okely, & Magarey, 2011; Cohen et al., 2015; Stodden et al., 2008). In several models of motor skill development (Clark & Metcalfe, 2002; Gallahue, Ozmun, & Goodway, 2012; Seefeldt, 1980) it is recognised that if children on entering late childhood do not acquire a good repertoire of FMS they confront a proficiency barrier that makes it difficult to be successful in future situations that require a combination of or more complex and challenging skills. As children enter adolescence, the traditional focus of physical activity tends to change from basic skills acquisition and development to a more competitive and sports related environment (e.g., secondary school physical education), thus having inadequate levels of FMS may reduce opportunities to progress to their full potential or fully engage in a range of developmentally appropriate activities throughout the rest of the life course. Although it has been suggested that FMS can be learnt and developed at any age (Gallahue & Ozmun, 2012; Haywood & Getchell, 2009), a more proficient and refined level of skill acquisition takes more time to develop after childhood partly due to a reduction in neuromuscular plasticity and elasticity (Lloyd & Oliver, 2012), negligible instruction, practice, encouragement and feedback (Gallahue & Ozmun, 2012). Therefore, a deficiency in FMS ability is continually attributed to inactivity, youth obesity and sedentary lifestyles (Hardy, Barnett, Espinel, & Okely, 2013). Previously, it has been reported by (Stodden et al., 2008) that there is limited consensus among academics on the accuracy of FMS assessment and what actually constitutes FMS proficiency. They suggested that several approaches to FMS assessment have resulted in inappropriate measurement. These include, the use of product approaches to measure FMS competence (i.e., a focus on the outcome of what an individual can achieve such as number of catches or successful strikes) which don't examine the developmental movement process or of those that do examine the developmental movement process many only report the proportion of children who are proficient and non-proficient on a collection of skills. This, therefore, limits the ability to identify the specific variability of FMS proficiency of children in individual skills. Giblin, Collins, and Button (2014), and Foweather (2010) suggested that more research was required to establish appropriate procedures for testing fundamental movement ability that provided empirical monitoring on a micro (individual) and macro (intervention) level. In turn, they implied that this would generate a more valid measure without compromising the quality of data measured. Therefore, a detailed and more specific analysis of FMS ability and the identification of individual skill differentiation across a group of children as demonstrated in this thesis may provide practitioners with an assessment opportunity which allows them to focus greater specificity of FMS development to individual skills of children at varying levels of ability. A practical implication may result in the identification of children with poor FMS ability being less likely to go unnoticed through misclassification as it has been reported that at present many aims and objectives of physical education and physical literacy programmes are overlooking children who are unable to produce requirements of FMS (Tompsett et al., 2014).

The choice of FMS assessment procedure in this thesis allowed for further investigation of meaningful relationships with other factors for promoting physical health (i.e., physical literacy). Essentially FMS will provide the foundations from which a child can develop physical literacy although previous models of physical literacy have focused too heavily on the sole development of FMS emphasizing a foundation of FMS as equating to being physically literate and not considering the importance of developing in tandem other domains of physical literacy (Lloyd & Tremblay, 2011). This thesis highlights that physical literacy is a multidimensional concept and may not be defined by one component that is FMS. The identification of several physical literacy variables that discriminate between the FMS performance groups of both boys and girls in this thesis suggests a more rounded approach to physical literacy is needed. The implications of identifying and targeting these specific physical literacy components in children with low FMS, specific to gender, may provide a more robust and effective strategy to promote a more positive trajectory of future physical health and assessment being able to be tracked against previous personal attainment. Of note, it was evident that several of the physical fitness variables significantly discriminated the FMS proficiency in both genders. Testing such components of physical literacy (e.g., physical fitness) with children has previously proven contentious with concerns over the accuracy of measurement and the interpretation for their use (Naughton, Carlson, &

Greene, 2006). Therefore, if physical literacy is to become a key outcome of physical activity experiences, Lloyd and Tremblay (2011) suggest that appropriate measurability of the physical literacy components is crucial. The use of a number of standardised tests in this thesis to test physical fitness demonstrated their suitability for the age group and their ease of use suggests they could be considered to assess and monitor the physical fitness component of physical literacy in future interventions.

The overall levels of FMS displayed in both genders and across all groups in this study were low, which may suggest the relative inability of a number of the physical literacy variables to significantly discriminate between the FMS groups. If higher levels of FMS were presented in both genders a greater number of physical literacy variables might therefore have contributed to the discriminant function and be targeted in any future intervention. The discriminant function analysis cut off score for the physical literacy variable loadings on FMS performance for both boys and girls used in this study was based on a value > 0.40. This value was based on Stevens' (1992) suggestion, irrespective of the sample size. It has been suggested by Tabacknick & Fidell, (2007) that the choice of the cut off value for reporting is a matter of researcher preference. They advocated that the correlation should be 0.30 or greater, since anything lower would suggest a weak relationship between the variables. Hair, Anderson, Tatham, and Black (1998) also recommends that cut off values greater than 0.30 be considered to meet the minimum level but suggests loadings of 0.40 and above are to be considered more important. Typically, Field (2013) reported that researchers tend to take a cut off value of more than 0.30 to be important. Therefore, of note, the results of this study following similar reporting at the minimal 0.30 level would have shown several additional variables in boys (DHG, PAQ, CY-SC, CY-PSW) and girls (CY-SC, CY-PC) as contributing to the significant discriminant function. The lack of such consensus in the reporting of these values therefore has significant potential to impact the approaches taken to develop children's physical literacy in any future intervention.

Developing and maintaining physical literacy will not only enhance an individual's quality of life but it may promote healthy living practices to family, friends and associates (Whitehead, 2007). This thesis demonstrated that parents have a significant role to play as socializing agents in their child's FMS and future physical health. Therefore, in addition to identifying children with low FMS and measures of physical literacy for development a greater focus needs to be on parental interaction and involvement in this process. Very little attention has actually focused on what goes on at home, with limited education provided to parents on FMS and physical activity engagement for their child. This in spite of the academic literature suggesting that family influences are the main drivers to early participation in and enjoyment of physical activity not just the school and teacher (Woods, Tannehill, Quinlan, Moyna, & Walsh, 2010). Therefore, along with physical assessment the impact of parent's behaviours and beliefs in future physical literacy interventions needs consideration.

Research Strengths

This research programme exhibits several strengths. It has demonstrated engagement with a number of research methods to explore the aims and objectives, including a variety of quantitative methods including confirmatory factor analysis, cluster analysis and decision trees, discriminant function analysis and non-parametric statistical analyses. The variety of analysis methods adopted, when taken together, has demonstrated the researcher's ability to conduct a well-controlled and large field based data collection study. The willingness to engage in a number of innovative methods also demonstrates the researcher's desire to contribute to the development of high quality research. The selection of the ''Get Skilled: Get Active' (NSW Department of Education and Training, 2000) process-oriented instrument for the FMS data collection, a core element of this research, included all categories of FMS (i.e., locomotor, manipulative and stability; Gallahue & Ozmun, 2012; Haywood & Getchell, 2009) providing a comprehensive overview of skill competence. The measurement tool did not focus on the areas of motor impairment and motor deficits. In addition, the instrument was relevant to the specific age range of children in the study with rigorous measurement of the FMS, assessed by a trained researcher using video analysis which affords greater level of objectivity than live observations. The alternative method (i.e., cluster analysis) of classifying FMS performance retained all information and categorised individuals that displayed similar characteristics across the full range of FMS. This is both novel and innovative and the findings clearly demonstrate the strength of using such a measure. To date, research has focused mainly on relationships among FMS and selective attributes of physical literacy. In addition, few of the studies have been conducted in the UK and very limited research has been used with primary school children in Wales. This thesis has also provided appropriate validity and measurement of certain physical literacy constructs for use with this population. This has been demonstrated through the use of confirmatory factor analysis to validate the CY-PSPP as a measure of physical self-perceptions and provide a robust measure of the psychometric domain of physical literacy with this population. In turn, this has facilitated our understanding of their impact on individual's physical literacy ability and allowed for reporting separately by gender. The measures of FMS and physical literacy were simple, relatively inexpensive and well received and could easily be replicated in any further intervention within the school environment.

Research Limitations

The research programme is not without its limitations. A number of limitations have been addressed in the discussion sections of each chapter; therefore, these will only be briefly mentioned here. In the main, FMS were not assessed in an open environment (e.g., school break time, physical education classes) and so no conclusions can be drawn on whether the level of skill competence assessed in a standardized closed environment in this thesis can be fully representative of a child's FMS proficiency. The interrelationships between FMS and other physical literacy variables in this thesis may be enhanced further if children were not only split by gender but by school year for all analyses. Though physical activity behaviour was measured, the types of physical activities that children engaged in (active or passive) were not recorded but may have affected the outcome of this measure. The choice of the self-report questionnaires (CY-PSPP, PAQ, and PBQ) may have been affected by recall bias and socially desirable responses in both children and parents/guardians. However, due to their low cost and ease of administration to assess the domain of physical literacy, their inclusion is warranted, although caution must be taken in their interpretation. The choice of parental behaviours and beliefs to represent the social domain of physical literacy only represents one aspect of this domain. Other factors, such as socio-economic profile, environmental characteristics, religious beliefs and ethnic characteristics would contribute to a wider understanding of this domain but were beyond the scope of this thesis. Due to a moderately large sample size, one of FMS proficiency groups identified in males (the low group) contained a smaller number of children for comparison with the other male groups in the study (the intermediate and high groups). Therefore, any future work will need to consider the appropriate recruitment and retention of children to ensure comparisons between subsequent FMS groups yield statistically valid results. The recruitment of primary schools used in this thesis was based on proximity to the test venue and minimum disruption to children's daily school routine, therefore restricting generalisation to the wider primary school population of South East Wales.

Future Research Directions

The research on physical literacy is still in its infancy, with a lack of consensus regarding how to develop a standardized assessment to monitor this important healthy living construct (Longmuir et al., 2015). Researchers should continue to develop evidence through interventions on how to improve FMS proficiency in children and the constituent sub-domains of physical literacy. Most importantly, such interventions will require a relevant FMS assessment tool that provides a distinction between individual's FMS performance and will clearly identify those children most in need of additional support. Interventions that monitor the domains within the concept of physical literacy need to include components which sufficiently challenge and intensify a stimulus in determining a change in FMS and physical literacy development, particularly in light of decreases in habitual physical activity (Baquet, Twisk, Kemper, VanPraagh, & Berthion, 2006). In addition, promoting fitness whilst encompassing activities for FMS learning that are generally conducted at a much lower intensity will remain a challenge for physical practitioners (O'Brien, 2013). Further, any intervention should be varied and fun to encourage participation especially with previously disengaged children.

Longitudinal assessment is required that follows children from preschool through childhood, adolescence and into adulthood to aid our understanding of how domains of physical literacy interact with each other during these life stages. Following intervention and evidence of best practice, it may be possible to establish a valid, reliable and informative measurement tool that offers a more comprehensive approach for monitoring the capacity for a healthy, active lifestyle (i.e., physical literacy). It has been suggested by Tremblay and Lloyd (2010) that developing an effective measurement tool to assess physical literacy is crucial as a means to elevate its importance and provide appropriate evidence to assist with resource and financial allocation by decision makers. It is important to establish through future research that FMS and physical literacy are not the same as FMS is just a separate construct of physical literacy. Although FMS are integral to the development of physical literacy any future intervention will need to give equal consideration to several other physical literacy domains which define the concept. Currently, the lack of consensus regarding the constituent sub-domains of physical literacy hampers the development of a standardized assessment to monitor this important healthy living construct (Longmuir et al., 2015).

In order to reach out to all children, future interventions should consider the primary school setting. Bryant et al. (2013) have suggested that children of ages 8-10 years old to be a good target age for intervention. Schools are popular settings for interventions as large numbers of children can be accessed simultaneously and school infrastructures are in place which can facilitate delivery of the intervention and cost-effectiveness (Stone, McKenzie, Welk, & Booth, 1998). This research setting should also consider parent and guardian interaction with physical literacy development tasks in addition to providing additional training materials that will effectively inform and educate parents on the importance of physical literacy. In particular, Aldinger et al. (2008) suggests that educating parents on aspects of physical competency should be just as important as key curriculum subjects with children of this age (i.e., English and Mathematics) and future interventions should incorporate behaviour changes which encourage parents to become more involved in their child's physical development (e.g., attend school events together, introduce interactive content between parent and child that can be developed at home). This multidimensional approach to physical literacy especially with children of poor physical health may generate greater impact than just adults spreading the knowledge to each other (Aldinger et al., 2008).

Conclusion

The purpose of this research programme was to explore the physical literacy attributes of primary school children in South East Wales, with a specific focus on their relationship with FMS. In addition, it investigated the impact from parents as being the most proximal socialisation agents in relation to their child's FMS development. Therefore, the thesis has provided rich data that has increased our understanding of FMS proficiency in UK primary school children. It has provided an alternative form of FMS classification, which may challenge our interpretation of FMS and development practice. Also, it has identified a number of significant relationships between the multidimensional domains of physical literacy to discriminate between children's FMS performance which may warrant additional research. Further, it has identified that parents have an important role to play in FMS and influencing a physically active lifestyle of their child.

In addition to the key findings, the methods employed within this thesis also contribute significantly to the research area. Firstly, the use of confirmatory factor analysis to validate the use of the CY-PSPP as a measure of physical self-perceptions has provided a robust measure of the psychometric domain of physical literacy with this population. Secondly, the use of hierarchical cluster analysis and subsequent decision tree induction analysis has been crucial in the classification of FMS groups presented in this thesis. In summary, the current thesis reports both theoretical and methodological strengths that make a significant contribution to the FMS and physical literacy research area.

References

Aarnio, M., Winter, T., Kujala, U. M., & Kaprio, J. (1997). Familial aggregation of leisure-time physical activity: a three generation study. *International Journal of Sports Medicine*, *18*, 549-556. doi:10.1055/s-2007-972680

Aldinger, C., Zhang, X. W., Liu, L. Q., Pan, X. D., Yu, S. H., Jones, J., & Kass, J. (2008). Changes in attitudes, knowledge and behaviour associated with implementing a comprehensive school health program in a province of China. *Health Education Research*, *23*, 1049-1067. doi:10.1093/her/cyn022

Altman, D. G. (1991). *Practical statistics for medical research.* Boca Raton, FL: Chapman & Hall.

American Academy of Pediatrics. (2006). Children, adolescents, and advertising. *Pediatrics, 118*, 2563-2569. doi:10.1542/peds.2006-2698

Armenakis, A., & Kiefer, C. (2007). *Social & cultural factors related to health: Recognizing the impact.* Retrieved from http://cugh.org/sites/default/files/content/resources/13_Social_And_Cultural_Factors_Related_To_Health_Part_A_Recognizing_The_Impact%20-%20Copy.pdf

Asci, F., Eklund, R., Whitehead, J. R., Kirazci, S., & Koca, C. (2005). Use of the CY-PSPP in other cultures: a preliminary investigation of its factorial validity for Turkish children and youth. *Psychology of Sport & Exercise*, *6*, 33-50. doi:10.1016/j.psychsport.2003.10.003

Bailey, R., Cope, E., & Parnell, D. (2015). Realising the benefits of sports and physical activity: The human capital model. *Retos, 28*, 147-154.

Baker, D. (1996). Improving vertical jump performance through general, special, and specific strength training: A brief review. *The Journal of Strength and Conditioning Research, 10*, 131-136. doi:10.1519/00124278-199605000-00015

Balyi, I., & Hamilton, A. (2004). *Long-term athlete development: trainability in children and adolescents, windows of opportunity, optimal trainability.* Victoria, BC: National Coaching Institute British Columbia & Advanced Training and Performance Ltd.

Balyi, I., Way, R., Norris, S., Cardinal, C., & Higgs, C. (2005). *Canadian sport for life: Long-term athlete development resource paper.* Vancouver, BC: Canadian Sport Centres.

Baquet, G., Twisk, J. W., Kemper, H. C., Van Praagh, E., & Berthoin, S. (2006). Longitudinal follow-up of fitness during childhood: Interaction with physical activity. *American Journal of Human Biology, 18*, 51-58. doi:10.1002/ajhb.20466

Barnett, L. M., Hardy, L. L., Lubans, D. R., Cliff, D. P., Okely, A. D., Hills, A. P., & Morgan P. J. (2013). Australian children lack the basic movement skills to be active and healthy. *Health Promotion Journal of Australia, 24*, 82-84. doi:10.1071/HE12920

Barnett, L. M., Morgan, P. J., Van Beurden, E., Ball, K., & Lubans, D. R. (2011). A reverse pathway ? Actual and perceived skill proficiency and physical activity. *Medicine and Science in Sports and Exercise, 43*, 898-904. doi:10.1249/MSS.0b013e3181fdfadd

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2008a). Does childhood motor skill proficiency predict adolescent fitness? *Medicine and Science in Sports and Exercise, 40*, 2137–2144. doi:10.1249/MSS.0b013e31818160d3.

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2008b). Perceived sports competence mediates the relationship between childhood motor skill proficiency and adolescent physical activity and fitness: a longitudinal assessment. *International Journal of Behavioural Nutrition and Physical activity, 5,* 40. doi:10.1186/1479-5868-5-40

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. *The Journal of Adolescent Health*, *44*, 252-259. doi:10.1016/j.jadohealth.2008.07.004

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2010). Gender differences in motor skill proficiency from childhood to adolescence: A longitudinal study. *Research Quarterly for Exercise and Sport, 81,* 162–170. doi:10.1080 /02701367.2010.10599663

Bauer, K. W., Nelson, M. C., Boutelle, K. N., & Neumark-Sztainer, D. (2008). Parental influences on adolescents physical activity and sedentary behaviour: longitudinal findings from project EAT-II. *International Journal of Behaviour Nutrition and Physical Activity, 5,* 12. doi:101186/1479-5868-5-12

Behringer, M., Vom Heede, A., Matthews, M., & Mester, J. (2011). Effects of strength training on motor performance skills in children and adolescents: a meta-analysis. *Pediatric Exercise Science; 23*, 186-206.

Bellew, B., Bauman, A., & Brown, W. (2010). Evidence-based policy and practice of physical activity in Australia: Awareness and attitudes of attendees at a national physical activity conference (the PAPPA study). *Health Promotion Journal Australia, 21*, 222–8. doi:10.1071/HE10222

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246. doi:10.1037/0033-2909.107.2.238

Bentler, P. M. (2002). *EQS 6 Structural Equations Program Manual.* Encino, CA: Multivariate Software, Inc.

Beunen, G., Malina, R. M., Vant Hof, M., Simons, J., Ostyn, M., Renson, R., & Van Gerven, D. (1988). *Adolescent growth and motor performance: A longitudinal study of Belgian boys*. Champaign, IL: Human Kinetics.

Beunen, G. P., & Malina, R. M. (2005). Growth and biological maturation: Relevance to athletic performance. In H. Hebestreit & O. Bar-Or (Eds.), *The Young Athlete* (pp. 3-17). Malden, MA: Blackwell.

