NELSON MANDELA UNIVERSITY

FUNDAMENTAL MOVEMENT SKILL PROFICIENCY, PHYSICAL ACTIVITY AND BODY MASS INDEX OF GRADE 1 LEARNERS FROM A LOW-INCOME COMMUNITY IN GQEBERHA

MOOVESHNI DUMALINGAM

2025

Fundamental Movement Skill Proficiency, Physical Activity and Body Mass Index of Grade 1 Learners from a Low-income Community in Gqeberha

By

Mooveshni Dumalingam

Submitted in fulfilment of the requirements for the degree of Master of Human Movement Science (Research) in the Faculty of Health Science to be awarded at Nelson Mandela University

April 2025

Supervisor: Professor Cheryl Walter
Co-supervisors: Dr Siphesihle Nqweniso & Dr Danielle Dolley

DECLARATION

NAME: Mooveshni Dumalingam

STUDENT NUMBER: 220532516

QUALIFICATION: Master of Human Movement Science (Research)

TITLE OF PROJECT: Fundamental Movement Skill Proficiency, Physical Activity and Body Mass Index of Grade 1 Learners from a Low-income Community in Gqeberha

DECLARATION:

In accordance with Rule G5.11.4, I hereby declare that the above-mentioned dissertation is my own work and has not previously been submitted for assessment to any other University or for any other qualification

Student Signature:

Date of signing: 06-12-2024

ACKNOWLEDGEMENTS

I want to acknowledge and extend my sincere appreciation and thanks to the following people and organisations for their support and commitment to this study:

- I would like to thank God first and foremost, for being a source of strength and courage in the challenges I faced, I appreciate all of His mercy, grace, and unending love.
- To my family, for the infinite patience and encouragement --especially my parents, for supporting my decision to further my education and complete this study. To my dearest sisters, your unwavering love and support during this period will forever be cherished.
- To my supervisor, Professor Cheryl Walter, I would like to express my deepest gratitude to you for your commitment and guidance. I could not have undertaken this journey without your help. I am truly grateful for all the knowledge you have bestowed and for always making me feel confident in my abilities.
- To my co-supervisors, Dr Danielle Dolley and Dr Siphesihle Nqweniso, thank you sincerely for the hard work, guidance, and consistent reassurances that will forever be appreciated.
- To Dr Bosma, your expertise, guidance and meticulous attention to detail will forever be appreciated.
- To the KaziBantu research project and team, thank you for the opportunity provided and unlimited support offered.
- To the staff and learners of the participating Siyaphakama Zwide Schools Project, thank for your participation and commitment to the study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

BMI	Body mass index
BS	Ball skills
cm	centimetres
FMS	Fundamental movement skills
GMI	Gross motor index
HAKSA	Healthy Active Kids report card South Africa
kg	Kilograms
kg/m^2	Kilograms per metre squared
LOC	Locomotor
LPA	Light physical activity
METs	Metabolic equivalent
MVPA	Moderate to vigorous physical activity
OC	Object control
PA	Physical activity
PE	Physical education
SES	Socioeconomic status
TGMD	Test for Gross Motor Development
VPA	Vigorous physical activity
WHO	World Health Organization

ABSTRACT

Fundamental movement skills (FMS) serve as the building blocks for basic movement patterns, which are necessary for the development of more complex motor skills. Proficiency in FMS has been linked to improved health outcomes, including increased participation in physical activity (PA) and optimal body composition. However, there is limited research on the status and association between FMS, PA and body mass index (BMI) among South African children. This study examined the status and interrelationship between FMS proficiency, PA status and BMI of grade 1 learners from a low-income community in Gqeberha.

A descriptive cross-sectional design was employed, with 99 grade 1 learners from five quintile 3 schools participating in the study. FMS, PA and BMI were assessed using the Test for Gross Motor Development –Third edition (TGMD-3), Actigraph accelerometers, and height and weight measurements, respectively. The results reported poor proficiency in FMS, no learner achieved mastery in all 13 FMS items and 23.2% failed to achieve mastery in any of the FMS. The majority of learners (77.9%) met the WHO PA guidelines, with school-based PA being the largest contributor. The majority of learners had a normal weight status (77.8%). Boys outperformed girls in three of the ball skills as well as the overall ball skills ($p<0.05$), achieved significantly higher MVPA across all PA categories ($p<0.05$), and had a lower prevalence of overweight and obesity compared to girls. Vigorous PA (VPA) correlated positively with ball skills for all PA categories ($p<0.05$), as well as with the locomotor subset during total, weekday and school daytime PA ($p<0.05$). A weak negative correlation was observed between BMI and the underhand throw ($p<0.05$). Overall, the findings highlighted poor FMS proficiency relative to developmental milestones, especially among girls. These findings highlight the need for PA-focused interventions to enhance FMS proficiency and maintain healthy body composition of learners in low-income communities.

Key words: Fundamental movement skills, physical activity, body mass index, low-income community

CHAPTER 1

PROBLEM IDENTIFICATION

1.1. INTRODUCTION

This study investigated the status and interrelationship of fundamental movement skills (FMS), physical activity (PA) and body mass index (BMI) among grade 1 learners residing in a low-income community of Gqeberha. This chapter provides an introduction to the study background, clarifies the research question, as well as the aim and associated objectives. Additionally, it outlines the study's scope and significance, as it relates to children’s health, motor proficiency and activity status. Key terms are defined and an overview of the upcoming chapters is provided.

1.2. STUDY BACKGROUND

The health status of children is multifaceted, encompassing mental, social and physical domains that are all interrelated in cultivating their growth and development. Exploring the status of children’s physical components linked to body composition, PA and FMS aids in providing a greater understanding of their well-being as these behaviours are crucial in setting the foundation for lifelong healthy habits (Mistry, Minkovitz, Riley, Johnson, Grason, Dubay, *et al.*, 2012).

The fundamental movement phase symbolises a pivotal stage in development that allows children to discover and enhance their movement abilities. FMS, defined as a group of motor behaviours that include locomotor, manipulation, and stability skills, serve as the basic building blocks for later movement (Logan, Ross, Chee, Stodden & Robinson, 2018). These precursor motor skills, consisting of coordinated motor sequences, later progress into specialised and advanced skills utilised in organised and non-organised games, sports and recreational activities (Dobell, Pringle, Faghy & Roscoe, 2020). The non-mastery of these foundational skills is considered a barrier to lifelong PA participation, resulting in sedentary behaviours associated with negative health consequences, including the risk of poor body composition and the development of cardiovascular diseases (Bonney, Ferguson & Smits-Engelsman, 2018).

PA is an essential component for children's healthy living, providing numerous benefits that enhance their overall quality of life (Walter, 2011). The World Health Organization (WHO) has emphasised the importance of regular PA in children and adolescents, highlighting its role in improving motor development, promoting bone and cardiometabolic health and overall physical fitness (World Health Organization, 2024). This signifies the need for purposeful movement and activities that increase PA levels to foster healthy behaviours in children and contribute to a positive health trajectory later in their life (Masanovic, Gardasevic, Marques, Peralta, Demetriou, Sturm, *et al.*, 2020). Exploring the relationship between PA and motor development which includes FMS is of great importance. Barnett, van Beurden, Morgan, Brooks and Beard, (2009) suggests that developing motor skills can serve as a significant strategy in the promotion of PA in children. Greater proficiency in FMS can yield improvements in health-related fitness and an increase in muscle strength and endurance (Holfelder & Schott, 2014). Similarly, Stodden and colleagues' theoretical model illustrates a dynamic and reciprocal association between PA and FMS (Stodden, Langendorfer, Goodway, Roberton, Rudisill, Garcia, *et al.*, 2008). While FMS proficiency enhances PA participation, engaging in PA also facilitates the development of FMS, this relationship results in sustained PA engagement that extends into adulthood.

The significant role of FMS in fostering PA and overall health and well-being becomes even more apparent when considering the extensive impacts of malnutrition, which can further impair motor development and motor competence. Malnutrition is depicted as a global health condition and is the outcome of under-or overnutrition (Govender, Rangiah, Kaswa & Nzaumvila, 2021). This double burden of disease contributes to the high rates of overweight and obesity, as well as the stunting and thinness observed among children in marginalised and under-resourced communities (May, Witten & Lake, 2020; World Health Organization, 2024). It is further characterised as an alarming repercussion of food insecurity among children five years and younger (Govender *et al.*, 2021), serving as a consequence in the deterioration of children's motor skills and muscle strength (Renault & Quesada, 1993). The sudden rise of overweight and obesity and poor nutritional diet among children often result in physical inactivity, compensating for their low dietary energy by reducing activity levels, which in turn decreases energy expenditure and results in poor motor development (Morano, Colella & Caroli, 2011; Girish, Bhattad, Ughade, Mujawar & Gaikwad, 2014).

Fostering healthy behaviours by promoting PA, good nutrition and motor development remains challenging in low-income communities and poorly resourced schools (Cohen, Morgan, Plotnikoff, Callister & Lubans, 2014; Walter, 2014). This is impacted by children's accessibility to equipment, facilities and quality movement education, targeting increased PA participation and motor performance (Seabra, Mendonça, Maia, Welk, Brustad, Fonseca, *et al.*, 2013). According to the World Bank, South Africa remains one of the most unequal nations globally (World Bank, 2023). Gross income disparities and the lasting effects of previous apartheid policies that have disadvantaged both urban and rural communities continue to contribute to the poor health status of these individuals. Subsequently, these inequalities influence the interaction between FMS, PA and BMI among children and their overall impact on children's health. Although a few studies in South Africa have reported on the relationship between PA and body composition in children in recent years (Toriola & Monyeki, 2012; Moselakgomo, Monyeki & Toriola, 2014; Müller, Schindler, Adams, Endes, Gall, Gerber, *et al.*, 2019; Nqweniso, du Randt, Adams, Degen, Gall, Gerber, *et al.*, 2021), there remains a paucity of research on their interrelationships with FMS. In addition, the Healthy Active Kids South Africa (HAKSA) 2022 report card has advocated for additional research to be conducted on motor proficiency in younger children (Naidoo, Christie, Lambert, Nyawose, Bassett, Monyeki, *et al.*, 2022). This study will, therefore, contribute to the knowledge gap by reporting on the status of FMS, PA and BMI and providing valuable insight into the interrelationships between these variables among children living in low-income communities.

1.3. PROBLEM STATEMENT

Early and middle childhood developmental periods signify a crucial stage for establishing the holistic well-being of children (Goodway, Ozmun & Gallahue, 2019). During this period, children acquire foundational movement patterns and skills, including FMS, which serve as the building blocks for more complex movements later on in life. According to theoretical models of developmental movement phases, children are expected to master FMS by the age of seven (Gallahue, Ozmun & Goodway, 2012). However, many children continue through primary school with a poor display of these skills, limiting their participation in long-term PA and the adoption of healthy behaviours (Pienaar & Kemp, 2014; Mukherjee, Ting Jamie & Fong, 2017; Bolger, Bolger, Neill, Coughlan, O'Brien, Lacey, *et al.*, 2018; Duncan, Roscoe, Noon, Clark, O'Brien & Eyre, 2020). Subsequently, poor motor proficiency during this critical developmental period is linked to behaviours that contribute to the onset of obesity (de Waal & Pienaar, 2021). The paucity of current literature on FMS proficiency and its interrelationship with PA and BMI among South African children, particularly those from low-income communities in the Eastern Cape, presents a gap in understanding these health parameters of this vulnerable group. Further investigation to address this knowledge gap and advance our understanding of these interconnected health factors in this demographic is therefore warranted.

1.4. RESEARCH QUESTIONS

- What is the current status of FMS, PA and BMI of grade 1 learners from a low-income community, and are there differences between the sexes for this age group?
- What is the relationship between FMS and BMI of grade 1 learners from a low-income community?
- What is the relationship between FMS and PA of grade 1 learners from a low-income community?

1.5. STUDY AIM AND OBJECTIVES

1.5.1. Aim

To examine the status and interrelationship between FMS proficiency, PA status, and BMI of grade 1 learners from a low-income community of Gqeberha.

1.5.2. Objectives

To achieve the aim of this study, the following objectives have been set:

- To explore and describe the FMS proficiency, PA status and BMI, per sex as they apply to grade 1 learners using the TGMD-3 protocol, actigraph devices and BMI-for-age z-scores, respectively.
- To determine the interrelationship between FMS proficiency and BMI of grade 1 learners
- To determine the interrelationship between FMS proficiency and PA status of grade 1 learners

1.6. SCOPE OF THE STUDY

This study was conducted as part of the KaziBantu project (www.kazibantu.org), a collaborative research project between Nelson Mandela University in Gqeberha, South Africa and the University of Basel in Switzerland. KaziBantu was originally established as a school-based intervention designed to improve the overall health and well-being of learners and teachers in disadvantaged communities within Gqeberha, following a targeted approach to develop healthier schools for healthier communities. Currently, the project works in collaboration with the Siyaphakama Zwide Schools Project to monitor the health-related components of learners and teachers and to promote the teaching of physical education in selected schools within Zwide township, Gqeberha.

The study is a non-experimental descriptive and correlational research design, employing a quantitative approach that focuses on describing FMS, PA and BMI in children, and reporting on the associations between these variables as they naturally occur. The research was conducted in five schools from the Siyaphakama Zwide Schools Project, all of which were quintile 3 schools located in a low-income community. The participants of the study were recruited using simple random sampling. Only one grade 1 class was randomly selected per school, from which 20 learners were randomly chosen based on the return of completed consent forms and inclusion criteria. All participants provided written informed consent from a parent or guardian and verbal assent. Moreover, participation was contingent on learners not having a diagnosed physical disability, which could prevent them from partaking in the FMS measurements. The following subsections provide a brief overview of the measuring instruments employed in the present study.

Fundamental Movement Skills

FMS was assessed using the TGMD-3 protocol, which includes two subsets, locomotor skills and ball skills, comprising a total of 13 FMS items, in accordance with the set protocol (Ulrich, 2019). All skill performances were video-recorded to enable retrospective evaluation using observed and performance-based criteria. Mastery of each skill was determined according to the successful completion of performance criteria. Participants were categorised as “mastery”, “near mastery” or “poor” for each FMS item.

Physical Activity

PA status was assessed using accelerometers (Actigraph wGT3x-BT, Shalimar, FL, USA). Participants received a detailed demonstration on the correct placement of the devices around the hip. They were instructed to wear the accelerometer continuously for seven consecutive days, including during sleep, and to remove it only for baths and showers (water-based activities). The ActiLife computer software was used to analyse the data and determine PA patterns.

Body Mass Index

BMI was assessed by measuring participants’ height and weight, using a Tanita weight scale (Tanita MC-580; Tanita Corp., Tokyo, Japan) and a stadiometer (Seca, model 213), respectively. Two trials were conducted for each measurement, with height recorded to the nearest 0.1cm and weight to the nearest 0.1kg. The average of these measurements was used to calculate BMI using the following formula: BMI (kg/m^2) = weight (kg) / [standing height in meters $(m)^2$]. BAZ was calculated using the WHO AnthroPlus software, categorising participants’ nutritional status into five groups; obese, overweight, normal, thin and severely thin.

1.7. CONCEPT CLARIFICATION

To establish a clear comprehension of how the concepts and terms are interpreted and discerned within the scope of the present study, the following terms are provided:

- **Motor Development:** Motor development is the ongoing acquisition of motor skills throughout the lifecycle. It further encompasses continuous, sequential, and age-associated changes in one's motor behaviour. It is described to be the product of the interaction related to the requirements of a movement task (e.g., throwing distance), individual (e.g., age, sex and heredity factors) and environment (e.g., available resources and socioeconomic background) (Roberton, 1989; Cech & Martin, 2012).
- **Fundamental Movement Skills (FMS):** A term that expresses a group of perceptible motor behaviour patterns comprising of manipulation, stability and locomotor skills, such as catching a ball, one-legged stance and jumping, respectively (Utley, 1988). These patterns of movement serve as the basis for complex sports skills and the facilitation of a physically active lifestyle.
- **Physical Activity (PA):** Any increase in bodily movements brought on by the skeletal muscles and therefore, results in an increase in energy expenditure (Caspersen, Powell & Christenson, 1985). This may include organised physical education lessons presented at schools, exercise sessions, scheduled athletic activities (e.g., cricket, rugby, netball) or play (e.g., walking, games, recreational dancing) (American College of Sports Medicine, 2021).
- **Body Mass Index (BMI):** The measurement of weight relative to an individual's height, which is calculated as follows; body mass in kilograms (kg) divided by height in metres squared (m^2).
- **Low-income Community**: For the purpose of this study, it relates specifically to peri-urban communities in South Africa called "townships". These marginalised communities are a remnant of former Apartheid policies (Morris, 1998), resided by individuals who face many challenges related to crime, high unemployment, overcrowding and poor service delivery (Draper, Tomaz, Jones, Hinkley, Twine, Kahn, *et al.*, 2019).
- **Quintile Ranking System:** The quintile ranking system categorises South African schools to allocate financial resources by the government. This includes ranking areas according to financial status, dependency ratios, and the level of literacy of the population-specific to the area (Sayed & Motala, 2012).The least impoverished schools are those in quintile 5, which follows quintile 1 representing the poorest public

schools (van Dyk & White, 2019). Schools with a quintile ranking of 1 to 3 are classified as "no fee-paying schools" situated in low-income communities, whereas schools with rankings of 4 to 5 are classified as "fee-paying schools" and are situated in more affluent areas (Sayed & Motala, 2012).

- **Accelerometery**: An objective measure of PA, using a wearable motion sensor detector, commonly worn around the hip, wrist and thigh. Accelerometers quantify the level of activity by determining the duration, intensity and activity type an individual engages in (Shah, Brumbach, Pearson, Vasilyev, King, Carlson-Kuhta, *et al.*, 2023).
- **Test for Gross Motor Development, Third Edition (TGMD-3):** A standardised assessment of children's gross motor skills, which is norm- and criterion-referenced to test children between the ages of 3 and 10 (Ulrich, 2019). The test primarily focuses on determining (i) children who display poor FMS and whose skill development is considerably lower than that of their peers; (ii) gauging individual advancement in FMS development. (iii) Function as a measurement tool in research pertaining to FMS development and (iv) appraisal of an intervention's successfulness (Ulrich, 2019).

1.8. SIGNIFICANCE OF THE STUDY

FMS are essential for efficient and skilful movement, supporting participation in physically active play, which promotes optimal body composition and enhances both the physical and psychological quality of life (Nilsen, Anderssen, Loftesnes, Johannessen, Ylvisaaker & Aadland, 2020). Several studies have reported a positive correlation between movement skills and health (Capio, Sit, Eguia, Abernethy & Masters, 2015; Cattuzzo, dos Santos Henrique, Ré, de Oliveira, Melo, de Sousa Moura, *et al.*, 2016; Logan *et al.*, 2018; Nilsen *et al.*, 2020), highlighting that FMS proficiency fosters PA and the promotion of overall well-being.

The early primary school years are a critical period for establishing healthy PA behaviours, particularly given the notable increase in sedentary behaviours observed during this phase. Schools provide an ideal setting in which children have the opportunity to engage in meaningful PA and movement education, both during and after school. However, current literature on children's FMS is limited, with the majority of research conducted internationally. This hinders the transferability of global trends to South African contexts, particularly given the influence of socioeconomic and cultural differences on the population. Monitoring and evaluating children's FMS, PA, and BMI, which will contribute to valuable insights into the trends, existing knowledge gaps and the impact of FMS proficiency on PA and BMI. The findings of this study can inform the design of tailored FMS and PA interventions for primary school-aged children within low-income communities. Specifically, these results will contribute to the development of short-learning programmes in physical education (PE) that target and aim to improve the quality of PE, while addressing barriers tailored to the unique challenges schools face in these communities. Lastly, determining children's BMI and its interrelationship with FMS proficiency will allow for an interdisciplinary perspective that integrates nutrition and movement. Such a holistic approach ensures that interventions advocate for children to adopt healthy habits that ultimately enhance their quality of life.

1.9. OUTLINE OF CHAPTERS

The study is presented in the following chapters:

Chapter 1 (Problem Identification): provides a general overview of the study, including the aims and objectives, scope, concept clarification and significance.

Chapter 2 (Literature Review): provides a broad overview of the research available, both local and international, in the area of FMS, PA and BMI in children concerning strategies, theories and empirical research review of existing literature.

Chapter 3 (Research Methods and Procedures): outlines the research design, study population, sampling, measuring instruments, data analyses and ethical considerations.

Chapter 4 (Results): Results obtained are analysed and presented in tabular form, and where appropriate, graphically.

Chapter 5 (Discussion, Conclusion, Limitations and Recommendations): provides a literature-based interpretation of the results, a summary of findings, conclusion, limitations and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION

Early childhood presents a critical period during which children acquire a range of movement patterns and skills, often referred to as fundamental movement skills (FMS) (Bolger, Bolger, O'Neill, Coughlan, O'Brien, Lacey, *et al.*, 2020). The development of these motor skills can serve as a significant strategy in the promotion of PA in children and supporting a healthy weight status (Barnett *et al.*, 2009) thus influencing lifestyle behaviours which transcend into adolescence and adulthood. The non-mastery of FMS can restrict a child's participation in life-long PA and lead to a sedentary lifestyle, with negative consequences for health and wellbeing, including the risk of poor body composition and malnutrition (Bonney *et al.*, 2018). Therefore, there is a need for current research on FMS proficiency, PA and BMI and the exploration of their interrelationships in children.

This chapter intends to present a comprehensive overview of the literature on motor development, FMS, PA and body composition in children. It will include an introduction to the key concepts, a discussion of their importance and associated benefits, and an outline of the various FMS measurement tools. Additionally, this chapter will include an empirical study review associated with FMS and its interrelationship between PA and BMI, both nationally and internationally, to offer insight into the prevalence and overall trends among children. To conclude, the chapter explores contextual factors within South Africa, such as socioeconomic status (SES), settlement type and the school environment.

2.2. MOTOR DEVELOPMENT

Motor development is defined as the changes in motor behaviour across a lifespan, culminating in the progression of all individuals' simple movements to more advanced motor skills (Roberton, 1989). This forms an integral part of a child's overall growth, development and change process, thus allowing them to actively explore and learn from their body actions and the environment through movement (Zarotis, 2020). While motor development is characterised as a lifelong process of learning, which provides the basis for children to master foundational movements, motor competence signifies the level of expertise in executing an array of basic skills, in addition to underlying mechanisms, including control, coordination, and movement quality (Bardid, Vannozzi, Logan, Hardy & Barnett, 2019; Goodway *et al.*, 2019). The following sections provide an overview of the principal theories explaining motor skill acquisition across the lifespan and influencing factors affecting performance in these skills.

2.2.1. Dynamic Systems Theory

From childhood to adulthood, the various movement patterns that are learned, enhanced and modified are influenced by numerous factors affecting skill performance. Newell (1986) discerned these factors as constraints and categorised them into three groups: task (e.g. characteristics of the task assigned), individual (learner-centred e.g. coordination, balance and motivation), and environment (e.g. ground, surface) demands. Several systems cooperating and functioning dynamically and collectively result in the coordination and control of movement.

The Dynamic Systems Theory illustrates how various factors, or “control parameters”, influence the development of specific skills to facilitate learning. The adaptation of equipment or the environment can compensate for underdeveloped control parameters (e.g. power) that may limit motor skill development. Therefore, the objective is to push the system into adopting new, desirable movement patterns by systemically changing the environment. The interactive role of heredity and environment in the developmental process acknowledges that the specific demands of a movement task interact with individual factors (i.e. biological variables) and environmental factors (i.e. experience) to develop stability, manipulation, and locomotor skills (Goodway *et al.*, 2019). According to this transactional model, in the process of developing motor control and movement competence the three constraints not only interact but have the capacity to modify and become modified (Newell, 1986). Both the process and outcomes of motor development highlight the distinction of each learner. Every person has a different time period for the development of motor skills. Whilst the “biological clock” dictates a specific succession for acquiring movement skills, the rate and degree of advancement are individually governed and significantly influenced by the specified performance standards of each task (Goodway *et al.*, 2019).

2.2.2. Hourglass Model

Changes in motor behaviour occur throughout one's life span and are the catalyst for the process of motor development. People of all ages – infants, children, adolescents, and adults – are continuously learning to move with greater control and competence in response to daily challenges influenced by Newell’s three constraints of movement (Newell, 1986).

Gallahue and Ozmun (2006), designed a conceptual Hourglass Model of motor development, demonstrating that while there is a general sequence of development, the rate varies. This model comprises four distinct phases, namely: reflexive movement phase, rudimentary movement phase, fundamental movement phase, and the specialised movement phase. Each phase is further divided into several stages, whereby individuals progress at varying rates based on a range of physical, social, psychological, and environmental factors (Goodway *et al.*, 2019). The skills developed during each phase form the foundation for expanding complexity across the hierarchical phases of movement. Perceptual motor development, which describes the reciprocal association between visual perception and motor development, begins in infancy when children learn to crawl by adjusting to environmental information (e.g. various surfaces) (Rao & Einstein, 2006). As children advance through later stages, these perceptual motor skills are utilised in more complex actions, such as in different sports.

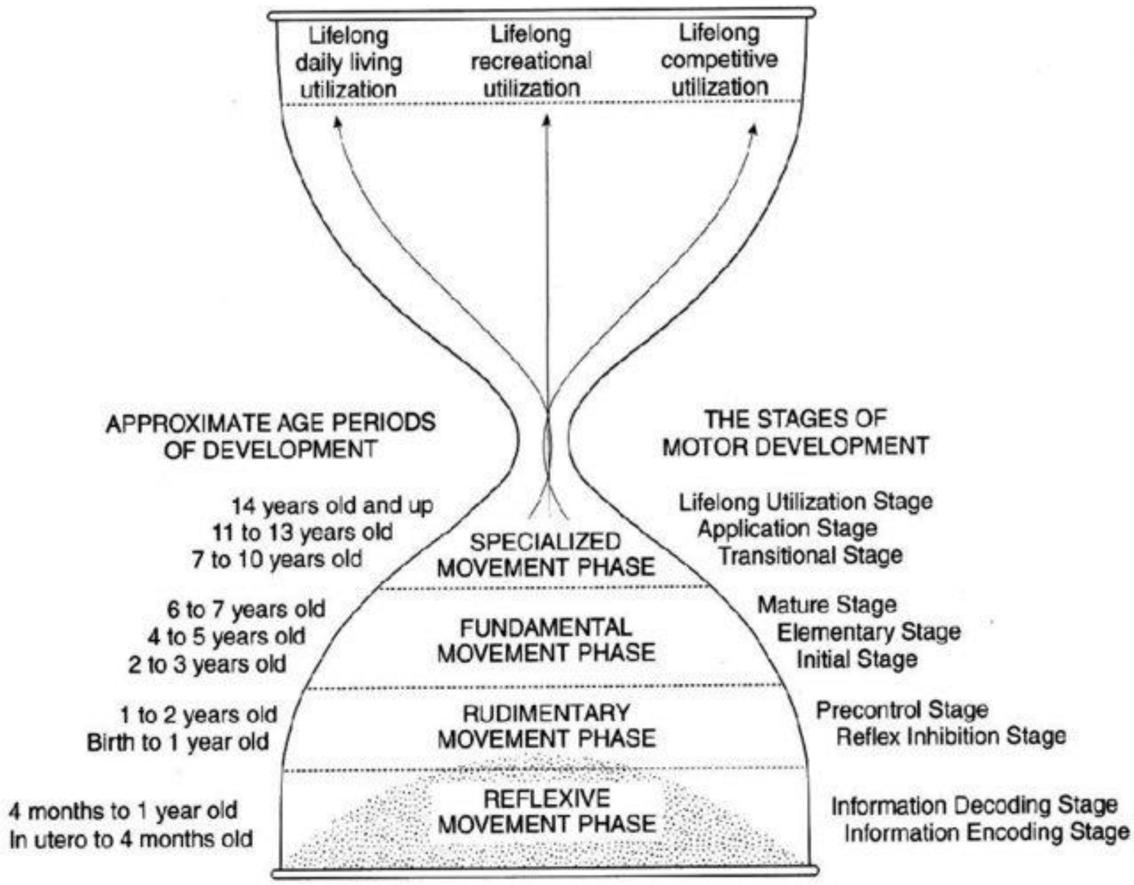


Figure 2.1: Hourglass Model of Motor Development (Gallahue *et al.*, 2012)

The Hourglass Model of motor development (see Figure 2.1) identifies the age period of two to seven years as the pivotal developmental phase for the onset and progression of FMS and devotes particular attention to expanding the rudimentary movement phase (the stage prior to FMS development) (Gallahue & Ozmun, 2006; Gallahue *et al.*, 2012). Therefore, children are expected to have attained satisfactory proficiency levels in FMS by the age of seven (Bolger *et al.*, 2020). This phase is followed by the specialised movement phase, with an approximate age period of 14 years. Gallahue *et al.* (2012) have suggested this phase is composed of three subdivisions relating to application, transitional and lifelong utilisation stages. Likewise, Cattuzzo, dos Santos Henrique, Ré, de Oliveira, Melo, de Sousa Moura, *et al.* (2016) report that increased motor proficiency leads to enhanced functional capability, contributing to favourable lifestyle habits which promote long-term health outcomes. However, if essential skills are not prioritised for growth at this critical age, a "proficiency barrier" may emerge, revealing challenges during a significant point of motor competence development. Specifically, those with underdeveloped or poor motor skills are more likely to avoid physical activities or participate in a limited range of activities due to low skill levels (Stodden, True, Langendorfer & Gao, 2013). Upon establishing key concepts and theories related to motor development and the various movement phases, the following section explores the stages and sequences of FMS.

2.3. FUNDAMENTAL MOVEMENT SKILLS

During the formative years of growth and development, the fundamental movement phase represents a crucial period whereby children explore and experiment with their bodies' movement potential (Goodway *et al.*, 2019). This developmental phase involves discovering how to execute various stabilising (e.g. twisting, balancing), locomotor (e.g. running, jumping, skipping), and manipulating (e.g. catching, kicking, throwing) movements, initially in isolation and subsequently in combination (Goodway *et al.*, 2019). Proficiency in FMS is crucial in determining a child's current and future PA status. More specifically, Joschtel, Gomersall, Tweedy, Petsky, Chang, and Trost (2021) report that FMS contribute to significant improvements, including cardiorespiratory fitness, weight management, academic achievement and demonstrations of higher levels of perceived competence(Lawson, Eyre, Tallis & Duncan, 2021). The fundamental movement phase spans from ages two to seven. It is divided into the following stages: the initial stage (two to three years), the emerging stage (three to five years) and the proficient stage (five to seven years) (Gallahue & Ozmun, 2006).

2.3.1. Stages of FMS

During the initial stage, children's movements are characterised by improperly sequenced parts that lack control and have poor coordination. Poor spatial and temporal integration of movement, together with notably limited or excessive use of the body, are frequently displayed in this stage. The emerging stage is characterised by children showcasing greater motor control and coordination of FMS (Goodway *et al.*, 2019). While the concurrence of temporal and spatial components of movement strengthens, the movement patterns during this stage are often restricted and over-accentuated, albeit better coordinated. Many children with adequate cognitive abilities and physical developments progress to the emerging stages, acquiring these motor abilities influenced by environmental variables and maturation. However, many individuals, including children and adults, fail to advance past these developing stages of one or more FMS. The three aspects characterising movement proficiency in FMS are mechanically efficient, coordinated, and controlled performances. With continuous favourable circumstances to practice and receive motivation and instruction, these skills will progress and become enhanced at the product components: total, speed, distance and number of skills performed correctly (Goodway *et al.*, 2019). Although children should become proficient in movement by six to seven years old, the complex visual-motor demands of tasks such as visual tracking or retrieving moving objects cause manipulative skills to develop later. While some children attain the proficient stage of FMS regarding maturity and environmental factors, the remaining majority need more opportunity for practice, support, and learning-oriented education. Without such opportunities, it becomes particularly challenging to achieve this stage of proficiency in FMS, which in turn hinders the additional application of motor development in the specialised movement phase (Goodway *et al.*, 2019). A school-based multicomponent FMS intervention among Irish primary school children aged six and ten supports these findings (Bolger, Bolger, O'Neill, Coughlan, Lacey, O'Brien, *et al.*, 2019). Conducted over 26 weeks, this intervention took place during stipulated PE periods, emphasising teaching, learning and opportunities for practice. After one year, the intervention group displayed significant improvements in the locomotor and object control (manipulation) standard scores and mastery levels across eight of the 12 skills among six year olds (Bolger *et al.*, 2019).

The school environment significantly contributes to providing children with opportunities to engage in PA and supports the development of FMS. During the academic year, primary school children spend approximately 40% of their waking hours in the school environment; therefore, it is crucial for schools to be equipped with the necessary resources, equipment and appropriately qualified teachers to ensure competence and confidence in delivering lessons that support FMS learning (Gabbard, 2011; Lander, Eather, Morgan, Salmon & Barnett, 2017). More specifically, PE is identified as being instrumental in the promotion of FMS, equipping children with the practice and instruction needed for the refinement of skills. According to the Institute of Medicine (2013), the age of seven marks a “context-specific period” in motor development whereby children begin cultivating foundational motor skills into combined skilful movement patterns, highlighting the importance of a developmentally appropriate PE curriculum in fostering FMS advancement.

2.3.2. Sequences of basic motor skill development

Developmental sequences are frequently used to investigate the emergence of FMS, emphasising the movement process and its qualitative aspects. These sequences can either focus on (a) total body sequences, describing the movements of an entire body or (b) component sequences, identifying developmental progressions for specific body segments such as the chest, hips or legs. Both approaches organise the descriptions of movement from basic, elementary and unskilled to more rhythmically competent and skilled forms (Goodway *et al.*, 2019). Each step or stage in the sequence outlines the common patterns children exhibit as they learn FMS. Using the total body approach, each stage represents the entire body's performance at a given moment. In contrast, the component method details how specific body segments evolve and how different segments may be linked together (Goodway *et al.*, 2019). The subsequent section will explore the various FMS assessment tools using the different sequences of motor skill development.

2.3.3. FMS Assessment Tools

To accurately describe and identify the strengths and weaknesses of children’s motor skill proficiency, it is important to use appropriate and accurate motor skill measuring tools (Nagy, Wilhelm, Domokos, Győri & Berki, 2023). Assessing motor skills in school children is particularly significant for teachers and coaches to aid in PE programme planning by providing insight into which skills children require additional practice. This enables the grouping of children for instruction according to the skills they have yet to master (Ulrich, 2000). Moreover, it allows for continuous evaluation and monitoring of children’s progress in mastering FMS (Nagy *et al.*, 2023). These assessments can either measure the quantitative (product-oriented) or qualitative (process-oriented) aspects of movement.

The process-oriented measurement tools analyse the manner in which the movement is carried out, characterising qualitative patterns of movement, whilst the product-oriented measurement tools assess the performance's result by comparing the outcome to normative data (Logan *et al.*, 2018).

Recently, a number of standardised FMS assessment instruments have been developed to evaluate foundational movements during early childhood. The majority of these instruments' focus on particular competencies and thus consist of distinctive tasks. The various and most common FMS evaluation instruments are discussed below.

2.3.3.1. Movement Assessment Battery for Children (M-ABC)

The Movement Assessment Battery for Children (MABC) and the revised, most recent version, MABC-2, are the most commonly used tools for diagnosing developmental coordination disorder (Cools, Martelaer, Samaey & Andries, 2009; Hadwin, Wood, Payne, Mackintosh & Par, 2023). The MABC-2 includes eight items, subdivided into three components: (i) balance (static and dynamic), (ii) aiming and catching, as well as (iii) manual dexterity, all of which are adapted for the three different age development periods: three to six years, seven to ten years and 11 to 16 years. Task completion time (measured using a stopwatch) and/or task achievement are the primary methods in which the performance of each task is evaluated. Upon cessation of the assessment, children are classified as "not at risk", "at risk", or "likely to have a motor coordination impairment" based on the total standardised score and percentile received (Hadwin *et al.*, 2023). Additionally, parents, educators and therapists will complete a questionnaire-based checklist that will provide supplementary information of a child's motor skill performance in school, home and community environments. The MABC-2 has been extensively used due to its cross-cultural validity (Smits-Engelsman, Henderson & Michels, 1998; Smits-Englesman, Verbecque, Denysschen & Coetzee, 2022) and acceptable reliability (Valentini, Ramalho & Oliveira, 2014). Moreover, its straightforward test administration allows for efficient screening of large samples within a short timeframe. However, the test combines scores across subtask categories, potentially masking weaknesses in one area with strengths in another (Hadwin *et al.*, 2023). Furthermore, the scoring system may lead to a "ceiling effect", overestimating motor performance by emphasising maximal rather than overall performance and children with poorer proficiency may have to perform more trials, increasing test administration time and causing fatigue and demotivation among participants (Hadwin *et al.*, 2023).

2.3.3.2. Bruininks-Oseretsky Test of Motor Proficiency (BOT)

The Bruininks-Oseretsky Test of Motor Proficiency (BOT) and the most recent version BOT-2 is a normative test which is individually administered to assess both fine and gross motor skills in children aged four to 21 years (Bruininks & Bruininks, 2005). There are two versions of the BOT-2, the complete form, consisting of 53 items and a test administration of 40-60 minutes per individual, the second version is the short form, which consists of 14 items and has a test administration time of 15 to 20 minutes per individual (Bruininks & Bruininks, 2005). The test enables the assessment of FMS in both the general population and particular subsets of children with mental health challenges. The following four domains of psychometrics are assessed: (i) fine manual control, or accuracy and integrity; (ii) manual coordination, or upper limb manual skill and coordination; (iii) physical coordination, or balance and (iv) bilateral coordination (Jírovec, Musálek & Mess, 2019). Whilst the condensed version of the BOT-2 allows for rapid and easily administered testing of motor proficiency with demonstrated construct validity, and strong inter-rater and moderate test / re-test reliability, caution must still be exercised (Deitz, Kartin & Kopp, 2007). The BOT-2 has been rejected in previous studies regarding cross-cultural validity and shows poor test / re-test reliability for certain age groups and motor area composites (Kambas & Aggeloussis, 2006; Deitz *et al.*, 2007).

2.3.3.3. Kinderkinetics Screening Assessment

The Kinderkinetics Screening Assessment measures the FMS of children aged three to six, encompassing the initial, elementary and mature developmental phases. The core components evaluated include locomotor skills, stability (dynamic and static), spatial orientation, body awareness, ball skills and coordination (de Waal, 2019), comprising a total of 23 skills. This instrument assesses movements using both process-oriented and product-oriented methods, with process-oriented criteria derived from fundamental stages of development (de Waal, 2019). The screening tool displays good construct and content validity, facilitating the development of appropriate perceptual-motor developmental programmes for varying age groups of preschoolers (Pienaar, van Reenen & Weber, 2016). Criterion-related validity has been confirmed against gold standard assessments like TGMD (see 2.3.3.4.) and MABC, showing moderate validity for the majority of the variables (Pienaar *et al.*, 2016). Despite the difficulty of assessing preschool-aged children, moderate test / re-test reliability is observed for the skills tested from 60 children, with qualitative assessment and body composition assessments exhibiting the strongest reliability. However, caution is advised regarding the reliability of measures in children as young as three (Pienaar *et al.*, 2016).

2.3.3.4. Test of Gross Motor Development

The Test of Gross Motor Development is one of the most frequently applied FMS screening tools in literature (Ulrich, 2017). It is a process orientated tool that provides movement practitioners, researchers and teachers with norm-referenced, valid and reliable data on gross motor skills in children aged three to ten (Ulrich, 2000, 2019). This screening assessment employs a criterion-based scoring system to evaluate object control (ball) and locomotor skills accordingly. Each of the 13 items tested is divided into three to five distinct skill criteria, inclusive of the presence or absence of each criterion, determining the degree to which a skill performance is graded (Ulrich, 2019).

The TGMD has undergone frequent revisions and standardisations by the test developer, adhering to best practices for educational and psychological testing (Ulrich, 2017). There are three editions of the TGMD protocol, with each successive edition reflecting re-evaluated and updated norms and performance criteria (Ulrich, 1985, 2000, 2017). The most recent edition (TGMD-3) was re-released in 2019 and includes amended skill criteria and modified skills, as informed by researchers' feedback (Ulrich, 2019). Field, Esposito Bosma and Temple (2019) examined the comparability of the TGMD-2 and TGMD-3 among eight to ten year olds following these revisions. While the two versions were reported to be similar, the TGMD-3 yielded a slightly lower percentage of maximum scores. According to Field *et al.* (2019) children’s locomotor subset scores improved over time for both versions, but not for the TGMD-2 object control subset. The latter outcome was attributed to the inclusion of the roll in the TGMD-2 object control subset, which has been re-termed as the ball skills subset in the TGMD-3, where the roll is absent. Palmer, Chinn, Scott-Andrews and Robinson (2021), investigated the compatibility of the two recent editions of the TGMD and concluded that their findings are consistent with Field *et al.* (2019). While the TGMD-2 and TGMD-3 are comparable they are not equivalent measures of FMS. The TGMD-3 protocol has been examined and measured amongst children globally, resulting in appropriate indexes of reliability, as well as factorial structure and validity (Mohammadi, Bahram, Khalaji & Ghadiri, 2017; Webster & Ulrich, 2017; Nilsen *et al.*, 2020; Garn & Webster, 2021; Valentini, Nobre, Zanella, Pereira, Albuquerque & Rudisill, 2021).

To summarise, this subsection highlighted the various FMS assessment tools, each measuring several different skills, categories and behavioural components. However, the type of assessment chosen should appropriately reflect the aim, objectives and sample setting of the participants included in the research study. The following section presents a table of prior and recent research findings of similar aims, testing batteries and participant demographics of the current study. This is followed by a discussion on the prevalence, differences between sexes and relationships between measured variables.

2.3.4. Fundamental movement skill proficiency (empirical research)

Despite the importance of FMS competency, research conducted over the last ten years, indicates that children are exhibiting poor proficiency in relation to their projected developmental milestones (Hardy, King, Farrell, Macniven & Howlett, 2010; Morley, Till, Ogilvie & Turner, 2015; Bolger *et al.*, 2019; Duncan *et al.*, 2020). Several factors contribute to the declining trend in perceptual-motor and FMS proficiency, including the current generation of children being less likely to participate in PA and sports activities. This is further exacerbated by unsafe environments, urbanisation and increased crime, resulting in more children opting for time spent indoors, restricting outdoor play and limiting access to safe spaces (Hills, King & Armstrong, 2007; Pienaar & Kemp, 2014). The integration of modern technology into everyday life, through the use of smartphones, televisions and computers, has increased the screen time children are exposed to. The average screen time spent among schoolchildren aged six to 14 is now 2.77 hours per day, thereby limiting time spent in PA (Qi, Yan & Yin, 2023). Similarly, the 2022 HAKSA report card graded the sedentary behaviour of children aged two to six “D”, in accordance with a study conducted in Gauteng - that indicated 69.9% of children’s time was spent in sedentary activities in preschool and grade R (Naidoo *et al.*, 2022). According to Eyre, Adeyemi, Cook, Noon, Tallis and Duncan (2022), another contributing factor to schoolchildren's decreased FMS is the limited time allocated to PE and access to movement education programmes. Additionally, the absence of qualified professionals to deliver lessons according to the lesson content and have clear objectives remains a pivotal issue (Van Deventer, 2004; Rajput & Van Deventer, 2010).

The subsequent tables (Tables 2.1 and 2.2) provide the relevant literature pertaining to children’s FMS statuses from 2010 to 2024. Table 2.1 presents the international research findings from Australia, Italy, England, Ireland, and Iran and a systematic review investigating children’s FMS proficiency across 25 countries. The national studies are summarised in Table 2.2. including research from the North West, Mpumalanga, Western Cape (Cape Town), Free State (Bloemfontein), Gauteng (Soweto) and Eastern Cape (Alice) provinces. The studies reviewed were conducted among three to ten year olds, reporting on FMS, with predominant use of the TGMD-2 and TGMD-3 test batteries, among others, and exploring and describing FMS’ relationship with PA and body composition.

Table 2.1. International studies on FMS proficiency and its association with PA and body composition

Reference	Aim of Study & Tests Used	Participant Demographics	Findings
Hardy *et al.* (2010)	• Aim: To explore and describe FMS proficiency, socio-demographic distribution, and corresponding performance criteria per skill among preschoolers in Australia. • Test: FMS (TGMD-2).	• 425 children (221 boys and 204 girls) • 4 year olds • Majority from low SES (56%) • New South Wales, Australia	• Girls achieved a greater total locomotor score, whereas boys achieved a greater object control skill, as well as each individual object control skill, apart from the catch when compared with girls. • No differences between sexes were observed for total FMS scores (p=0.87). • The run was the highest mastered skill (75%). While the strike (14%), throw (16%) and catch (20%) had the lowest mastery levels. • Apart from boys from high-middle SES exhibiting greater mastery in the hop compared with low SES boys, no further SES differences were observed.
Morano *et al.* (2011)	• Aim: To determine the gross motor skill performance of overweight (OW) and normal weight (NW) preschoolers. • Anthropometric measurements (Height, weight, body mass index). Gross motor skills (TGMD)	• 80 children (38 boys and 42 girls) • 4 to 5 year olds • Italy	• 52.5% of participants were identified as having NW 31.25% were classified as OW and 16.25% as obese. • The TGMD revealed no significant differences between sexes for object control skills. • However, overweight children displayed poorer movement competence in locomotor and object control skills in comparison to NW children (OW: 12.6 ± 3.6 vs NW: 15.8 ± 2.1) and locomotor (OW: 10.3 ± 3.8 vs NW: 13.9 ± 2.6). • A greater proportion of OW children were categorised as being "average" in locomotor (42.1%) and object control (39.5%). In contrast, NW children were categorised predominantly as "very superior" and "superior" in locomotor (21.4%, 26.2%) and object control (45.2%, 28.6%).
Cohen *et al.* (2014)	• Aim: To investigate the relationship between FMS competency and objectively measured MVPA during key physical activity periods among school children in low-income communities.	• 460 children (248 girls and 212 boys) • Grades 3 and 4 (mean age: 8.5 years) • Low-income communities • Australia	• The prevalence of overweight was 22.8%, and obesity was 17% among the participants. No age, BMI-z scores, or SES differences were found between the sexes. • On average, girls displayed greater competence in locomotor skills (p=0.008), whereas boys showed greater competence in object-control skills (p<0.001).

	• Test: Anthropometric measurements (height, weight, BMI). PA (triaxial Actigraph GT3X+ and GT3X accelerometers) Gross motor skills (TGMD-2).		• Participants spent an average of 54.8 ± 19.7 minutes in MVPA daily, with boys spending more time in MVPA than girls across all periods. 50% of the participant's daily MVPA occurs during lunchtime, recess and after school. • Whilst the locomotor skill subset was positively correlated with total ($p=0.002$) and after-school MVPA ($p=0.014$), it was not associated with lunchtime ($p=0.075$) or recess MVPA ($p=0.108$). • Conversely, the object control skill subset was positively correlated with total ($p<0.001$), lunchtime ($p=0.030$), recess ($p=0.006$) and after-school ($p=0.022$) MVPA.
Mohammadi *et al.* (2017)	• Aim: To investigate the gross motor development status, age differences, and the prevalence of mastery and low proficiency among 3-10-year-olds. • Test: Gross motor skills (TGMD-3)	• 1600 children • 3 to 10 year olds • Ahvaz, Iran	• A significant difference was observed in boys' and girls' performance; locomotor skills revealed no difference, but the ball skills subset mean score was higher in boys than girls. The boys displayed better performance in the two-hand strike, one-hand forehand strike, stationary dribble, catching, kicking, overhand and underhand throws. • While girls performed better in galloping and skipping, boys performed better in running, horizontal jump and sliding of the locomotor subset. • Low proficiency was observed in skipping (boys: 38.3% & girls: 32.9%), forehand strikes boys: 34.6% & girls: 50.5%), and overhand throws (boys: 20.1% & girls: 37.3%). Girls displayed higher low proficiency in the horizontal jump, dribble and underhand throw compared with boys ($p<0.05$) • Mastery was observed in running (boys: 58.9% & girls: 45.3%), hopping (boys: 30.1% & girls: 27.1%), and sliding (boys: 67.9% & girls: 65.3%), for locomotor skills and boys dribbling (32.5%) and catching (30.1 %) ball skills. • Significant age differences were observed for age groups 3 to 10, with the total mean raw score of locomotor and ball skills increasing significantly per year among the sample.