Bickham, D. S., Blood, E. A., Walls, C. E., Shrier, L. A., & Rich, M. (2013). Characteristics of screen media use associated with higher BMI in young adolescents. *Pediatrics*, *131*, 935-941. doi:10.1542/peds.2012-1197

Biddle, S., Page, A., Ashford, B., Jennings, D., Brooke, R., & Fox, K. (1993). Assessment of children's physical self-perceptions. *International Journal of Adolescence and Youth, 4,* 93-109. doi:10.1080/02673843.1993.9747728

Biddle, S., Gourley, T., Pearson, N., & Bull, F. C. (2011). An assessment of self-reported physical activity instruments in young people for population surveillance: project ALPHA, International *Journal of Behavioural Nutrition and Physical Activity*, *8*, 1. doi:10.1186/1479-5868-8-1

Birchwood, D., Roberts, K., & Pollock, G. (2008). Explaining differences in sports participation rates among young adults: Evidence from the South Caucasus. *European Physical Education Review, 14*, 283-298. doi:10.1177 /1356336X08095667

Bois, J. E., Sarrazin, P. G., Brustad, R. J., Trouilloud, D. O., & Cury, F. (2005) Elementary school children's perceived competence and physical activity involvement: The influence of parents role modelling behaviours and perceptions of their child's competence. *Psychology of Sport and Exercise, 6*, 381-397. doi:10.1016 /j.psychsport.2004.03.003

Booth, M., Denney-Wilson, E., Okely, A. D., & Hardy, L. L. (2005). Methods of the NSW schools physical activity and nutrition survey (SPANS). *Journal of Science and Medicine in Sport, 8*, 284-293. doi:10.1016/S1440-2440(05)80039-8

Booth, M. L., Macaskill, P., Phongsavan, P., McLellan, L. & Okely, T. (1998). Methods of the NSW schools fitness and physical activity survey, 1997. *Journal of Science Medicine and Sport, 1*, 111-124. doi:10.1016/S1440-2440(98)80019-4

Booth, M. L., Okely, T., McLellan, L., Phongsavan, P., Macaskill, P., Patterson, J., ... Holland, B. (1999). Mastery of fundamental motor skills among New South Wales school students: prevalence and socio demographic distribution. *Journal of Science and Medicine in Sport, 2*, 93–105. doi:10.1016/S1440-2440(99)80189-3

Booth, M., Okely, A. D., Denney-Wilson, E., Hardy, L., Yang, B., & Dobbins, T. (2006). *NSW schools physical activity and nutrition survey (SPANS) 2004: Full report*. Sydney, Australia: NSW Department of Health.

Boreham, C., & Riddoch, C. (2001). The physical activity, fitness and health of children. *Journal of Sport Sciences, 19*, 915-929. doi:10.1080/026404101317108426

Bouchard, C., Blair, S. N., & Haskell, W. L. (2007). *Physical activity and health.* Champaign, IL: Human Kinetics.

Bouchard, C., Shephard, R. J., & Stephens, T. (1994). *Physical activity, fitness and health: International proceedings and consensus statement.* Champaign, IL: Human Kinetics.

Bouffard, M., Watkinson, E. J., Thompson, L. P., Causgrove-Dunn, J. L., & Romanow, S. K. E. (1996). A test of the activity deficit hypothesis with children with movement difficulties. *Adapted Physical Activity Quarterly*, *13*, 61-73.

Branta, C. F. (2010). Sport specialization: Developmental and learning issues. *The Journal of Physical Education, Recreation & Dance, 81*, 19-28. doi:10.1080 /07303084.2010 .10598521

Branta, C., Haubenstricker, J., & Seefeldt, V. (1984). Age changes in motor skills during childhood and adolescence. *Exercise and Sport Sciences Reviews*, *12*, 467-520. doi:10.1249/00003677-198401000-00015

Breslin, G., Murphy, M., McKee, D., Delaney, B., & Dempster, M. (2012). The effect of teachers trained in a fundamental movement skills programme on children's self-perceptions and motor competence. *European Physical Education Review Journal*, *18*, 114. doi:10.1177/1356336X11430657

British Heart Foundation. (2013). *Making the Case for Physical Activity.* London: Author.

Bruininks, R. H., & Bruininks, B. D. (Eds.). (2005). *BOT-2*, *Bruininks-Oseretsky test of motor proficiency* (2nd ed.). Minneapolis, MN: Pearson Assessments.

Brustad, R. J. (1993). Who will go out and play? Parental and psychological influences on children's attraction to physical activity. *Pediatric Exercise Science, 5*, 210–223.

Brustad, R. J. (1996). Parental and peer influence on children's psychological development through sport. In F. L. Smoll & R. E. Smith (Eds.), *Children and youth in sport: A bio psychosocial perspective* (pp. 112- 124). Madison, WI: Brown and Benchmark.

Bryant, E. S., Duncan, M. J., & Birch, S. L. (2013). Fundamental movement skills and weight status in British primary school children. *European Journal of Sport Science*, *14*, 730-736. doi:10.1080/17461391.2013.870232

Bryant, E. S., James, R. S., Birch, S. L., & Duncan, M. (2014). Prediction of habitual physical activity level and weight status from fundamental movement skill level. *Journal of Sports Sciences, 32*, 1775-1782. doi:10.1080/02640414.2014.918644.

Burton, A. W., & Miller, D. E. (1998). *Movement skill assessment*. Champaign, IL: Human Kinetics.

Byrne, B. M. (2006). *Structural equation modelling with EQS.* New York: Taylor & Francis Group.

Callea, M. B., Spittle, M., O'Meara, J., & Casey, M. (2008). Primary school teacher perceived self-efficacy to teach fundamental motor skills. *Research in Education, 79*, 67–75. doi: 10.7227/RIE.79.6

Carr, S., Weigand, D. A., & Jones, J. (2000). The relative influence of parents, peers, and sport heroes on the goal orientations of children and adolescents in sport. *Journal of Sport Pedagogy, 6*, 34-56.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Journal of Public Health Reports, 100*, 126-131.

Castelli, D. M., Centeio, E. E., Beighle, A. E., Carson, R. L., & Nicksic, H. M. (2014). Physical literacy and comprehensive school physical activity programs. *Preventative Medicine, 66*, 95-100. doi:10.1016/j.ypmed.2014.06.007

Castelli, D. M., & Valley, J. A. (2007). Chapter 3: The relationship of physical fitness and motor competence to physical activity. *Journal of Teaching in Physical Education, 26*, 358–374.

Castro-Piñero, J., Artero, E. G., España-Romero, V., Ortega, F. B., Sjostrom, M., Suni, J., & Ruiz, J. R. (2010). Criterion-related validity of field-based fitness tests in youth: A systematic review. *British Journal of Sports Medicine*, *44*, 934-943. doi:10.1136 /bjsm.2009.058321

Castro-Piñero, J., Gonzalez-Montesinos, J. L., Keating, X. D., Mora, J., Sjostrom, M., & Ruiz, J. R. (2010). Percentile values for running sprint field tests in children ages 6-17 years: Influence of weight status. *Research Quarterly for Exercise and Sport, 81*, 143-151. doi:10.1080/02701367.2010.10599661

Chinapaw, M. M., Mokkink, L. B., Van Poppel, M. N., Van Mechelen, W., & Terwee, C. B. (2010). Physical activity questionnaires for youth: A systematic review of measurement properties. *Sports Medicine, 40*, 539–563. doi:10.2165/11530770

Clark, J. E., & Metcalfe, J. S. (2002). The mountain of motor development: A metaphor. In J. E. Clark & J. H. Humphrey (Eds.), *Motor development research & reviews* (Vol. 2, pp. 163-190). Reston, VA: NASPE.

Cliff, D. P., Okely, A. D., & Magarey, A. M. (2011). Movement skill mastery in a clinical sample of overweight and obese children. *International Journal of Pediatric Obesity, 6*, 473–475. doi:10.3109/17477166.2011.575154

Cliff, D. P., Okely, A. D., Smith, L. M., & McKeen, K. (2009). Relationships between fundamental movement skills and objectively measured physical activity in pre-school children. *Paediatric Exercise Science*, *21*, 436-449.

Coates, J. (2011). Physically fit or physically literate? How children with special educational needs understand physical education. *European Physical Education Review*, *17*, 167-181. doi:10.1177/1356336X11413183

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). New York, NY: Academic Press.

Cohen, D., Vioss, C., Taylor, M., Delextrat, A., Ogunleye, A., & Sandercock, G. (2011). Ten-year secular changes in muscular fitness in English children. *Acta Pediatrica, 100*, 175–177. doi:10.1111/j.1651-2227.2011.02318.x

Cohen, K. E., Morgan, P. J., Plotnikoff, R. C., Barnett, L. M., & Lubans, D. R. (2015). Improvements in fundamental movement skill competency mediate the effect of the SCORES intervention on physical activity and cardiorespiratory fitness in children. *Journal of Sports Sciences.* doi:101080/02640414.2015.1017734

Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2009). Movement skills assessment of typically developing preschool children: A review of seven movement skill assessment tools. *Journal of Sports Science and Medicine*, *8*, 154-168.

Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2011). Fundamental movement skill performance of preschool children in relation to family context. *Journal of Sport Sciences*, *29*, 649-660. doi:10.1080/02640414.2010.551540

Corder, K., & Ekelund, U. (2008). Physical activity. In N. Armstrong & W. Van Mechelen (Eds.), *Paediatric exercise science and medicine* (2nd ed., pp. 129-143). Oxford: Oxford University Press.

Crocker, P. R. E., Bailey, D. A., Faulkner, R. A., Kowalski, K. C. & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the Physical Activity Questionnaire for Older Children. *Medicine and Science in Sports and Exercise*, *29*, 1344-1349. doi:10.1097/00005768-199710000-00011

Crocker, P., Eklund, R., & Kowalski, K. (2000). Children's physical activity and physical self-perceptions. *Journal of Sports Sciences, 18,* 383-394. doi:10.1080 /02640410050074313

Cumming, S. P., Standage, M., Gillison, F., & Malina, R. M. (2008). Sex differences in exercise behaviour during adolescence: Is biological maturation a confounding factor? *Journal of Adolescent Health, 42*, 480–485. doi:10.1016/i.jadohealth.2007.10.005

Currie, C., Zanotti, C., Morgan, A., Currie, D., De Looze, M., Roberts, C., … Barnekow, V. (2012). *Social determinants of health and well-being among young people. Health behaviour in school-aged children (HBSC) study: International report from the 2009/2010 survey* (Report No. 6). Copenhagen: World Health Organisation Regional Office for Europe.

Deitz, J. C., Kartin, D., & Kopp, K. (2007). Review of the Bruininks-Oseretsky test of motor proficiency, 2nd Edition (BOT-2). *Physical and Occupational Therapy in Pediatrics*, *27*, 87-102. doi:10.1080/J006v27n04_06

Department of Education and Training NSW. (2000). *Get skilled: Get active. A K-6 resource to support the teaching of fundamental movement skill.* Sydney: Author.

Department of Health. (2011). *Start active, stay active. A report on physical activity for health from the four home countries*': Chief medical officer's new guidelines on physical activity. London: TSO.

D'Hondt, E. D., Deforche, B., Gentier, I., De Bourdeaudhuij, I., Vaeyens, R., Philippaerts, R., & Leoir, M. (2013). A longitudinal analysis of gross motor coordination in overweight and obese children versus normal-weight peers. *International Journal of Obesity*, *37*, 61-67. doi:10.1038/ijo.2012.55

Dineen, L. C., & Blakesley, B. C. (1973). Algorithm AS 62: A Generator for the sampling distribution of the Mann-Whitney U statistic. *Applied Statistics*, *22*, 269-273.

Dobbins, M., Husson, H., DeCorby, K., & LaRocca R. L. (2013). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database System Reviews* (2). doi:10.1002 /14651858.CD007651

Dowling, A. M., Steele, J. R., & Baur, L. A. (2001). Does obesity influence foot structure and plantar pressure patterns in prepubescent children? *International Journal of Obesity and Related Metabolic Disorders*, 25, 845-852. doi:10.1038/sj.ijo.0801598

Dunn, O. J. (1964). Multiple comparisons using rank sums. *Technometrics*, *6*, 241-252. doi:10.1080/00401706.1964.10490181

Eccles, J. S., & Harrold, R. D. (1991). Gender differences in sport involvement: Applying the Eccles' expectancy-value model. *Journal of Applied Sport Psychology 3*, 7-35. doi:10.1080/10413209108406432

Eccles, J., Wigfield, A., Harold, R. D., & Blumenfeld, P. (1993). Age and gender differences in children's self and task perceptions during elementary school. *Child Development, 64*, 830-847. doi:10.1111/j.1467-8624.1993.tb02946.x

Eccles, J. S., Wigfield, A., & Schiefele, U. (1998). Motivation to succeed. In N. Eisenberg (Ed.), *Social, emotional and personal development.* (pp. 1017-1095) New York: Wiley.

Edwardson, C. & Gorely, T. (2010). Activity-related parenting practices and children's objectively measured physical activity. *Pediatric Exercise Science*, *22*, 105-113.

Eiser, C., Eiser, J. R., & Havermans, T. (1995). The measurement of self-esteem: Practical and theoretical considerations. *Personality and Individual Differences, 18,* 429-432. doi:10.1016/0191-8869(94)00179-v

Ekelund, U., Tomkinson, G., & Armstrong, N. (2011). What proportion of youth are physically active? Measurement issues, levels and recent time trends. *British Journal of Sports Medicine. 45*, 859-865. doi:10.1136/bjsports-2011-090190

Eklund, R. C., Whitehead, J. R., & Welk, G. J. (1997). Validity of the children and youth physical self-perception profile: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport, 68*, 240- 256. doi:10.1080/02701367.1997.10608004

Enoka, R. M. (2008). *Neuromechanics of human movement.* (4th ed.). Champaign, IL: Human Kinetics.

España-Romero, V., Artero, E. G., Jimenez-Pavón, D., Cuenca-Garcia, M., Ortega, F. B., Castro-Piñero, J., ... Ruiz, J. R. (2010). Assessing health-related fitness tests in the school setting: Reliability, feasibility and safety; The ALPHA Study. *International Journal of Sports Medicine, 31*, 490–497. doi:10.1055/s-0030-1251990

Eyre, A. (2008). *The relationship between physical activity levels, physical self-worth and global self-worth in high school physical education students. A correlational study* (Master's thesis, Brigham Young University, Provo). Retrieved from http://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=2606&context=etd

Faigenbaum, A. D., Chu, D. A., Paterno, P. T., & Myer, G. D. (2013). Responding to exercise deficit disorder in youth: Integrating wellness care into pediatric physical therapy. *Pediatrics Physical Therapy, 25*, 2-6. doi:10.1097/PEP.0b013 e31827a 33f6.

Faigenbaum, A. D., Stracciolini, A., & Myer, G. D. (2011). Exercise deficit disorder in youth: A hidden truth. *Acta Paediatrica, 100*, 1423-1425. doi:10.1111/j.1651-2227 .2011.02461.x

Fairclough, S. J., & Ridgers, N. D. (2010). Relationships between maturity status, physical activity, and physical self-perceptions in primary school children. *Journal of Sports Sciences, 28*, 1-9. doi: 1080/02640410903334780.

Ferreira, I., Van der Horst, K.,Wendel-Vos, W., Kremers, S., Van Lenthe, F. J., & Brug, J., (2007).Environmental correlates of physical activity in youth—a review and update. *Obesity Reviews. 8*, 129–154. doi:10.1111/j.1467-789X.2006.00264.x

Field, A. P. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). London: Sage.

Fisher, A., Reilly, J. J., Kelly, L. A., Montgomery, C., Williamson, A., Paton, J. Y., & Grant, S. (2005) Fundamental movement skills and habitual physical activity in young children. *Medicine and Science in Sport and Exercise, 37*, 684-688. doi:10.1249/01 .MSS.0000159138.48107.7D

Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Kong, A., Braunschweig, C. L., Gomez-Perez, S. L., ...Dyer, A. R. (2013). Family-based hip-hop to health: Outcome results. *Obesity, 21*, 10. doi:10.1002/oby.20269

Fleiss, J. L., Levin, B., & Paik, M. C. (2003) *Statistical methods for ratters and proportions* (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Fogelholm, M., Nuuttinen, O., Pasanen, E., Myohanen, E., & Saatela, T. (1999). Parent-child relationship of physical activity patterns and obesity. *International Journal of Obesity and Related Metabolic Disorders, 23*, 1262-1268. doi:10.1038/sj.ijo.0801061

Ford, P., De Ste Croix, M., Lloyd, R., Meyers, R., Moosavi, M., Oliver, J., ...Williams, C. (2011). The Long-Term Athlete Development model: Physiological evidence and application. *Journal of Sports Sciences, 29*, 389-402. doi:10.1080/02640414 .2010.536849

Foulkes, J. D., Knowles, Z., Fairclough, S. J., Stratton, G., O'Dwyer, M, Ridgers, N. D., Foweather, L. (2015). Fundamental movement skills of preschool children in Northwest England. *Perceptual and Motor Skills, 121*, 260-283. doi:10.2466 /10.25.PMS.121c14x0

Foweather, L. (2010). *The effect of interventions on fundamental movement skills, physical activity and psychological well-being among children*. (Doctoral dissertation). Retrieved from http://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.517870 (Order No. 517870).

Fox, K. R. (1990). *The physical self-perception profile manual.* DeKalb, IL: Office for Health Promotion, Northern Illinois University.

Fox, K. R. (1992). Physical education and the development of self-esteem in children. In N. Armstrong (Ed.), *New directions in physical education: Towards a national curriculum* (Vol. 2, pp. 33-54). Champaign, IL: Human Kinetics.

Fox, K. R. (1997). *The physical self from motivation to well-being.* Champaign, IL: Human Kinetics

Fox, K. R. (2000). Self-esteem, self-perceptions and exercise. *International Journal of Sport psychology, 31*, 228-240

Fox, K. R. (2010). The physical self and physical literacy. In M. Whitehead (Ed.), *Physical literacy throughout the life course* (pp.71-82). Abingdon, Oxon: Routledge.

Fox, K., & Corbin, C. (1989). The physical self-perception profile: Development and preliminary validation. *Journal of Sport and Exercise Psychology*, *11*, 408-430.

Fox, K. R., Corbin, C. B., & Couldry, W. H. (1985). Female physical estimation and attraction to physical activity. *Journal of Sport and Exercise Psychology*, 7, 125 - 136.

Fredericks, J. A., & Eccles, J. S. (2004). Parental influences on youth involvement in sports. In M. R.Weiss (Ed.), *Developmental sport and exercise psychology: A lifespan perspective* (pp. 144–164). Morgantown, WV: Fitness Information Technology.

Freitas, D. L., Lausen, B., Maia, J. A., Lefevre, J., Gouveia, E. R., Thomis, M.,…Malina, R. M. (2015). Skeletal maturation, fundamental movement skills and motor coordination in children 7-10 years. *Journal of Sports Sciences.* doi:10.1080/02640414.2014 .977935

Gabbard, C. (1992). *Lifelong motor development*. Dubuque, Iowa: Wm. C. Brown.

Gallahue, D. L., & Donnelly, F. C. (2003). *Developmentally physical education for all children* (4th ed.). Champaign, IL: Human Kinetics

Gallahue, D. L., & Ozmun, J. C. (2006). *Understanding motor development: infants, children, adolescents, adults* (6th ed.). New York, NY: McGraw-Hill.

Gallahue, D. L., Ozmun, J., & Goodway, J. (2012). *Understanding motor development: infants, children, adolescents, adults*. (7th ed.). New York, NY: McGraw-Hill.

Gentier, I., D'Hondt, E., Shultz, S., Deforche, B., Augustijn, M., Hoorne, S., …Lenoir, M. (2013). Fine and gross motor skills differ between healthy weight and obese children. *Research in Developmental Disabilities, 34,* 4043-4051.

Giblin, S., Collins, D. & Button, C. (2014). Physical literacy: Importance, assessment and future directions. *Sports Medicine, 44,* 1177-1184. doi:10.1007/s40279-014-0205-7

Gillis, L., Tomkinson, G., Olds, T., Moreira, C., Christie, C., Nigg, C., …VanMechelen, W. (2013). Research priorities for child and adolescent physical activity and sedentary behaviours: an international perspective using a twin-panel Delphi procedure. *International Journal of Behavioural Nutrition and Physical Activity, 10*, 112. doi:10.1186/1479-5868-10-112

Goodway, J., Famelia, R. & Bakhitar, S. (2014). Future directions in physical education & sport: Developing fundamental motor competence in the early years is paramount to lifelong physical activity. *Asian Social Science*; *10*, 1911-2025. doi: 10.5539 /ass.v10n5p44

Goodway, J., Ozmun, J. C., Dieringer S. T., & Lee, J. (2013). Promoting physical literacy and activity in young children. In D. R. Reutzel (Ed.). *The handbook of research – based practice in early childhood education.* New York, NY: Guilford Press.