Mukherjee *et al.* (2017)	• Aim: To explore the status of FMS in Singaporean children, compare the results to normative US data and investigate the long-term FMS proficiency through primary school with exposure to PE. • Test: FMS (TGMD-2)	• 244 children (112 girls and 132 boys) • 6 to 7 year olds (P1) • 8 to 9 year olds (P3) • Singapore	• Among the 6 to 7 year group, the run was the highest mastered and near mastered skill, followed by the gallop and leap. • For object control skills, less than 50% of participants achieved near mastery, apart from the catch. • Overall, poor FMS mastery was observed for this age group, and no participant mastered all FMS items. • Majority of participants achieved average ratings for locomotor skills, whereas most participants achieved poor or below average ratings for object control skills. • No significant differences between the sexes were reported for FMS proficiency (p=0.579).
Hall, Eyre, Oxford and Duncan (2018)	• Aim: To determine the relationship between motor competence, PA and obesity among British preschoolers • Test Anthropometric measurements (height, weight, BMI) PA (triaxial wrist-worn accelerometers) Gross motor skills (TGMD-2)	• 166 children (91 boys and 75 girls) • 3 to 5 year olds • Britain	• Boys displayed greater activity in total PA (TPA) and MVPA and were more proficient in object control skills than girls. • Children classified as overweight (n=20) showed greater proficiency in motor competence and locomotor skills and were more active in TPA. • Significant correlations were revealed between PA and motor competence, particularly the association between TPA and total motor competence (p=0.001), TPA and object control skills (p=0.001), MVPA and total motor competence (p=0.001), and MVPA and object control skills (p=0.001). • No significant differences between sexes were reported for any of the measured variables. Similarly, there were no significant differences in weight status for TPA, MVPA, total motor competence, locomotor or object control skills. • Children who achieved TPA (p=0.008) and MVPA (p=0.014) recommendations displayed greater total motor competence than those who did not.
Bolger *et al.* (2018)	• Aim: To examine the FMS proficiency of Irish school children with respect to sex and age differences.	• 203 primary school children • 102 senior infants (6 year olds) • 101 fourth class (10 year olds)	• No significant differences were observed between boys' and girls' anthropometric measures. • Age differences were statistically significant, with 10 year olds scoring higher in locomotor and object control skills (p<0.05) compared with 6 year olds.

	• Test: Anthropometric measurements (height, weight, BMI). FMS (TGMD-2)	• Ireland	• Differences between sexes were statistically significant, with girls scoring higher than boys in locomotor skills, whereas boys scored higher in object-control skills than girls($p<0.05$). • No child mastered all 12 skills, no 6 year old obtained mastery in more than 6 skills. • Within both cohorts, accounting for age and sex, the run was the most mastered locomotor skill (boys–87.1%; girls–71.8%), while the jump was the least mastered (boys–11.8%; girls-12.9%). • Mastery in the object control skills revealed the kick to be the most mastered skill across both age groups and sexes (boys-77.3%; girls–40.9%) ($p<0.01$), with the roll being the least mastered skill for boys and girls (boys–12.7%; girls–1.1%).
Bolger *et al.* (2020)	• Aim: To investigate the FMS proficiency among children worldwide, using the TGMD-2 assessment tool • Test: Systematic review	• 64 International articles • 25 countries • 3 to 10 year olds	• Among 3 to 5 and 6 to 8 year olds, girls achieved a slightly greater locomotor raw score compared with boys. However, boys achieved higher object control raw scores for all age groups than girls. • Locomotor standard scores for boys and girls across the 3 to 5 and 6 to 8 year categories indicate "below average" performance. Meanwhile, object control standard scores for all age groups indicate "average" performance. Mastery of the skills revealed that the "run" was the most mastered across all age groups, followed by the gallop. Throwing was among the least mastered object control skills; only 6-7% of 6 to 8 year olds achieved mastery.
Dobell *et al.* (2020)	• Aim: To examine the FMS and PA status during early childhood. • Test: systematic review PA (accelerometers) FMS (TGMD-2, TGMD-3 and static single leg)	• 28 International articles • 21 countries • 4 to 5 year olds	• Participants exhibited greater locomotor performance than object control, and the skill with the highest competency was run. • Conversely, one study found object control performed with greater competency • Differences between sexes revealed that girls performed locomotor skills with greater competency than boys, while no significant differences were reported for object control and total raw scores between sexes. • While one article reported a positive and significant association between locomotor and object control skills with MVPA, another found that FMS mastery did not influence PA level.

Lawson *et al.* (2021)	• Aim: To examine the FMS proficiency of British schoolchildren at an individual and behavioural component level. • Test: Anthropometric measurements (height, weight, BMI). FMS (8 skills from TGMD-2 & TGMD-3; 1 skill from Rudd stability assessment)	• 219 primary school children (111 boys and 108 girls) • 7 to 10 year olds • Low-medium SES • Central England	• Overall poor performance was observed across the sample; no child mastered the 8 skills. 27% of the participants could not achieve mastery in any of the skills. • Similar results were reported across sexes for the non-mastery of skills. Although girls had a greater probability of achieving "near mastery" at the run, boys had a greater probability of "near mastery" for the overarm throw. • The catch had the highest number of children classified as "poor" and "near mastery". The behavioural component revealed that children could not catch and control the ball with their hands only and flex their elbows. • The behavioural component with the greatest failure rate for the underarm throw across sexes and competence level with the contralateral action of limbs. • Overall, girls displayed a significantly greater proficiency in locomotor skills (girls: m=21.71; boys: m=20.34), and boys had a significantly greater proficiency in object control skills (girls: m=14.65; boys: m=15.92).

Table 2.2. National studies on FMS proficiency and its association with PA and body composition

Reference	Aim of Study & Tests Used	Participant Demographics	Findings
Pienaar and Kemp (2014)	• Aim: To identify the motor proficiency among grade 1 learners and examine the probable sex and racial differences among them. • Test: BOT-2 short form	• 816 children (419 boys and 397 girls) • 6 to 7 year olds (grade 1) • 20 selected schools • North West, South Africa	• Overall, the participants received a standard score of 41.11 for motor proficiency placing them in the "average" category. When categorised individually, the majority of the group was placed in the "average" (48.16%) or "below average" (49.63%) descriptive class. • Differences between sexes were observed, with 63.96% of boys categorised in the "average" class and 64.74% of girls in the "below average" class. • Boys showed greater mastery in upper limb coordination (8.16>7.59) and strength (4.84>4.35); however, girls yielded better scores in manual dexterity (5.04>4.78) and bilateral coordination (5.20>4.87) when compared to boys. • Subsequently, the difference in motor proficiency between Black African and White learners revealed that White learners displayed better proficiency (69.27% placed in the "average class) than Black African learners (58.73% placed in the "below average" class).
Pienaar *et al.* (2016)	• Aim: To identify the FMS proficiency of 6 year old children and determine the sex disparities in FMS development. • Test: Kinderkinetics screening assessment.	• 72 children (35 boys, and 37 girls) • 6 year olds • Low-middle income SES living in rural and urban areas. • Potchefstroom and Vaalharts, North West, South Africa	• From the 8 locomotor skills tested, most participants scored in the mature phase for the subset; 96% displayed mastery in running, 89% for two-legged jumping and 71% for skipping (considered the most difficult locomotor skill to master). • Overall, only a 1.6% difference was illustrated between boys and girls in the mature mastery of locomotor skills, with girls displaying greater mastery. • Only 74% of participants were classified in the mature stage for the 6 balancing skills tested. Furthermore, girls displayed greater mean percentages for mastery than boys, resulting in a 12% difference in the balancing skills performed. • Proficiency of the object control subset revealed that only 70.4% of the participants were in the mature mastery phase, with only 48.6% able to master throwing a ball overhead.

			• Moreover, there was a 9.5% disparity among sexes, with boys displaying greater mean percentages for mastery among all 3 skills tested. • The body coordination subset was performed poorly, with only 43.1% of the participants displaying mature mastery.
Cook, Howard, Scerif, Twine, Kahn, Norris, *et al.* (2019)	• Aim: To determine the interrelationships that exist between early executive function (EF), PA and gross motor skills in a low-income sample in South Africa. • Test: EF (Early Years Toolbox, measuring language, numeracy and social-emotional development) PA (Actigraph GT3X+ accelerometers) Gross motor skills (TGMD-2)	• 129 children • 3 to 6 year olds • Urban (64) and rural (65) low-income settings • Gauteng and Mpumalanga, South Africa	• More than 85% of participants fall between average and superior categories for gross motor skill proficiency. Participants met all PA guidelines and, in both settings, performed within or above the norms for executive function. • Bivariate correlations indicate that age is significantly associated with gross motor skills and EF. All measures of gross motor skills were significantly associated with the components of EF. • Multiple regression analysis indicated: ○ Inhibition: only age and locomotor skills indicated a significant association with inhibition. ○ Working memory: Age, setting, locomotor skills, and MVPA were all significant predictors of working memory.
Tomaz, Jones, Hinkley, Bernstein, Twine, Kahn, *et al.* (2019)	• Aim: To determine the gross motor skill proficiency among preschoolers in urban high-income (UH), urban low-income (UL) and rural low-income (RL) settings and to explore differences in proficiency by income setting and sex. • Test: Gross motor skill (TGMD-2)	• 259 preschoolers (130 boys and 129 girls) • 3 to 6 year-olds • 46-UH; 91-UL; 122- RL • Western Cape and Mpumalanga, South Africa	• 93% of participants achieved an “average” or better rating. • RL participants outperformed the UH and UL counterparts, particularly in locomotive and object control skills ($p=0.028$; $p=0.029$ and $p=0.009$; $p=0.006$). • However, decreases in performance were noted during the run ($p<0.001$), slide ($p=0.002$) and stationary dribble ($p=0.001$) of RL participants in comparison to UH. • Differences between sexes revealed, that boys achieved superior results for the leap, strike, stationary dribble, kick and object control skills collectively when compared with girls ($p<0.001$). • It was further observed, that neither sex nor SES was found to be significant predictors of locomotor skills ($p>0.05$).

Tomaz, Prioreschi, Watson, McVeigh, Rae, Jones, *et al.* (2019)	• Aim: To examine and explore the interrelationship between PA, BMI, gross motor skills, sedentary behaviour and sleep of preschoolers. • Tests: Anthropometric measurements (height, weight, BMI) PA (Actigrapgh GT3X+ accelerometers) Gross motor skills (TGMD-2)	• 78 children (39 boys and 39 girls) • 3 to 5 year olds • Black African ethnicity • Soweto, Johannesburg, South Africa	• BMI revealed minimal differences between boys and girls of similar age. 28% of participants were classified as normal weight, 8% as overweight/obese and the remaining 6% as thin. • Overall, 83.0% of participants met the guidelines of a minimum of 60 minutes of MVPA daily, and all children completed ≥180 of LMVPA. • No differences between sexes were observed at any PA intensity or sedentary behaviour for this age group. • Participants were mostly active on weekdays during early morning and late afternoons. Subsequently, on weekends, preschool children appeared to have less variation in activity intensity during the day. • Gross motor skill proficiency revealed that boys displayed a decreased object control standard score ($p<0.01$) as well as gross motor quotient ($p=0.04$) when compared with girls. • Although differences were insignificant boys scored higher raw scores for locomotor (boys: 39.3 & girls: 38.9) and object control subsets (boys: 36.7 & girls: 35.2).
de Waal (2019)	• Aim: To investigate whether a correlation exists between FMS and the academic performance of preschoolers. • Test: FMS (Kinderkinetics screening assessment) Academic performance (academic reports provided by the school)	• 69 children (38 boys and 31 girls) • 5 to 6 years old • High SES and predominantly Caucasian preschoolers • Bloemfontein, South Africa	• Overall, most participants demonstrated elementary- and mature-phase execution of the locomotor skills. However, a large number of participants exhibited initial-stage execution of balancing skills, particularly when tasked with their eyes closed and heel-to-toe walking. • Poor performance was observed for kicking a ball (15.94%) and performing star jumps (17.39%), whereas body awareness skills were identified to be in the mature stage • Dynamic and static balance, star jumps and locomotor skills displayed a moderate statistical correlation with all home languages. • Dynamic and static balancing skills positively and statistically correlated in all learning areas. • Star jumps were strongly significant with mathematics performance. Of all the learning areas included, Mathematics showed the most significant association with FMS

Draper *et al.* (2019)	• Aim: To examine the relationship between PA, GMS and adiposity in preschoolers • Tests: Anthropometric measurements (height, weight, BMI-for-age, height-for-age, weight-for-age) PA (Actigraph GT3X+ accelerometers) Gross motor skills (TGMD-2)	• 268 children (136 boys and 132 girls) • 3 to 6 year olds • UH, (48), UL (91) and RL (122) settings • Cape Town and Mpumalanga, South Africa	• 70-76% of children were of normal weight status; significantly more children in the UL setting were overweight/obese (16.49%) and had higher BMI and BAZ than UH and RL settings (p=0.001). • Participants in the UL setting showed a weak but significant negative correlation between the object control subset and BMI and BAZ. • Overall, no association was found between adiposity and gross motor proficiency among the participants.
van Stryp, Duncan and Africa, (2022)	• Aim: To investigate the status of FMS proficiency and compare differences between boys and girls in grade 1. • Test: FMS (TGMD-2)	• 178 children (98 boys and 80 girls) • 6 to 8 years old (grade 1) • Cape Town, Western Cape, South Africa	• 35% of the participants were found to have mastered all the FMS, 37% were considered to be near mastery level, and the remaining 28% were classified as poor. • Locomotor skills had a higher number of participants classified as poor (30%) as compared with object control (26%). • Running was the highest mastered skill (67%), whereas hopping was the least mastered (18%). • No statistical significance (p>0.05) was present between girls and boys for locomotor skills. • However, a statistical significance was present between boys and girls for object control skills. Boys performed better in kicking and striking. • The only skill to be best mastered by girls was the catch • Overall, from the results obtained, FMS was not influenced by sex. With the dribble, catch and roll exhibiting no differences between sexes.

Idamokoro, Pienaar, Gerber and van Gent (2024)	• Aim: To determine the effects of a nine-week movement programme on FMS of school children. • Test: FMS (TGMD-3)	• 93 schoolchildren (57 intervention; 36 control) • 7 to 8 year olds (grade 2) • Rural primary school settings • Alice, Eastern Cape, South Africa	• A significant improvement was observed from the pre-test to the post-test in both groups ($p<0.001$; $d>0.8$), albeit the intervention group scored a higher locomotor total raw score than the control group during the post-test. Similar improvements were observed from the pre-test to re-test while the intervention group scores were higher, it was not statistically significant ($p>0.05$) • Total scores for the ball skills subset improved in both groups from the pre-test to the post-test, similarly, in the post-test to re-test. Significant improvement and practical significance were observed for the intervention group from pre-test to re-test ($p<0.001$; $d>0.8$), compared with the control group, which had also improved; however, improvements were smaller) • Gross motor index (GMI) was improved in the intervention group from pre-test to re-test, revealing a significant statistical improvement ($p<0.001$; $d>0.8$), while the control group's GMI score significantly improved from the pre-test to post-test ($p<0.001$; $d>0.8$).

The FMS proficiency prevalence is discussed below, drawing on findings summarised in Table 2.1 and Table 2.2 above. The international studies presented in Table 2.1 reveal that two recent systematic reviews evaluating the global levels of FMS in children using the TGMD-2 protocol found an overall decline in FMS competency with low levels of proficiency in both the locomotor and object control skills (Bolger et al., 2020; Dobell et al., 2020). Bolger et al. (2020) further propose that when both age and sex are considered, standardised FMS performance suggests children between the ages of six and eight exhibit "below average" FMS levels, stating this rating may be due to inadequate instruction, feedback or lack of opportunities to practice FMS. Mastery levels amongst the locomotor skill items completed in the TGMD-2 revealed the run had the greatest proportion of children achieving mastery, followed by the gallop and leap, with the hop being the least proficient skill among all age groups (three to five; six to eight, and nine to ten) (Bolger *et al.*, 2020). Mastery in the object-control skills revealed that the roll and throw was the least mastered skill, with only 6 to 7% of six to eight year olds achieving mastery in the throw (Bolger *et al.*, 2020). More specifically, in relation to specific countries, an early study in Australia found the run to be the highest mastered skill among the sample, whilst three object control skills were reported to have the lowest mastery levels (strike, throw and catch). Similarly, Singaporean six to nine year olds displayed the greatest mastery in the run; however, they failed to demonstrate age-appropriate FMS competency and no child mastered all 12 skills (Mukherjee *et al.*, 2017). Across 203 children in an Irish cohort (ages six and ten), no child exhibited mastery across 12 FMS items using the TGMD-2 (Bolger *et al.*, 2018). Furthermore, no six year old mastered more than six FMS items, indicating that low motor proficiency is demonstrated in this age group (Bolger *et al.*, 2018). 1600 [1]neurotypical Iranian children aged three to ten were tested using the TGMD-3 protocol, which revealed poor motor proficiency in skipping (boys: 38.3% and girls: 32.9%), forehand strike (boys: 34.6% and girls: 50.5%), and overhand throw (boys: 20.1% and girls: 37.3%), whilst mastery was observed in the run (boys: 58.9 % and girls: 45.3%), hop (boys: 30.1% and girls: 27.1%), and sliding (boys: 67.9% and girls: 65.3%), of both boys and girls (Mohammadi *et al.*, 2017). Mohammadi

[1] Having a normal neurocognitive function (Shah, Boilson, Rutherford, Prior, Johnston, MacIver, *et al.*, 2022).

et al. (2017), propose that poor motor proficiency observed in the skip is due to the complexity of movement patterns for the skill, coupled with the child's inability to coordinate movements. Additionally, the poor performance in the forehand strike is attributed to its absence in PE programmes in Iran, resulting in unfamiliarity and lack of experience amongst the children. In contrast, the mastery of the run and slide may be due to these skills maturing at an earlier age in children compared with other skills.

South African studies published over the last decade reported varying results. A study conducted in Cape Town revealed that 35% of grade 1 learners mastered all FMS, 37% were observed to be near mastery level, whilst the remaining 28% were classified at a poor level (van Stryp *et al.*, 2022). Whereas an earlier study by Pienaar and Kemp (2014) reported that a high percentage of grade 1 children scored below average (49.63%) to average (48.16%) in motor proficiency. The authors further suggest that the poor results obtained indicate that one out of every two learners were categorised as having below-average motor proficiency. Contrary to these findings, a later study by Pienaar, van Reenen and Weber (2016) found that locomotor skills were highly mastered by six year olds, with 84.3% found to be in the mature phase. Object control and body coordination were less successful, with only 48.6% and 43.1% exhibiting full mastery, respectively. Research done on preschoolers showed similar trends. Tomaz, Jones, Hinkley, Twine, Kahn, Norris, et al., (2019) explored gross motor skills across different income settings within the Western Cape and Mpumalanga and revealed that children had good proficiency, with 51.3% of the sample classified as superior. Moreover, it was reported that the gross motor skills of children residing in rural low-income settings were substantially higher than those of urban low-income and urban high-income children. However, contrary to this study, Cook *et al.* (2019) found that children from both urban settings in Gauteng and rural low-income areas in Mpumalanga reported similar gross motor skill patterns, with no apparent differences between the two settings. A study involving 69 preschool children from a high SES background in the North West province found that the majority displayed elementary and mature phase performance in locomotor skills, whilst only the initial stage performance level for balancing skills was achieved (de Waal, 2019). TGMD-2 testing was conducted in private Montessori preschools in the Western Cape among three to six year olds. While none of the participants fully mastered any area of FMS, the overall performance varied between “average” and “above average rating”. The highest mastered skills among six year olds were the run (87.5%), slide (87.5%), leap (50%) hop (50%), kick (50%), and catch (50%), indicating overall good FMS proficiency (Africa, Duncan & Bath, 2024). Another recent study carried out in the Eastern Cape assessed the FMS proficiency of rural school children aged seven to eight using the TGMD-3 protocol (Idamokoro *et al.*, 2024). The research employed a two-group, pre-test, post-test and re-test design to investigate the effects of a nine week movement programme on FMS, including 57 children in the intervention group and 36 in the control group. Idamokoro *et al.* (2024), reported that both groups achieved higher mean scores in the ball skills raw scores in the pre-test compared with the locomotor raw scores (INT: 41.79 vs 36.46 and CON: 39.79 vs 33.66). In addition, overall significant improvements were observed for the intervention group for locomotor skills from pre- to post- and post- to re-testing ($p<0.001$), compared with the control group which deteriorated in locomotor performance from post- to re-testing ($p=0.016$; $d=0.7$). Similarly, ball skills improved significantly in the intervention group from pre- to re-testing increasing from 41.79 ± 0.56 to 49.70 ± 0.59. This improvement is remarkably greater than that of the control group.

The lack of studies reporting on FMS amongst grade 1 children within the Eastern Cape, coupled with research indicating that the Eastern Cape has greater challenges concerning low quality education, severe poverty and inequality than other provinces within South Africa (Moyo, Mishi & Ncwadi, 2022) highlights the need for further investigation in this area.

Sex differences in FMS

Sex has been established as a significant factor in FMS performance among children. Cliff, Okely, Smith and McKeen (2009), report that progression to proficiency and mastery levels does not occur at the same rate among boys and girls. These differences can be described according to biological, environmental and sociological factors proposed by Thomas and French (1985). However, prior to puberty, boys and girls tend to exhibit similar biological characteristics, including body composition, strength, genotypes and limb length, rendering these factors less influential at this age. Therefore, differences between sexes during the early childhood period can largely be influenced by environmental and socialisation associations, including physical environment, family, peers and teachers (Thomas & French, 1985). The role of parents in children's participation in FMS is significantly influential. Their attitude toward PA, PA behaviours and the availability of equipment in the home can also impact FMS performance (Thomas & French, 1985; Hardy *et al.*, 2010). Cools, de Kristine, Samaey and Andries (2011) revealed that a father's PA was positively associated with boys' FMS performance, while the availability of equipment was positively associated with girls' FMS performance. Research trends also suggest that boys are influenced by competitiveness and display greater participation in ball sports (manipulation-centred activities), whereas girls showcase more caring and cooperative characteristics resulting in greater participation in dance and gymnastics (locomotor-centred activities) (Hardy *et al.*, 2010; Bardid, Huyben, Lenoir, Seghers, De Martelaer, Goodway, *et al.*, 2016). This is further supported by studies conducted over several years reporting superior manipulation proficiency in boys relative to girls (Barnett *et al.*, 2009; Hardy *et al.*, 2010; Bardid *et al.*, 2016; Bolger *et al.*, 2018; van Stryp *et al.*, 2022). In comparison to the proficiency in locomotor skills, contradictory findings are reported, with some research studies suggesting girls display superior performance compared to boys (Barnett *et al.*, 2009; Bolger *et al.*, 2018), whereas other studies report no differences between sexes in locomotor skills (Mukherjee *et al.*, 2017; Tomaz, Jones, Hinkley, Bernstein, *et al.*, 2019; van Stryp *et al.*, 2022). Ultimately, the differences in practice opportunities for various movement education and FMS programmes, or the absence thereof for boys and girls, may contribute to the disparities reported above.

In Iran, Mohammadi *et al.* (2017), reported that boys aged three to ten performed significantly better in TGMD-3 motor skills than ($p<0.05$). A more recent study using the TGMD-3 protocol among Irish primary school children aged five to 11 revealed that boys performed better in object control skills, including the kick, overhand and underhand throw, one-hand strike and two-hand strike, while girls scored higher in locomotor skills, namely; run, skip, gallop, hop and the horizontal jump (Duncan, Martins, Ribeiro Bandeira, Issartel, Peers, Belton, *et al.*, 2022). Similar findings were reported in an earlier study in Ireland: the run was the highest mastered locomotor skill for both sexes, although the girls significantly outperformed the boys ($p<0.05$). Correspondingly, the kick (manipulative skill) was the highest mastered skill for both sexes; however, a significant proportion of boys demonstrated mastery in comparison to girls, including better performance in the throw and roll ($p<0.05$) (Bolger *et al.*, 2018).

Baseline data from the ExAMIN Youth South African study investigating the process-orientated FMS skills of running, jumping, catching, and kicking in 636 children aged five to eight indicated boys scored significantly higher mean scores in the running, kicking, and jumping compared with girls ($p<0.01$) (Pienaar, Monyeki, Coetzee, Gerber, du Plessis, du Plessis, *et al.*, 2022). Tomaz, Jones, *et al.* (2019), reported in a cohort of preschool children that boys performed significantly better in the leap, strike, stationary dribble, and kick ($p<0.001$) in comparison to girls, in addition to obtaining higher scores in the object control raw scores total ($p<0.001$). Consequently, in contradiction to the above-mentioned evidence Tomaz, Prioreschi, *et al.* (2019),observed that preschool boys from low to middle-income urban settings had significantly lower object control standard scores than girls ($p<0.01$).

Aligned with the international studies, a study examining differences between the sexes in mastery amongst South African preschool children in low to middle income families reported a 9.5% difference in the mature mastery of object control skills, reporting boys displayed greater mastery compared with girls (75.23% > 65.76%). However, only a slight difference of 1.6% was observed for mature mastery of locomotor skills, with boys achieving a higher score compared with girls (84.6% > 82.5%) (Pienaar *et al.*, 2016). According to van Stryp *et al.* (2022) grade 1 learners performing the TGMD-2 revealed similar mastery levels in locomotor skills, whereas more differences were observed in object control skills - only 13% of girls achieved mastery in striking a stationary ball, compared with 22% of boys, similarly a significant difference was shown in the throw, 33% of boys demonstrated mastery compared with 18% of girls. The only skill girls out-mastered boys in was the catch.