Gopinath, B., Hardy, L., Baur, A., Burlutsky, G., & Mitchell, P. (2012). Physical activity and sedentary behaviours and health-related quality of life in adolescents. *Pediatrics, 130*, 167-174. doi:10.1542/peds.2011-3637

Gould, D., Lauer, L., Rolo, C., James, J., & Pennisi, N. (2008). The role of parents in tennis success: Focus group interviews with junior coaches. *The Sport Psychologist, 22*18-37.

Gottileb, N. H., & Chen, M. S. (1985). Socio cultural correlates of childhood sporting activities: The implications for heart health. *Social Science & Medicine*, *21*, 533-539. doi:10.1016/0277-9536(85)90037-1

Graf, C., Koch, B., Falkowski, G., Jouck, S., Christ, H., Stauenmaier, K.,…Predel, H. (2005). Effects of a school based intervention on BMI and motor abilities in childhood. *Journal of Sports Science and Medicine*, *4*, 291-299

Graf, C., Koch, B., Falkowski, G., Jouck, S., Christ, H., Stauenmaier, K., …Dordel, S. (2008). School-based prevention: Effects on obesity and physical performance after 4 years. *Journal of Sports Sciences*, *26*, 987–994. doi:10.1080 /02640410801930176

Green, K. (2004). Physical education, lifelong participation and 'the couch potato society'. *Physical Education & Sport Pedagogy, 9*, 73 – 86. doi:10.1080 /1740898042000208133

Gustafson, S. L., & Rhodes, R. E. (2006). Parental correlates of physical activity in children and early adolescents. *Sports Medicine, 36*, 79-97. doi:10.2165/00007256-200636010 -00006

Gutin, B., Yin, Z., Humphries, M. C., & Barbeau, P. (2005). Relations of moderate and vigorous physical activity to fitness and fatness in adolescents. *The American Journal of Clinical Nutrition, 81*, 746–750.

Haga, M. (2008). The relationship between physical fitness and motor competence in children. *Child: Care, Health and Development*, *34*, 329-334. doi:10.1111/j.1365 -2214.2008.00814.x

Hagger, M., Ashford, B., & Stambulova, N. (1998). Russian and British children's physical self-perceptions and physical activity participation. *Paediatric Exercise Science, 10*, 137- 152.

Hagger, M., Biddle, S., & Wang, J. (2005). Physical self-concept in adolescence: Generalizability of a multi-dimensional hierarchical model across gender and grade. *Educational and Psychological Measurement, 65*, 297-322. doi:10.1177 /0013164404272484

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Halfon, N., Verhoef, P. A., & Kuo, A. A. (2012). Childhood antecedents to adult cardiovascular disease. *Pediatrics, 33*, 51-61. doi:10.1542/pir.33-2-51

Hands, B. (2002). *How can we best measure Fundamental Movement Skills?* Paper presented at the 23rd Biennial National/International Conference, Australia.

Hands, B., & Larkin, D. (2001). Children with developmental coordination disorder. In S. A. Cermak & D. Larkin (Eds.), *Developmental coordination disorder: Theory and practice*. San Diego, CA: Singular Press.

Hands, B., Larkin, D., Parker, H., Stranker, L., & Perry, M. (2009). The relationship among physical activity, motor competence and health-related fitness in 14 year-old adolescents. *Scandinavian Journal of Medicine Science and Sports, 19*, 655-663. doi:10.1111j.1600-0838.2008.00847

Hardy, L. L., Barnett, L., Espinel, P., & Okely, A.D., (2013). Thirteen-year trends in child and adolescent fundamental movement skills: 1997-2010. *Medicine and Science in Sports and Exercise, 45*, 1965-70. doi:10.1249/MSS.0b013e318295a9fc

Hardy, L., King, L., Espinel, P., Cosgrove, C., & Bauman, A., (2010). *NSW schools physical activity and nutrition survey (SPANS)*: Full report. Sydney: NSW Ministry of Health.

Hardy, L., King, L., Farrell, L., Macniven, R., & Howlett, S. (2010). Fundamental movement skills among Australian preschool children. Journal of Science and Medicine in Sport, 13, 5, 503-508. doi:10.1016/i.jsams.2009.05.010

Hardy L. L., Reinten-Reynolds, T., Espinel, P., Zask, A., & Okely, A. D. (2012) Prevalence and correlates of low fundamental movement skill competency in children. *Pediatrics, 130*, e390-e398. doi:10.1542/peds.2012-0345

Harro, M., & Riddoch, C. J. (2000). Physical activity. In N. Armstrong & W. V. Mechelen (Eds.), *Paediatric exercise science and medicine.* (pp. 77 - 84). Oxford: Oxford University Press.

Harter, S. (1978). Effectance motivation reconsidered: Toward a developmental model. *Human Development, 21*, 34-64. doi:10.1159/000271574

Harter, S. (1982). The perceived competence scale for children. *Child Development*, *53*, 87-97. doi:10.2307/1129640

Harter, S. (1985a). *Manual for the self-perception profile for children*. Denver, CO: University of Denver Press.

Harter, S. (1985b). Competence as a dimension of self-evaluation: Toward a comprehensive model of self-worth. In R. E. Leahy (Ed.), *The development of the self (*pp. 55-121). Orlando, FL: Academic Press.

Harter, S. (1987). The detriments and mediation role of global self-worth in children. In N. Eisenberg (Ed.) *Contemporary issues in developmental psychology* (pp. 219-242). New York: Willey.

Harter, S. (1990) Causes, correlates, and the functional role of global self-worth: A life-span perspective. In R.J. Sternberg & J. Kolligian (Eds.) *Competence Considered* (pp. 67-97). New Haven, CT: Yale University Press.

Harter, S., & Pike, R. (1984). The pictorial scale of perceived competence and social acceptance for young children. *Child Development, 55*, 1969–1984. doi:10.2307 /1129772

Harvey, W. J., Reid, G., Bloom, G. A., Staples, K., Grizenko, N., Mbekou, V., … Joober, R. (2009). Physical activity experiences of boys with and without ADHD. *Adapted Physical Activity Quarterly, 26*, 131-150.

Hayden-Davies, D. (2008, September). So what is physical literacy (and what use is it?). Paper presented at British Educational Research Association annual conference, University of Edinburgh.

Haywood, K. M. & Getchell, N. (2009). *Life span motor development* (5th ed.). Champaign, IL: Human Kinetics.

Heene, M., Hilbert, S., Draxler, C., Ziegler, M., & Bühner, M. (2011). Masking misfit in confirmatory factor analysis by increasing unique variances: A cautionary note on the usefulness of cut off values of fit indices. *Psychological Methods, 16*, 319-336. doi:10.1037/a0024917

Henderson, S. E., Sugden, D. A. & Barnett, A. L. (2007). *Movement assessment battery for children (Movement ABC-2)* (2nd ed.). London: The Psychological Corporation.

Higgs, C. (2010). Physical literacy-two approaches, one concept. *Physical and Health Education Journal, 76*, 6-7.

Higgs, C., Balyi, I., Way, R., Cardinal, C., Norris, S., & Bluechardt, M. (2008). *Developing physical literacy: A guide for parents of children ages 0 to 12.* A supplement to Canadian Sport for Life, Vancouver, British Columbia.

Hively, K., & El Alayli, A. (2014). "You throw like a girl:" The effect of stereotype threat on women's athletic performance and gender stereotypes, *Psychology of Sport and Exercise, 15,* 48-55

Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: A systematic review. *Psychology of Sport and Exercise, 15*, 382-391. doi:10.1016/j.psychsport2014.03.005

Hu, L., & Bentler, P. M. (1999). Cut off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling, 6,* 1-55. doi:10.1080/10705519909540118

Hume, C., Okely, A., Bagley, S., Telford, A., Booth, M., Crawford, D., & Salmon, J. (2008). Does weight status influence associations between children's fundamental movement skills and physical activity. *Research Quarterly for Exercise and Sport, 79*, 158–165. doi:10.5641/193250308X13086753543374

Jaakkola, T., & Washington, T. (2013). The relationship between fundamental movement skills and self-reported physical activity during Finnish junior high school. *Physical Education and Sport Pedagogy, 18*, 492-505. doi:10.1080/17408989.2012.690386

Jackson, D. M., Reilly, J. J., Kelly, L. A., Montgomery, C., Grant, S., & Paton, J. Y. (2003). Objectively measured physical activity in a representative sample of 3 to 4 year old children. *Obesity Research, 11*, 420-425. doi:10.1038/oby.2003.57

Jago, R., Page, A. S., & Coopers A. R. (2012) Friends and physical activity during the transition from primary to secondary school. *Medicine & Science in Sport & Exercise, 44*, 111-117. doi:10.1249/MSS.0b013e318229df6e.

Jones, R. J. A., Polman, R. C. J., & Peters, D. M. (2009). Physical self-perceptions of adolescents in years 8, 9, and 10 in independent schools, state comprehensive schools and specialist sport colleges in England. *Physical Education and Sport Pedagogy, 14,* 109-124. doi:10.1080/17408980701712122

Kaplan, R. M., & Sacuzzo, D. P. (2012). *Psychological testing: Principles, applications, and issues.* Belmont, CA: Wadsworth Cengage Learning.

Keegan, R. J, Keegan, S. L, Daley, S, Ordway, C., & Edwards, A. (2013). Getting Australia moving: Establishing a physically literate and active nation (game plan). Retrieved from the University of Canberra http://www.canberra.edu.au/researchrepository/file /50f8c79c-2aca-a83f-aee8-254288c36220/1/full_text_final.pdf

Kenyon, D. B., Kubik, M. Y., Davey, C., Sirard, J., & Fulkerson, J. A. (2012). Alternative high school student's physical activity: Role of self-efficacy. *American Journal of Health Behaviour, 36*, 300-310. doi:10.5993/AJHB.36.3.2

Kirk, D. (2005). Physical education, youth sport and lifelong participation: The importance of early learning experiences. *European Physical Education Review*, 11, 239-255. doi:10.1177/1356336X05056649

Kirk, D. (2010). *Physical education futures*. New York, NY: Routledge.

Klint, K. A., & Weiss, M. R. (1987). Perceived competence and motives for participating in youth sports: A test of Harter's competence motivation theory. *Journal of Sport Psychology*, 9, 55-65.

Knudson, D. & Morrison, C. (2002) *Qualitative analysis of human movement.* (2nd ed.). Champaign, IL: Human Kinetics.

Kohl, H. W., & Hobbs, K. E. (1998). Development of physical activity behaviours among children and adolescents. *Pediatrics*, *101*, 549-54.

Kolovelonis, A., Mousouraki, M., Goudas, M., & Michalopoulou, M. (2013) Psychometric properties of the Greek Version of the Children and Youth Physical Self-Perception Profile Questionnaire. *Advances in Physical Education, 3,* 158-164. doi:10.4236/ap .213.34026.

Kowalski, K., Crocker, P., Kowalski, N., Chad, K., & Humbert, M. L. (2003). Examining the physical self in adolescent girls over time: Further evidence against the hierarchical model. *Journal of Sport and Exercise Psychology*, *25,* 5-18.

Kriemler, S., Meyer, U., Martin, E., Van Sluijs, E. M .F., Andersen, L. B., & Martin, B. W. (2011). Effect of school based interventions on physical activity and fitness in children and adolescents: A review of reviews and systematic update. *British Journal of Sports Medicine, 45,* 1-17. doi:10.1136/bjsports-2011-090186

Krombholz, H. (2006). Physical activity in relation to age, sex, birth order, social class and sport activities of preschool children. *Perceptual and motor skills, 102*, 477-484. doi:10.2466/pms.102.2.477-484

Larkin, D. & Hoare, D (1991). *Out of step: Coordinating kids' movement*. The University of Western Australia, Nedlands, West Australia: Active Life Foundation.

Lee, H. (2009). *The Influence of parenting practices and behaviours in the relationship between social disadvantage and physical inactivity risk in the transition to young adulthood*. Extended abstract submitted to the Population Association of America.

Lee, H. (2014). The role of parenting in linking family socioeconomic disadvantage to physical activity in adolescence and young adulthood. *Youth and Society, 46*, 255-285. doi:10.1177/0044118X12470431

Light, R. L., Harvey, S., & Memmert, D. (2013). Why children join and stay in sports clubs: case studies in Australian, French, and German Swimming clubs. *Sport, Education and Society, 18*, 550-566. doi:10.1080/13573322.2011.594431

Lillegard, W. A., Brown, E. W., Wilson, D. J., Henderson, R., & Lewis, E. (1997). Efficacy of strength training in prepubescent to early post pubescent males and females: effects of gender and maturity. *Pediatric rehabilitation, 1,* 147-157.

Lindwall, M., Aşçı, F. H., Palmeira, A., Fox, K. R., & Hagger, M. S. (2011). The importance of importance in the physical self: Support for the theoretically appealing but empirically elusive model of James. *Journal of Personality, 79*, 303-334. doi:10.1111 /j.1467-6494.2010.00678.x

Lloyd, R. J. (2011). Awakening movement consciousness in the physical landscapes of literacy: Leaving, reading and being moved by one's trace. *Phenomenology & Practice, 5*, 73-95.

Lloyd, M., Colley, R. C., & Tremblay, M. S. (2010). Advancing the debate on 'fitness testing for children: Perhaps we're riding the wrong animal. *Paediatric Exercise Science*, *22*, 176-182.

Lloyd, M., & Tremblay, M. S. (2011). Introducing the Canadian assessment of physical literacy. In G. Baquet & S Berthoin (Eds.), *Children and exercise XXV: proceedings of the 25th Pediatric Work Physiology Meeting* (pp. 239-243). London: Routledge.

Lloyd, R. S., Faigenbaum, A. D., Stone, M. H., Oliver, J. L., Jeffreys, I., Moody, J. A., … Myer, G. D. (2014). Position statement on youth resistance training: The 2014 international consensus. *British Journal of Sports Medicine, 48*, 498-505. doi:10.1136 /bjsports-2013-092952

Lloyd, R. S., & Oliver, J. L. (2012). The Youth Physical Development (YPD) model: a new approach to long-term athletic development. *Strength and Conditioning Journal, 34*, 61-72. doi:10.1519/SSC.0b013e31825760ea

Logan, S. W., Robinson, L. E., Rudisill, M. E., Wadsworth, D., & Morera, M. (2012). The comparison of performances of at-risk school-age children on two motor assessments. *Physical Education & Sport Pedagogy*, 38, 305-315. doi:10.1080/17408989.2012 .726979

Loitz, C. (2013). The importance of lifelong physical literacy. *Wellspring, 24*, 4

Longmuir, P. E., Boyer, C., Lloyd, M., Yang, Y., Bolarskala, E., … Tremblay, M. S. (2015). The Canadian assessment of physical literacy: methods for children in grades 4 to 6 (8 to 12 years). *Bio Med Central, 15,* 767. doi:10.1186/s12889-015-2106-6

Lopes, V. P., Rodrigues, L. P., Maia, A. R., & Mallina, R.M. (2011). Motor coordination as predictor of physical activity in childhood. *Scandinavian Journal of Medicine and Science in Sports. 21*, 663-669. doi:10.1111/j.1600-0838.2009.01027.x

Lopes, V. P., Stodden, D. F., Bianchi, M. M., Maia, J. A. R., & Rodrigues, L. P. (2011). Correlation between BMI and motor co-ordination in children. *Journal of Science and medicine in Sport, 15*, 38-43. doi:10.1016/j.jsams.2011.07.005

Lounsbery, M. A. F., & McKenzie, T. L. (2015). Physically literate and physically educated: A rose by another name? *Journal of Sport and Health Science*, *4*, 1-6. doi:10.1016/j .jshs.2015.02.002

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Medicine, 40*, 1019-35. doi:10.2165/11536850-000000000-00000

Lundvall, S. (2015). Physical literacy in the field of physical education – A challenge and a possibility. *Journal of Sport and Health Science*, *4*, 113-118. doi:10.1016 /j.jshs.2015 .02.001

Mahon, A. D., Corral, P., Howe, C. A., Duncan, G. E., & Ray, M. L. (1996). Physiological correlates of 3 kilometre running performance in male children. *International Journal of Sports Medicine, 17*, 580-584. doi:10.1055/s-2007-972898

Malina, R. M. (2009). Children and adolescents in the sport culture: The overwhelming majority to the select few. *Journal of Exercise Science Fitness, 7*, 1-10. doi:10.1016 /s1728-869X(09)60017-4

Malina, R. M. (2012). Movement proficiency in childhood: Implications for physical activity and youth sport. *Kinesiologia Slovenica, 18*, 19-34.

Malina, R. M. & Bouchard, C. (1991). *Growth maturation and physical activity*. Champaign, IL: Human Kinetics.

Malina, R., Bouchard, C., & Bar-Or, O. (2004). *Growth, maturation and physical activity* (2nd ed.). Champaign, IL: Human Kinetics.

Mandigo, J., Francis, N., & Lodewyk, K. (2007). *Physical literacy concept paper.* Retrieved from http://canadiansportforlife.ca

Mandigo, J., Francis, N., Lodewyk, K., & Lopez, B. (2009). Physical literacy for educators. *Physical Health Education Journal*, *75*, 27-30.

Marsh, H.W. (1997). The measurement of physical self-concept: A construct validation approach. In K. Fox (Ed.), *The physical self-concept: From motivation to well-being* (pp. 27-58). Champaign, IL: Human Kinetics.

Marsh, H. W., Barnes, J., Cairns, L., & Tidman, M. (1984). Self-description questionnaire: Age and sex effects in the structure and level of self-concept for pre-adolescent children. *Journal of Educational Psychology, 76*, 940-956. doi:10.1037//0022-0663.76.5.940

Marsh, H. W., & Cheng, J. (2012). Physical Self-Concept. In G. Tenenbaum, R. Eklund & A. Kamata (Eds.), *Measurement in Sport and Exercise Psychology* (pp. 215-226). Champaign, IL: Human Kinetics.

Marsh, H. W., Hau, K., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis testing approaches to setting cut off values for fit indexes and dangers in over generalizing Hu and Bentler's (1999) findings. *Structural Equation Modelling, 11*, 320-341. doi:10.1207/s15328007sem1103_2

Marsh, H. W., Richards, G. E., Johnson, S., Roche, L. & Tremayne, P. (1994). Physical self-description questionnaire: Psychometric properties and a multitrait-multimethod analysis of relations to existing instruments. *Journal of Sport and Exercise Psychology,* 16, 270-305.

Marsh, H. W., & Shavelson, R. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist*, *20,* 107-123. doi:10.1207/s15326985ep2003_1

Marshall, J., & Bouffard, M. (1997). The effects of quality daily physical education on movement competency in obese versus non obese children. *Adapted Physical Activity Quarterly, 14*, 222-37.

Martinek, T., Cheffers, J., & Zaichkowsky, L. (1978). Physical activity, motor development and self concept: race and age differences. *Perceptual Motor Skills, 46,* 147-154.

Mattocks, C., Ness, A., Deere, K., Tilling, K., Leary, S., … Riddoch, C. (2008). Early life determinants of physical activity in 11 to 12 year olds: cohort study. *British Medical Journal, 336*, 26. doi:10.1136/bmj.39385.443565.BE

McGuire, M. T., Neumark-Sztainer, D. R., & Story, M. (2002). Correlates of time spent in physical activity and television viewing in a multi-racial sample of adolescents. *Pediatric Exercise Sci*ence, *14*, 75–86.

McIntyre, F. (2000). *Gender differences and developmental trends in the over arm throw: A qualitative and quantitative analysis* (Unpublished honours), University of Western Australia, Perth.

McKenzie, T. L. (2007). The preparation of physical educators: A public health perspective. *Quest, 59*, 346-357. doi:10.1080/00336297.2007.10483557

McKenzie, T. L., Sallis, J. F., Broyles, S. L., Zive, M. M., Nader, P. R., Berry, C. C., & Brennan, J. J. (2002). Childhood movement skills: Predictors of physical activity in Anglo American and Mexican American adolescents? *Research Quarterly for Exercise and Sport, 73*, 238–44. doi:10.1080/02701367.2002.10609017

Meusel, D., Ruiz, J. R., Ortega, F. B, Hagstromer, M., Bergman, P., & Sjostrom, M. (2007). Assessing levels of physical activity in the European population – the ALPHA project. *Seleccion, 16*, 9-12.

Miller, J. (2002). *The product and process performance of the two handed sidearm strike for primary school-aged children: The interrelationship of coordination, age and gender* (Unpublished doctoral dissertation), University of New England, Australia.

Miller, J. (2006, November). *Primary School-Aged Children and Fundamental Movement Skills-What is all the Fuss About?* Paper presented at the Australian Association for Research in Education (AARE), Adelaide, Australia.

Mitchell, B., McLennan, S., Latimer, K., Graham, D., Gilmore, J., & Rush, E. (2013). Improvement of fundamental movement skills through support and mentorship of class room teachers. *Obesity Research & Clinical Practice, 7,* 230-234. doi:10.1016 /j.orcp.2011.11.002

Moreno-Briseño, P., Díaz, R., Campos-Romo, A., & Fernandez-Ruiz, J. (2010). Sex related differences in motor learning and performance. *Behavioural and Brain Functions, 6*, 74-77. doi:10.1186/1744-9081-6-74.

Morgan, P. J., Barnett, L. M., Cliff, D. P., Okely, A. D., Scott, H. A., Cohen, K. E., & Lubans, D. R. (2013). Fundamental movement skill interventions in youth: A systematic review and meta-analysis. *Pediatrics, 132*, 1361-1381. doi:10.1542 /peds .2013-1167.

Morgan, P. J., & Hansen, V. (2008). Classroom teachers perceptions of the impact of barriers to teaching physical education on the quality of physical education programs. *Research Quarterly for Exercise and Sport, 79*, 506-516.

Morgan, S., Williams, M. D., & Barnes, C. (2013). Applying decision tree induction for identification of important attributes in one-versus-one player interactions: A hockey exemplar. *Journal of Sport Sciences*, *31*, 1031-1037. doi:10.1080/02640414.2013 .770906

Morrison, R. (1969). *A movement approach to educational gymnastics*, London: J.M. Dent & Son.

Morrow, J. R., Jackson, A. W., Disch, J. G., & Mood, D. P. (2005). Measurement and evaluation in human performance (3rd ed.). Champaign, IL: Human Kinetics.

Mullan, E., Albinson, J., & Markland, D. (1997). Children's perceived physical competence at different categories of physical activity. *Pediatric Exercise Science, 9,* 237-242.

Muthen, L. K., & Muthen, B. O. (2010). Mplus user’s guide (6th ed.). Los Angeles, CA: Muthen & Muthen.

National Assembly for Wales. (2013). Childhood obesity research service: Quick guide, Enquiry no: 13/1743. Retrieved from http://www.assembly.wales/Research %20Documents/Childhood%20Obesity%20-%20Quick%20guide-02072013 -29581/qg12-0004-English.pdf

Naughton, G. A., Carlson, J. S., & Greene, D. A. (2006). A challenge to fitness testing in primary schools. *Journal of Science and Medicine in Sport, 9,* 40-45. doi:10.1016/j .jsams.2006.01.002

Naylor, P. J., & McKay, H. A. (2009). Prevention in the first place: Schools a setting for action on physical inactivity. *British Journal of Sports Medicine, 43*, 10-3. doi:10.1136/bjsm.2008.053447

O’Brien, W. (2013). *The design, development, implementation and evaluation of the youth-physical activity towards health (Y-PATH) intervention* (Doctoral dissertation). Retrieved from http://doras.dcu.ie/19378/

O’Brien, W., Belton, S., & Issartel, J. (2015). Fundamental movement skill proficiency amongst adolescent youth. *Physical Education and Sport Pedagogy.* doi:10.1080 /17408989.2015.1017451

Ogden, C. Carroll, M. D., Kit, B., & Flegal, K. (2012). *Prevalence of obesity in the United States, 2009–2010 (*NCHS data brief No. 82). Hyattsville, MD: National Centre for Health Statistics. Retrieved from: hhttp://www.cdc.gov/nchs/data/databriefs/db82.pdf

Okely, A. D., & Booth, M. L. (2004). Mastery of fundamental movement skills among children in New South Wales: prevalence and socio demographic distribution. *Journal of Science and Medicine in Sport, 7*, 358-372. doi:10.1016/s1440 -2440(04)80031-8

Okely, A. D., Booth, M., & Chey, T. (2004). Relationship between body composition and fundamental movement skills among children and adolescents. *Research Quarterly for Exercise and Sport*, *75*, 238-247. doi:10.1080/02701367.2004.10609157

Okely, A. D., Booth, M., & Patterson, J. W. (2001). Relationship of physical activity to fundamental movement skills among adolescents. *Medicine and Science in Sports and Exercise*; *33*, 1899 – 1904. doi:10.1097/00005768-200111000-00015

Oliver, J. L., & Meyers, R. W. (2009). Reliability and generality of measures of acceleration, planned agility, and reactive agility. *International Journal of Sports Physiology and Performance, 4,* 345-354.

Page, A., Fox, K., Biddle, S., & Asmord, B. (1993). Evidence of cross-cultural validity for the physical self-perception profile. *Personality and Individual Differences, 14,* 585-590. doi:10.1016/0191-8869(93)90151-r

Parry, W. (2013). *Experiences of physical activity at age 10 in the 1970 British Cohort Study.* CLS working paper 2013/6. London: Centre for Longitudinal Studies.

Parsonage, J. R., Williams, R. S., Rainer, P., McKeown, I., & Williams, M. D. (2014). Assessment of conditioning-specific movement tasks and physical fitness measures in talent identified under 16 year-old rugby union players. *Journal of Strength and Conditioning Research*, *28*, 1497-1506. doi:10.1519/JSC.0000000000000298

Pate, R. R., Almeida, M. J., McIver, K. L., Pfeiffer, K. A., & Dowda, M. (2006). Validation and calibration of an accelerometer in preschool children. *Obesity, 14*, 2000–2006. doi:10.1038/oby.2006.234

Pate, R. R., McIver, K., Dowda, M., Brown, W. H., & Addy, C. (2008). Directly observed physical activity levels in preschool children. *Journal of School Health, 78*, 434-444. doi:10.1111/j.1746-1561.2008.00327.x

Penney, D., & Chandler, T. (2000). Physical education: What future(s)? *Sport, Education and Society, 5*, 71-87. doi:10.1080/135733200114442

Physical Activity Guidelines Advisory Committee. (2008). *Physical activity guidelines advisory committee report.* Washington, DC: U.S. Department of Health and Human Services.

Pot, N. (2014). *Sport socialisation and the role of the school*. (Doctoral dissertation, VU University Amsterdam, The Netherlands). Retrieved from http://dare.ubvu.vu.nl /bitstream/handle/1871/50830/title_page.pdf?sequence=15

Pot, N., & van Hilvoorde, I. (2013). A critical consideration of the use of physical literacy in the Netherlands. ICSSPE bulletin. *Journal of Sport Science and Physical Education*, *65*.

Powell, K. E., Caspersen, C. J., Koplan, J. P., & Ford, E. S. (1989). Physical activity and chronic diseases. *American Journal of Clinical Nutrition, 49*, 999-1006.

Public Health England. (2014). *National child management programme: England, 2013/14 school year.* Retrieved from the Health and Social Care Information Centre http://www.hscic.gov.uk/catalogue/PUB16070/nati-chil-meas-prog-eng-2013-2014 -rep.pdf

Rainer, P., Cropley, B., Jarvis, S., & Griffiths, R. (2012). From policy to practice: The challenges of providing high quality physical education and school sport faced by head teachers within primary schools. *Physical Education & Sport Pedagogy, 17*, 429-446. doi:10.1080/17408989.2011.603125

Raudsepp, L., & Liblik, R. (2002). Relationship of perceived and actual motor competence in children. *Perceptual & Motor Skills, 94*, 1059-70. doi:10.2466/pms.2002.94.3c.1059

Raudsepp, L., & PäII, P. (2006). The Relationship between fundamental motor skills and outside-school physical activity of elementary school children. *Pediatric Exercise Science, 18*, 426-435.

Raustorp, A., Mattsson, E., Svensson, K, & Stähle, A. (2006). Physical activity, body composition and physical self-esteem: A 3-year follow-up study among adolescents in Sweden. *Scandinavian Journal of Medicine and Science in Sports, 16,* 258-266. doi:10.1111/j.1600-0838.2005.00483.x

Raustorp, A., Stähle, A., Gudasic, H., Kinnunen, A., & Mattsson, E. (2005). Physical activity and self-perception in school children assessed with the children and youth physical self-perception profile. *Scandinavian Journal of Medicine and Science in Sports, 15,* 126-134. doi:10.1111/j.1600-0838.2004.406.x

Reeves, L., Broeder, C.E., Kennedy-Honeycutt, L., East, C., & Matney, L. (1999). Relationship of fitness and gross motor skills for five-to-six year-old children. *Perceptual & Motor Skills, 89*, 739-47. doi:10.2466/pms.1999.89.3.739

Reilly, J. J. (2010). Low levels of objectively measured physical activity in preschoolers in child care. *Medicine & Science in Sports & Exercise, 42*, 502-507. doi:10.1249/MSS .0b013e3181cea100

Ridgers, N. D., Stratton, G. & Fairclough, S. J. (2006). Physical activity levels of children during school playtime. *Sports Medicine, 36*, 359-371. doi:10.2165/00007256 -200636040-00005.

Roberton, M. A. (1977). Stability of stage categorisations across trials: implications for the "stage theory" of over arm throw development. *Journal of Human Movement Studies, 3*, 49-59.

Roetert, P. E., & Jefferies, S. C. (2014). Embracing physical literacy. *Journal of Physical Education, Recreation & Dance, 85*, 38-40. doi:10.1080/07303084.2014.948353

Rosenberg, M. (1965). *Society and the adolescent self-image.* Princeton, NJ: Princeton University Press.

Rosenthal, R. (1991). *Meta-analytic procedures for social research* (2nd ed.). Newbury Park, CA: Sage.

Rudd, J. (2015). *Can't throw, can't catch: Australian kids are losing that sporting edge.* Retrieved February 2015, from https://theconversation.com/cant-throw-cant-catchaustralian-kids-are-losing-that-sporting-edge-36822

Ruiz, J. R., Castro-Pinero, J., Espana-Romero, V., Artero, E. G., Ortega, F. B., & Cuena, M. M. (2010). Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. *British Journal of Sports Medicine, 45*, 518-524. doi:10.1136 /bjsm.2010.075341

Ruiz, J. R., Ortega, F. B., Gutierrez, A., Meusel, D., Sjostrum, M., & Castillo, M. J. (2006). Health-related fitness assessment in childhood and adolescence: a European approach based on the AVENA, EYHS and HELENA studies. *Journal of Public Health, 14*, 269-277. doi:10.1007/s10389-006-0059-z

Saakslahti, A., Numminen, P., Ninnikoski, H., Rask-Nissila, L., Viikari, J., Tuominen, J., & Valimaki, I. (1999). Is physical activity related to body size, fundamental movement skills, and CHD risk factors in early childhood? *Pediatric Exercise Science, 11*, 327-340.

Sallis, J. F., & Owen, N. (1999). *Physical activity and behavioural medicine*. London: Sage

Salmon, J., Ball, K., Crawford, D., Booth, M., Telford, A., Hume, C., ... Worsley, A. (2005). Reducing sedentary behaviour and increasing physical activity among 10-year-old children: overview and process evaluation of the switch-play intervention. *Health Promotion International*, *20*, 7-17. doi:10.1093/heapro/dah502.

Salmon, J., Booth, M. L., Phongsavan, P., Murphy, N., & Timperio, A. (2007). Promoting physical activity participation among children and adolescents. *Epidemiologic Reviews, 29*, 144–159. doi:10.1093/epirev/mxm010

Sandercock, G. (2015 June). Child fitness falls further than feared. Retrieved from https://www.essex.ac.uk/news/event.aspx?e_id=7764

Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. In A. von Eye & C. C. Clogg (Eds.), *Latent variables analysis: Applications for developmental research* (pp. 399-419). Thousand Oaks, CA: Sage.

Schoot, R, van de, Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European Journal of Developmental Psychology, 9*, 486-492. doi:10.1080/17405629.2012.686740

Schutz, R. W., & Gessaroli, M. E. (1993). Use, misuse and disuse of psychometrics in sport psychology research. In R. N. Singer, M. Murphy, and L. K. Tennant (Eds.), *Handbook of Research on Sport Psychology* (pp. 901-917). New York: Macmillan.

Seefeldt, V. (1980). The concepts of readiness applied to motor skill acquisition. In R. A. Magill, M. J. Ash, & F. L. Smoll (Eds.), *Children in Sport.* Champaign, IL: Human Kinetics.

Seefeldt, V., & Haubenstricker, J. (1982). Patterns, phases or stages: An analytical model for the study of developmental movement. In J. A. S. Kelso & J. E. Clark (Eds.), *The* *development of movement control and co-ordination* (pp. 309-318). Chichester, England: Wiley.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self concept: Validation of construct interpretations. *Review of Educational Research, 46*, 407-441. doi:10.3102 /00346543046003407

Shilling, C. (2008). *Changing bodies*. London: Sage.

Sonstroem, R. J., Harlow, L. L., & Josephs, L. (1994). Exercise and self-esteem: Validity of model expansion and exercise associations. *Journal of Sport and Exercise psychology, 16,* 29-42.

Sonstroem, R. J., & Morgan, W. P. (1989). Exercise and self-esteem: Rationale and model. *Medicine and Science in Sports and Exercise, 21*, 329-337. doi:10.1249/00005768 -198906000-00018

Sonstroem, R. J., & Potts, S. A. (1996). Life adjustment correlates of physical self-concepts. *Medicine and Science in Sport and Exercise, 28,* 619-625. doi:10.1097/00005768 -199605000-00014

Sonstroem, R. J., Speliotis, E. D., & Fava, J. L. (1992). Perceived physical competence in adults: An examination of the Physical Self-Perception Profile. *Journal of Sport and Exercise Psychology, 4,* 207-221.

Soule, J. C., Drummond, J., & McIntire, W. G. (1981). Dimensions of self-concept for children in kindergarten and grades 1 and 2. *Psychological Reports, 48*, 83-88. doi:10.2466/pr0.1981.48.1.83

Southall, J. E., Okely, A., & Steele, J. R. (2004). Actual and perceived physical competence in overweight and non-overweight children. *Pediatric Exercise Science, 16*, 15–24.

Spiller, V. (2009). Young people's perceptions and experiences of their physical bodies. (Doctoral dissertation). Victoria University, Melbourne, Australia.

Steiger, J. (1990). Structural model evaluation and modification: an interval estimation approach. *Multivariate Behaviour research, 25*, 173-180. doi:10.1207/s15327906mbr2502_4

Stein, C. J., Fisher, L., Berkey, C., & Colditz, G. A. (2007). Adolescent physical activity and perceived competence: does change in activity level impact self-perception*? Journal of Adolescent Health, 40,* 1-8. doi:10.1016/j.jadohealth.2006.11.147

Stevens, J. P. (1992). *Applied multivariate statistics for the social sciences* (4th ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Stodden, D. F., Gao, Z., Goodway, J. D., & Langendorfer S. J. (2014). Dynamic relationships between motor skill competence and health-related fitness in youth. *Pediatric Exercise Science, 26*, 231-241. doi:10.1123/pes.2013-0027

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *QUEST, 60*, 290-306. doi:10.1080/00336297.2008.10483582

Stodden, F. D., & Holfelder, B. (2013). No child left behind: the role of motor skill development. *Zeitschrift fur Sportpsychologie, 20*, 10-17. doi:10.1026/1612-5010/a000088.

Stodden, F. D., True, L. K., Langendorfer, S. J., & Gao, Z. (2013). Associations among selected motor skills and health related fitness: Indirect evidence for Seefeldt's proficiency barrier in young adults. *Research Quarterly for Exercise and Sport, 84*, 397-403. doi:10.1080/02701367.2013.814910

Stodden, D., Langendorfer, S., & Roberton, M. A. (2009). The association between motor skill competence and physical fitness in young adults. *Research Quarterly for Exercise and Sport, 80,* 223–229. doi:10.1080/02701367.2009.10599556

Stone, E. J., McKenzie, T. L., Welk, G. J., & Booth, M. L. (1998). Effects of physical activity interventions in youth. Review and synthesis. *American Journal of Preventative Medicine*, *15*, 298-315. doi:10.1016/S0749-3797(98)00082-8

Strath, S. J., Kaminsky, L. A., Ainsworth, B. E., Ekelund, U., Freedson, P. S., Gary, R. A., ...Swartz, A. M. (2013). Guide to the assessment of physical activity: clinical and research applications: a scientific statement from the American Heart Association. *Circulation; 128*, 2259–2279. doi:10.1161/01.cir.0000435708.67487.da

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. (5th ed.). Boston: Pearson/Allyn & Bacon.

Tompsett, C., Burkett, B., & McKean, M. R. (2014). Development of physical literacy and movement competency: A literature review. *Journal of Fitness Research*, *3*, 53-74.

Townsend, N., Bhatnagar, P., Wickramasinghe, K., Williams, J., Vujcich, D., & Rayner, M. (2013). *Children and young people statistics 2013*. London: British Heart Foundation.

Townsend, N., Wickramasinghe, K., Williams, J., Bhatnagar, P., & Rayner, M. (2015). *Physical activity statistics 2015*. London: British Heart Foundation.

Tremblay, M., Gray, C., Akinroye, K., Harrington, D., Katzmarzyk, P., Lambert, E., & Liukkonen, J. (2014). Physical activity of children: A global matrix of grades comparing 15 countries. *Journal of Physical Activity and Health, 11*, 113-125. doi:10.1123/jpah.2014-0177.

Tremblay, M., & Lloyd, M. (2010). Physical literacy measurement - The missing piece. *Physical and Health Education Journal, 76*, 26-30.

Tse, M. M. Y., & Yuen, D. T. W. (2009). Effects of providing a nutrition education program for teenagers: Dietary and physical activity patterns. *Nursing and Health Sciences, 11*, 160-165. doi:10.1111/j.1442-2018.2009.00443.x

Ulrich, D. A. (2000). *Test of gross motor development. Examiner's manual* (*2nd ed.).* Austin, Texas: Pro-ED. Inc.

Van Beurden, E., Zask, A., Barnett, L. M., & Dietrich, U. C. (2002). Fundamental movement skills - how do primary school children perform? The 'Move it Groove it' program in rural Australia. *Journal of Science and Medicine in Sport, 5*(3), 244-252. doi:10.1016 /s1440-2440(02)80010-x

Van Beurden, E., Barnett, L. M., Zask, A., Dietrich, U. C., Brooks, L. O., & Beard, J. (2003). Can we skill and activate children through primary school physical education lessons? ''Move it Groove It'': A collaborative health promotion intervention. *Preventative Medicine*, *36*, 493–501. doi:10.1016/s0091-7435(02)00044-0

Van der Horst, K., Chin A Paw, M. J., Twisk, J. W. R., & Van Mechelen, W. (2007). A brief review on correlates of physical activity and sedentariness in youth. *Medicine and science in sports and exercise, 39*, 1241–1250. doi:10.1249/mss.0b013e318059bf35

Vandorpe, B., Vandendriessche, J., Lefevre, J., Pion, J., Vaeyens, R., Matthys, S., ... Lenoir, M. (2011). The Körperkoordinations Test für Kinder: reference values and suitability for 6-12-year-old children in Flanders *Scandinavian Journal of Medicine and Science in Sports*, *21*, 378-388. doi:10.1111/j.1600-00838.2009.01067.x

Van Sluijs, E. M. F., McMinn, A. M., & Griffin, S. J. (2007). Effectiveness of interventions to promote physical activity in children and adolescents: Systematic review of controlled trials. *British Medical Journal,* 335, 703. doi:10.1136 /bmj.39320 .843947.BE

Vaseghi, B., Jaberzadeh, S., Kalantari, K. K., & Naimi, S. S. (2013). The impact of load and base support on electromyographic onset in the shoulder muscle during push-up exercises. *Journal of Bodywork and Movement Therapies, 17,* 192-199. doi:10.1016 /j.jbmt.2012.06.006

Verloigne, M., Van Lippevelde, W., Maes, L., Yildirim, M., Chinapaw, M., Manios, Y., ... Bourdeauduij, I. (2012) Levels of physical activity and sedentary time among 10-12 year-old boys and girls across 5 European countries using accelerometers: an observational study within the ENERGY-project. *International Journal of Behavioural Nutrition and Physical Activity*, *9*, 34. doi:10.1186/1479-5868-9-34

Walkley, J., Holland, B., Treloar, R., & Probyn-Smith, H (1993). Fundamental motor skill proficiency of children. *ACHPER National Journal, 40*, 11-14.