In summary, the research findings presented above report contradictory findings on differences between sexes for FMS. Subsequently, while some studies report that boys outperform girls in object control skills and girls perform better in locomotor skills, others report no significant differences between sexes. These inconsistencies highlight the research gap and emphasise the need for further investigation. The following section will continue discussing the importance of PA for children's health, the PA prevalence and its association with FMS.

2.4. PHYSICAL ACTIVITY DURING EARLY CHILDHOOD

PA is a multifaceted behaviour governed by psychological, social, environmental and demographic factors (Charlton, Gravenor, Rees, Knox, Hill, Rahman, *et al.*, 2014). It is characterised as movements produced by the body's skeletal muscles that result in an increase in energy expenditure above resting values (Caspersen *et al.*, 1985). Monyeki (2014) describes PA relative to children to be inclusive of active play, such as walking and cycling, organised PE classes at schools in the form of structured PA, organised sporting codes (rugby, swimming, soccer, etc.) and exercise sessions. Moreover, unstructured active play is further advocated to enhance motivation and enjoyment of PA among younger children; this consists of short rest intervals interspersed with several sporadic moderate-to-vigorous PA (MVPA) bouts (American College of Sports Medicine, 2021). PA guidelines have been established to inform individuals about the appropriate and optimum levels of PA needed to sustain a healthy lifestyle. While numerous countries have established PA guidelines, the WHO recommendations are widely regarded as the benchmark for PA. It suggests children aged five and older should partake in 60 minutes of MVPA daily, including strengthening exercises three times a week to maintain healthy body weight and musculoskeletal development (World Health Organization, 2020). However, it is still suggested that all PA be age-appropriate and incorporate VPA-centred activities during the week (World Health Organization, 2020).

Two major classifications can be used for the measurement of PA, namely, subjective and objective measures. Subjective methods require the individual to account for or record their activities as they occur or to recollect past events (e.g. PA diaries and PA questionnaires). In contrast, objective methods involve wearable devices, directly measuring variables such as heart rate, acceleration step count or other PA metrics (Strath, Kaminsky, Ainsworth, Ekelund, Freedson, Gary, *et al.*, 2013). Accelerometers, an objective measure, assess PA over a defined period of time, providing data concerning the pattern and intensity of activity by detecting movement in three planes (vertical, anteroposterior and horizontal planes) (Strath *et al.*, 2013; Lynch, Kaufman, Rajjo, Mohammed, Kumar, Murad, *et al.*, 2019). The raw data from accelerometers [expressed as counts per time interval (10 to 60 seconds) at a sampling frequency of 30Hz] can be processed using specialised software to calculate the time spent in various PA intensities according to predefined cut-off values. Therefore, the accelerometer devices can be configured to convert the data into either an estimate of energy expenditure or classifications of activity, such as sedentary behaviour (Strath *et al.*, 2013).

Continuous participation in PA has been widely recognised as a crucial component of a high quality of life, offering both health benefits and precautionary measures for a range of health risks and non-communicable diseases (Charlton *et al.*, 2014). There are numerous bodies of research which indicate a direct correlation between PA levels and overnutrition in children and adolescents over the age of six, which emphasises the significance of PA during these formative years as it continues into later childhood and adolescence (Carson, Rinaldi, Torrance, Maximova, Ball, Majumdar, *et al.*, 2014; Mitchell, Dowda, Pate, Kordas, Froberg, Sardinha, *et al.*, 2017). Health benefits associated with consistent participation in PA include lower levels of serum lipids, together with lipoprotein and adiposity, as well as low blood pressure values among youth (Van Der Horst, Paw, Twisk & Van Mechelen, 2007). Meanwhile, psychological benefits encompass improved self-esteem and reduced levels of stress and anxiety. Having explored the importance of PA for children's health, the subsequent section will highlight the PA prevalence and differences between sexes across international and South African studies and PA in a school setting.

2.4.1. Physical activity

Children aged five to six and younger are generally categorised as highly active, more specifically in light-intensity PA. Regardless, six year olds are already displaying a noticeable decline in PA levels with increased sedentary activities and an emphasis on screen-based behaviours (Bruijns, Truelove, Johnson, Gilliland & Tucker, 2020; Steene-Johannessen, Hansen, Dalene, Kolle, Northstone, Møller, *et al.*, 2020).

Despite the above-mentioned benefits of PA, there is an alarming increase in inactivity rates globally, whereby only an estimated 27 to 33% of children and adolescents meet WHO daily MVPA recommendations of 60 minutes, with overall PA given a “D” grade as per the Global Physical Activity Report Card (Aubert, Barnes, Abdeta, Nader, Adeniyi, Aguilar-Farias, *et al.*, 2022). These trends were highlighted in low to middle income countries that have limited PA policies implemented to ensure children and adolescents are achieving daily PA. According to research in South Africa, the HAKSA 2022 Report Card, shows that overall, PA improved to a B, which indicates that 60 to 66% of children meet the daily MVPA recommendations (Naidoo et al., 2022). These results represent a positive shift from preceding HAKSA report cards which showed no progress in children’s PA from 2016 to 2018, whereby only 48 to 51.7% of children were meeting the PA guidelines (Uys, Bassett, Draper, Micklesfield, Monyeki, De Villiers, *et al.*, 2016; Draper, Tomaz, Bassett, Burnett, Christie, Cozett, *et al.*, 2018)(Uys *et al.*, 2016; Draper *et al.*, 2018). Additionally, Gerber, Ayekoé, Beckmann, Bonfoh, Kouassi, Gba, *et al.* (2021) measured PA among children in grades 1 to 4 in low-income communities of Gqeberha and found that 76.9% of children achieved the recommended daily MVPA. These patterns extend to preschool-aged children, who have also been observed to exceed the PA guidelines (Cook *et al.*, 2019; Tomaz, Prioreschi, *et al.*, 2019) However, contradictory findings show that a gradual decline in school children’s physical fitness and activity has been observed (Van Biljon, McKune, Dubose, Kolanisi & Semple, 2018; Nqweniso, Walter, du Randt, Adams, Beckmann, Degen, *et al.*, 2021). This is further evidenced by Gomwe, Seekoe, Lyoka, Marange and Mafa (2022), who identified 53.3% of children (nine to 14 years old) in the Eastern Cape province participate in low PA, with 76.6% of those in peri-urban areas also reporting low PA participation.

Sex differences in PA

Across various studies, sex disparities are highlighted, with girls being significantly less active than boys (Cohen *et al.*, 2014; Hall *et al.*, 2018; Van Biljon *et al.*, 2018; Tomaz, Prioreschi, *et al.*, 2019). Correspondingly, Cohen *et al.* (2014) reports that in low-income communities within Australia, boys spend significantly more time in MVPA for all time periods (total daily, lunchtime, recess and after-school) in comparison to girls ($p<0.01$).

Among British preschoolers, boys were observed to be more active in MVPA and total PA when compared with girls (Hall *et al.*, 2018). Moore, Beets, Kaczynski, Besenyi, Morris and Kolbe (2014), suggests the sex differences observed between boys and girls may be attributed to the interaction of physical, social and environmental factors, resulting in changes to PA status. Further explanations propose that when girls engage in PA, they receive less social support, and their overall enjoyment decreases when engaging in PE at school. In addition, Telford, Telford, Olive, Cochrane and Davey (2016) state that girls are less likely to possess favourable individual characteristics that correlate with PA, such as poorer cardiorespiratory fitness, higher body fat percentage and decreased levels of perceived proficiency.

This is further corroborated by local studies (Van Biljon *et al.*, 2018; Gerber *et al.*, 2021; Nqweniso, Walter, *et al.*, 2021). Differences between sexes were the most pronounced in Gqeberha, South Africa, when compared with school children from Tanzania and Cote d'Ivoire. Boys were found to be significantly more active than girls ($p<0.01$), whereas girls engaged in more sedentary behaviour (Gerber *et al.*, 2021). Gomwe *et al.* (2022) stated in the Eastern Cape, 51.0% of boys participated in MPA, while 43.3% of girls were active in MPA. These differences can be highlighted according to gender preferences, as boys tend to gravitate towards competitive and outdoor-based games, whereas girls opt for household chores and indoor activities (Gomwe *et al.*, 2022). Conversely, Tomaz, Prioreschi, *et al.* (2019) reported no differences between boys and girls at any PA intensity for preschool children in Gauteng. These contrasting local results for the PA status between sexes warrant additional research specific to grade 1 learners.

PA in the school day

Ideally, the school environment provides a hypothetically optimal setting to promote school children's PA, which accounts for the PE curriculum, experienced teachers to facilitate movement education, resources and facilities (Cohen *et al.*, 2014). Apart from organised sport and PE, the school day offers lunch and recess periods (break time), serving as prime opportunities for children to participate in PA and achieve daily MVPA recommendations. According to Ridgers, Stratton and Fairclough (2006) the combined time for lunch periods and breaks has the potential to account for 40% of children's daily

PA. Moreover, the after-school period has been termed as the “critical window” for PA to take place. It is proposed to be an ideal period for children to choose activities or active behaviours independently that they would like to engage in, which can contribute approximately 25% of their daily PA (Arundell, Ridgers, Veitch, Salmon, Hinkley & Timperio, 2013). A study conducted in Munich, Germany, examined the PA status and sedentary behaviour of school children, comparing those that attend school the full day to those that attend half the day. The results illustrated that children who attended full school days presented with the highest MVPA percentages and exhibited the least sedentary behaviour (Kuritz, Mall, Schnitzius & Mess, 2020). Moreover, a cross-national study including 21 primary schools in the Netherlands illustrated that half of children’s daily recommended MVPA was achieved at school (Remmers, Koolwijk, Fassaert, Nolles, de Groot, Vos, *et al.*, 2024). This underscores the importance of the school environment in promoting children’s PA by offering scheduled opportunities for daily PA such as break times and purposeful movement on the premise of them receiving quality PE, supported by facilities and structures designed to encourage active participation and play.

2.5. ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND FUNDAMENTAL MOVEMENT SKILLS

As highlighted in section 2.2., it is crucial for children to practice and adopt healthy behaviours to enhance their growth and development and well-being in later stages of life. As such, Stodden *et al.* (2008) developed a conceptual trajectory model that proposes proficiency in FMS, setting the foundation for lifelong adherence to PA and maintaining a healthy lifestyle. The underlying concept of this model is the dynamic and reciprocal association between motor competence and PA, which is subject to change from early to middle childhood (Goodway *et al.*, 2019). In conjunction with this, the model’s developmental processes support the argument that children’s PA trajectories illustrate the interplay between motor skill development, weight status and PA (refer to Figure 2.2). The model further highlights the role motor skill competence serves as the fundamental factor influencing PA, affected by variables such as age, health-related fitness, perceived motor competence and the risk of overnutrition resulting in obesity.

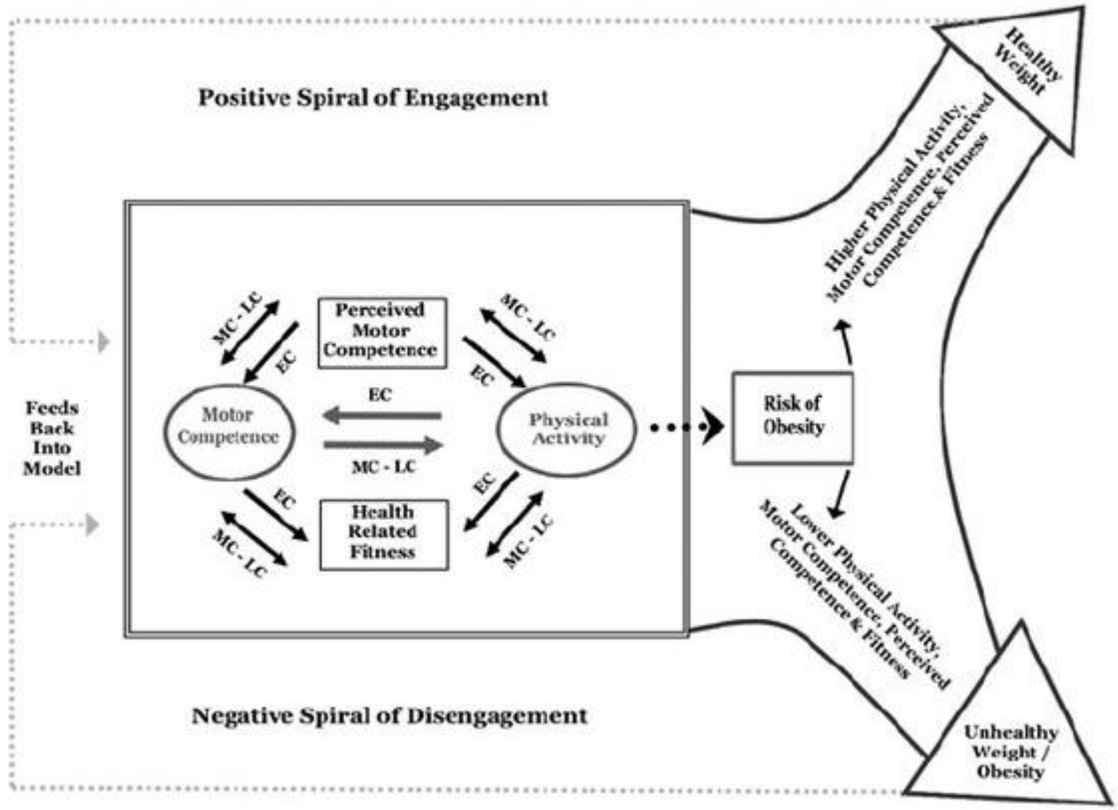


Figure 2.2: Theoretical model of developmental mechanisms influencing PA pathways of children (Stodden *et al.*, 2008).

While there is a common misconception that children instinctively learn and develop FMS, they need opportunities to practice in an environment that supports their growth and allows them to apply these abilities to sports and PA engagement. Specifically, during early childhood, children's desire to engage in PA and active play prompts the development of their motor abilities, particularly FMS. It is further suggested that the decreased PA levels reported worldwide, may account for the poor FMS proficiency reported among children (Tremblay, Barnes, González, Katzmarzyk, Onywera, Reilly, *et al.*, 2016; Parrish, Tremblay, Carson, Veldman, Cliff, Vella, *et al.*, 2020). A study conducted by Duncan, Roscoe, Faghy, Tallis and Eyre (2019), investigated the contributions of FMS to children's PA. The study concluded that when children are performing manipulation skills, their energy expenditure ranges from light (throwing and catching) to moderate (instep kicking). Therefore, performing repetitive practices of FMS, e.g. instep kicking - classified as MPA - may contribute to children achieving their daily PA recommendations (Duncan *et al.*, 2019). Subsequently, children who have more opportunities to participate in PA will likely experience more significant opportunities for FMS development compared with those with limited access to PA. These affordances to PA are associated with SES, the role of family, outdoor environment and the availability of age-appropriate motor skill programmes and activities. Similarly, Goodway *et al.* (2019) suggest that children with greater proficiency in motor competence will have more range and skill sets in movements, resulting in greater possibilities and a sense of enjoyment to sustain their behaviours in PA, games, and sports. Stodden *et al.* (2008) have linked the relationship between FMS and PA to be associated with children's intrinsic motivation to participate, the perceptions of competence and success. Ultimately, determining FMS proficiency and competence is the primary factor of PA (Stodden *et al.*, 2008).

A growing body of research has revealed a positive relationship between FMS proficiency and PA levels (Kambas, Michalopoulou, Fatouros, Christoforidis, Manthou, Giannakidou, *et al.*, 2012; Holfelder & Schott, 2014; Foweather, Knowles, Ridgers, O'Dwyer, Foulkes & Stratton, 2015; Gu, 2016). Two South African studies have investigated the variables including PA and gross motor skills among preschoolers, both using the TGMD-2 protocol and Actigraph accelerometers respectively, (Cook *et al.*, 2019; Tomaz, Prioreschi, *et al.*, 2019). Cook *et al.* (2019) examined the relationship between executive function, PA and gross motor skills, but did not directly explore the association between PA and gross motor skills. In contrast, a study of similar participants and SES demographics found no significant association between PA and gross motor skills (Tomaz, Prioreschi, *et al.*, 2019). An Australian study conducted by Cohen and colleagues reported that children's locomotor and object control skills are positively associated with total PA and after-school PA (Cohen *et al.*, 2014). British preschoolers who met the total PA ($p=0.008$) and daily MVPA recommendations ($p=0.014$) presented with greater motor competence, as measured by the TGMD-2, compared with those who had not (Hall *et al.*, 2018). Therefore, while the latest reports have been positive for South Africa on PA status, minimal research studies have been found that specifically report on the relationship between FMS and PA, specifically among grade 1 learners. This highlights the gap in knowledge and the paucity of research needed to better understand the interaction between FMS and PA during early childhood, particularly in the South African context. The next section will elaborate on the spirals of engagement presented in Stodden's theoretical model by exploring body composition and the benefits, prevalence of malnutrition and its association with FMS.

2.6. BODY COMPOSITION AND HEALTH DURING EARLY CHILDHOOD

Maintaining a healthy body composition status during early childhood, in addition to the health benefits associated with FMS proficiency and PA, is crucial, as these variables all impact energy requirements and overall physical well-being. Body composition can be influenced by numerous factors, such as age, sex, genetics, ethnicity, prenatal factors, and energy balance, which encompass nutrition, PA and sedentary behaviour variables (Androutsos & Zampelas, 2022). The nutritional and lifestyle transition currently underway in South Africa (particularly in low socioeconomic areas) explains the accelerating trend of overweight and obesity at a population level, notwithstanding the continuing undernutrition concerns among certain groups of children (Modjadji & Madiba, 2019). Nqweniso, du Randt, *et al.* (2021) indicated that schoolchildren with a low SES, classified as having a normal body weight, are threatened with becoming overweight or obese. Coupled with malnutrition due to the poor nutrition received during childhood, they are facing a double burden. The formative years serve as a critical time for the development of overweight and obesity. The increased intake of processed foods, such as sugar-concentrated beverages and pre-packaged meals that are nutrient-poor and high in energy, coupled with unhealthy amounts of sodium and fats, have been closely related to increased body weight and numerous non-communicable diseases associated with poor nutrition (Popkin, Barquera, Corvalan, Hofman, Monteiro, Ng, *et al.*, 2021; Barros, Silva, Silva, Souza, Silva, Silva, *et al.*, 2022). These obesity-causing factors give rise to an increased prevalence of hypertension, dyslipidaemia, non-insulin-dependent diabetes and psychosocial challenges, ultimately, associated with increased morbidity (Barros *et al.*, 2022). Childhood obesity has been shown to persist into adulthood, with approximately 15 to 30% of obese adults having been obese during adolescence and childhood (Barros *et al.*, 2022; Unicef, 2022). This underscores the importance of encouraging healthy lifestyle choices and behaviours from an early age.

The long-term consequences of childhood obesity necessitate the need for the assessment of body composition, which is important in reporting the developments in growth from infancy to adulthood, as it specifies the nutritional state and functional capacities of the human body (Kuriyan, 2018). Body composition measurements may involve field methods such as anthropometry, which require inexpensive tools and minimal invasiveness and can be used to monitor nutritional interventions. In contrast, laboratory methods display greater accuracy but become impractical with large sample sizes and expensive equipment (Kuriyan, 2018). The findings presented highlight the importance of maintaining a healthy body weight and the consequences of poor nutrition; the next section will report on the body composition prevalence and differences between sexes.

2.6.1. Body composition

Malnutrition among children is a global concern, with escalating rates of childhood overweight and obesity reported in recent years. The WHO stated that by 2022, the prevalence of overweight among children and adolescents 5 to 19 years old exceeded 390 million (World Health Organization, 2024). While it has predominantly been categorised as a high-income country issue, overweight and obesity are increasingly becoming a concern in low-middle-income countries (World Health Organization, 2024). A global study, based WHO-based standards for children reported on the BMI and BAZ across 198 international studies. It found that boys had an average BMI of 18.293kg/m^2 while girls had an average BMI of 18.746k g/m^2 (González-álvarez, Lázaro-Alquézar & Simón-Fernández, 2020). Since 2000, Africa has seen a noticeable increase (23%) children under five years old who are overweight (World Health Organization, 2024). Sub-Saharan Africa is specifically affected by the burden of rising childhood obesity rates, where the majority of healthcare systems are unable to help with the probable problems stated above, thus posing a serious public health concern (Danquah, Ansu-Mensah, Bawontuo, Yeboah, Udoh, Tahiru, *et al.*, 2020).

A national study by May, Witten and Lake (2020) found that one in four children was stunted or too short for their age, whereas one in eight children was overweight or obese. According to the 2022 HAKSA report, children (7 to 18 years old) were given a grade of “D” (27 to 33% of normal weight), for overweight and obesity, reflecting no change since the 2018 HAKSA report (Naidoo *et al.*, 2022). Similarly, undernutrition was graded “C”, which also remained unchanged from the previous report. In Gqeberha (formerly, Port Elizabeth) 65% of children aged seven to ten were of normal weight status, 20.9% were overweight, 10% were obese and the remaining 4% were classed as underweight (Baard & McKersie, 2014). While the latest findings among grade 1 learners in Cape Town, South Africa reveal that 84.23% of children were of normal weight, 10.86% were categorised as overweight, and the remaining 4.89% were classified as obese (van Stryp *et al.*, 2022)

Sex differences in body composition

The Global Atlas on childhood obesity, published by the World Obesity Federation, presented country-specific obesity rates based on the WHO growth references for children aged five to nine, disaggregated by sex. A prominent trend was observed, with 65% of countries accounting for higher obesity prevalence among boys compared with girls (Lobstein & Brinsden, 2019). These differences between sexes may be attributed to variations in sex steroid hormone concentrations and their influence on appetite regulation and energy expenditure. Additional influencing factors include PA, sleep and screen time (Shah, Tombeau Cost, Fuller, Birken & Anderson, 2020). School-aged girls report less television viewing, shorter sleeping durations and subsequently lower levels of PA compared with boys. However, while low PA and sleep durations have been associated as risk factors for obesity, this contrasts with previous studies suggesting that girls have lower obesity levels than boys (Shah *et al.*, 2020). Contrastingly, a much earlier study revealed no significant differences in fat mass between prepubescent boys and girls. It was further stated that prior to puberty both sexes displayed similar heights, weights and BMI (Siervogel, Roche, Guo, Mukherjee & Chumlea, 1991). A study that presented differences between sexes in the fat mass of five to seven year old children in Germany, revealed that while boys displayed increased weight, BMI and waist-to-hip ratio, girls exhibited a higher percentage of fat mass as measured by bioelectrical impedance analysis (Mast, Körtzinger, König & Müller, 1998). Similarly, a Polish study investigating the prevalence of overweight and obesity amongst six to seven year olds reported that while boys displayed higher mean values for height, body weight and BMI compared with girls, there were no significant differences found for either overweight or obesity between the sexes (Szczyrska, Jankowska, Brzeziński, Jankowski, Metelska &

Szlagatys-Sidorkiewicz, 2020). Whereas Bolger *et al.* (2018) reported insignificant differences and similar results between Irish boys' and girls' height, body weight and BMI for six and ten year olds, respectively.

However, South African studies demonstrated minimal differences between sexes for preschoolers (aged three to five) and grade 1 learners (mean age 6.1 years) for weight, height or BMI (Tomaz, Prioreschi, *et al.*, 2019; van Stryp *et al.*, 2022). Slightly older children between the ages of eight and twelve years showed girls displaying higher weight (31.0 ± 8.3 kg) and BMI (17.3 ± 3.3 kg/ m^2) in comparison with boys (30.0 ± 6.5 kg, 16.8± 2.6 kg/ m^2), despite no statistical significance presence ($p=0.013$) (Salvini, Gall, Müller, Walter, du Randt, Steinmann, *et al.*, 2018). A study of similar SES demographics in the same region reported that among children attending grades 1 to 4, boys were more likely to be in the normal weight category (girls: 72.3%, boys: 85.7%), while girls were over-represented in the underweight (girls: 7.1%, boys: 2.0%), overweight (girls: 11.4%, boys: 8.3%) and obese (girls: 9.3%, boys: 4.0%) categories (Gerber, Lang, Beckmann, du Randt, Long, Müller, *et al.*, 2022). Ultimately, there remain inconsistent findings reporting on body composition and differences between sexes among children, specifically regarding six to seven year olds. Having reported on the prevalence of children's nutritional status across international and national studies, the following section will review and discuss literature related to the relationship between body composition and FMS.

2.7. ASSOCIATION BETWEEN BODY COMPOSITION AND FUNDAMENTAL MOVEMENT SKILLS

According to the conceptual model proposed by Stodden *et al.* (2008) a healthy weight status can be effectively maintained through adequate motor competence. The proposed model (refer to Figure 2.1) suggests over time, a healthy weight status can be achieved through the combined impact of the perceived competence, health-related fitness and PA factors included in the model (Stodden *et al.*, 2008). Correspondingly, it has been hypothesised that during the formative years of childhood, physically active children have been reported to have an improved ability to maintain and coordinate their centre of mass and limbs in a gravity-based environment. Coupled with a healthy weight status, this assists children in achieving motor milestones, particularly posture-based movements seen in locomotion (e.g. walking, standing, running) (Stodden *et al.*, 2008). Webster, Sur, Stevens and Robinson (2021) describe BMI to be inversely related to motor competence and further observed that children presenting with poor motor coordination had an increased probability of being overweight, an observation which is also aligned with previous research findings (Logan, Scrabis-Fletcher, Modlesky & Getchell, 2011; Khalaj & Amri, 2014). Studies conducted by Siahkouhian, Mahmoodi and Salehi (2011), as well as Bryant, Duncan and Birch (2014) revealed a significant negative correlation between locomotor skills and an increase in BMI. According to both studies, overweight and obese children have greater difficulty in performing complex body movements proficiently. More recently, children aged five to 11 who were tested to have a higher BMI demonstrated decreased locomotor scores in comparison to children with a lower BMI (Maïano, Morin, April, Webster, Hue, Dugas, *et al.*, 2022). Furthermore, there is an indication that inadequate proficiency among children with different weight statuses could be attributed to increased sedentary behaviour and the limited opportunities for PA which accompany it, resulting in poor motor development (Morano *et al.*, 2011). Supplementary explanations include increased body weight leading to poor postural control and stability, as well as brain function, more specifically brain plasticity changes caused by increased fat accumulation that may be correlated with inferior motor control and cognitive function (Wang, Chan, Ren & Yan, 2016).

There were very few South African studies found that investigated the relationship between FMS and body composition. An early study investigating the relationship between body composition and motor competence of grade 1 learners in the North West province of South Africa revealed overweight and obese children performed significantly poorer in their fine motor skills, balancing, running speed, agility and strength when compared with children of normal weight (Kemp & Pienaar, 2013). A study of girls aged nine to 12 in the Eastern Cape found an unfavourable relationship between BMI and running and jumping (Kahts, du Randt & Venter, 2017). Findings reported in a recent study by de Waal and Pienaar (2021) in the North West province, over a span of seven school years, stated that 9.97% of children classed as overweight and obese exhibited poorer and declining balance and weight-bearing motor skills than those in the normal weight range, which can have a detrimental impact on their healthy behaviours. Contradictorily, a study conducted across low-income rural and low and high-income urban areas among children aged three to six years old found no associations between motor proficiency and adiposity when PA status was accounted for (Draper *et al.*, 2019). Whilst competence in FMS has an influential role in the increase of PA, which can effectively address the issue of obesity from childhood to adulthood, there remains a clear lack of evidence accounting for the relationship between FMS and BMI in South African children. The next section continues with a discussion of the nutritional status, PA and FMS proficiency of children, outlining the impact of social factors specific to South Africa.

2.8. FACTORS IMPACTING FMS, PA AND BMI IN THE CONTEXT OF SOUTH AFRICA

Despite South Africa's classification as a low-to-middle-income country, it is characterised by high socioeconomic inequality among its diverse population and is at the top of the global list compiled by the World Bank (World Bank, 2022). Although half the country lives in poverty, and the unemployment rate continues to increase toward 32.9%, there remain limited signs of improvement for the poorest in the foreseeable future (Francis & Webster, 2019; Statistics South Africa, 2024). This inequality and socioeconomic divide transcend in schools in South Africa. The present study was conducted in the Eastern Cape province, reported to be the poorest province which also has the highest number of low-quintile schools: 71.6% of schools classified as quintile 1 to 3, that are no fee-paying schools, situated in impoverished neighbourhoods (van Dyk & White, 2019). Socioeconomic status describes the social standing of an individual or population that is categorised according to education, income level and social status (Darin-Mattsson, Fors & Kåreholt, 2017). Peri-urban settlements can be described as "townships" or informal settlements, formed on the outskirts of the city and marked by individuals of low SES and substandard conditions and service delivery (Macagnano, 2002; Statistics South Africa, 2003). Children's SES can influence their access to equipment, resources and organised programmes aimed at improving motor performance and PA participation (Seabra *et al.*, 2013). Children from high and medium SES backgrounds were found to display a greater interest in PA, as they are more likely to recognise the benefits than those from low SES backgrounds. These behaviours are predicted to be influenced by family members of higher social standing, who express positive attitudes toward the importance of PA and overall health, subsequently passed on to their children (Seabra *et al.*, 2013). Tomaz, Okely, Van Heerden, Vilakazi, Samuels and Draper (2020), propose that children in low SES communities have a lack of access to safe environments and facilities; this highlights the safety concerns within these communities and their subsequent influence as a barrier to PA. A qualitative South African study revealed that youth in the Western Cape and Gauteng provinces report the recreational facilities available for public engagement are unkept and poorly maintained. This has created a hotspot for gang-related activities and violence, further deterring children's participation in PA and recreation-centred activities (Ndhlovu & Tanga, 2021).

With the majority of low-income schools in South Africa unable to provide access to quality extracurricular activities, such as organised sports and movement education programmes (e.g. Monkeynastix and Playball) compared with schools in high-income settings, therefore, PA in these contexts are predominantly unstructured and naturally occurring (Cook *et al.*, 2019). Differences in the quality and context of PA have been accounted for across high to low-income settings. Research conducted by Tomaz, Jones, Hinkley, Twine, Kahn, Norris, *et al.*, (2019) in low-income settings across urban and rural contexts suggests that PA is unstructured, with very few prompts and teacher-led activities. More specifically, only 6% of teachers in the urban setting and 13% in the rural setting organised and facilitated FMS-centred activities for learners. SES can serve as a construct to children's nutritional status, negatively impacting those from low SES and previously disadvantaged communities in particular. Unfavourable environments make it difficult to adopt a balanced diet and intentionally active lifestyle (Maguire, Burgoine, Penney, Forouhi & Monsivais, 2017). Schoolchildren in low-income communities experience poor nutritional status due to the prevalence of informal convenience stores. These stores lead to the frequent purchases of unhealthy and highly processed foods that are nutrient-poor and lack sufficient fibre, giving rise to malnutrition (Faber, Laurie, Maduna, Magudulela & Muehlhoff, 2014). In accordance with the National School Nutrition Program (NSNP) - a government feeding scheme, schools within low-income communities provide learners with one nutritious meal per school day. However, a study conducted in KwaZulu Natal, identified that 76.4% of food handlers had not received any nutrition education training, regardless of prior years' experience working with the NSNP (Legbara & Selepe, 2017). Therefore, it is recommended that food handlers receive adequate training to effectively prepare nutritious meals to alleviate malnutrition as per the NSNP's primary objectives. As discussed earlier, the developmental model presented by Stodden and colleagues describes the interrelationship between FMS, PA participation and body composition. Children from low SES backgrounds have limited and unsafe opportunities for PA participation, which in turn affects their motor performance and nutritional status (Stodden *et al.*, 2008).

In conclusion. the importance of establishing healthy behaviours in early childhood related to FMS, PA and BMI, along with their associated benefits, is highlighted throughout this chapter. However, despite these advantages, the empirical research presented spanning both international and South African studies reveals concerning trends, including poor FMS proficiency, declining PA levels and the rise in malnutrition among children. Furthermore, the evidence regarding differences between sexes is inconsistent. While some studies suggest that boys are more motor proficient and physically active than girls, others report no significant difference in FMS, PA or BMI. Notwithstanding the contextual factors within South Africa and its additional challenges, such as severe inequality disparities, safety and environmental concerns and the lack of quality PE programmes in schools significantly influence these variables. The proficiency in FMS plays a crucial and reciprocal role in the promotion of PA, which can effectively address the issue of overweight and obesity from childhood through to adulthood (Stodden *et al.*, 2008). However, there is limited research addressing this interplay, particularly in the Eastern Cape. This underpins the need for further investigation into the status and interrelationships of FMS, PA and BMI within a low-income community.

The following chapter provides a framework for the research design, sampling methods and measuring instruments employed for the current study. Including a detailed explanation of the study setting, participants and the ethical considerations undertaken during data collection.

CHAPTER 3

METHODS AND PROCEDURES

3.1. INTRODUCTION

This chapter serves as an outline for the measures and procedures followed to fulfil the aim and objectives of this study. This includes a detailed description of the research design, participants, sampling methods, the equipment and methods utilised in the data collection process, as well as a description of the statistical analyses and ethical considerations undertaken.

3.2. RESEARCH DESIGN

The research design encompasses a logical framework that details the strategies and methods implemented for collecting and interpreting the pertinent data (Abutabenjeh & Jaradat, 2018). The study adopted a quantitative approach with a non-experimental, descriptive, correlational study design to address the research question as stated in section 1.4. Quantitative non-experimental research allows for the exploration of variables by observing or measuring them as they naturally occur without the manipulation of conditions, behaviours or environments (Burkholder, Cox, Crawford & Hitchcock, 2019). The numerical data collected is then used for statistical analysis, correlating the research question with the findings.

A descriptive and correlational study design enables researchers to describe a population's abilities and characteristics while identifying the relationship between two or more constructs without establishing cause and effect (De Vos, Strydom, Fouche & Delport, 2011; Burkholder *et al.*, 2019). Thus, the study utilised quantitative measures, which were employed to critically investigate and delineate the status and interrelationship between FMS proficiency, PA and BMI amongst grade 1 learners from a low-income community in Gqeberha. This research design accurately depicts the cohort's characteristics, trends, behaviours and relationships as they exist in the real world, without intervention (De Vos *et al.*, 2011; Aggarwal & Ranganathan, 2019). Table 3.1. summarises the quantitative methods and data analysis employed relative to each research objective. The corresponding protocols, equipment and research procedures are elaborated on further in Section 3.5.

Table 3.1 Research strategies

Objective	Quantitative Method	Analysis method
1. To explore and describe the (i) FMS proficiency, (ii) PA status and (iii) BMI, per sex as they apply to grade 1 learners	i. Test for gross motor development, third edition (TGMD-3) to measure FMS ii. Actigraph accelerometery to measure PA status iii. Height and weight computed into BMI-for-age-z-scores to measure BMI status	Descriptive statistics (mean and standard deviation) Inferential analysis (t-tests, F-tests, chi-square tests, Cramer's V and Cohen's d)
2. To determine the interrelationship between FMS proficiency and PA status of grade 1 learners	As specified above	Inferential analysis (Pearson correlation and bivariate regression analysis)
3. To determine the interrelationship between FMS proficiency and BMI of grade 1 learners	As specified above	Inferential analysis (Pearson correlation)

3.3. STUDY SETTING

This study forms part of the KaziBantu project in collaboration with the Siyaphakama Zwide Schools Project (www.kazibantu.org/zwide-siyaphakama-schools-project/). This collaborative programme seeks to address the societal challenges affecting children within the Zwide community. The project provides pathways for both sports and academic achievement through life skills, PE, adequate nutrition and academic education initiatives.

All participating schools are located within the peri-urban area of Zwide Township, a previously disadvantaged, marginalised community consisting of predominately Black African individuals (a remnant of the Apartheid's Group Areas Act). Historically, marginalised communities are severely impacted by poverty and high unemployment rates. The social injustices and inequalities stemming from the previous apartheid government policies, compounded by the community's heavy reliance on the underfunded public sector, have consequently led to poorer health status among members of the community (Christopher, 1987; Gordon, Booysen & Mbonigaba, 2020). More specifically, Hlatshwayo, Dloto and Mutekwe. (2023) have described the Zwide community as having working-class households that face significant challenges due to poor socioeconomic conditions and, therefore, lack reliable sources of income to support their families. These disparities in socioeconomic status (SES) have adversely affected the access to adequate facilities and resources for sports, active play and PA among children (Myer, Ehrlich & Susser, 2004).

3.4. POPULATION AND SAMPLING

Due to the specific representation and demographics of the schools associated with the collaborating project, a non-probability method termed convenience sampling was utilised at the school level. The participants of the present study were all recruited from the five participating schools within the Siyaphakama Zwide Schools project, all of which are quintile 3 public schools. Simple random sampling was utilised to determine a sample of 20 learners per school. One class from each school was randomly identified with the assistance of school management, ensuring minimal disruptions to the school day. The 20 learners included in the sample were chosen through a random selection process based on the return of the completed consent forms. This sampling strategy is outlined by the equal probability of selecting study participants from a homogenous population. More specifically, the goal was to identify a sample of the most likely study participants who may yield pertinent and relevant information to allow for generalisations marked by a lack of bias (Noor, Tajik & Golzar, 2022). A total of 105 participants were included in the study; however, due to absenteeism on the days of testing, the sample size consisted of 99 Black African schoolchildren aged between six and seven years from grade 1.

3.4.1. Inclusions and exclusion criteria

Participants were included in the study if they met the following inclusion criteria:

- Children attending one of the participating schools of the Siyaphakama Zwide Schools Project
- Children in grade 1 and aged between six and seven on the date of testing

- Written informed consent of parent or guardian in combination with verbal assent of learner
- Children without known physical disabilities that may hinder participation in PA and FMS screening

Participants were excluded from the study if they met the following exclusion criteria:

- Children not attending one of the participating schools of the Siyaphakama Zwide Schools Project
- Children attending grade 1, younger than six and older than seven years on the date of testing
- Parent or guardian written informed consent and learner assent not provided
- Children diagnosed with a known physical disability which may hinder participation in PA and FMS screening (e.g., wheel chair bound or an injury to the leg and arms (temporary or permanent))

3.5. MEASURING INSTRUMENTS

Three principal components were assessed for the present study, namely, FMS, PA and BMI. The TGMD-3 protocol (a revision of the TGMD-2 protocol), commonly used in local and international research, was used to assess FMS proficiency (Mohammadi *et al.*, 2017; Garn & Webster, 2021; Valentini *et al.*, 2021). PA was measured using Actigraph accelerometers, and BMI was assessed and calculated from height and weight measurements using the Tanita scale and a portable stadiometer. The following subsections provide additional information concerning the tests and measurements utilised.

3.5.1. Fundamental movement skills

Purpose of Measurement: To measure the FMS proficiency of grade 1 learners using the TGMD-3 protocol.

Equipment used: Refer to Appendix A for the required equipment of the TGMD-3.

Method:

- Each subset was divided into two stations, to accommodate the environmental criteria for each skill and to make use of the available space at the school (refer to Appendix B and Table 3.2). The sample was evenly divided into equal-grouped sizes.
- Initially, the locomotor skills were set up and completed, and the groups proceeded clockwise through each station, once all participants within the group concluded the required skills. Afterwards, the fieldworkers set up the ball skills, which the participants completed.
- Preceding the testing of each skill, all participants were given a visual demonstration and verbal instruction. Refer to Appendix A for the description of each subset's skills and the performance criteria participants were marked on.
- To enable retrospective evaluation and grading, two trials of each skill were video recorded for each participant and video analysed using Kinovea (version 2023.1.2). Participants' individual ID numbers were presented to the camera prior to the trial of skills.

Table 3.2 TGMD-3 testing stations

Skill Subset	Testing Station	Skills Assessed	Environment criteria
Locomotor	One	1. Run 2. Gallop 3. Hop	A maximum space of 18.3m
	Two	1. Skip 2. Horizontal Jump 3. Slide	A maximum space of 9.1m
Ball Skills	One	1. Two-hand strike of a stationary ball 2. One-hand dribble 3. Two-hand Catch	A clear space
	Two	1. One-hand forehand strike 2. Underhand throw 3. Overhand throw 4. Kick of a stationary ball	A maximum of 8.5m from a wall

Trials: Each participant was given three trials to perform each skill, this included one practice trial as well as two test trials (Ulrich, 2019). If a participant was unable to execute the skill, an additional demonstration was provided, however, no verbal correction or encouragement was given.

Scoring: The TGMD-3 protocol encompasses two subsets, namely; ball skills and locomotor skills. The assessment is made up of a total of 13 skills, which are evaluated using observed and performance-based criteria (Appendix A). For each performance criterion performed correctly, the participant received a "1", whereas criteria that were absent or incorrectly performed received a "0" per test trial. The final score is then calculated by taking into account a sum of all skills across both trials. Each skill was evaluated using three to five performance criteria; raw scores for each subset were recorded and transformed into percentile ranks, age equivalents and scaled scores to derive a descriptive term for the subset; the sum of scaled scores was used to derive the gross motor index followed by an overall descriptive term. The maximum raw scores that can be achieved for the locomotor and ball skills subset are 46 and 54 points, respectively, totalling 100 points for the overall gross motor score.

FMS performance was further categorised according to mastery of the skills performed. The term "mastery" was assigned to participants who successfully completed the performance criteria in both trials (achieving a perfect score for the skill), "near mastery" was identified as having all but one of the performance criteria in both trials. At the same time "poor" was coded to describe participants who had more than one missing component (Lawson *et al.*, 2021).

Validity and Reliability: The TGMD-3 protocol is deemed both valid (Webster & Ulrich, 2017; Garn & Webster, 2021; Duncan *et al.*, 2022) and reliable (Rey, Carballo-Fazanes, Varela-Casal & Abelairas-Gómez, 2020; Valentini *et al.*, 2021) in the assessment of FMS amongst 3-10 year olds. Although the TGMD-3 is the latest version and only a limited number of studies have reported on it so far, compared to the preceding TGMD-2, the initial findings denote strong validity and reliability, supporting its use and the accumulation of new normative data.

Video Recording: Despite the TGMD-3 being scored in live action by research assistants at each station, the participants were also video recorded performing all 13 skills. A video camera was placed at each testing station to record the trials (Panasonic Lumix DMC-FZ2500 – Digital camera) (Appendix B). The video recording served as a secondary analysis to ensure the accuracy of the recorded data. Prior to the commencement of testing, each participant prominently displayed an individual ID number on their chest to provide visibility for recording by the video camera.

3.5.2. Physical activity

Purpose of Measurement: To measure the PA status of grade 1 learners using accelerometers.

Equipment used: Accelerometery devices (Actigraph wGT3x-BT, Shalimar, FL, USA) and a belt was used (see Figure 3.1).

Method:

- All parents and/or guardians received a letter outlining the instructions and requirements for the actigraph device (refer to Appendix C).
- All participants received clear instructions on how to wear the actigraph device before the data assessment period, in a language they understood, as well as on the day of commencement.
- This included a demonstration by a research assistant on how to properly place and adjust the belt, ensuring the device is placed on the right hip (refer to Figure 3.1).
- It was explained to the children that the actigraph device should be worn for seven consecutive days, at all times including during sleep, and should only be removed for baths and showers (any water-based activity).
- Posters were placed in each classroom, reminding children to wear their actigraph devices once they got to school.
- Each participant received a unique identification number, which together with their name, was labelled and pre-programmed on each device, in an attempt to avoid the exchanging of devices.
- The devices were collected on day eight.

Trials: One measurement was taken over a period of seven days.

Scoring: A sample epoch of 15 seconds was utilised (Rowlands, 2007) and accelerometers were configured with a sampling rate of 30 Hz. Raw accelerometery data in combination with the ActiLife computer software was used in calculating time spent daily in sedentary time [≤ 1.5 metabolic equivalents (MET)], light PA (1.51 – 2.99 MET) moderate PA (>3 MET), vigorous PA (≥6 MET), with cut-off values derived from Freedson, Melanson and Sirard (1998). The present study measured the time each child spent in MVPA [>3 to > 6 MET) and presented it as an average across total number of days, weekdays, school hours and weekday leisure time, respectively. Wear time validation was conducted based on the Troiano 2008 algorithm (Troiano, Berrigan, Dodd, Mâsse, Tilert & Mcdowell, 2008). To ensure the inclusion of data, participants were required to wear the devices for a minimum of four weekdays. A day was considered valid for analysis if the actigraph was worn for a minimum duration of eight hours daily.

Validity and Reliability: ActiLife accelerometery has been validated amongst both boys and girls for the prediction of PA intensity (Crouter, Horton & Bassett, 2013; Hänggi, Phillips & Rowlands, 2013). Moreover, Barreira, Schuna, Tudor-Locke, Chaput, Church, Fogelholm, *et al.* (2015) described the use of actigraphy over the course of seven days to be appropriate with regards to the reliability of accelerometer-derived measures.

Figure 3.1: Actigraph device (Actigraph wGT3x-BT, Shalimar, FL, USA)

3.5.3. Anthropometric and body composition measurements

Purpose of Measurement: To determine body weight and height used in computing BMI of grade 1 learners

Equipment used:

- A Tanita scale (Tanita MC-580; Tanita Corp., Tokyo, Japan) was used to measure body weight.
- A portable stadiometer (Seca, model 213) was used to measure standing height.

Method:

Each participant was asked to remove shoes, socks and jerseys for minimal clothing weight (≤ 1 kg) in preparation for the WHO-based anthropometric protocols (World Health Organization, 2017).

- Body weight: The Tanita scale was placed on a flat, level surface to ensure stability and accurate measurements. At least two hours prior to data collection, participants were instructed to refrain from eating. During the measurement participants stood at the centre of the scale with minimal movement, facing forward while a research assistant recorded the reading.
- Height: The stadiometer was placed on a flat, level surface to ensure stability and accurate measurements. Participants stood on the stadiometer in the Frankfurt position, shoulders relaxed, upright, with the feet flat and heels, glutes and thoracic spine touching the back of the stadiometer for height measurement. The research assistant advised the participants on the correct procedure.

Trials: All measurements were taken and recorded twice on the data capturing sheets.

Scoring: Weight was recorded in kilograms (kg) to the nearest 0.1kg, and height was recorded in centimetres (cm) to the nearest 0.1cm.

Validity: Face validity is accepted for this measurement; the anthropometric measure is deemed reliable if conducted by a trained and competent individual.

3.6. CALCULATED VARIABLES

Additional calculations were required for the abovementioned anthropometric measurements, enabling the interpretation and comparison of BMI against normative values. BMI is calculated by dividing weight in kilograms (kg) by height squared in metres (m) [BMI (kg/m^2) = weight (kg) / (standing height in meters (m))^2]. The WHO standardised child growth measures based on age and sex, represented by Z-scores were used (De Onis, Onyango, Borghi, Siyam, Nishida & Siekmann, 2007; World Health Organization, 2007; De Onis & Lobstein, 2010). Z-scores represent the anthropometric value as a numerical expression of how many standard deviations above or below the reference mean value. Z-scores are calculated using the following formula (De Onis *et al.*, 2007):

$$\text{Z-score} = \frac{\text{observed value - median value of the reference population}}{\text{Standard deviation value of reference population}}$$

BMI-for-age z-scores (BAZ) are used in the identification of children's nutritional status, namely, obese, overweight, normal, thin and severely thin. All calculations were completed through the WHO AnthroPlus software (version 1.0.4), which provides references for school-age children. Table 3.3 shows the cut-off values for BAZ in children aged 5-19 years old.

Table 3.3: BAZ cut-off values for nutritional status classification

BMI-for-age Z scores (BAZ)	
Severely Thin	< -3 SD
Thin	< -2 SD to -3 SD
Normal	-2 SD to 1 SD
Overweight	> +1 SD to <= 2 SD
Obese	> +2 SD

Adapted from WHO (2007) Growth reference data for 5-19 years (World Health Organization, 2007).

3.7. DATA COLLECTION

Upon receiving ethical clearance from the Nelson Mandela University Research Ethics Committee (Human) H24-HEA-HMS-007 (Appendix D), permission to conduct research in schools was subsequently obtained from the Eastern Cape Department of Education. Following the approval (Appendix E), an information-sharing session was organised for the principals of the schools involved in the Siyaphakama Zwide Schools Project. The session, presented by the researcher, provided detailed information regarding their school's participation in the proposed study. Thereafter, a grade 1 class from each school was selected randomly, and all parents/guardians from the respective class identified from each school received an information letter and informed consent sheet detailing the study particulars and learner participation. A sample size of 20 children per school was then randomly selected from all informed consent forms returned.

Personal and biographical information of the participants, including names, surnames, ages, dates of birth and home addresses (for clinic referral purposes for participants identified as thin/severely thin or obese/overweight) was collected from informed consent forms and class lists. This identifiable information was recorded onto a master file, and each participant was assigned a unique ID number to maintain confidentiality and ensure personal information was not used in the data analysis process.