Wall, A. E. (2004). The developmental skill-learning gap hypothesis: Implications for children with movement difficulties. *Adapted Physical Activity Quarterly*, *21*, 197-218.

Wall, A. E., Reid, G., & Harvey, W. J. (2007). Interface of the knowledge-based and ecological task analysis approaches. In W. E. Davis & D. Broadhead (Eds.), *Ecological approach to analyzing movement* (pp. 259–277). Champaign, IL: Human Kinetics.

Wall, J. & Murray, N. (1994). Children and movement: Physical education in the elementary school. Dubuque, Iowa: Wm. C. Brown.

Weigand, D. A., Carr, S., Petherick, C., & Taylor, A. (2001). Motivational climate in sport and physical education: The role of significant others. *European Journal of Sport Science*, *1*, 1-13. doi:10.1080/17461390100071402

Weiss, M. R. (2000). Motivating kids in physical activity. *President's Council on Physical Fitness and Sport Research Digest, 3*, 11.

Welk, G. J. (1999). *Promoting physical activity in children: Parental influences.* ERIC Digest (ERIC Publications #ED436480). Washington, DC: Teaching and Teacher Education.

Welk, G. J., Corbin, C, B., Dowell, M, N., & Harris, H. (1997). The Validity and reliability of two different versions of the children and youth physical self-perception profile. *Measurement in Physical Education and Exercise Science, 1,* 163-177. doi:10.1207 /s15327841mpee0103_2

Welk, G. J., Corbin, C. B., & Lewis, L. A. (1995). Physical self-perceptions of high school athletes. *Paediatric Exercise Science, 7,* 152-161.

Welk, G. J., & Eklund, B. (2005). Validation of the children and youth physical self perceptions profile for young children. *Psychology of Sport & Exercise*, *6*, 51-65. doi:10.1016/j.psychsport.2003.10.006

Welk, G., Wood, K., & Morss, G. (2003). Parental influences on physical activity in children: An exploration of potential mechanisms. *Pediatric Exercise Science, 15*, 19–33.

Welsh Government. (2012). *Welsh health survey 2011*. Retrieved from http://gov.wales /docs/statistics/2012/120919healthsurvey2011en.pdf

Welsh Government (2013). *Physical Literacy – an all-Wales approach to increasing levels of physical activity for children and young people. Retrieved from http://gov.wales/docs /dcells/publications/130621-sports-and-physical-activity-review-en.pdf*

Welsh Government. (2014). *Welsh index of multiple deprivation (WIMD).* Retrieved from http://gov.wales/statistics-and-research/welsh-index-multiple-deprivation/?lang=en

West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with non-normal variables. In R. H. Hoyle (Ed.), *Structural equation modelling: concepts, issues, and applications* (pp. 56–75). Thousand Oaks, CA: Sage.

Westcott, S. L., Lowes, L. P., & Richardson, P. K. (1997). Evaluation of postural stability in children: Current theories and assessment tools. *Physical Therapy*, *77*, 629-645.

Wheaton, B., Muthen, B., Alwin, D., & Summers, G. (1977). Assessing reliability and stability in panel models. In D. R. Heise (Ed.), *Sociological Methodology 1977* (pp. 84-136). San Francisco: Jossey-Bass.

Wheeler, S. (2012). The significance of family culture for sports participation. *International Review for the Sociology of Sport, 47*, 235-252. doi:10.1177/1012690211403196

Whitehead, J. R. (1995). A study of children's physical self-perceptions using an adapted physical self-perception profile questionnaire. *Paediatric Exercise Science*, *7*, 132-151.

Whitehead, J. R., & Corbin, C. B. (1991). Effects of fitness test type, teacher, and gender on exercise intrinsic motivation and physical self-worth. *Journal of School Health, 61,* 11-16. doi:10.1111/j.1746-1561.1991.tb07850.x

Whitehead, M. (2001). The concept of physical literacy. *European Journal of Physical Education*. *6*, 127-138. doi:10.1080/1740898010060205

Whitehead, M. (2005). Physical literacy - A developing concept. Paper presented at the British Philosophy of Sport Conference, Durham.

Whitehead, M. (2007). Physical literacy: philosophical considerations in relation to the development of self, universality and propositional knowledge. *Sport Ethics and Philosophy*, *1*, 281-298. doi:10.1080/17511320701676916

Whitehead, M. (2010). *Physical literacy: Throughout the life course*. Abingdon, Oxon: Routledge.

Whitehead, M. (2013). What is physical literacy and how does it impact on physical education? In S. Capel & M. Whitehead (Eds.), *Debates in physical education* (pp. 37–53). Abingdon, Oxon: Routledge.

Wickstrom, R. L. (1983) *Fundamental motor patterns* (3rd ed.). Philadelphia, PA: Lea & Febiger.

Wilgenbusch, T., & Merrell, K. W. (1999). Gender differences in self-concept among children and adolescents: A meta-analysis of multi dimensional studies. School *Psychology Quarterly, 14*, 101-120. doi:10.1037/h0089000

Williams, H. G., Pfeiffer, K. A., O'Neill, J. R., Dowda, M., McIver, K. L., Brown, W. H., & Pate, R. R. (2008). Motor skill performance and physical activity in preschool children. *Obesity, 16*, 1421-1426. doi:10.1038/oby.2008.214

Woods, C. B., Tannehill, D., Quinlan, A., Moyna, N., & Walsh, J., (2010). The Children's Sport Participation and Physical Activity Study (CSPPA). Research Report No 1. School of Health and Human Performance, Dublin City University and The Irish Sports Council, Dublin, Ireland.

World Health Organisation. (2008). *Inequalities in Young People's Health: Health Behaviour in School Aged Children 2005-2006 Survey. Health policy for children and adolescents, No.5.* Retrieved from http://www.euro.who.int /__data /assets/pdf_file /0005/53852/E91416.pdf

World Health Organization. (2011a). *Obesity and overweight factsheet*. No. 311. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/index.html

World Health Organization. (2011b). *Global recommendations on physical activity for health*. Retrieved from http://www.who.int/dietphysicalactivity/leaflet-physical-activity-recommendations.pdf

World Health Organization. (2011c). *10 facts on physical activity*. Retrieved from http://www.who.int/features/factfiles/physical_activity/en/

World Health Organisation (2012). Physical Activity Fact Sheet. Retrieved from http://www.wpro.who.int/mediacentre/factsheets/physical_activity/en/

World Health Organisation (2015). *Obesity and overweight factsheet updated.* No.311. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/

Wright, J., & Burrows, L. (2006) Re-conceiving ability in physical education: A social analysis. *Sport Education and Society*, *11*, 275-291. doi:10.1080 /13573320600813440

Wrotniak, B. H., Epstein, L. H., Dorn, J. M., Jones, K. E., & Kondilis, V. A. (2006). The relationship between motor proficiency and physical activity in children. *Pediatrics*, *118*, 1758-1765. doi:10.1542/peds.2006-0742

Yang, X., Telama, R., & Laakso, L. (1996). Parents' physical activity, socio-economic status and education as predictors of physical activity and sport among children and youth: A 12 year follow up study. *International Review for the Sociology of Sports*, *31*, 273-291. doi:10.1177/101269029603100304

Young, D. R., Haskell, W. L., Taylor, C. B., & Fortmann, S. P. (1996). Effect of community health education on physical activity knowledge, attitudes, and behaviour. The Stanford Five-City Project. *American Journal Epidemiology*, *144*, 264 -274. doi:10.1093/oxfordjournals.aje.a008921

APPENDICIES

APPENDIX A

SCHOOL CONSENT FORM

University of Glamorgan
Prifysgol Morgannwg
Faculty of Health, Sport and Science
Cyfadran Iechyd, Chwaraeon a Gwyddoniaeth

SCHOOL CONSENT FORM

Title of Project: Physical Literacy in South East Wales Primary School Children: The Role of Fundamental Movement Skills.

Name of Principal Researcher: Mr. Stuart Jarvis, Faculty of Health, Sport and Science, University of Glamorgan.

I (Headteacher)____of

(School)____

Hereby consent to the children attending the school being approached to become volunteer participants in the above project.

I have read the information sheet and had opportunity to discuss and have sound answers of the project to my satisfaction. I agree that the children and their parents/guardians may be approached to discuss possible participation in this study, realizing that I or the children may withdraw at any time without prejudice.

I understand that all information gathered is treated as strictly confidential and will not be released by the investigator unless required to do so by law.

I agree that research data gathered for the study may be published provided the children's name or other identifying information is not used.

Signed Head teacher: ______________________________ Dated: _______________________

Signed Researcher: ________________________________ Dated: ______________________

The Human Research Ethics Committee at the University of Glamorgan requires that all participants are informed that, if they have any complaint regarding the manner in which a research project is conducted, it may be given to the researcher, or please contact the Research Office at the Faculty of Health Sport and Science at the University of Glamorgan on 01443 483143.

Professor/ Yr Athro Donna M Mead O.B.E.
Dean of Faculty/Deon y Cyfadran
University of Glamorgan/Prifysgol Morgannwg, Pontypridd, CF37 1DL, UK/DU
Tel/Ffôn 01443 483094 Fax/Ffacs 01443 483118
www.glam.ac.uk
Julie E Lydon Vice-Chancellor/Is-Ganghellor

APPENDIX B

PARENT/GUARDIAN CONSENT FORM

University of Glamorgan
Prifysgol Morgannwg
Faculty of Health, Sport and Science
Cyfadran Iechyd, Chwaraeon a Gwyddoniaeth

PARENT/GUARDIAN CONSENT FORM

Title of Project: Physical Literacy in South East Wales Primary School Children: The Role of Fundamental Movement Skills.

I agree for my child to take part in the above Faculty of Health, Sports and Science (University of Glamorgan) research project. I have had the project explained to me, and I have read the Parents/Guardians Information Sheet. I understand that agreeing for my child to take part means that I am willing for them to:

- Participate in testing of Fundamental Movement Skills and Physical Fitness for a period of 1 day.
- Allow measures of height, weight, waist circumference and muscle mass with the use of Bioelectrical Impedance Analysis to be taken.
- Complete questionnaires asking them about Physical Activity.
- Be videotaped performing the Fundamental Movement Skills for later analysis.

This information will be held and processed for the following purposes:

- To establish the levels of Fundamental Movement skill competency in primary school children and measure associated behaviours which may impact on the child's physical literacy competence.

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party. No identifiable personal data will be published. The identifiable data will not be shared with any other organisation.

I also agree to the University of Glamorgan recording and processing this information of my child. I understand that this information will be used for the purpose set out in this statement and my consent is conditional on the University complying with its duties and obligations under the Data Protection Act 1998.

I understand that my child's participation is voluntary, and they can choose not to participate in part or the entire project and they can withdraw at any stage of the project without being penalised or disadvantaged in any way.

Name :____(please print)

Signature: ___________________________________**Date:**__________________

ISO 14001 INVESTORS IN PEOPLE | BUDDSODDWYR MEWN POBL
Professor/ Yr Athro Donna M Mead O.B.E.
Dean of Faculty/Deon y Cyfadran
University of Glamorgan/Prifysgol Morgannwg, Pontypridd, CF37 1DL, UK/DU
Tel/Ffôn 01443 483094 Fax/Ffacs 01443 483118
www.glam.ac.uk
Julie E Lydon Vice-Chancellor/Is-Ganghellor

APPENDIX C

PARTICIPANT ASSENT FORM

University of Glamorgan
Prifysgol Morgannwg
Faculty of Health, Sport and Science
Cyfadran Iechyd, Chwaraeon a Gwyddoniaeth

PARTICIPANT ASSENT FORM

Title of Project: Physical Literacy in South East Wales Primary School Children: The Role of Fundamental Movement Skills.

I agree to take part in the University of Glamorgan research project. I have had the project explained to me, and I have read the Participant Information Sheet. I understand that agreeing to take part means that I am willing to:

- Take part for 1 day doing a variety of sports skills and physical tests.
- Complete questionnaires about Physical Activity.
- Allow the Sports Skills I do to be videotaped.

By me taking part in this project I know that it will:

- Give valuable information on basic sports skills and physical fitness. It will also highlight the type and amount of sports I play and let the researchers know why I do or do not enjoy playing games or sports and being physically active.

I understand that all the information collected about me will not be seen by anyone else other than the persons giving me the tests from the University. I will also not be named or identified in any reports on the project.

I also agree to the University of Glamorgan recording and processing this information about me. I understand that this information will only be used to look at my sports skills and my permission is given based on the University complying with its duties and obligations under the law.

I understand that my taking part in this project is totally up to me. If I so wish I can choose not to take part or I can withdraw at any stage without having to say why.

Name :____(please print)

Signature: ____Date:____________

Professor/ Yr Athro Donna M Mead O.B.E.
Dean of Faculty/Deon y Cyfadran
University of Glamorgan/Prifysgol Morgannwg, Pontypridd, CF37 1DL, UK/DU
Tel/Ffôn 01443 483094 Fax/Ffacs 01443 483118
www.glam.ac.uk
Julie E Lydon Vice-Chancellor/Is-Ganghellor

APPENDIX D

EXERCISE AND PHYSICAL ACTIVITY READINESS ASSESSMENT QUESTIONNAIRE

University of Glamorgan
Prifysgol Morgannwg
Faculty of Health, Sport and Science
Cyfadran Iechyd, Chwaraeon a Gwyddoniaeth

Exercise and Physical Activity Readiness Assessment Questionnaire
PRE-TEST QUESTIONNAIRE
Completed by a Parent/Guardian of Child

NAME OF CHILD ……………………………………………………………………………….

CHILD DATE OF BIRTH ……………………………**CHILD'S AGE:** ……………….

As your child is to be a participant in this project, would you please complete the following physical activity readiness questionnaire for your child?

Please tick appropriate box

	YES	NO
Has the test procedure(s) that your child will participate in been fully explained to you?	☐	☐
Any information contained herein will be treated as confidential		
1. Has your doctor ever said that your child has a heart condition and that your child should only do physical activity recommended by a doctor?	☐	☐
2. Does your child ever experience chest pain during physical activity?	☐	☐
3. Does your child ever lose balance because of dizziness or do they ever lose consciousness?	☐	☐
4. Does your child have a bone or joint problem that could be made worse by a change in their physical activity participation?	☐	☐
5. Does your child have uncontrolled asthma (i.e. asthma that is not easily controlled by an inhaler?	☐	☐

		YES	NO
6.	Is your doctor currently prescribing any medication for your child's blood pressure or a heart condition?	☐	☐
7.	Do you know of any other reasons why your child should not undergo or be restricted in their ability to undertake physical activity? This might include diabetes, a recent injury, serious illness or suffering from a physical or mental impairment.	☐	☐

If you have answered NO to <u>all</u> questions then you can be reasonably sure that your child can take part in the physical activity requirement of this project.

I .... Declare that the above information is correct at

the time of completing this questionnaire on date.........../.........../.........

Please note: If your child's health changes so that you can answer YES to any of the above questions notify the investigators and consult with your doctor regarding the level of physical activity that your child can participate in.

If you answered YES to one or more questions:
Talk to your doctor in person discussing with him/her those questions you answered yes.

Ask your doctor if your child is able to participate in the physical activity requirements of the project.

Doctor's Name.. Date ....

Doctor's Signature ....

Signature of Investigator .... Date ....

Professor/ Yr Athro Donna M Mead O.B.E.
Dean of Faculty/Deon y Cyfadran
University of Glamorgan/Prifysgol Morgannwg, Pontypridd, CF37 1DL, UK/DU
Tel/Ffôn 01443 483094 Fax/Ffacs 01443 483118
www.glam.ac.uk
Julie E Lydon Vice-Chancellor/Is-Ganghellor

APPENDIX E

PARENTAL BEHAVIOUR QUESTIONNAIRE

Dear Parent,

Thank you for taking the time to complete this short questionnaire about physical activity behaviour. We have tried to make the questionnaire as quick and easy to fill in as possible. On completion of this questionnaire your identity will be kept totally anonymous and any information you provide will be kept confidential. You will not be identified in any publication of the research results. On completion of this questionnaire please could you place it back in the envelope labelled PBQ and return to your child's school.

When completing this questionnaire please remember:

- There are no right or wrong answers; this is not a test.
- Please answer all questions as honestly and accurately as you can.
- Please complete each section as fully as possible as each question is important to the project.

Please tick or place a cross in the box which you think applies to you

1. Birth date of your child :………/………/………(dd/mm/year) School:

2. How often does your child on average do the following activities?

	Less than 1 hour a week	1 hour a week	2-4 hours a week	5-7 hours a week	More than 7 hours a week
Quiet play with small play equipment	❑	❑	❑	❑	❑
Active play (running, rolling, climbing)	❑	❑	❑	❑	❑
Creative play (drawing, crafts,)……………	❑	❑	❑	❑	❑
Computer Games / Game Consoles……….	❑	❑	❑	❑	❑
TV / Video and DVD watching………………	❑	❑	❑	❑	❑
Read books…………………………………………….	❑	❑	❑	❑	❑
Move/dance to music………………………………	❑	❑	❑	❑	❑

3. On average how frequently does your child play?

	Never	Monthly or less	Several times a month	Once a week	Several times a week	Daily
Indoors……………………………………	❑	❑	❑	❑	❑	❑
Outdoors………………………………..	❑	❑	❑	❑	❑	❑

4. How often during the past year has your child participated in these activities?

	Never	Once	2-5 times	6-12 times	More than 12 times
After school sports clubs……………	❑	❑	❑	❑	❑
Swimming clubs………………………………	❑	❑	❑	❑	❑
Children's sports camps………………..	❑	❑	❑	❑	❑
Community sports clubs……………….	❑	❑	❑	❑	❑
Other, namely…………………………………	❑	❑	❑	❑	❑

5. How does your child travel to school?

	Not applicable	Never	Little	Occasionally	Often	Always
Public or school transport…	❑	❑	❑	❑	❑	❑
Bike…………………………………………	❑	❑	❑	❑	❑	❑
On foot…………………………………..	❑	❑	❑	❑	❑	❑
Car, motorcycle, moped……	❑	❑	❑	❑	❑	❑

6. Who looks after your child before and/or after school?

	Not applicable	Monthly or less	Several times / month	1-2 times a week	3-4 times a week
Father / Stepfather……	❑	❑	❑	❑	❑
Mother / Stepmother…	❑	❑	❑	❑	❑
Grandparent (s)……………..	❑	❑	❑	❑	❑
Family………………………………	❑	❑	❑	❑	❑
Babysitter……………………	❑	❑	❑	❑	❑
School……………………………	❑	❑	❑	❑	❑

7. If your child is looked after for you before and/or after school, how long is this on average per day?

Pre-school ……………Hours ……………Minutes

After-school ……………Hours ……………Minutes

8. How much importance do you attach to the following for your child?

	Very little	Little	Average	Many	Very much
Intellectual development……….	❑	❑	❑	❑	❑
Movement skill development.	❑	❑	❑	❑	❑
Social development…………………	❑	❑	❑	❑	❑
Physical activity ………………………	❑	❑	❑	❑	❑
5 a Day………………………………………	❑	❑	❑	❑	❑
Getting enough sleep………………	❑	❑	❑	❑	❑

9. **How often do you discuss your child's physical education lessons or physical activity with their teacher?**

	Never	Annually or less	Several times a year	Monthly	Several times a month	Weekly or more
Father / Stepfather	❑	❑	❑	❑	❑	❑
Mother / Stepmother	❑	❑	❑	❑	❑	❑