All data assessments were conducted at the participating schools over the course of one day per school. Assessments took place in the morning, with the date and time agreed by the class teacher to ensure convenience and to minimise disruption of the school operations. All testing sessions were conducted within a timeframe of 90 to 180 minutes by the research team comprising of a qualified Biokineticist, fourth-year Biokinetics students and coaches from the Siyaphakama Zwide Schools Project, who received training through the KaziBantu project. Prior to data collection, the research team underwent specific training on the research protocol (including video analysis) by the principal investigator, to ensure the accurate demonstration and scoring of skills, in accordance with the performance criteria and test protocol.

3.8. STATISTICAL ANALYSIS

Descriptive statistics was utilised in presenting the measures of central tendency and measures of variability. This included summarising and describing the following characteristics: individual FMS scores, and their respective subset scores, PA and BMI. Paired t-tests were used to establish differences between sexes for the measured numerical differences. In comparison, a chi-square test was conducted for the measure of categorical data. Inferential statistics further included Pearson Correlation analysis to establish whether significant relationships exist between FMS proficiency, PA and BMI and determine the effect size thereof. Bivariate regression analysis was used to determine the relationship between GMI, PA and BMI, and to predict the subsequent outcomes. An effect was deemed statistically significant when $p<0.05$ is depicted. Once statistical significance was established, practical significance was determined by Cohen's d tests using the following criteria; $d=0.2$ small practical significance, $d=0.5$ medium practical significance, $d>0.8$ large practical significance (Cohen, 1988). Similarly, practical significance for chi-square tests was measured using the Cramer's V effect, which is determined using small ($d=0.10$), medium ($d=0.30$), and large ($d=0.50$) values.

3.9. ETHICAL CONSIDERATIONS

Ethics refers to a set of values and philosophies that are guided by a moral framework, standards that govern distinctions between acceptable and unacceptable practices (McNamee, 2001).The study included primary schoolchildren; therefore, additional ethical obligations were observed to protect this vulnerable group. The following principles were addressed during the course of the research process (De Vos *et al.*, 2011), as per the principles outlined in the Belmont report (The Belmont Report, 1979).

Voluntary Participation: All participants had free will; participation was completely voluntary. Moreover, withdrawal from the study could occur at any point in time, without any repercussions. All participants were informed of this concept before commencement of the study via the information sheet and verbal explanation.

Informed consent: Prior to beginning the study, all participants were given clear and formal information on all the processes and details pertaining to the study (Appendix F).

Furthermore, all information was given in a language the participants understood. Due to the young age of the study participants, the parents/guardians of these participants were asked to provide informed consent (Appendix G). Information sheets and consent forms outlining all the necessary information was made available for all parents/guardians to make an informed decision with regards to their child's involvement. Additionally, prior to the start of the study, the children's oral assent was requested (Appendix H).

Confidentiality and Anonymity: The children's personal identifiable information was encrypted, and all information gathered was utilised solely for scientific research. Informed consent/assent forms are locked away in a locked office cupboard in the Department of Human Movement Science. The study result sheets were captured in an Excel file which contained deidentified information (each participant was represented by a unique number) and saved as a password-protected file on the researcher's computer. After testing concluded at each school, the video recordings were stored on an encrypted hard drive stored in a secured filing cabinet. Following the testing, the researcher pixelated the face of each participant to ensure their identification was removed. Only permitted individuals of the research team who are actively involved in the research have access to the data entered into computerised files.

Actions and competence of researchers: It is imperative for the researcher to be proficient, capable, honest and considerate towards their participants. Therefore, the primary investigator and all research assistants received comprehensive training on all protocols and equipment. The primary investigator also received training for research ethics and regulation of health research involving human participants (Training and Resources in Research Ethics Evaluation)

The present study proposal was submitted to the Department of Human Movement Science Research Committee, followed by the Faculty Postgraduate Studies Committee, and then served at the institution's Research Ethics Committee: Human (REC-H) where ethical clearance to conduct the study was received (Appendix D). Prior to data collection commencement, permission to conduct the research was first sought and received from the respective authorities such as the Eastern Cape Department of Education and relevant school principals.

This chapter outlined the research design, sampling methods, measuring instruments and procedures followed during data collection. This was followed by a description of the statistical analyses utilised and an overview of the ethical considerations employed. The following chapter provides a detailed report on the results and findings of the present study.

CHAPTER 4

RESULTS

4.1. INTRODUCTION

The study aimed to report on the status and further investigate the interrelationship between FMS, BMI and PA among grade 1 learners in a low-income community. This chapter presents the results in alignment with the research objectives outlined in Chapter 1. The first section describes participant demographics. This is followed by the analysis and interpretation of results pertaining to FMS, measured using the TGMD-3 protocol; PA, measured with Actigraph accelerometery; and BMI, calculated as BMI-for-age z-scores; presented through descriptive and inferential statistics. These results are summarised by means (M) and standard deviation (SD), while t-tests and chi-square tests were employed to examine differences between sexes. Subsequently, the final section focuses on the Pearson Correlation analysis to investigate the interrelationship between FMS and PA, as well as FMS and BMI.

4.2. DESCRIPTIVE INFORMATION OF PARTICIPANTS

Descriptive statistics were employed to describe the participant and anthropometric information, represented in Table 4.1. These results are expressed as mean (M) and standard deviation (SD) per variable of the total study sample. Inferential statistics include t-tests and F-tests, to evaluate whether the observed means and variances of the two groups differ significantly represented by the p-value.

Table 4.1 Participant information

	Demographic Profile				
	Total (n = 99)	**Girls (n = 47)**	**Boys (n = 52)**	**Inferential statistics**	
Variable	(M ± SD)	(M ± SD)	(M ± SD)	F-test	p-value
Age (years)	6.81 ± 0.46	6.80 ± 0.48	6.82 ± 0.44	0.1239	0.7256
Height (cm)	115.17 ± 12.41	116.27 ± 6.87	116.14 ± 5.88	0.0113	0.9156
Weight (kg)	22.06 ± 4.86	22.91 ± 6.13	21.43 ± 2.98	2.3940	0.1251

A total of 105 learners were initially enrolled in the study. However, the final sample of participants, with complete data for FMS and BMI, included 99 grade 1 learners and 95 for PA data. From the total sample, 47.5% were girls, and 52.5% were boys, representing a fairly equal distribution between the sexes. The mean height across the participants was 115.17 $\pm$ 12.41 cm, with minimal differences between sexes. Weight averaged at 22.06 kg for the total sample; however, girls presented with a marginally greater sample mean and standard deviation for weight in comparison to boys (22.91 $\pm$ 6.13 verses 21.43 $\pm$ 2.98). Notably no significant differences between sexes were observed for age, height and weight for the present sample ($p>0.05$).

4.3. OBJECTIVE 1: TO EXPLORE AND DESCRIBE THE FMS PROFICIENCY, PA STATUS AND BMI PER SEX AS THEY APPLY TO GRADE 1 LEARNERS

The following subsections present an overview of the results for each measured variable. This includes interpreting the statistical analysis conducted, highlighting the differences between sexes and outlining the significant findings.

4.3.1. Fundamental movement skills

FMS was measured using the TGMD-3 protocol, 13 skills were scored according to the three to five performance criteria. The participant received a “1” for each performance criterion performed correctly, whereas criteria that were absent or incorrectly performed received a “0” per test trial.

4.3.1.1. Fundamental movement skill proficiency

Table 4.2 below shows the comparison of the average score for each skill and subset across two trials, categorised, by sex.

Table 4.2 FMS proficiency status

Skill	Total	Girls	Boys	Maximum Score Attainable	Statistics	
	M (SD)	M (SD)	M (SD)		p-value	Cohen's d
Run	5.94 (1.73)	6.26 (1.75)	5.65 (1.67)	8	0.0832	0.35
Gallop	4.24 (1.97)	4.26 (1.91)	4.23 (2.04)	8	0.9510	0.01
Hop	5.39 (1.50)	5.57 (1.56)	5.23 (1.45)	8	0.2582	0.23
Skip	3.46 (1.57)	3.55 (1.41)	3.38 (1.71)	6	0.5955	0.11
Horizontal Jump	5.06 (1.92)	5.11 (1.93)	5.02 (1.92)	8	0.8225	0.05
Slide	6.21 (1.74)	6.19 (1.60)	6.23 (1.87)	8	0.9113	-0.02
LOC Subset	30.31 (5.51)	30.94 (5.16)	29.75 (5.79)	46	0.2868	0.22
Two-hand Strike	7.12 (1.44)	6.83 (1.24)	7.38 (1.56)	10	0.0547	-0.39
One-hand Forehand Strike	5.19 (1.51)	4.77 (1.40)	5.58 (1.51)	8	0.0070	-0.55
Stationary Dribble	4.74 (1.95)	4.72 (1.93)	4.75 (1.99)	6	0.9464	-0.01
Two-hand Catch	4.07 (1.35)	4.13 (1.39)	4.02 (1.32)	6	0.6919	0.08
Kick	6.13 (1.30)	5.77 (1.42)	6.46 (1.09)	8	0.0071	-0.55
Overhand Throw	4.82 (1.45)	4.51 (1.44)	5.10 (1.42)	8	0.0446	-0.41
Underhand Throw	4.68 (1.26)	4.51 (1.38)	4.85 (1.13)	8	0.1868	-0.27
BS Subset	36.76 (5.06)	35.23 (5.28)	38.13 (4.47)	54	0.0039	-0.60

Notes: LOC= locomotor, BS = Ball skills, t-test: p<0.05 = statistically significant; Cohen's d effect: d=0.2 small practical significance, d=0.5 medium practical significance, d>0.8 large practical significance.

As depicted in Table 4.2, among all the participants, the poorest performed skill was the skip (3.46 ± 1.57), with the two-hand strike (7.12 ± 1.44) being the best-performing skill. When comparing differences between sexes, girls performed better in five of the six locomotor skills (run, gallop, hop, skip and horizontal jump) than boys; however, no significant differences between sexes were reported in this subset (p>0.05). Within the ball skills subset, boys scored better than girls in six of the seven skills. More specifically, boys performed significantly better in the one-hand forehand strike (p=0.0070), kick (p=0.0071) and overhand throw (p=0.0446) when compared to girls.

Table 4.3 reflects the overall average subset scores for locomotor and ball skills and the subsequent gross motor index (GMI), a calculation of an individual's raw scores converted to scaled scores and the summation of those scores. This represents the full scope of FMS.

Table 4.3 GMI, locomotor and ball skills raw score distribution by sex

	Girls	Boys	Statistics	
	M (SD)	M (SD)	p-value	Cohen's d
LOC Raw score	30.92 (5.10)	29.71 (5.87)	0.277	0.22
BS Raw Score	35.31 (5.25)	38.06 (4.53)	0.007	-0.56
GMI	97.4 (8.4)	94.5 (10.5)	0.140	0.30

Notes: LOC= locomotor, BS = ball skills, GMI =Gross motor index; t-test: p<0.05 = statistically significant, Cohen's d effect: d=0.2 small practical significance, d=0.5 medium practical significance, d>0.8 large practical significance.

It can be noted that although girls in the present sample scored overall better in the locomotor subset than boys, no significant differences were reported (p>0.05). However, on average, boys scored 7.8% better than girls in the ball skills subset (p=0.007). No significant differences between sexes were reported for GMI (p>0.05), irrespective of girls demonstrating slightly higher scores than boys (97.4 versus 94.5).

4.3.1.2. Fundamental movement skill mastery

In this section, the results pertaining to FMS mastery were determined according to criteria stated in Section 3.5.1. Total participants' mastery, near mastery and poor percentages for each skill are illustrated in Figure 4.1 The skill mastered collectively by the participants was the stationary dribble (58%), followed by the slide (25%) and the run (21%). Near mastery percentages varied from 0% for the skip, two-hand strike and two-hand catch to 48% for the kick. Conversely, the two-hand strike (95%) had the highest poor percentage, while the slide (28%) had the lowest poor percentage among the 13 skills.

Table 4.4 presents the results based on a chi-square test used to examine the differences between the sexes with regard to the mastery level percentage achieved for each skill. Cramer's V indicates the strength of the relationship between the mastery categories.

Figure 4.1 Percentage of total participants achieving mastery, near mastery and poor across the sample

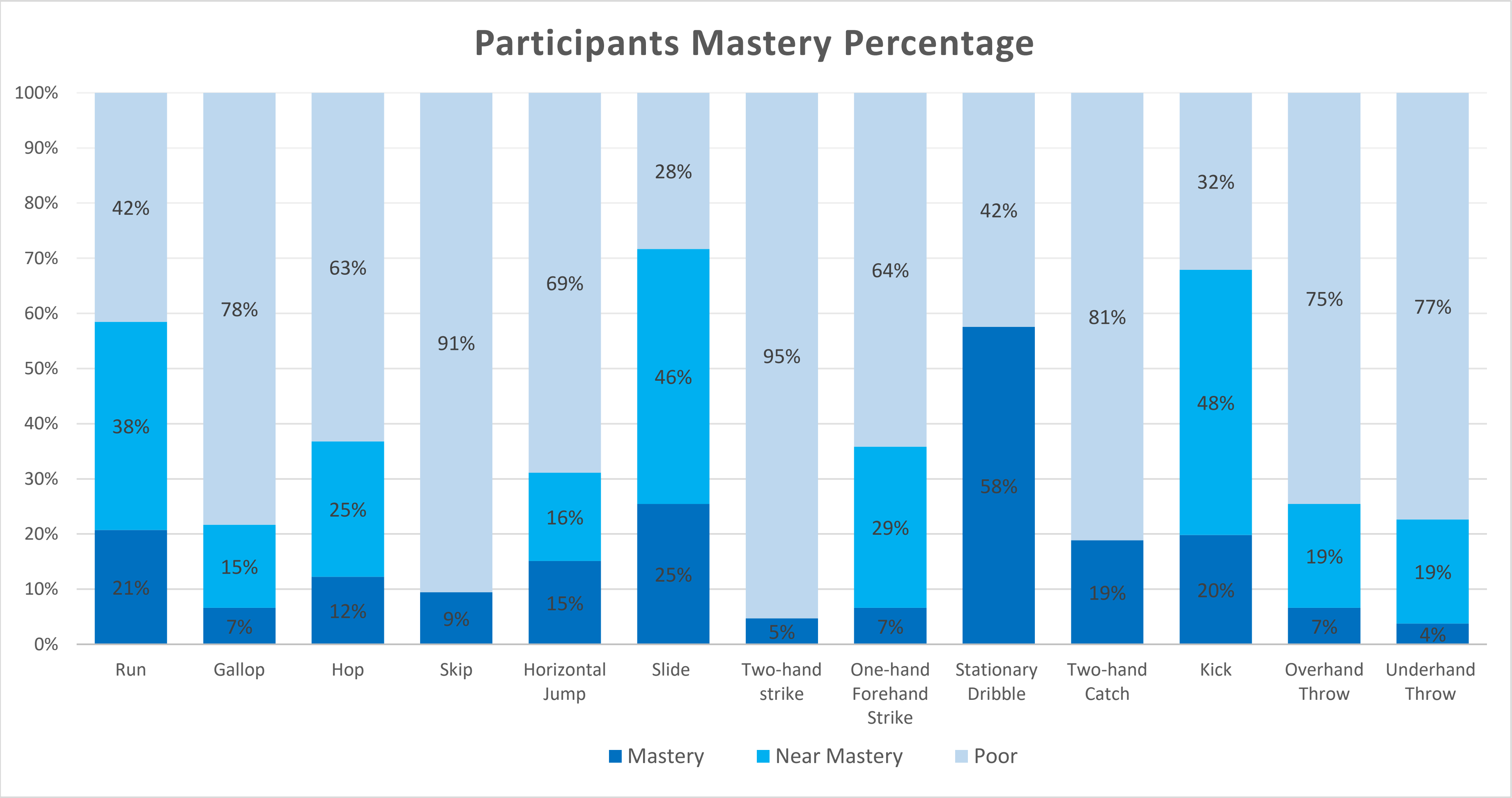


Table 4.4 Differences between sexes' FMS mastery

	Skill	Sex	%M	%NM	%P	p-value	Cramer's V	OR
LOC Subset	Run	G	30.8	32.7	36.5	0.0444	0.2424	1.50
		B	11.1	42.6	46.3			
	Gallop	G	1.9	23.1	75.0	0.0199	0.2720	1.47
		B	11.1	7.4	81.5			
	Hop	G	17.3	17.3	65.4	0.1129	0.2023	0.83
		B	7.4	31.5	61.1			
	Skip	G	7.7	0.0	92.3	0.5472	0.0584	0.67
		B	11.1	0.0	88.9			
	Horizontal Jump	G	17.3	11.5	71.2	0.4280	0.1265	0.81
		B	13.0	20.4	66.7			
	Slide	G	23.1	48.1	28.8	0.8538	0.0546	0.95
		B	27.8	44.4	27.8			
BS Subset	Two-hand strike	G	3.8	0.0	96.2	0.6781	0.0403	0.68
		B	5.6	0.0	94.4			
	One-hand Forehand Strike	G	3.8	17.3	78.8	0.0083	0.3007	0.27
		B	9.3	40.7	50.0			
	Stationary Dribble	G	53.8	0.0	46.2	0.4493	0.0733	0.74
		B	61.1	0.0	38.9			
	Two-hand catch	G	21.2	0.0	78.8	0.5550	0.0572	1.34
		B	16.7	0.0	83.3			
	Kick	G	15.4	38.5	46.2	0.0096	0.2961	0.27
		B	24.1	57.4	18.5			
	Overhand Throw	G	3.8	15.4	80.8	0.3065	0.1494	0.52
		B	9.3	22.2	68.5			
	Underhand Throw	G	3.8	19.2	76.9	0.9945	0.0102	1.05
		B	3.7	18.5	77.8			

Notes: G= girls, B = boys, LOC= locomotor, BS = ball skills, %M = mastery percentage, %NM = near mastery percentage, %P= poor percentage; Chi-square test: $p<0.05$ = statistically significant, Cramer's V effect: d=0.2 small practical significance, d=0.5 medium practical significance, d>0.8 large practical significance

When comparing FMS mastery levels between sexes, Table 4.4 reflects that for locomotor skills, girls exhibited higher mastery percentages in the hop (17.3% mastery) and horizontal jump (17.3% mastery). Additionally, girls demonstrated significantly better achievements in the mastery categories for the run and gallop compared to boys ($p<0.05$). The odds of girls achieving mastery or near mastery, rather than poor performance, for the run and gallop, were approximately 1.5 times higher than for boys, although the effects were weak (run: $V=0.2424$, gallop: $V=0.2720$).

Conversely, while boys displayed a greater mastery percentage for the skip (11.1% mastery) and slide (27.8% mastery), the distribution across the mastery categories for these skills was not significant ($p>0.05$). In the ball skills subset, boys demonstrated higher mastery in five of the seven skills, including the two-hand strike (5.6% mastery), stationary dribble (61.1% mastery), and overhand throw (9.3% mastery). Significant differences in the distributions of the mastery frequency were observed for the one-hand forehand strike ($p<0.05$, $V=0.3007$) and the kick ($p<0.05$, $V=0.2961$). Albeit these effects were small, boys are 3.8 times more likely to achieve mastery or near mastery than poor in the one-hand forehand strike and kick compared to girls ($OR=0.27$).

4.3.2. Physical activity

Physical activity was measured using Actigraph accelerometery over a seven-day period. MVPA was calculated as the sum of MPA and VPA and presented by total time (all days), weekdays (Monday to Friday), school days (weekdays from 08:00 – 14:00) and weekday leisure (weekdays from 14:00 -20:00). Due to missing actigraph data, the total number of participants for the total, weekday and school day subgroup was 95. In contrast, the weekday leisure subgroup included 92 participants. Table 4.5 presents the comparison of the average MVPA in minutes across weekdays, school days, leisure time, and a total number of days according to sex.

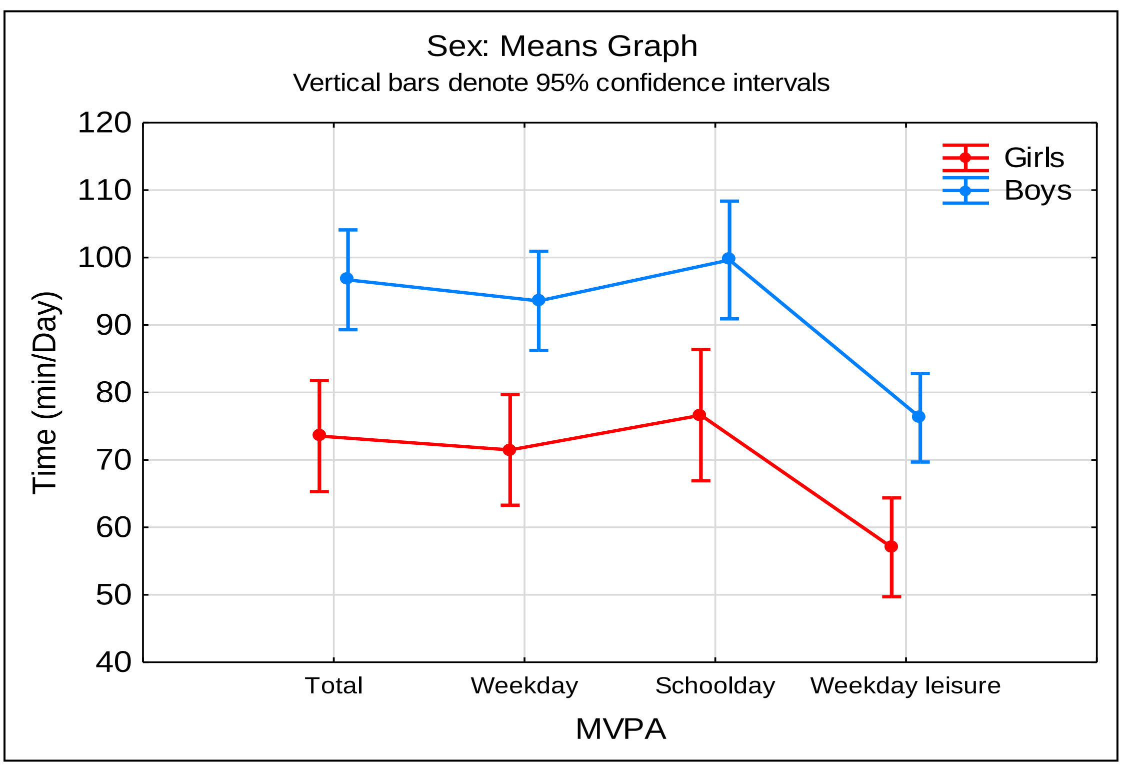
Table 4.5 Comparison of MVPA by category and sex

	Total	Girls	Boys	Statistics
	M (SD)	M (SD)	M (SD)	p-value
Total MVPA	86.4 (28.9)	73.5 (22.4)	96.7 (29.5)	0.0023
Weekday MVPA	83.7 (28.5)	71.5 (22.6)	93.6 (29.1)	0.0043
School day MVPA	89.4 (33.2)	76.6 (26.0)	99.6 (35.0)	0.0025
Weekday Leisure MVPA	67.7 (25.4)	57.0 (21.6)	76.3 (25.1)	0.0221

Notes: MVPA = moderate-to-vigorous physical activity; t-test: $p<0.05$ = statistically significant.

As presented in Table 4.5, across all participants, the greatest time spent in MVPA was during school hours (89.4 min/day), whereas the least time spent in MVPA was during weekday leisure (67.7 min/day). For all four categories of MVPA, boys recorded significantly higher PA levels than girls ($p<0.05$). This is evidenced by Figure 4.2, which shows the average MVPA of girls and boys and the corresponding 95% confidence intervals indicating the significant differences between sexes across PA categories.

Figure 4.2 Mean MVPA between sexes and the corresponding 95% confidence interval for the categories of PA



The trends observed in Figure 4.2 align with the data presented in the preceding table, highlighting similar patterns and relationships. Boys engage in higher MVPA levels than girls for all categories of PA. While both sexes display a relatively consistent trend with small fluctuations between total, school day and weekday MVPA, there is a notable decline in MVPA during leisure periods for both sexes.

According to the WHO PA guidelines for children, a minimum of 60 minutes of MVPA is recommended daily (World Health Organization, 2024). Table 4.6 presents the results of a Chi-square test comparing the number of participants who met the daily PA recommendations across categories stratified by sex. The odds ratio (OR) indicates the likelihood of one group meeting the PA recommendations compared to the other.

Table 4.6 Distribution of daily PA recommendations by category and sex

Total MVPA			**Inferential Statistics**	
	< 60 min MVPA	≥ 60 min MVPA	p-value	OR
Total Group	21	74		
Girls	14	30	0.0341	2.93
Boys	7	44		
Weekday MVPA				
Total Group	22	73		
Girls	14	30	0.0631	2.51
Boys	8	43		
School day MVPA				
Total Group	21	74		
Girls	15	29	0.0089	3.88
Boys	6	45		
Weekday Leisure MVPA				
Total Group	39	53		
Girls	23	18	0.0171	2.80
Boys	16	35		

Notes: OR= odds ratio, MVPA = moderate-to-vigorous physical activity; Chi-square: $p<0.05$ = statistically significant.