10. **How frequently do you and your child undertake the following activities together?**

	Less than 1 hour a week	1 hour a week	2-4 hours a week	5-7 hours a week	More than 7 hours / week
Quiet play with small play equipment	❑	❑	❑	❑	❑
Active play (running, rolling, climbing, …)	❑	❑	❑	❑	❑
Creative play (drawing, crafts,)…………	❑	❑	❑	❑	❑
Computer Games / Game Consoles………….	❑	❑	❑	❑	❑
TV / Video and DVD watching……………….	❑	❑	❑	❑	❑
Consult and read books…………………………….	❑	❑	❑	❑	❑
Move to music/dancing……………………………	❑	❑	❑	❑	❑

11. **How frequently do you get to conduct these activities with your child?**

Visiting:	Never	Once per year	2-4 times per year	5 times per year	6-9 times per year	More than 10 times per year
Playground……………………………	❑	❑	❑	❑	❑	❑
Forest…………………………………	❑	❑	❑	❑	❑	❑
Park……………………………………	❑	❑	❑	❑	❑	❑
Walking with Pets………………	❑	❑	❑	❑	❑	❑
Zoo…………………………………….	❑	❑	❑	❑	❑	❑
Amusement Park…………………	❑	❑	❑	❑	❑	❑
Cinema……………………………………	❑	❑	❑	❑	❑	❑
Museum……………………………………	❑	❑	❑	❑	❑	❑
Theatre…………………………………	❑	❑	❑	❑	❑	❑
Shops………………………………………	❑	❑	❑	❑	❑	❑
Other, namely: ……………………	❑	❑	❑	❑	❑	❑

12. **How frequently outside of school hours does your child undertake any form of physical activity with their contemporaries (friends, cousins, siblings, neighbourhood children)?**

	Never	Monthly or less	Several times a month	Once a week	Several times a week	Daily
Indoors……………………	❑	❑	❑	❑	❑	❑
Outdoors…………………	❑	❑	❑	❑	❑	❑

13. **When your child participates in sport or games how would you rate the importance of the following elements?**

	Unimportant	Rather unimportant	Neutral	Rather important	Important
Having a fun experience……………………………	❑	❑	❑	❑	❑
Experiencing movement which contributes	❑	❑	❑	❑	❑
Experiencing success………………………………	❑	❑	❑	❑	❑
Learning to play within a team………….	❑	❑	❑	❑	❑
Learning to respect the game rules……	❑	❑	❑	❑	❑
Developing specific sport skills (e.g., football, dance, gymnastics)…………………	❑	❑	❑	❑	❑
Experiencing a variety of games or sports.	❑	❑	❑	❑	❑
Producing high performance…………………	❑	❑	❑	❑	❑

14. **If you and your child play or do physical activity together, do you do this:**

	Exceptional	Rather rare	Regular	Rather often	Very common
Spontaneously……………………………………………….	❑	❑	❑	❑	❑
If your child asks for……………………………………	❑	❑	❑	❑	❑
If you yourself are in need of exercise……	❑	❑	❑	❑	❑

15. **Do you know which sports or games activities your child likes playing?**

❑ Yes
❑ Sometimes
❑ No idea

16. **Does your child have any brothers/step brothers and/or sisters/step sisters still living at home?**

❒ **Older brothers**	**Number**……………	❒ **Older sisters**	**Number**……………
❒ **Younger brothers**	**Number**……………	❒ **Younger sisters**	**Number**……………

17. Is the family where your child grows up mainly composed of?

- ❑ One-parent families
- ❑ Two-parent families
- ❑ Co-parenting
- ❑ Foster
- ❑ Other, namely … … … …

18. What is your current employment situation?

Father / Stepfather	**Mother / Stepmother**
❑ Civil Servant	❑ Civil Servant
❑ Professional (e.g., teacher)	❑ Professional (e.g., teacher)
❑ Self Employed	❑ Self Employed
❑ Employee	❑ Employee
❑ House person	❑ House person
❑ Retired	❑ Retired
❑ Unemployed	❑ Unemployed
❑ Disability	❑ Disability
❑ Other	❑ Other
❑ Not applicable	❑ Not applicable

19. What is your current contract of employment?

	Father / Stepfather	**Mother / Stepmother**
Full-time	❑	❑
Part-time	❑	❑
Not applicable	❑	❑

20. How frequently on average do you undertake sports activity / exercise per week?

	Not applicable	**Less than 1 hour a week**	**1 hour a week**	**2-4 hours a week**	**5-7 hours a week**	**More than 7 hours / week**
Father / Stepfather	❑	❑	❑	❑	❑	❑
Mother / Stepmother	❑	❑	❑	❑	❑	❑

Thank you very much for your co operation. Please place this completed questionnaire in the envelope labelled PBQ and return to school.

APPENDIX F

THE CHILDREN AND YOUTH PHYSICAL SELF PERCEPTION QUESTIONNAIRE (CY-PSPP)

The Children and Youth Physical Self-Perception Profile (CY-PSPP)

The 36 item, six sub-scales CY-PSPP (Ecklund et al., 1997) includes scales to address perceptions of Physical Conditioning, Sports Competence, Body Attractiveness, and Strength as well as scales to assess Physical Self Worth and Self-Esteem. Each scale is assessed with six items scored on a four-point scale with the average score used to represent the value for the scale. All of the items use a structured alternative format to reduce the tendencies for socially desirable responses (Harter, 1982) and approximately half of the items are reverse coded to keep the instrument more interesting for participants. For each question, participants decide between two statements that best describe their beliefs and then decide if it is sort of true or really true for them. Each question gives a score between one and four, with four being the highest self-perception. The maximum score for each domain is 24 (the sum of six items associated with each domain scale).

Name	Age	Gender
Teacher	Class	Date

Please look at the sample question first. Put an X on one of the four lines. Please choose only one answer to each question. There are no right or wrong answers. Simply put an X in the box which you think is most true of you.

#	Really True for me	Sort of True for me	**SAMPLE SENTENCE**			Sort of True for me	Really True for me
			Some kids would rather play outdoors in their spare time.	**BUT**	Other kids would rather watch TV.		
#	Really True for me	Sort of True for me				Sort of True for me	Really True for me
1			Some kids do very well at all kinds of sports	**BUT**	Other kids don't feel that they are very good when it comes to sports.		
2			Some kids feel uneasy when it comes to doing vigorous physical exercise.	**BUT**	Other kids feel confident when it comes to doing vigorous physical exercise.		
3			Some kids feel that they have a good-looking (fit looking) body compared to other kids.	**BUT**	Other kid's feel that compared to most, their body doesn't look so good.		
4			Some kids feel that they lack strength compared to other kids their age.	**BUT**	Other kids feel that they are stronger than other kids their age.		
5			Some kids are proud of themselves physically.	**BUT**	Other kids don't have much to be proud of physically.		
6			Some kids are often unhappy with themselves.	**BUT**	Other kids are pretty pleased with themselves.		
7			Some kids wish they could be a lot better at sports.	**BUT**	Other kids feel that they are good enough at sports.		
8			Some kids have a lot of stamina for vigorous physical exercise.	**BUT**	Other kids soon get out of breath and have to slow down or quit.		

9			Some kids find it difficult to keep their bodies looking good physically.	**BUT**	Other kids find it easy to keep their bodies looking good physically.		
10			Some kids think that they have stronger muscles than other kids their age.	**BUT**	Other kids feel that they have weaker muscles than other kids their age.		
11			Some kids don't feel confident about themselves physically.	**BUT**	Other kids really feel good about themselves physically.		
12			Some kids are happy with themselves as a person.	**BUT**	Other kids are often not happy with themselves.		
13			Some kids think they could do well at just about any new sports activity they haven't tried before.	**BUT**	Other kids are afraid they might not do well at sports they haven't ever tried.		
14			Some kids don't have much stamina and fitness.	**BUT**	Other kids have lots of stamina and fitness.		
15			Some kids are pleased with the appearance of their bodies.	**BUT**	Other kids wish that their bodies looked in better shape physically.		
16			Some kids lack confidence when it comes to strength activities.	**BUT**	Other kids are very confident when it comes to strength activities.		
17			Some kids are very satisfied with themselves physically.	**BUT**	Other kids are often dissatisfied with themselves physically.		
18			Some kids don't like the way they are leading their life.	**BUT**	Other kids do like the way they are leading their life.		
19			In games and sports some kids usually watch instead of play.	**BUT**	Other kids usually play rather than watch.		
20			Some kids try to take part in energetic physical exercise whenever they can.	**BUT**	Other kids try to avoid doing energetic exercise if they can.		
21			Some kids feel that they are often admired for their good looking bodies.	**BUT**	Other kids feel that they are seldom admired for the way their bodies look.		
22			When strong muscles are needed, some kids are the first to step forward.	**BUT**	Other kids are the last to step forward when strong muscles are needed.		
23			Some kids are unhappy with how they are and what they can do physically.	**BUT**	Other kids are happy with how they are and what they can do physically.		

24			Some kids like the kind of person they are.	**BUT**	Other kids often wish they were someone else.		
25			Some kids feel that they are better than others their age at sports.	**BUT**	Other kids don't feel they can play as well.		
26			Some kids soon have to quit running and exercising because they get tired.	**BUT**	Other kids can run and do exercises for a long time without getting tired.		
27			Some kids are confident about how their bodies look physically.	**BUT**	Other kids feel uneasy about how their bodies look physically.		
28			Some kids feel that they are not as good as others when physical strength is needed.	**BUT**	Other kids feel that they are among the best when physical strength is needed.		
29			Some kids have a positive feeling about themselves physically.	**BUT**	Other kids feel somewhat negative about themselves physically.		
30			Some kids are very unhappy being the way they are.	**BUT**	Other kids wish they were different.		
31			Some kids don't do as well at new outdoor games.	**BUT**	Other kids are good at new games right away.		
32			When it comes to activities like running, some kids are able to keep going.	**BUT**	Other kids soon have to quit to take a rest.		
33			Some kids don't like how their bodies look physically.	**BUT**	Other kids are pleased with how their bodies look physically.		
34			Some kids think that they are strong and have good muscles compared to kids their age.	**BUT**	Other kids think that they are weaker and don't have such good muscles as other kids their age.		
35			Some kids wish that they could feel better about themselves physically.	**BUT**	Other kids always seem to feel good about themselves physically.		
36			Some kids are not very happy with the way they do a lot of things.	**BUT**	Other kids think the way they do things is fine.		

APPENDIX G

THE PHYSICAL ACTIVITY RECALL QUESTIONNAIRE FOR CHILDREN (PAQ-C)

Physical Activity Questionnaire (Primary School)

Dear Participant,

Thank you for taking the time to complete this short questionnaire about your physical activity levels. We have tried to make the questionnaire as quick and easy to fill in as possible, but if you have any questions please just ask your teacher or a researcher who is present.

Remember:

- There are no right or wrong answers; this is not a test.
- Please answer all questions as honestly and accurately as you can.
- Please complete each section as fully as possible as each question is important to the project.

Section 1 – About You

Name: ___________________________________

Date of Birth: _____________________________

Your Bib Number: __________________________

Section 2 – Your physical activity levels

We are trying to find out about your level of physical activity from the last 7 days (in the last week). These includes sports or dance that makes you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others. Please tick or place a cross in the box which you think applies to you.

Q1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, tick how many times?

Activity	No	1-2 times	3-4 times	5-6 times	7 times or more
Bike Riding	⬭	⬭	⬭	⬭	⬭
Household Chores (e.g., Mow lawn)	⬭	⬭	⬭	⬭	⬭
Jogging / Running	⬭	⬭	⬭	⬭	⬭
Roller skating / Ice skating	⬭	⬭	⬭	⬭	⬭
Skateboarding	⬭	⬭	⬭	⬭	⬭
Skipping	⬭	⬭	⬭	⬭	⬭
Swimming	⬭	⬭	⬭	⬭	⬭
Tag / Chase games	⬭	⬭	⬭	⬭	⬭
Walking for exercise	⬭	⬭	⬭	⬭	⬭
Aerobics	⬭	⬭	⬭	⬭	⬭
Athletics	⬭	⬭	⬭	⬭	⬭
Badminton	⬭	⬭	⬭	⬭	⬭
Basketball	⬭	⬭	⬭	⬭	⬭
Boxing / Wrestling	⬭	⬭	⬭	⬭	⬭
Cheerleading	⬭	⬭	⬭	⬭	⬭
Cricket	⬭	⬭	⬭	⬭	⬭
Dance	⬭	⬭	⬭	⬭	⬭
Fitness Class (e.g., circuits)	⬭	⬭	⬭	⬭	⬭
Football	⬭	⬭	⬭	⬭	⬭
Golf	⬭	⬭	⬭	⬭	⬭
Gymnastics	⬭	⬭	⬭	⬭	⬭
Hiking	⬭	⬭	⬭	⬭	⬭
Hockey	⬭	⬭	⬭	⬭	⬭
Horse riding	⬭	⬭	⬭	⬭	⬭
Lacrosse	⬭	⬭	⬭	⬭	⬭

Martial Arts (e.g., Karate)	◯	◯	◯	◯	◯
Multi-skills	◯	◯	◯	◯	◯
Mountaineering	◯	◯	◯	◯	◯
Netball	◯	◯	◯	◯	◯
Orienteering	◯	◯	◯	◯	◯
Rock climbing	◯	◯	◯	◯	◯
Rounders	◯	◯	◯	◯	◯
Rowing / Canoeing	◯	◯	◯	◯	◯
Rugby	◯	◯	◯	◯	◯
Sailing	◯	◯	◯	◯	◯
Squash / Racquetball	◯	◯	◯	◯	◯
Table tennis	◯	◯	◯	◯	◯
Trampolining	◯	◯	◯	◯	◯
Volleyball	◯	◯	◯	◯	◯
Weight training	◯	◯	◯	◯	◯
Yoga	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

Q2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Please tick one box only.)

I don't do PE……………………………………………………… ◯
Hardly ever……………………………………………………… ◯
Sometimes……………………………………………………… ◯
Quite often……………………………………………………… ◯
Always……………………………………………………… ◯

Q3. In the last 7 days, what did you do most of the time at break time? (Please tick one box only.)

Sat down (talking, reading, doing school work) ◯
Stood around or walked around……………………… ◯
Ran or played a little bit……………………………… ◯
Ran around and played quite a bit………………… ◯
Ran and played hard most of the time…………… ◯

Q4. In the last 7 days, what did you normally do at lunch time (besides eating lunch)? (Please tick one box only.)

- Sat down (talking, reading, doing school work) ○
- Stood around or walked around………………………. ○
- Ran or played a little bit…………………………………. ○
- Ran around and played quite a bit……………………. ○
- Ran and played hard most of the time……………. ○

Q5. In the last 7 days, on how many days straight after school, did you do sport, dance, or play games in which you were very active? (Please tick one box only.)

- None…………………………………………………………………. ○
- 1 time last week……………………………………………. ○
- 2 or 3 times last week…………………………………. ○
- 4 times last week…………………………………………. ○
- 5 times last week…………………………………………. ○

Q6. In the last 7 days, on how many evenings did you do sports, dance, or play games in which you were very active? (Please tick one box only.)

- None…………………………………………………………………. ○
- 1 time last week……………………………………………. ○
- 2 or 3 times last week…………………………………. ○
- 4 times last week…………………………………………. ○
- 5 times last week…………………………………………. ○
- 6 or 7 times last week…………………………………. ○

Q7. On the last weekend, how many times did you do sports, dance, or play games in which you were very active? (Please tick one box only.)

- None…………………………………………………………………. ○
- 1 time………………………………………………………………. ○
- 2 - 3 times………………………………………………………. ○
- 4 – 5 times………………………………………………………. ○
- 6 or more times……………………………………………. ○

Q8. Which one of the following describes you best for the last 7 days? Read all five statements before deciding on the <u>one</u> answer that describes you.

A. All or most of my free time was spent doing things that involve little physical effort ○

B. I sometimes (1-2 times last week) did physical things in my free time (e.g., played sports, went running, swimming, bike riding, did aerobics)…………………………………………… ○

C. I often (3-4 times last week) did physical things in my free time……………………………… ○

D. I quite often (5-6 times last week) did physical things in my free time……………………… ○

E. I very often (7 or more times last week) did physical things in my free time…………… ○

Q9. Please tick how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	A Little bit	Medium	Often	Very often
Monday………………..	○	○	○	○	○
Tuesday………………	○	○	○	○	○
Wednesday………..	○	○	○	○	○
Thursday…………….	○	○	○	○	○
Friday………………….	○	○	○	○	○
Saturday…………….	○	○	○	○	○
Sunday…………………	○	○	○	○	○

Q10. Were you ill last week, or did anything prevent you from doing your normal physical activities? (Please tick one.)

Yes…………………………………. ○

No………………………………….. ○

If yes, what prevented you? …………………………………………………………………………………

Thank you for completing this questionnaire. Your responses are really important to this project

APPENDIX H
EXAMPLE FUNDAMENTAL MOVEMENT SKILL SCORE SHEET

Fundamental Movement Skills Subtest Performance Record

Participant Identification Number:		Sex: Male / Female	Date of Birth:	

Non Locomotor Subtest

Skill	Performance Criteria (component)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Score
Static Balance	1. Support leg still, foot flat on the ground						
	2. Non-support leg bent, not touching the support leg						
	3. Head stable, eyes focused forward						
	4. Trunk stable and upright						
	5. No excessive arm movements						
						Skill Score	

Locomotor Subtests

Skill	Performance Criteria (component)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Score
Run	1. Lands on ball of the foot.						
	2. Non-support knee bends at least 90 degrees during the recovery phase.						
	3. High knee lift (thigh almost parallel to the ground).						
	4. Head and trunk stable, eyes focused forward.						
	5. Elbows bent at 90 degrees.						
	6. Arms drive forward and back in opposition to the legs.						
						Skill Score	
Skill	**Performance Criteria (component)**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Score**
Vertical Jump	1. Eyes focused forward or upward throughout the jump.						
	2. Crouches with knees bent and arms behind the body.						
	3. Forceful forward and upward swing of the arms.						
	4. Legs straighten in the air.						
	5. Lands on balls of the feet and bends knees to absorb landing.						
	6. Controlled landing with no more than one step in any direction						
						Skill Score	
Skill	**Performance Criteria (component)**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Score**
Side Gallop	1. Smooth rhythmical movement.						
	2. Brief period where both feet are off the ground.						
	3. Weight on the balls of the feet.						
	4. Hips and shoulders point to the front.						
	5. Head stable, eyes focused forward or in the direction of travel.						
						Skill Score	

Skill	Performance Criteria (component)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Score
Leap	1. Eyes focused forward throughout the leap.						
	2. Knee of take-off leg bends.						
	3. Legs straighten during flight.						
	4. Arms held in opposition to the legs.						
	5. Trunk leans slightly forward.						
	6. Lands on ball of the foot and bends knee to absorb landing.						
						Skill Score	
	Manipulative Subtests						
Skill	**Performance Criteria (component)**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Score**
Catch	1. Eyes focused on the object throughout the catch.						
	2. Feet move to place the body in line with the object.						
	3. Hands move to meet the object.						
	4. Hands and fingers relaxed and slightly cupped to catch the object.						
	5. Catches and controls the object with hands only (Well-timed closure).						
	6. Elbows bend to absorb the force of the object.						
						Skill Score	
Skill	**Performance Criteria (component)**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Score**
Over arm Throw	1. Eyes focused on target area throughout the throw.						
	2. Stands side-on to target area						
	3. Throwing arm moves in a downward and backward arc.						
	4. Steps towards target area with foot opposite throwing arm						
	5. Hips then shoulders rotate forward.						
	6. Throwing arm follows through, down and across the body.						
						Skill Score	
Skill	**Performance Criteria (component)**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Score**
Kick	1. Eyes focused on the ball throughout the kick.						
	2. Forward and sideward swing of arm opposite kicking leg.						
	3. Non-kicking foot placed beside the ball.						
	4. Bends knee of kicking leg at least 90 degrees during the back-swing.						
	5. Contacts ball with top of the foot (a "shoelace" kick) or instep.						
	6. Kicking leg follows through high towards target area.						
						Skill Score	

APPENDIX I

ALPHA PHYSICAL HEALTH AND FITNESS SCORE SHEET

MEASUREMENT RECORDING SHEET					
Participant Identification Number		Sex: Male / Female	D.O.B.:	/ /	
BODY COMPOSITION TESTS	(1)			(2)	
Weight (kg)		Weight (kg)			
Height (cm)		Height (cm)			
Sitting height (cm)		Sitting height (cm)			
Leg Length (Height – Sitting height) (cm)		Leg Length (Height – Sitting height) (cm)			
Waist circumference (cm)		Waist circumference (cm)			
BIA		BIA			
MUSKELOSKELETAL TESTS	(1)			(2)	
Handgrip strength – right hand(kg)		Handgrip strength – right hand(kg)			
Handgrip strength – left hand (kg)		Handgrip strength – left hand (kg)			
Standing long jump (cm)		Standing long jump (cm)			
MOTOR FITNESS TESTS	(1)			(2)	
20m sprint (sec)		20m sprint (sec)			
CARDIORESPIRATORY FITNESS TEST					
20m Shuttle run test (stage)					
Notes: (e.g., reasons for exclusion, problems occurring during the test)					

Name of the tester: ___________________________________ Date of test: _________________

Adapted from The ALPHA Fitness Test Battery for Children and Adolescents: www.thealphaproject.net

APPENDIX J

Physical literacy and fundamental movement skills of South East Wales primary school children

Summary Report

Report Contents

1. Executive Summary

1.1 The purpose of this report is to present current levels of fundamental movement skills (FMS) competency in a sample of primary school children in South East Wales, and investigate their relationship with other domains of physical literacy (i.e., physical fitness, physical activity, psychological self perceptions and socio-cultural domains) based on this FMS ability. The early development of FMS is considered a key determinant of physical literacy and its relationship with other domains of physical literacy have potential to influence future physically active lifestyles.

1.2 To date research has focused mainly on relationships among FMS and selective markers of physical literacy. In addition, few of the studies have been conducted in the UK with very limited research evident with primary school children (aged 9 -12 years old) in Wales and in particular areas of South East Wales classified as having high levels of multiple deprivation. Measurement of FMS has also been inconsistent among the various studies that have been conducted to date, making comparisons between studies difficult.

1.3 This report contains, one large-scale data collection completed over a single school term, with children (*n* = 553), from eighteen primary schools in two local unitary authorities of South East Wales. These primary school children (294 boys and 259 girls) were assessed on several FMS skills and classified into groups based on FMS ability levels. The FMS groups were then used to determine which aspects of physical literacy (i.e., physical fitness, physical activity behaviour, psychological self perceptions and socio-cultural behaviours and beliefs) were associated with FMS ability.

1.4 The findings of this report show that, overall, FMS proficiency for all participants were low. Several FMS ability groups were classified in both genders who displayed similar characteristics across the range of FMS with further distinctions between these groups established across the range of FMS. In both boys and girls several measures of physical literacy were significant predictors of FMS ability. In summary, the identification of FMS ability, skill differentials and physical literacy variables which impact on the FMS performance of primary school children could enhance our understanding of FMS development and the promotion of physical literacy within the UK.

2. Introduction

2.1 The wider context

2.1.1 Worldwide obesity more than doubled between 1980 and 2014 with nearly 42 million children across the globe being overweight or obese in 2013 (World Health Organisation [WHO], 2015). In Wales, the rates of childhood obesity are the highest in the UK, with about 35% of children either classified as overweight or obese and this trend has been predicted to continue to rise in forthcoming years (National Assembly for Wales [NAW], 2013). Obesity is a known risk factor of a number of serious chronic diseases and disorders (e.g., cardiovascular diseases, musculoskeletal disorders and some cancers) and therefore threatens to become a significant burden to the nation's future health.

2.1.2 Low levels of physical activity and excessive sedentary behaviour are identified as major contributors to this obesity epidemic. Children who engage in less physical activity also demonstrate reduced psychological well-being, poorer physical health, lower self esteem, reduced life satisfaction, and poorer cognitive performance. Such behaviours established during childhood and adolescence will tend to carry over into adulthood and further impact on health therefore, it is important to identify those most vulnerable to developing such a negative spiral.

2.1.3 Physical inactivity is now identified as the fourth leading risk factor for global mortality (WHO, 2015). The estimated cost per annum of physical inactivity to the UK economy is estimated to be around £8.2 billion and the estimated economic cost of the health implications associated with physical inactivity and obesity in Wales alone is approximately £650 million a year (NAW, 2013).

2.2 Physical literacy

2.2.1 Reflecting the increasing financial burden to health and the economy from physical inactivity many nations, within the past decade, including the UK, Canada, Australia and New Zealand, have invested heavily in initiatives within education, community and public health settings to promote and increase levels of physical activity participation. Such initiatives have involved the promotion of a concept that is known as physical literacy. Physical literacy is defined as a disposition acquired by individuals encompassing the motivation, confidence, physical competence, knowledge and understanding that establishes purposeful physical pursuits as an integral part of their lifestyle (Whitehead, 2010). Physical literacy is supposed to develop a lifelong habit with individuals taking up options in one or more areas of physical activity. Through the concept of physical literacy being physically active does not necessarily have to mean being competitive (i.e., in a sporting context) in order to promote a healthy lifestyle as it also promotes opportunity for everybody to express and reach his or her own potential, regardless of their level compared to others.

2.2.2 In developing lifelong physical literacy, it is recognised that positive habits need to be established during childhood (WHO, 2015). Many physical literacy programmes identify fundamental movement skills (FMS) as the underpinning component in this development of children's physical literacy. FMS are common motor activities comprised of an agreed series of observable movement patterns (such as throwing, kicking, catching, running and jumping). To date, the FMS competency levels of children attending primary school (7-11 years old) in the UK, Canada, and Australia have been identified as being only low to moderate (Foulkes et al., 2015). Having inadequate FMS at this age is seen to limit the development of children's physical literacy and therefore there is a rationale for developing the level of competency in these skills with primary school aged children (Foulkes et al., 2015).

2.2.3 As FMS proficiency is continually demonstrated to be low in children researchers have attempted to address the need for standardisation and clarification of FMS measurement scores that report the same objective but which, confusingly, may provide different information. For example, several systems of FMS classification use either a selection of distinct categories to group FMS and provide an aggregate score or collectively group all FMS to provide a total score. The pooling of scores into distinct categories such as these may be discriminating or limiting our understanding of children's individual FMS performance which in turn may result in ineffective support and intervention strategies based on these collective outcomes. Therefore, to develop children's FMS ability a more precise FMS assessment scoring tool is required that provides a clear distinction between individual FMS scores and clearly identifies those children most in need of additional support.

2.2.4 In addition to the development of FMS the concept of physical literacy is conceived to be the result of the multidimensional interaction between FMS and several other domains (i.e., physical fitness, physical activity, psychological self-perceptions and socio-cultural domains) to facilitate lifelong healthy active living behaviours in children and youth. Although these domains are (theoretically and practically) distinct they do have interlinking constructs that have the potential to impact on FMS and on the physical literacy development of a child (Lloyd, Tremblay, & Colley, 2010). Inadequate development of these physical literacy domains can often lead to children facing proficiency barriers as they progress through the key transitions during their lives (e.g., from primary school to secondary school). The end result is often that children progress through these transitions without key elements of physical literacy which impacts on their motivation and commitment to engage in and sustain physical activity throughout the life course. It may be beneficial therefore to investigate the relationships of these domains with the FMS ability of primary school children, particularly in the UK, as at present data is sparse

3. Aim and Objectives

3.1 Aim

The purpose of this research is to identify current levels of FMS competency of primary school children in South East Wales, and investigate their relationship with other domains of physical literacy (i.e., physical fitness, physical activity, psychological self perceptions and socio-cultural domains) based on this FMS ability.

3.2 Objectives

- To establish existing levels of FMS in boys and girls.
- Classify boys and girls based on their FMS proficiency.
- Identify specific FMS profiles that differentiate the groups in boys and girls
- Establish which aspects of physical literacy are associated with FMS proficiency.

4. Methods

4.1 The participants and the setting

4.1.1 A total of twenty-seven primary schools (approximately 844 children) were invited to participate in the study, of which eighteen accepted. Schools were briefed on the aims and objectives of the study. Subsequently, each school attended the test centre at the University of South Wales on separate dates. Children who returned both a signed consent form by parents/guardian and an assent form from themselves were included in the study. A total of 553 children, aged 9-12 years old attended the test centre. Of these attendees, complete data sets were recorded on 294 boys, and 259 girls.

4.2 What did we measure?

4.2.1 *Fundamental movement skills*

Assessment of FMS behaviour was conducted using the process orient checklist taken from the "Get Skilled: Get Active" fundamental skills resource (NSW Department of Education and Training, 2000). The checklist for this study comprised of eight FMS including the run, vertical jump, side gallop, leap, catch, overhand throw, kick, and static balance.

4.2.2 *Physical fitness*

Physical fitness assessments were conducted with the ALPHA (Assessing Levels of Physical Activity and Fitness) Health-Related Fitness Test Battery for Children and Adolescents Test Manual (Ruiz et al., 2010) which is based on children in European populations. The High Priority battery of tests were selected for use, which included assessments of cardio-respiratory fitness (20m shuttle run test), musculoskeletal fitness (handgrip strength, standing long jump), and body composition (weight, height, BMI). In addition, a measure of motor fitness (sprint run) was also conducted.

4.2.3 *Physical activity*

The Physical Activity Questionnaire for Children (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997) was used as an indicator of the children's typical physical activity patterns. The questionnaire asks the child to recall their physical activity in a variety of situations and times (e.g., before school, school break, lunchtime, after school, evening, weekend etc.) during the previous 7-day period.

4.2.4 *Psychological self-perceptions*

The Children and Youth Physical Self-Perception Profile (CY-PSPP; Eklund, Whitehead, & Welk, 1997) was used to assess the children's perceptions and beliefs of and towards physical activity. These self-perceptions were investigated on scales of Global Self

Worth, Physical Self Worth, Sports Competence, Physical Conditioning, Body Attractiveness and Physical Strength. Prior to its use with South East Wales primary school children the questionnaire underwent a validation process. This was to ensure the children with diverse characteristics in this population could understand the questions (selected to reduce the influence of socially desirable responses) and appropriately respond to questions selected to measure the different scales of the physical self perception profile. The evidence provided from this validation process subsequently supported the use of the CY-PSPP questionnaire to measure psychometric properties with this population.

4.2.5 *Socio-cultural factors*

Although socio-cultural factors are extensive this measure focused specifically on parental factors related to physical activity (Cools, De Martelaer, Samaey, & Andries, 2011). The parents of children participating in the study responded to specific questions relating to family characteristics, parental behaviour, parental beliefs and parental awareness/knowledge of their child's physical activity trends.

4.3 Procedures of FMS classification

4.3.1 Two trained assessors analysed FMS competence using video analysis. To assess the FMS we used a process oriented checklist (NSW Department of Education and Training, 2000) to determine the number of components performed correctly on each skill (examples of skills assessments are provided in appendix 1). Based on the number of correctly identified components for each skill, an individual score was assigned. Using these FMS scores, a series of statistical procedures were then used to classify the children into separate FMS groups based on similar levels of FMS ability for both genders. Upon closer analysis of these established FMS group classifications it was then possible to identify specific FMS that differentiated in performance between the groups in both genders. Further, based on these FMS group classifications subsequent analyses with other physical literacy measures were conducted to establish which aspects of physical literacy were significant predictors of FMS proficiency.

5. Findings

5.1 FMS status

The overall level of FMS competency demonstrated by both boys and girls was identified as low. As previously suggested children develop FMS at different rates therefore it is important to further assess and identify those children who differ in FMS competency. The FMS classification system adopted for use here provides a detailed analysis of FMS proficiency; these outcomes are reported separately by gender below.

5.1.1 *Boys*

- Based on the FMS scores from the total sample of boys (*n* = 294), three groups were established. These groups were identified as Low (*n* = 31), Intermediate (*n* =187), and High (*n* = 76) FMS ability groups (Figure 1).
- Overall skill mastery (i.e., correctly demonstrating all components of the skill, either 5 out of 5 or 6 out of 6 components) is relatively low in each of the groups across all FMS with no group achieving greater than 20% competence (Figure, 1). The leap is the least proficient skill performed by boys.
- Although relative levels of FMS competency are low for boys across all the FMS (< 20%) there are distinct differences between the boys FMS groups (Low, Intermediate and High) on their ability to perform each individual FMS. Further statistical procedures (Table 1) identified which of the FMS differentiated in ability between the groups. It is clear that the FMS of the vertical jump, overhand throw and leap were the FMS tasks that showed the largest differential in ability between the boys groups followed to a lesser extent by the FMS of the side gallop, static balance and the catch. The FMS of run

- and kick were established as having no differentiation in ability between the boys FMS groups based on this statistical procedure.
- Of the identified FMS to differentiate the groups the high FMS group demonstrated the strongest performances. The intermediate group demonstrated lower performance than the high group across these FMS but better performance than the low group.

5.1.2 *Girls*

- Based on the FMS scores from the total sample of girls (*n* = 259), two groups were established. These groups were identified as High (*n* = 157) and Low (*n* = 102) FMS ability groups (Figure 2).
- Overall skill mastery (i.e., correctly demonstrating all components of the skill) is relatively low in each of the groups across all FMS with no group achieving greater than 15% competence (Figure, 2). The overhand throw and kick are the least proficient skills performed by girls.
- Although relative levels of FMS competency are low for girls across all the FMS (< 15%) there are distinct differences between the girls FMS groups (Low and High) on their ability to perform each individual FMS. As in boys, further statistical procedures (Table 1) identified which of the FMS differentiated in ability between the girls groups. It is clear that the FMS of the static balance is the FMS task that showed the largest differential in ability between the girls groups followed by the catch, vertical jump and the leap. The FMS of run, side gallop, kick and the overhand throw were established as having no differentiation between the girls FMS groups from this analysis.
- Of the identified FMS to differentiate the groups the High FMS group demonstrate stronger performances than the Low group for each of these skills.

Figure 1. Fundamental movement skills proficiency of boys based on group classification

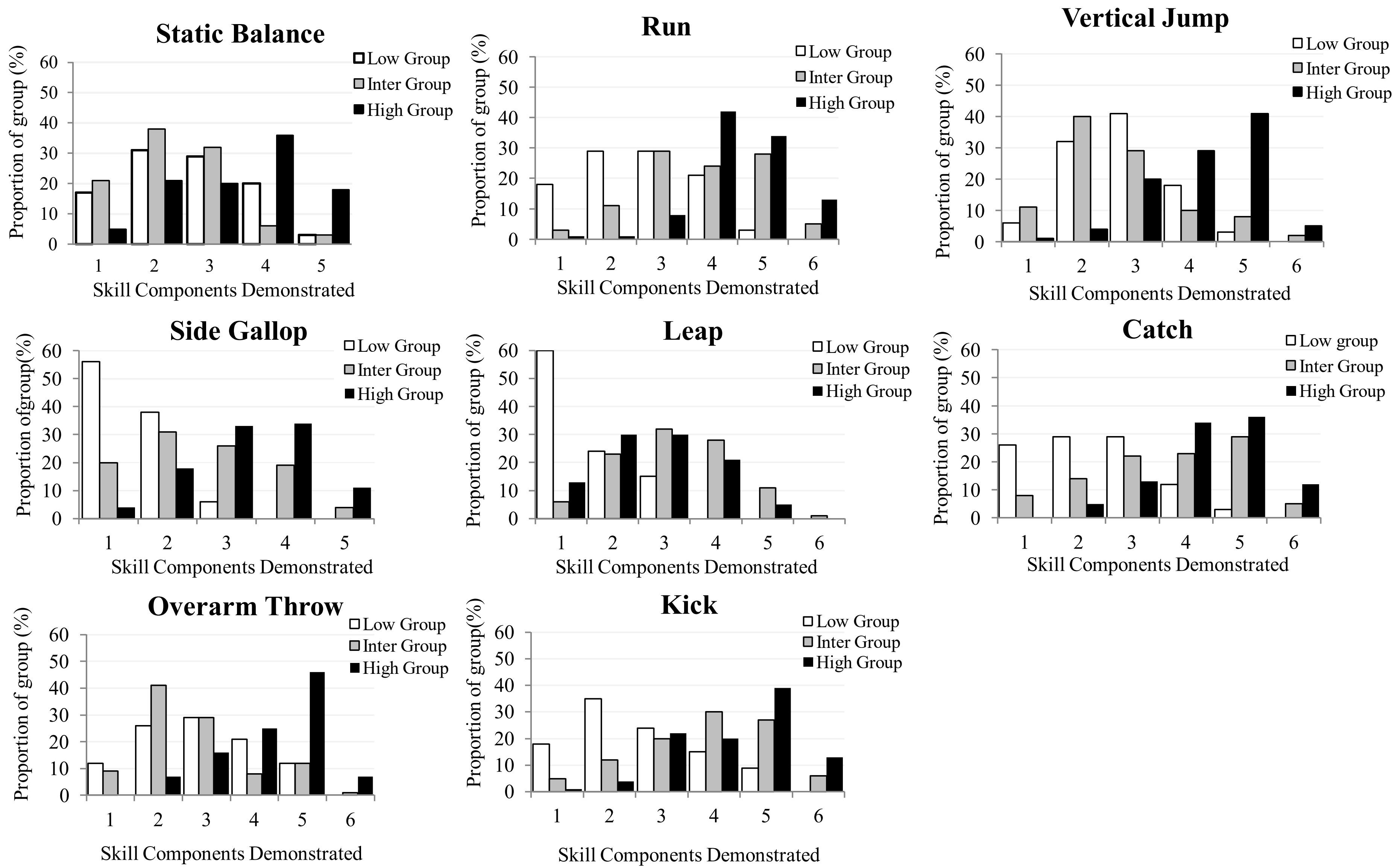

Figure 2. **Fundamental movement skills proficiency of girls based on group classification**

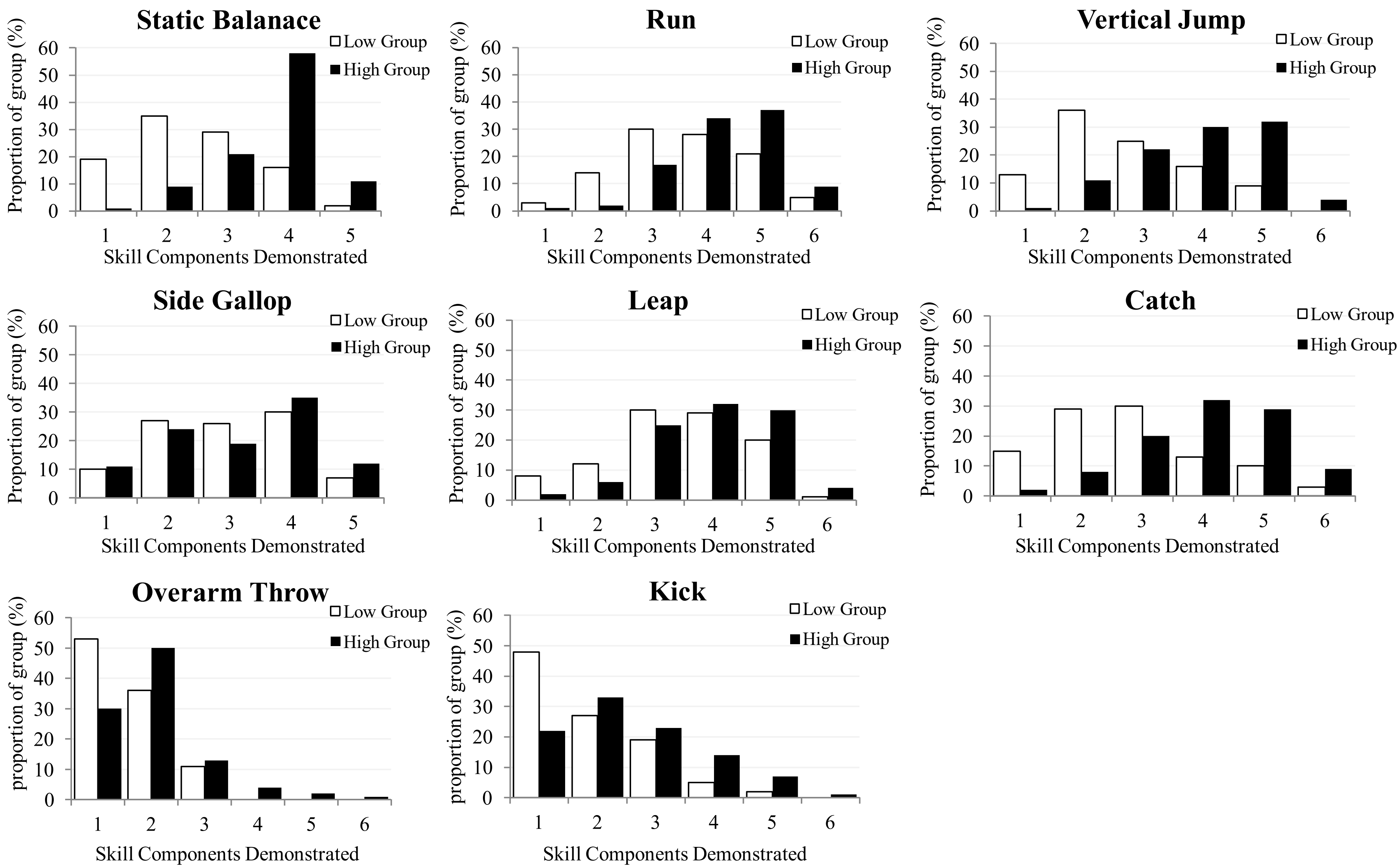

Table 1. Column contributions for boys and girls FMS skills

Boys

FMS	G^2
Static balance	18.58
Run	0.00
Vertical jump	78.03
Side gallop	23.06
Leap	31.19
Catch	18.49
Overhand throw	64.26
Kick	0.00

Girls

FMS	G^2
Static balance	84.36
Run	0.00
Vertical jump	27.34
Side gallop	0.00
Leap	10.84
Catch	44.51
Overhand throw	0.00
Kick	0.00

5.2 FMS group performance of physical literacy measures

Enhancing physical health has been identified as a complex interaction of multiple factors (i.e. domains of physical literacy) with mounting evidence to suggest that these domains of physical literacy are related to each other underpinned by FMS ability. Based on the FMS group classifications in boys and girls subsequent analyses with the physical literacy measures (i.e., physical fitness, physical activity, psychological self-perceptions and socio-cultural domains) revealed several aspects of physical literacy to be significant predictors of FMS proficiency. The findings are discussed in detail by gender below.