As reflected in Table 4.6, the majority of participants achieved the daily PA recommendations for each category. More participants met the WHO recommendation during both the 8-hour school day (77.9%) and the full 24-hour day (77.9%), compared to the 6-hour weekday leisure time that has the least number of participants meeting the PA recommendation (57.6%). For all categories, apart from weekday MVPA, significantly fewer girls achieved the PA recommendation than boys ($p<0.05$). Moreover, the odds of the total MVPA across all seven days exceeding 60 minutes per day is nearly three times higher for boys than for girls (OR=2.93), while the odds of school day MVPA exceeding 60 minutes daily are three point nine times greater in boys than in girls (OR=3.88).

4.3.3. Body mass index and body mass index-for-age-z-scores

Body composition was assessed using BMI and BAZ, calculated from measured height and weight variables, and calculations were completed using the WHO AnthroPlus software. Table 4.7 reflects the comparative statistics for BMI and BAZ by sex.

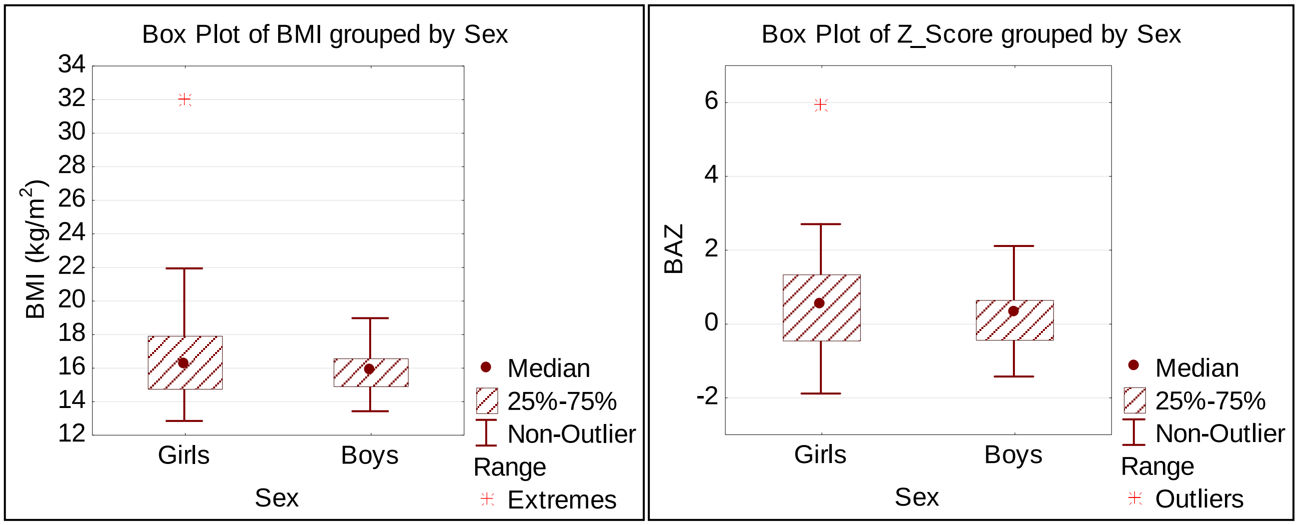
Table 4.7 BMI and BAZ statistics as per sex

	Total	Girls	Boys	Range		Inferential statistics	
Variable	**M ± SD**	**M ± SD**	**M ± SD**	**Min**	**Max**	**p-value (M)**	**p-value (SD)**
BMI (kg/m^2)	16.26 ± 2.42	16.77 ± 3.12	15.83 ± 1.34	12.79	32.01	0.0546	<0.0001
BAZ	0.38 ± 1.16	0.58 ± 1.37	0.20 ± 0.90	-1.91	5.9	0.1079	0.0036

Notes: BMI = body mass index, BAZ = BMI-for-age z-scores, $p<0.001$ = statistically highly significant, $p<0.05$ = statistically significant.

As presented in Table 4.7, girls had a higher BMI average than boys (16.77 >15.83 kg/m^2). The mean differences in BMI were suggestive but not statistically significant ($p=0.0546$); however, an F-test revealed strong evidence that the variability in BMI among girls was statistically and greater than that of boys ($p<0.0001$). Similar trends were observed for BAZ; girls had a higher average BAZ than boys (0.58 > 0.20), with the standard deviations statistically significant ($p=0.0036$). This is represented by Figure 4.3, a box and whisker plot, illustrating the distribution of BMI and BAZ according to sex.

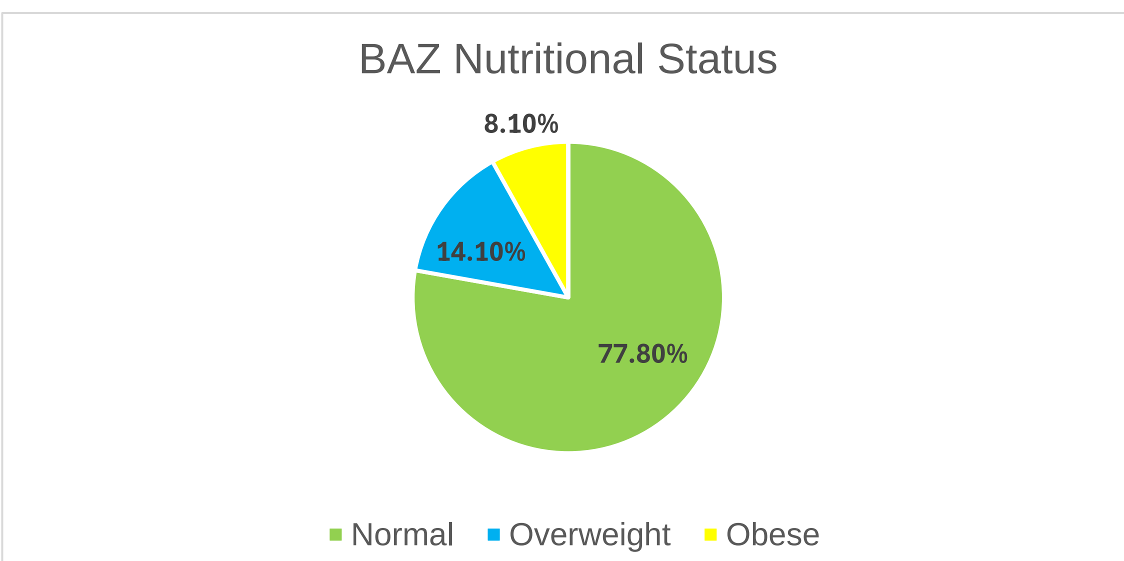
Figure 4.3 Box and whisker plots for BMI and BAZ distribution according to sex



As depicted in Figure 4.3, the skewness displayed in girls' BMI and BAZ distributions is more pronounced, whereas boys present more symmetric distributions. This is representative of the greater variability observed for girls' BMI and BAZ compared to boys.

Figure 4.4 illustrates the distribution of participants' nutritional status according to the WHO cut-off values for BAZ in children aged 5-19. The descriptive terms were identified as follows; normal weight -2 <BAZ< +1, overweight +1 >BAZ ≤ +2, Obese >+2, thin <-2 BAZ < -3 and severely thin was identified as <-3 BAZ.

Figure 4.4 Percentage of total participants' nutritional status



The distribution of nutritional status among the participants is presented in Figure 4.4 shows that the majority are within the normal weight category (77.8%), followed by overweight (14.1%) and then obese (8.1%).

Table 4.8 represents the distribution percentage of the nutritional status according to sex and a chi-square test to determine the statistical significance between categories. The comparison between sexes reveals more boys categorised as normal weight (82.7%) than girls (72.3%). While overweight trends were similar among both groups, girls exceeded boys in the obese category (12.8%>3.8%). There were no significant differences in the percentages of boys and girls with normal, overweight or obese nutritional status (p>0.05). Moreover, no child in the sample was identified as thin (0%) or severely thin (0%).

Table 4.8 Distribution of BAZ cut-off value nutritional status

	Normal	**Overweight**	**Obese**	**Thin**	**Severely Thin**	**Statistical Significance**
	%	%	%	%	%	p-value
Girls	72.3	14.9	12.8	0	0	0.2458
Boys	82.7	13.5	3.8	0	0	

Notes: Chi-square; p<0.05 = statistically significant.

4.4. OBJECTIVE 2: TO DETERMINE THE INTERRELATIONSHIP BETWEEN FMS PROFICIENCY AND PA OF GRADE 1 LEARNERS

In this section, the interrelationship between FMS and PA is presented by total time (all days), weekdays (Monday to Friday), school days (weekdays from 08:00 – 14:00) and weekday leisure (weekdays from 14:00 - 20:00). PA was further categorised according to sedentary time, LPA, MPA, MVPA and VPA. Table 4.9 to Table 4.12 illustrate the results of a Pearson correlation analysis examining the effect of the PA intensity on each of the FMS, represented by a correlation value (r) and p-value.

As depicted in Table 4.9 across total time, weak negative associations between sedentary time and the run (r=-0.2446; p=0.0290) and locomotor subset (r=-0.2378; p=0.0340) were displayed, suggesting an inversely proportional relationship between the time spent in sedentary behaviour, and the locomotor subset and run scores. Subsequently, positive and significant associations were reported between VPA and the horizontal jump (r=0.2473; p=0.0270) and locomotor subset (r=0.2558; p=0.0220), suggesting that the more time spent in VPA, the greater the proficiency in the locomotor subset and horizontal jump. Conversely, the ball skills subset was positively and significantly associated with increased time spent in MPA (r=0.2254; p=0.0440), MVPA (r=0.2598; p=0.0200) and VPA (r=0.2742; p=0.0140) (Table 4.9).

Similarly, a common trend is presented in Table 4.10 and Table 4.11, whereby a positive and significant correlation exists between weekday and school day time spent in VPA and the horizontal and locomotor subset score ($p<0.05$). Moreover, across all categories of PA (Table 4.9 - 4.12), VPA is positively and significantly correlated with the ball skills subset, suggesting the greater time spent in VPA during the total time (r=0.2742; p=0.0140), weekday (r=0.2546; p=0.0230), school day (r=0.2321; p=0.0380), and weekday leisure (r=0.2251; p=0.0450), the greater the performance in ball skill proficiency.

Overall, higher-intensity PA (MPA, MVPA and VPA) showed more significant and positive correlations with the individual skills and subsets compared to lower-intensity PA levels (LPA and sedentary).

Table 4.9 The interrelationship between FMS and total days PA intensities

TOTAL DAYS: 7 days per week (06:00-00:00)										
	Sedentary		LPA		MPA		MVPA		VPA	
Skill	R	p-value	R	p-value	R	p-value	R	p-value	R	p-value
Run	-0.2446	0.0290	0.0619	0.5850	0.1207	0.2860	0.1504	0.1830	0.1731	0.1250
Gallop	-0.1705	0.1300	-0.0026	0.9820	0.1239	0.2740	0.1624	0.1500	0.1964	0.0810
Hop	-0.0739	0.5150	-0.0191	0.8660	-0.1159	0.3060	-0.0908	0.4230	-0.0417	0.7140
Skip	-0.1391	0.2190	-0.0450	0.6920	0.0792	0.4850	0.1408	0.2130	0.2114	0.0600
Horizontal Jump	-0.1453	0.1980	0.1612	0.1530	0.1723	0.1260	0.2148	0.0560	0.2473	0.0270
Slide	-0.0760	0.5030	-0.0359	0.7520	0.0731	0.5200	0.0945	0.4040	0.1129	0.3190
LOC Subset	-0.2378	0.0340	0.0382	0.7370	0.1342	0.2350	0.1945	0.0840	0.2558	0.0220
Two-hand Strike	-0.2099	0.0620	0.1276	0.2590	0.1966	0.0800	0.2138	0.0570	0.2095	0.0620
One-hand forehand strike	-0.1853	0.1000	0.1341	0.2360	0.1441	0.2020	0.1810	0.1080	0.2099	0.0620
One-hand dribble	-0.0536	0.6360	-0.0156	0.8900	0.1219	0.2810	0.1250	0.2690	0.1122	0.3220
Two-hand Catch	-0.1229	0.2770	-0.0267	0.8140	0.0923	0.4150	0.1278	0.2590	0.1620	0.1510
Kick	-0.0616	0.5870	0.1380	0.2220	0.1752	0.1200	0.1865	0.0980	0.1775	0.1150
Overhand Throw	-0.1121	0.3220	0.2341	0.0370	0.1815	0.1070	0.1695	0.1330	0.1287	0.2550
Underhand Throw	0.0875	0.4400	-0.1101	0.3310	-0.0102	0.9280	0.0484	0.6700	0.1274	0.2600
BS Subset	-0.1662	0.1410	0.1192	0.2920	0.2254	0.0440	0.2598	0.0200	0.2742	0.0140

Notes: LOC= locomotor, BS = ball skills, LPA = light physical activity, MPA = moderate physical activity, MVPA = moderate-to-vigorous physical activity, VPA = vigorous physical activity; Pearson correlation: $p<0.05$ = statistically significant, $p<0.001$ = statistically highly significant, Correlation values: r of 0.10-0.29 (weak), 0.30-0.49 (moderate) and 0.50-1.0 (strong).

Table 4.10 The interrelationship between FMS and weekday PA intensities

WEEKDAYS: 5 days per week (06:00-00:00)										
	Sedentary		LPA		MPA		MVPA		VPA	
Skill	R	p-value	R	p-value	R	p-value	R	p-value	R	p-value
Run	-0.1690	0.1340	0.0470	0.6790	0.1282	0.2570	0.1573	0.1630	0.1836	0.1030
Gallop	-0.2082	0.0640	0.0054	0.9620	0.1500	0.1840	0.1782	0.1140	0.2006	0.0740
Hop	-0.0517	0.6490	-0.0083	0.9420	-0.1116	0.3250	-0.0933	0.4110	-0.0537	0.6360
Skip	-0.0517	0.6490	-0.0350	0.7580	0.1037	0.3600	0.1529	0.1760	0.2109	0.0600
Horizontal Jump	-0.0854	0.4510	0.1694	0.1330	0.1703	0.1310	0.1994	0.0760	0.2208	0.0490
Slide	-0.0540	0.6340	-0.0463	0.6830	0.1021	0.3680	0.1252	0.2690	0.1460	0.1960
LOC Subset	-0.1762	0.1180	0.0410	0.7180	0.1590	0.1590	0.2077	0.0640	0.2585	0.0210
Two-hand Strike	-0.2199	0.0500	0.1009	0.3730	0.1666	0.1400	0.1918	0.0880	0.2080	0.0640
One-hand forehand strike	-0.1542	0.1720	0.1098	0.3320	0.0848	0.4550	0.1278	0.2590	0.1793	0.1120
One-hand dribble	0.0514	0.6500	-0.0329	0.7720	0.1102	0.3310	0.1226	0.2790	0.1272	0.2610
Two-hand Catch	-0.1018	0.3690	-0.0254	0.8230	0.0810	0.4750	0.1066	0.3470	0.1336	0.2370
Kick	-0.0809	0.4760	0.1316	0.2450	0.1670	0.1390	0.1691	0.1340	0.1520	0.1780
Overhand Throw	-0.1253	0.2680	0.2346	0.0360	0.1896	0.0920	0.1854	0.1000	0.1567	0.1650
Underhand Throw	0.0819	0.4700	-0.1161	0.3050	-0.0170	0.8810	0.0197	0.8620	0.0744	0.5120
BS Subset	-0.1315	0.2450	0.0986	0.3840	0.1954	0.0820	0.2294	0.0410	0.2546	0.0230

Notes: LOC= locomotor, BS= ball skills, LPA = light physical activity, MPA = moderate physical activity, MVPA = moderate-to-vigorous physical activity, VPA = vigorous physical activity; Pearson correlation: $p<0.05$ = statistically significant, $p<0.001$ = statistically highly significant, Correlation values: r of 0.10-0.29 (weak), 0.30-0.49 (moderate) and 0.50-1.0 (strong).

Table 4.11 The interrelationship between FMS and weekday PA intensities

SCHOOL DAY: 5 days per week (08:00-14:00)										
	Sedentary		LPA		MPA		MVPA		VPA	
Skill	R	p-value	R	p-value	R	p-value	R	p-value	R	p-value
Run	-0.1022	0.3670	0.0491	0.6650	0.1192	0.2920	0.1441	0.2020	0.1634	0.1480
Gallop	-0.0520	0.6470	-0.0279	0.8060	0.0697	0.5390	0.1127	0.3200	0.1637	0.1470
Hop	0.0619	0.5850	0.0095	0.9330	-0.0724	0.5240	-0.0686	0.5460	-0.0540	0.6340
Skip	-0.0418	0.7120	-0.0704	0.5350	0.0702	0.5360	0.1208	0.2860	0.1824	0.1050
Horizontal Jump	-0.1073	0.3440	0.1604	0.1550	0.1563	0.1660	0.1946	0.0840	0.2281	0.0420
Slide	-0.0597	0.5990	-0.0703	0.5360	0.0380	0.7380	0.0707	0.5330	0.1115	0.3250
LOC Subset	-0.0884	0.4360	0.0176	0.8770	0.1114	0.3250	0.1656	0.1420	0.2269	0.0430
Two-hand Strike	-0.1925	0.0870	0.0638	0.5740	0.1323	0.2420	0.1579	0.1620	0.1765	0.1170
One-hand forehand strike	-0.1941	0.0840	0.2106	0.0610	0.1546	0.1710	0.1869	0.0970	0.2121	0.0590
One-hand dribble	-0.1098	0.3320	-0.0799	0.4810	0.0711	0.5310	0.0843	0.4570	0.0935	0.4090
Two-hand Catch	-0.0386	0.7340	0.0145	0.8990	0.1175	0.2990	0.1369	0.2260	0.1488	0.1880
Kick	-0.0892	0.4310	0.1244	0.2720	0.1196	0.2910	0.1336	0.2370	0.1377	0.2230
Overhand Throw	-0.2338	0.0370	0.1076	0.3420	0.1211	0.2850	0.1199	0.2890	0.1027	0.3650
Underhand Throw	0.0924	0.4150	-0.1851	0.1000	-0.0851	0.4530	-0.0218	0.8480	0.0777	0.4930
BS Subset	-0.1979	0.0790	0.0617	0.5860	0.1587	0.1600	0.1978	0.0790	0.2321	0.0380

Notes: LOC= locomotor, BS= ball skills, LPA = light physical activity, MPA = moderate physical activity, MVPA = moderate-to-vigorous physical activity, VPA = vigorous physical activity; Pearson correlation: $p<0.05$ = statistically significant, $p<0.001$ = statistically highly significant, Correlation values: r of 0.10-0.29 (weak), 0.30-0.49 (moderate) and 0.50-1.0 (strong).

Table 4.12 The interrelationship between FMS and weekday leisure PA intensities

WEEKDAY LEISURE: 5 days per week (14:00-20:00)										
	Sedentary		LPA		MPA		MVPA		VPA	
Skill	R	p-value	R	p-value	R	p-value	R	p-value	R	p-value
Run	-0.1683	0.1360	0.0510	0.6530	0.1046	0.3560	0.1210	0.2850	0.1270	0.2620
Gallop	-0.0066	0.9530	-0.0609	0.5910	0.0133	0.9070	0.0507	0.6550	0.0970	0.3920
Hop	0.0049	0.9660	-0.0203	0.8580	-0.0938	0.4080	-0.1016	0.3700	-0.0982	0.3860
Skip	-0.1090	0.3360	-0.1654	0.1430	0.0415	0.7140	0.1222	0.2800	0.2201	0.0500
Horizontal Jump	-0.1444	0.2010	0.0988	0.3830	0.1366	0.2270	0.1890	0.0930	0.2369	0.0340
Slide	-0.1297	0.2520	0.0660	0.5610	0.1095	0.3340	0.1307	0.2480	0.1423	0.2080
LOC Subset	-0.1553	0.1690	-0.0027	0.9810	0.0923	0.4150	0.1481	0.1900	0.2067	0.0660
Two-hand Strike	-0.0614	0.5890	0.0872	0.4420	0.1350	0.2320	0.1515	0.1800	0.1533	0.1750
One-hand forehand strike	-0.1077	0.3410	0.1722	0.1270	0.1688	0.1350	0.2288	0.0410	0.2819	0.0110
One-hand dribble	-0.1977	0.0790	-0.1751	0.1200	0.0449	0.6920	0.0596	0.5990	0.0721	0.5250
Two-hand Catch	-0.0302	0.7900	-0.0159	0.8890	0.0840	0.4590	0.1029	0.3640	0.1153	0.3090
Kick	-0.0490	0.6660	0.0814	0.4730	0.0990	0.3820	0.1197	0.2900	0.1321	0.2430
Overhand Throw	-0.1623	0.1500	0.1236	0.2750	0.1273	0.2600	0.1403	0.2140	0.1388	0.2200
Underhand Throw	0.0480	0.6720	-0.1374	0.2240	-0.1060	0.3490	-0.0574	0.6130	0.0205	0.8570
BS Subset	-0.1521	0.1780	0.0254	0.8230	0.1399	0.2160	0.1859	0.0990	0.2251	0.0450

Notes: LOC= locomotor, BS= ball skills, LPA = light physical activity, MPA = moderate physical activity, MVPA = moderate-to-vigorous physical activity, VPA = vigorous physical activity; Pearson correlation: $p<0.05$ = statistically significant, $p<0.001$ = statistically highly significant, Correlation values: r of 0.10-0.29 (weak), 0.30-0.49 (moderate) and 0.50-1.0 (strong).

Table 4.13 shows the results of a bivariate regression analysis used to investigate the effect of weekday MVPA on GMI. A bivariate regression determines the prediction of one independent variable (weekday MVPA) on a dependent variable (GMI).

Table 4.13 Bivariate regression output for GMI (independent variable: weekday MVPA)

Variable	b	SE	t-value	p-value
Intercept	2.2471	29.4081	0.0764	0.9393
Weekday MVPA	0.8329	0.3061	2.7211	0.0078

Notes: GMI = gross motor index, b= estimated regression coefficient, SE = standard error, p<0.05 = statistically significant.

From the regression output given in Table 4.13 it can be noted that a statistically significant relationship exists between weekday MVPA and GMI (p=0.0078), suggesting that increased levels of weekday MVPA are correlated with an increase in GMI.

Table 4.14 Bivariate regression output for GMI (dependent variable: total MVPA)

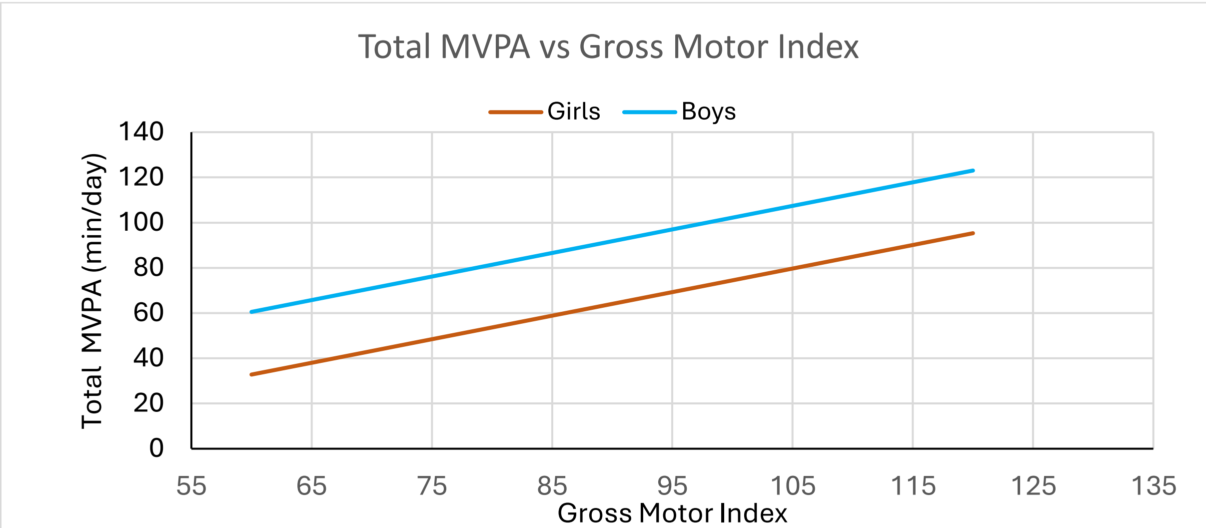
Variable	b	SE	t-value	p-value
Intercept	-29.7194	27.0833	-1.0973	0.2754
Sex	27.7224	5.2947	5.2359	0.0000
GMI	1.0419	0.2763	3.7708	0.0003

Notes: GMI = gross motor index, b= estimated regression coefficient, SE =standard error, p<0.05 = statistically significant

As shown in Table 4.14, a significant correlation between GMI and total MVPA was observed in the present sample (p=0.0003). Using the estimated regression coefficients, it is predicted that for both boys and girls, every 10-point increase in GMI corresponds to an average increase of 10.4 minutes per day in total MVPA.