5.2.1 *Boys*

- Descriptive statistics showed the High FMS group had a tendency to score higher (although not significantly different) across the physical literacy measures of physical fitness, physical activity and psychological well-being (Table 2) than the Intermediate and the Low FMS groups. The Low FMS group scored the lowest across all these measures.
- Further analysis of the physical literacy domains revealed that the physical fitness measures of the sprint run (motor fitness), the MSFT (cardiovascular fitness), SLJ (lower body musculoskeletal strength) and a psychological well-being measurement sub scale (physical condition) were significant in differentiating the High from the Intermediate and Low FMS ability groups (Table 2).
- Significant relationships were also shown between aspects of parental behaviours, parental beliefs and parental knowledge/awareness with boys FMS groups (Table 3). Those parents of children with High FMS ability demonstrated more positive scores to these relevant features than those in the Intermediate or Low FMS group.

5.2.2 Girls

- Descriptive statistics showed the High FMS group had a tendency to score higher (although not significantly different) across all the physical literacy measures of physical

- fitness, physical activity and psychological well-being (Table 2) than the Low FMS group.
- Further analysis of the physical literacy domains revealed that the physical fitness measures of the sprint run (motor-fitness), the standing long jump (lower body musculoskeletal strength), the hand grip (upper body musculoskeletal strength), the multi stage fitness test (cardio-respiratory fitness) and the physical activity recall behaviour measure were significant in differentiating the High FMS ability group from the Low FMS ability group (Table 2).
- Significant relationships were shown between aspects of family characteristics, parental behaviours, parental beliefs, and parent employment status with girls FMS groups (Table 3). Those parents of children in the High FMS ability group demonstrated more positive scores to these relevant features than those in the Low FMS ability group.

6. Discussion

6.1.1 The purpose of this research was to identify current levels of fundamental movement skills (FMS) competency of primary school children in South East Wales, and investigate their relationship with other domains of physical literacy (i.e., physical fitness, physical activity, psychological self perceptions and socio-cultural domains) based on this FMS ability.

6.1.2 The overall levels of FMS proficiency across both genders were shown to be low. Groups of varying FMS skill proficiency were established for boys (3 groups) and girls (2 groups) with clear distinctions in FMS ability shown between the groups in both boys and girls across individual FMS. In addition, several physical literacy variables were shown to differentiate between the FMS performance groups in both boys and girls.

Table 2. Means, standard deviations and significant physical literacy measures for boys and girls by FMS group classification

	Descriptive group data (mean ± SD)								
	Boys					**Girls**			
Variables	Total Group (n = 294)	Low Group (*n* = 31)	Inter. Group (n = 187)	High Group (n = 76)	DFA	Total Group (n = 259)	Low Group (n = 102)	High Group (n = 157)	DFA
BMI	18.5 ± 2.9	19.5 ± 4.9	18.4 ± 2.7	18.2 ± 2.3	-.180	19.1 ± 3.1	19.07 ± 3.43	19.03 ± 2.81	-.017
SLJ (cm)	143 ± 22	129 ± 20.7	141 ± 20.4	153 ± 19.9	. 581*	131 ± 18	125 ± 17.17	135 ± 18.13	.718*
DHG (Kg)	18.5 ± 3.4	17.7 ± 3.1	18.1 ± 3.4	19.8 ± 3.3	.351	17.1 ± 3.3	16.17 ± 3.57	17.74 ± 3.01	.598*
MSFT (m)	821 ± 400	506 ± 339	773 ± 360	1066 ± 389	.754*	612 ± 304	539 ± 263	659 ± 320	.497*
SPRINT (sec)	4.14 ± 0.33	4.50 ± 0.41	4.15 ± 0.28	3.96 ± 0.29	-.834*	4.31 ± 0.34	4.44 ± 0.37	4.24 ± 0.30	-.748*
PAQ-C	3.44 ± 0.65	3.06 ± 0.71	3.46 ± 0.64	3.53 ± 0.58	.309	3.22 ± 0..65	3.06 ± .065	3.33 ± 0.63	.522*
CY-PSPP	18.91 ± 3.03	17.32 ± 3.38	18.90 ± 2.94	19.6 ± 2.88	-	18.0 ± 3.11	17.49 ± 3.00	18.29 ± 3.14	-
CY-SC	3.16 ± 0.65	2.85 ± 0.78	3.14 ± 0.64	3.31 ± 0.54	.330	2.97 ± 0.65	2.85 ± 0.63	3.04 ± 0.65	.363
CY-PC	3.14 ± 0.63	2.76 ± 0.70	3.11 ± 0.60	3.36 ± 0.70	.461*	2.98 ± 0.65	2.86 ± 0.64	3.06 ± 0.65	.391
CY-BA	2.95 ± 0.75	2.72 ± 0.89	2.97 ± 0.76	2.99 ± 0.74	.149	2.79 ± 0.75	2.73 ± 0.74	2.82 ± 0.75	.148
CY-PS	2.91 ± 0.68	2.71 ± 0.71	2.89 ± 0.68	3.04 ± 0.65	.231	2.75 ± 0.65	2.68 ± 0.61	2.80 ± 0.67	.234
CY-PSW	3.27 ± 0.57	2.98 ± 0.60	3.29 ± 0.56	3.37 ± 0.54	.300	3.10 ± 0.62	3.02 ± 0.66	3.15 ± 0.59	.247
CY-GSW	3.50 ± 0.50	3.31 ± 0.64	3.50 ± 0.48	3.53 ± 0.49	.185	3.39 ± 0.55	3.34 ± 0.55	3.42 ± 0.55	.174

Note. BMI = Body mass index; SLJ = Standing long jump; DHG = Dominant handgrip; MSFT = Multistage fitness test; PAQ-C = Physical activity questionnaire children; CY-PSPP =Children and youth physical self-perception profile ; CY-PSPP- SC = Sport competence subscale; CY-PSPP –PC = Physical competence subscale; CY-PSPP –BA =Body attractiveness subscale; CY-PSPP –PS = Physical strength subscale; CY-PSPP –PSW = Physical self worth subscale; CY-PSPP –GSW = Global self worth subscale; DFA = Discriminant function analysis loadings; *Significant loadings (≥ ± 0.40; Stevens, 1992)

Table 3. Significant responses of the Parental behaviour questionnaire based on boys and girls FMS classification groups

Boys	FMS group mean rank			
Variable	Low (n = 29)	Inter. (n = 160)	High (n = 66)	*p-value*
Parental behaviours - Parent and child activity together				
Calm play	146.53	128.63	118.33	.168
Active play	130.95	128.24	126.13	.953
Creative play	140.38	126.11	127.15	.585
Gaming	143.45	132.18	111.07	.040*
TV-viewing	143.26	127.63	122.18	.410
Books	146.17	122.41	133.58	.191
Dance activities	148.66	124.52	127.37	.182
Parental beliefs - Importance of child developmental aspects				
Cognitive development	111.29	132.27	124.98	.172
Motor development	95.71	130.34	136.52	.013*
Social development	95.26	132.26	132.06	.004*
Participation in PA	97.83	129.64	137.27	.009*
Healthy nutrition	127.78	129.05	125.55	.939
Sufficient sleep	110.50	132.04	125.89	.194
Parental knowledge / awareness - Child participation in after school activity				
After school sports clubs	105.36	130.18	132.66	.150
Swimming clubs	129.71	121.17	143.80	.085
Sports camps	123.84	123.82	139.95	.196
Community sport club	95.48	127.97	142.37	.009*
Other group PA	119.34	126.94	134.38	.523
Parental knowledge/awareness				
Childs PA preferences	-	-	-	.008*

Girls	FMS group mean rank		
Variable	Low (n = 92)	High (n = 137)	*p-value*
Family characteristics - Care of child prior / after school			
Father	116.47	114.01	.772
Mother	121.63	110.55	.060
Grandparent	103.76	122.55	.020*
Other family	102.68	123.27	.001*
Babysitter	114.20	115.54	.719
School	111.16	117.58	.239
Family characteristics – Parent employment status			
Father	-	-	.008*
Mother	-	-	.023*
Parental Beliefs- Rating of importance to physical activity			
Enjoyment	113.66	116.38	.556
Support motor development	114.59	115.27	.932
Experiencing success	113.90	115.74	.829
Social function	106.01	121.04	.044*
Learning rules	104.30	122.18	.017*
Sport specific PA goals	105.82	121.17	.063
Variety of physical activities	107.36	120.13	.114
High performance - winning	115.50	114.66	.922
Parental behaviours - Frequency of parents' physical activity			
Father	109.96	118.39	.331
Mother	106.45	127.73	.013*

*** Significant value ($p < 0.05$)**

6.1.3 The low levels of FMS competency demonstrated by both boys and girls in this study are consistent with the FMS proficiency levels demonstrated in similar studies of primary school children worldwide (Hardy, Reinten-Reynolds, Espinel, & Okely, 2012). This trend is worrying given the importance the role of FMS has in enhancing physical literacy and promoting health in many policies worldwide. There is, therefore, significant potential to improve FMS among children of primary school age.

6.1.4 Children will develop movement skills at different rates, and it was shown that there were different levels of FMS ability established on the range of FMS in both genders in this study. These FMS do not develop naturally; they must be taught and practiced for improvement therefore it is important to identify children who are most at risk of developmental delay in individual FMS. It was shown that the performance of several skills were clearly different across both the boys and girls ability groups with the Low FMS groups in both genders performing most poorly. The specific identification of individual skill differentiation across a group of children as demonstrated in this study may provide practitioners with an assessment opportunity which allows them to focus greater specificity of FMS development to individual skills of children at varying levels of ability and therefore challenging current interpretation of FMS assessment and its future development practice.

6.1.5 It was established that differences existed in FMS ability between boys and girls across particular FMS. It was clearly evident that boys were more proficient at the object control skills of the over hand throw and kick than girls. A suggestion for poor object control skills of girls could be that within this population boys are more likely to engage in traditional ball games compared to girls, and in the process receive greater encouragement, positive reinforcement and prompting to participate in activities involving object control skills. As a consequence, girls may not receive enough practice time in developing these skills to become proficient. Therefore, future interventions in FMS may consider avoiding societal stereotypes into traditional activity by gender whether free play or organised physical activity to develop FMS and recognise that both boys and girls need similar exposure to specific FMS to enhance competency.

6.1.6 In order to promote better physical literacy it would seem highly beneficial to identify which physical literacy domains significantly impact FMS performance. Fundamental movement skills have been proposed as the cornerstone or bedrock of physical literacy in children and it has been suggested in the literature that higher FMS proficiency is associated with high levels of all other aspects of physical literacy (except BMI, which would be a negative relationship). Although relative levels of FMS were low in both genders of this study, there were distinct differences between the FMS groupings in terms of FMS ability. The groups demonstrating relative high levels of FMS in both genders were associated with possessing certain aspects of physical literacy (as identified by the DFA in Table 2) which were significant over the remaining groups. Therefore, identifying and reinforces the positive multidimensional interaction of these physical literacy components alongside the development of FMS particularly in those children with poor ability levels may promote a more positive physical activity pathway into adolescence and possibly adulthood. Of interest, BMI failed to discriminate the FMS performance in either gender in this study. Due to its continued scrutiny with physical health it continues to warrant further investigation with children's FMS although, its negligible contribution to impacting on FMS proficiency as demonstrated here may imply more important roles and focus for other factors of physical literacy in affecting movement development and proficiency with children at this age.

6.1.7 Significant relationships between aspects of parental behaviours and beliefs, and varying levels of FMS proficiency were identified in boys and girls. It is argued that parents play a crucial role in children's physical activity and the movement skill socialization process and are important agents who monitor movement skills and encourage children to engage in activities that promote movement skill performance and competence (Williams et al., 2008). The assumptions behind physical literacy are to promote new and more experiential ways of how to reach and increase personal development potential of children beyond the school environment. Therefore, the role of parents and guardians play in children's FMS and physical literacy development may require greater consideration.

7. Recommendations

- As FMS provide the foundation to physical literacy, children of early to mid primary school age need to be provided with opportunities for practice and instruction to enhance the skill proficiency across both genders.
- In providing these opportunities to develop FMS with primary school children developing sufficient FMS training with practitioners and monitoring its effectiveness are important.
- Further research is needed into the FMS measurement tool adopted for use in this study which provides a more robust and comprehensive assessment of FMS ability with children. In particular how it can be developed and be effectively used by FMS practitioners (i.e., classroom teachers) in different environments.
- The introduction of formative physical literacy assessments which involve tests of FMS and the basic levels of domains such as physical fitness (e.g., strength, cardiovascular endurance, and motor ability) to identify if primary school children are progressing sufficiently enough for health benefits and not based on performance outcomes for development of sporting prowess or talent identification maybe of interest.
- Developing a greater awareness of other components of physical literacy (e.g., positive physical activity behaviour, psychological perceptions, parental behaviours and beliefs) and not just the physical components having potential to impact on the development of children's FMS.

- Educate, interact and involve parents/guardians on the importance of their roles to promote positive attitudes towards their child's FMS, physical literacy and future physical health. In turn this may help reduce the over reliance on primary school sport and physical education programmes to solely enhance FMS and physical literacy.
- To follow up on the findings of this programme of research an intervention is proposed which follows the impact of enhanced FMS training for practitioners on developing primary school children's FMS ability levels. In addition it is important to consider whether the enhancement of this FMS ability has a positive impact upon other aspects of physical literacy in children.

References

Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2011). Fundamental movement skill performance of preschool children in relation to family context. *Journal of Sport Sciences*, *29*(7), 649-660.

Crocker, P.R.E., Bailey, D.A., Faulkner, R.A., Kowalski, K.C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the Physical Activity Questionnaire for Older Children. *Medicine and Science in Sports and Exercise*, *29*(10), 1344-1349.

Eklund, R.C., Whitehead, J.R., & Welk, G.J. (1997). Validity of the children and youth physical self-perception profile: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport, 68*, 240- 256.

Foulkes, J. D., Knowles, Z., Fairclough, S. J., Stratton, G., O'Dwyer, M, Ridgers, N. D., Foweather, L. (2015). Fundamental movement skills of preschool children in Northwest England. *Perceptual and Motor Skills, 121*, 260-283.

Hardy, L.L., Reinten-Reynolds, T., Espinel, P., Okely, A.D. (2012) Prevelence and correlates of low fundamental movement skill competency in children. *Pediatrics, 130*, e390-e398.

Lloyd, M., Tremblay, M., & Colley, R. (2010). Physical literacy measurement – the missing piece. *Physical Health Education Journal 76*(1), 26-30.

National Assembly for Wales (2013). Childhood Obesity. Research Services Quick Guide.

New South Wales Department of Education and Training (2000). Get Skilled: Get Active. Sydney, Australia: New South Wales Department of Education and Training.

Ruiz, J.R., Castro-Pinero, J., Espana-Romero, V., Artero, E.G., Ortegat, F.B., ...Castillo, M.J. (2010). Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. *British Journal of Sports Medicine, 45*(6), 518-524.

Whitehead, M., (2010). Physical Literacy: Throughout the Lifecourse. New York, NY: Routledge.

Williams, H.G., Pfeiffer, K.A., O'Neill, J.R., Dowda, M., McIver, K.L., Brown, W.H., & Pate, R. R. (2008). Motor skill performance and physical activity in preschool children. *Obesity, 16*, 1421-1426.

World Health Organisation (2015). *Obesity and overweight factsheet updated.* No.311. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/

ACKNOWLEDGEMENTS

Thanks are expressed to Professor Richard Mullen and Dr. Morgan Williams in the co-ordination and supervision of this study, Paul Rainer and Helen Giles for their assistance with the data collection and analysis of FMS. Thanks are also given to the primary schools, head teachers, parents and children who agreed to participate.

APPENDICIES

Table 1. **Fundamental movement skill assessment tool examples**

Skill	Skill task	Performance criteria (components)
Sprint Run	Run as fast as possible between two points 20 metres apart	1. Lands on ball of the foot. 2. Non-support knee bends at least 90 degrees during the recovery phase. 3. High knee lift (thigh almost parallel to the ground). 4. Head and trunk stable, eyes focused forward. 5. Elbows bent at 90 degrees. 6. Arms drive forward and back in opposition to the legs.
Vertical Jump	Jump up vertically as high as possible from knees bent standing position	1. Eyes focused forward or upward throughout the jump. 2. Crouches with knees bent and arms behind the body. 3. Forceful forward and upward swing of the arms. 4. Legs straighten in the air. 5. Lands on balls of the feet and bends knees to absorb landing. 6. Controlled landing with no more than one step in any direction
Over arm throw	Throw a tennis ball over arm as far as possible towards a target area	1. Eyes focused on target area throughout the throw. 2. Stands side-on to target area 3. Throwing arm moves in a downward and backward arc. 4. Steps towards target area with foot opposite throwing arm 5. Hips then shoulders rotate forward. 6. Throwing arm follows through, down and across the body.
Catch	Catch a tennis ball thrown underarm from a distance of 5 metres distance	1. Eyes focused on the object throughout the catch. 2. Feet move to place the body in line with the object. 3. Hands move to meet the object. 4. Hands and fingers relaxed and slightly cupped to catch the object. 5. Catches and controls the object with hands only (Well-timed closure). 6. Elbows bend to absorb the force of the object.