Figure 4.5 below illustrates the relationship between total MVPA and GMI

Figure 4.5 Trend lines showing the association between total MVPA and GMI per sex



In conjunction with the preceding table, Figure 4.5 shows a linear trend between the total MVPA and GMI, which exists for both sexes. More interestingly, the difference in average MVPA between boys and girls remains consistent across the measured GMI at just below 28 minutes per day. Table 4.15 presents an overview of the results from a Pearson Correlation analysis, examining the association between GMI and various measures of MVPA.

Table 4.15 Correlation between GMI and MVPA

Variable	R	p-value
Total MVPA	0.2811	0.0078
Weekday MVPA	0.2876	0.0060
School day MVPA	0.2434	0.0210
Weekday Leisure MVPA	0.2309	0.0290

Notes: MVPA = moderate-vigorous physical activity; Pearson correlation: $p<0.05$ = statistically significant, Correlation values: r of 0.10-0.29 (weak), 0.30-0.49 (moderate) and 0.50-1.0 (strong)

As depicted in Table 4.15, GMI is positively and significantly associated with all categories of MVPA: total time ($r=0.2811$, $p<0.05$), Weekday ($r=0.2876$, $p<0.05$), school day ($r=0.2434$, $p<0.05$), and weekday leisure ($r=0.2309$, $p<0.05$). Suggesting that the higher the GMI score, the greater the time spent in MVPA.

4.5. OBJECTIVE 3: TO DETERMINE THE INTERRELATIONSHIP BETWEEN FMS PROFICIENCY AND BMI STATUS OF GRADE 1 LEARNERS

In this section, the interrelationship between FMS and BMI, as per sex, is presented. Table 4.16 shows the results of a Pearson correlation analysis examining the effect of BMI on each of the FMS by sex, which is represented by a correlation value (r) and p-value.

Table 4.16 Interrelationship between FMS and BMI

Skill	Total (n = 99)		Girls (n = 47)		Boys (n = 52)	
	R	p-value	R	p-value	R	p-value
Run	-0.0843	0.4070	-0.1767	0.2350	-0.0294	0.8360
Gallop	0.0500	0.6230	0.0713	0.6340	0.0216	0.8790
Hop	0.0484	0.6340	-0.0085	0.9550	0.1137	0.4220
Skip	0.0559	0.5830	0.0176	0.9070	0.1138	0.4220
Horizontal Jump	-0.0057	0.9550	-0.1207	0.4190	0.2223	0.1130
Slide	-0.0766	0.4510	-0.0468	0.7550	-0.1547	0.2730
LOC Subset	-0.0056	0.9560	-0.0908	0.5440	0.0850	0.5490
Two-hand Strike	0.0652	0.5210	0.2216	0.1340	-0.0462	0.7450
One-hand forehand strike	-0.1556	0.1240	-0.1366	0.3600	-0.0882	0.5340
One-hand dribble	-0.0303	0.7660	-0.0703	0.6390	0.0466	0.7430
Two-hand Catch	-0.0120	0.9060	-0.1475	0.3220	0.2610	0.0620
Kick	-0.1473	0.1460	-0.1593	0.2850	0.0475	0.7380
Overhand Throw	-0.1251	0.2170	-0.1107	0.4590	-0.0652	0.6460
Underhand Throw	-0.2383	0.0180	-0.2248	0.1290	-0.2363	0.0920
BS Subset	-0.1758	0.0820	-0.1808	0.2240	-0.0167	0.9060

Notes: LOC =locomotor, BS =ball skills; Pearson correlation: $p<0.05$ =statistically significant, Correlation values: r of 0.10-0.29 (weak), 0.30-0.49 (moderate) and 0.50-1.0 (strong)

As depicted in Table 4.16 No significant correlations were reported between the sexes for FMS, including locomotor and ball skills subsets and BMI (p>0.05). Among the total participants, only one significant correlation was found, a weak negative association between BMI and the underhand throw (r=-0.2383; p =0.0180), indicating that the higher the BMI, the lower the underhand throw proficiency. The square of the Pearson correlation coefficient (R^2) indicates that 5.7% of the variation in the underhand throw performance can be explained by differences in BMI.

Table 4.17 presents an overview of the results from a Pearson Correlation analysis, examining the association between GMI and BMI.

Table 4.17 Correlation between GMI and BMI

Variable	R	p-value
BMI	-0.0165	0.8770

Notes: BMI= body mass index; Pearson correlation: p<0.05 = statistically significant, Correlation values: r of 0.10-0.29 (weak), 0.30-0.49 (moderate) and 0.50-1.0 (strong)

As depicted in Table 4.17, no significant relationship exists between BMI and GMI (p>0.05) among the grade 1 learners.

In conclusion, the results and findings presented in this chapter indicate significant differences between sexes in children's BMI, PA status and selected FMS. Although no significant relationship was found between FMS and BMI, PA intensities across categories were statistically significant in relation to FMS proficiency among this cohort of grade 1 learners. The following chapter will further discuss results reported according to the existing literature and summarise findings, limitations and recommendations.

CHAPTER 5

DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATION

5.1. INTRODUCTION

This study aimed to investigate the status and interrelationships between FMS, PA and BMI among grade 1 learners from a low-income community in Gqeberha. Chapter 5 discusses the results of these measured variables as reported and analysed in Chapter 4. These discussions reference empirical research reviewed, highlighting the comparisons with, and differences between previous literature presented in Chapter 2. This chapter begins with an overview of the demographic profile of participants, followed by sections on FMS, PA and BMI, and the interrelationships thereof. It concludes with a summary of findings, conclusions, and an outline of the study's limitations and recommendations for future research.

5.2. DEMOGRAPHIC PROFILE OF PARTICIPANTS

The study participants comprised of 99 grade 1 learners recruited from five quintile 3 schools located in Zwide, Gqeberha. However, four participants presented with incomplete actigraph data, resulting in a PA subgroup of 95 participants. Of the total sample, 47.5% were girls and 52.5% were boys, with an average age of 6.81 $\pm$ 0.46 years.

The study participants were Black African children attending five of the selected schools from the Siyaphakama Zwide Schools Project. Zwide is in a peri-urban low-income community, otherwise known as a "Township". Distinctive to South Africa, these township settings are characterised as marginalised communities represented by lower socioeconomic populations that face many challenges related to poverty, crime, increased unemployment, and public health concerns (Myer *et al.*, 2004; Hlatshwayo *et al.*, 2023)

5.3. DISCUSSION

The following subsections present the main findings relative to literature in the research area, and aim to provide interpretations and plausible explanations for the results obtained. These findings are organised in accordance with the study's objectives, beginning with the status of FMS, PA and BMI, followed by the exploration of their interrelationships.

5.3.1. Objective 1: To Explore and Describe the FMS Proficiency, PA Status and BMI per sex as they apply to Grade 1 Learners

The subsections below provide a discussion on each of the measured variables, disaggregated by sex.

5.3.1.1. Fundamental movement skill proficiency

The results from the present study align with results from previous international and national studies on children, reporting poor proficiency in FMS. Across the total sample of grade 1 learners, no child achieved mastery in all 13 FMS. The highest number of skills mastered was seven FMS achieved by only three learners (3.03%), while 23 learners (23.23%) failed to achieve mastery in any of the FMS. A similar tendency was reported in a study on British children aged seven to ten, where poor performance was observed across the sample. Moreover, no child achieved mastery in the eight skills assessed, and 27% of participants did not attain mastery in any of the skills (Lawson *et al.*, 2021). Similarly, in an Irish cohort of six year olds, Bolger *et al.* (2018) reported that no child mastered more than six TGMD-2 FMS items. Compared to a recent South African study of children from the same age group with higher SES, the results from the present study reported comparatively poorer outcomes. van Stryp *et al.* (2022) found grade 1 learners from Cape Town in the Western Cape, to perform relatively well, with 37% of learners mastering their FMS. Similarly, an intervention study in Alice, Eastern Cape province examining the effects of a nine-week movement programme on the FMS of rural grade 2 learners (aged seven to eight) reported higher scores than those observed in the present study (Idamokoro *et al.*, 2024). Using the same measuring instrument (TGMD-3), both the intervention and control groups in the Eastern Cape study achieved better mean scores for eight of the 13 skills during pre-testing. These findings suggest that irrespective of the contrasting socioeconomic contexts, both studies exhibit better FMS performances than the present study.

As reflected in Figure 4.1, the skill with the highest percentage of mastery by the participants was the stationary dribble (by hand) (58% mastery), a skill similar to the dribbling technique used in basketball. The second and third highest mastery levels in the ball skill category was the kick (20% mastery) and two-handed catch (19% mastery), respectively, with very low mastery levels for the rest of the ball skills. The locomotor skill with the highest mastery level was the slide (25% mastery), followed by the run (21% mastery) and the horizontal jump (15% mastery). The best-mastered skills in the locomotor (slide) and ball skill (stationary dribble) subsets can be attributed to the lower level of difficulty associated with their performance criteria compared to the other FMS items. Specifically, these skills can be achieved by simple verbal instruction and visual demonstration, requiring neither complex bilateral coordination nor simultaneous upper and lower body movements as seen in the gallop and throw (see Appendix A). Compared to the present study, Mohammadi *et al.* (2017) reported greater mastery levels of Iranian children (using the TGMD-3 protocol), across seven skills including the run (52.1% vs 21%), hop (28.6% vs 12%), skip (19.9% vs 9%), slide (66.6% vs 25%), stationary dribble (60.2% vs 58%), catch (25.8% vs 19%) and underhand throw (31.6% vs 4%). A South African study that reported on mastery levels, examined the FMS proficiency of Montessori preschoolers using the TGMD-2 assessment (Africa *et al.*, 2024). Higher levels of mastery were reported in seven FMS items, when compared with the present study. These skills included the run (87.5%), slide (87.5%), hop (50%), jump (37.5%), kick (50%), strike of a stationary ball (37.5%) and catch (50%) (Africa *et al.*, 2024).

Similar to previous South African studies, a trend of mastery of the kick was observed in the present study, identifying the kick as the second most mastered ball skill (Tomaz, Jones, *et al.*, 2019; Africa *et al.*, 2024). This is further supported by the findings of Pienaar *et al.* (2016) who reported that 79.16% of six year olds in the North West province achieved the mature phase of kicking. In South Africa, soccer is a widely played sport that is particularly popular in low-income communities, where it is practised in both formal leagues and during leisure time. A study conducted in three disadvantaged schools in Gqeberha (formerly known as Port Elizabeth) found that boys frequently engaged in informal soccer games before, during and after school (Walter, 2011). However, although these informally organised games lack formal coaching and feedback, they provide children with increased opportunities for practice, which may contribute to the improved lower-limb coordination and skill observed, resulting in the higher mastery of kicking.

A result of particular concern, is the notable difference in the mastery of the run, between the present study and findings from other studies (Mohammadi *et al.*, 2017; Dobell *et al.*, 2020; van Stryp *et al.*, 2022; Africa *et al.*, 2024). More particularly, Bolger *et al.* (2018) found that 80.4% of six year olds displayed mastery in the run compared to the 21% of six to seven year olds in the present study. This is further evidenced by the Bolger *et al.* (2020) review of 64 international articles reporting on children's FMS proficiency using the TGMD-2 protocol, which found the run to be the most mastered skill across all age groups. When combining the mastery percentage (21%) with those demonstrating near mastery (38%), then more than half of the participants (59%) in the present study would have achieved near mastery or mastery of the run. As per the mastery scoring guidelines used in this study, to attain near mastery participants were required to meet all but one of the performance criteria. The higher percentage of participants classified as near mastery compared to mastery may be attributed to the lack of instruction and teaching of biomechanics techniques, such as correct foot placement. Lawson *et al.* (2021) investigated the behavioural components of running skills among seven to ten year olds and found that learners classified as near mastery were unable to demonstrate narrow or heel-to-toe placement (i.e. not flat-footed), therefore resulting in the poor performance of this skill.

According to Figure 4.1, the skill with the lowest mastery percentage was the underhand throw (4%). Similarly, only 6-7% of six to eight year olds from a global systematic review were reported to have achieved mastery in the throw (Bolger *et al.*, 2020). These findings are consistent with two other South African studies on six year olds; Pienaar *et al.* (2016) identified the throw as the least mastered object control skill and similarly, Africa *et al.* (2024) reported that no six year old achieved mastery in throwing. Lawson *et al.* (2021) suggests that the poor performance observed in the skill may involve the complexity of the behavioural component, which requires simultaneous use of the upper and lower body, with contralateral action of the limbs. The second lowest-mastered skill (5%) was the two-hand stationary strike, among the FMS items. Consistent trends were observed for van Stryp *et al.* (2022) who reported the strike was the least mastered ball skill (18%) among grade 1 learners. In contrast, a study conducted in a similar socioeconomic background (high SES) reported the strike was the second most mastered ball skill (37.5%) among the 6 year olds in selected South African Montessori schools. The low proficiency observed among participants can be explained by the complexity of the performance criteria, such as the body's rotation and coordination of the legs and arms. While the striking action is common in cricket, a sport widely popular in South Africa, the two-hand striking technique is a characteristic of baseball or softball, a sport more typical to American contexts. The biomechanics of these striking actions differ, with cricket batting involving controlled movements of the forearms and hands, whereas baseball striking is explosive, dynamic and requires full body rotation. Thus, the absence of baseball striking in the South African PE curriculum coupled with the lack of practice and familiarity with the skill, may have contributed to the poor performance observed in the study sample.

The discrepancies in FMS performance exhibited between the present study and other national studies may stem from differences in the socioeconomic backgrounds and demographics of the participants. The present study's population were Black African children, from quintile 3 schools (no-fee paying schools), situated in an impoverished township, contrasting with the other study settings which included high-socioeconomic communities (van Stryp *et al.*, 2022), private schools (Africa *et al.*, 2024) and assessment of predominantly White children of high SES (de Waal, 2019). This is further evidenced by an earlier study by Pienaar and Kemp (2014), who highlighted a significant difference in motor proficiency between White and Black African grade 1 learners, with the latter categorised in the "below average" category and the White learners displaying better performance and placed in the "average" category. However, the majority of the Black African learners were from low SES, representing quintile 1 to 3 schools respectively. Therefore, the observed differences between the two groups were likely influenced by environmental factors rather than racial differences (Pienaar & Kemp, 2014). It was further reported that White learners, predominantly from high socioeconomic backgrounds, have access to high-quality preschools before entering grade 1 (formal schooling). These schools often provide motor development programmes run by private companies (e.g. Playball and Monkeynastix) that parents can afford, enabling these learners to demonstrate higher motor proficiency consistent with the stages of the fundamental movement phase (Figure 2.1: Hourglass Model of motor development). Children residing in low-income communities may have limited access to equipment, resources and organised programmes designed to provide practice opportunities and improve motor performance (Seabra *et al.*, 2013). In addition, non-fee paying, low-quintile primary schools in South Africa restrict children's accessibility to quality extracurricular activities and structured movement education programmes, leaving them to participate in informally organised sports and traditional games (Walter, 2011; Cook *et al.*, 2019). However, while these activities increase children's PA participation, the absence of proper instruction and trained coaching prevents children from exposure to correct techniques for sports skills associated with FMS, thus contributing to their poorer FMS performance

Sex differences in FMS proficiency

Tables 4.2 and Table 4.3 highlight the notable differences between sexes across the subsets and 13 FMS items assessed. The girls outperformed the boys in five of the six locomotor skills; however, no significant differences were observed for the raw scores ($p>0.05$). These findings align with research conducted by Hardy *et al.* (2010); Mukherjee *et al.* (2017); Tomaz, Jones, *et al.* (2019) and van Stryp *et al.* (2022) who also found no apparent differences between sexes in locomotor skills. The boys, however, outperformed girls in six of the seven ball skills, with significant and superior performances in the one-hand forehand strike, kick and overhand throw raw scores ($p<0.05$). Furthermore, on average, boys scored 7.8% better than girls in the ball skills subset ($p=0.007$). Comparably, Mohammadi *et al.* (2017) reported no significant differences between sexes among Iranian children for the locomotor skills; however, boys presented with significantly greater mean raw scores for ball skills compared to girls ($p<0.05$). These included significantly better performances in the two-hand strike, one-hand forehand strike, stationary dribble, catching, kicking, overhand and underhand throw. A consistent trend has been observed across literature; with boys outperforming girls in individual ball skills and related subsets (Barnett *et al.*, 2009; Hardy *et al.*, 2010; Cohen *et al.*, 2014; Bolger *et al.*, 2018, 2020). This concurs with a South African study which also found boys to have a significantly greater object control skill score than girls, with superior performances in the strike, stationary dribble and kick (p<0.001) (Tomaz, Jones, *et al.*, 2019).

Table 4.4 presents the differences between the sexes across the mastery level percentage achieved for each skill. This study found boys to display a higher and significantly better achievement for the one-hand forehand strike and kick (p<0.05). Furthermore, they were 3.8 times more likely to achieve mastery or near mastery than poor in these ball skills. Conversely, girls demonstrated significantly better achievements in the mastery categories for the run and gallop (p<0.05) both of which are locomotor skills. These findings align with the findings by Barnett *et al.* (2009) and Bolger *et al.* (2018) who found girls to have significantly superior performance in locomotor skill proficiency compared to boys. In keeping with these differences between the sexes, another South African study found that boys displayed greater object control proficiency, particularly in the kick (Pienaar *et al.*, 2016). Contradictory findings were reported by van Stryp *et al.* (2022) who found no overall differences between sexes in mastery for locomotor and object control skills, apart from the kick and throw (object control skills), where boys displayed statistically and significantly greater proficiency than girls. Hardy *et al.* (2010) explained that differences between sexes in skill performance among prepubescent children are not influenced by biological characteristics such as limb length, body composition and strength but rather by socialisation. More specifically, the role of teachers, family, and peers in encouraging PA behaviours and the availability of equipment in the home is likely to have an effect on FMS performance (Thomas & French, 1985). Furthermore, common patterns in research reveal that boys' PA participation is influenced by competitiveness and ego-driven motivations, leading to greater involvement in object control-centred activities. In contrast, girls display personality traits associated with caring and cooperation, which is more aligned with locomotor-centred-activities. Thus, boys experience greater exposure to ball skill practice opportunities, resulting in greater participation and overall better performances in these skills compared to girls (Hardy *et al.*, 2010; Bardid *et al.*, 2016).

5.3.1.2. Physical activity

The results of the present study indicated that the majority of learners (77.9%) engaged in the daily MVPA, as per the WHO-recommended PA guidelines. These results exceed the national PA levels as reported in the 2022 HAKSA report card, which estimated that only 60-73% of children aged seven to 19 met the PA guidelines. Other South African studies also found similar results for preschool aged children achieving and exceeding the PA guidelines (Cook *et al.*, 2019; Tomaz, Prioreschi, *et al.*, 2019). In Gqeberha, a study by Gerber *et al.* (2021) investigating PA among children in grades 1 to 4, from a similar SES demographic to the present study, found that 76.9% of children achieved the daily PA guidelines. These findings are in contrast to international studies that report an alarming decrease in PA rates. According to the Global Physical Activity Report Card, only 27-33% of children and adolescents are estimated to meet daily MVPA recommendations of 60 minutes (Aubert *et al.*, 2022). Additionally, a study conducted in the Eastern Cape found that 76.6% of peri-urban learners (aged nine to 14) reported low levels of PA (Gomwe *et al.*, 2022). These increased rates of low PA participation may result from the study's use of the Physical Activity Questionnaire for Older Children (PAQ-C), a subjective measure of PA which differs from the present study that employed Actigraph accelerometery, an objective measure.

This study found that 77.9% of participants met the MVPA recommendations during school hours (see Table 4.6). These findings exceed those from a cross-national study conducted in the Netherlands, which found that primary school children (n = 248) only met half of their daily MVPA time at school (i.e., 29 minutes) (Remmers *et al.*, 2024). This highlights the idyllic setting the school environment provides for the promotion of children's PA. According to Ridgers *et al.* (2006) excluding the time spent in organised sport and physical education, the recess and lunch period can contribute 40% of children's daily PA. The significant contribution of recess on children's activity levels may result from the facilities and resources available at schools. Irrespective of unfixed equipment such as broken-down playground amenities, items like balls or skipping ropes can still effectively increase children's PA levels (Ridgers *et al.*, 2006). In marginalised South African communities, schools generally provide safe spaces for outdoor play and greater access to sports resources that are generally unavailable and poorly maintained in low socioeconomic contexts. The prevalence of gang-related activities and violence in many townships in South Africa, are often barriers to the participation in purposeful and recreational PA (Ndhlovu & Tanga, 2021).

Sex differences in PA status

This study supports existing literature suggesting sex disparities for PA, with boys being more active than girls (Cohen *et al.*, 2014; Moore *et al.*, 2014; Hall *et al.*, 2018; Van Biljon *et al.*, 2018; Nqweniso, Walter, *et al.*, 2021). In the present study, boys reported significantly higher PA levels for all categories of MVPA (total time, weekday, school day and weekday leisure) than girls ($p<0.05$). Furthermore, excluding weekday MVPA, boys were more likely to achieve and exceed the 60 minutes of daily MVPA during total time (boys: 46.3%; girls: 31.6%), school day (boys: 47.4%; girls: 30.5%) and weekday leisure (boys: 38%; girls: 19.6%) (Table 4.6). Comparable trends across international (Telford *et al.*, 2016) and South African (Tomaz, Prioreschi, *et al.*, 2019; Gerber *et al.*, 2021) studies are observed for PA differences between the sexes. This is further corroborated by Cohen *et al.* (2014), who investigated PA in preschoolers from low-income communities in Australia and found that boys engaged in more MVPA than girls, for all time periods ($p<0.01$). A South African study conducted in the Eastern Cape, reported that a higher percentage of boys engaged in MPA than girls (boys: 51%; girls: 43.3%) (Gomwe *et al.*, 2022). While Gerber *et al.* (2021) also reported PA differences in participants from a similar geographic area to the present study, where boys engaged in an estimated 25 minutes more of MVPA than girls. This study went on further to suggest that South African children displayed the greatest variance between sexes for PA, when compared with children from Tanzania and Cote d'Ivoire. These disparities were attributed to the increased rate of urbanisation and lifestyle change experienced, resulting in fewer areas that were suitable for outdoor PA and thereby decreasing girls' access to engage in meaningful PA (Gerber *et al.*, 2021). This is further supported by Gomwe *et al.* (2022) who reported that girls were more likely to participate in indoor activities and household chores, while boys engaged in more outdoor or competitive games and sports. Further explanations include the biological and individual characteristics of girls that are associated with reduced PA, such as poorer cardiorespiratory fitness, higher body fat percentage and decreased levels of perceived proficiency (Telford *et al.*, 2016).

5.3.1.3. Body mass index

This study found grade 1 learners to have an average BMI of 16.26 kg/m^2 and a BAZ score of 0.38 (Table 4.7). These scores are lower when compared to a global study that investigated the BMI and prevalence of overweight and obesity, based on WHO standards for children aged five to 19 (González-álvarez *et al.*, 2020). The study, which analysed 198 international studies conducted between 1975 and 2016 reported an average BMI of 18.293 kg/m^2 for boys and 18.746 kg/m^2 for girls. Moreover, regarding the nutritional status of all participants, according to the WHO BAZ cut-off values, 77.8% of learners were of normal weight, 14.1% were overweight, and 8.1% were obese. However, no child in the sample was reported to be thin or severely thin. These trends are aligned with the WHO findings, which highlight that overweight and obesity are becoming a growing concern in low-middle-income countries (World Health Organization, 2024). Reflecting international trends, the 2022 HAKSA report card graded children's overweight and obesity "D", and undernutrition "C" both consistent with the previous 2018 HAKSA report card grade (Naidoo *et al.*, 2022). A similar distribution in patterns of nutritional status among grade 1 learners in Cape Town was observed. It revealed 84.23% of children to be of normal weight, 10.86% as overweight and 4.89% as obese, with no child reported to be underweight (van Stryp *et al.*, 2022). Another South African study measured preschoolers' adiposity from the same economic setting as the present study (i.e., urban low-income) presented with an average BMI and BAZ of 16.00 kg/m^2 and 0.40, respectively (Draper *et al.*, 2019). Moreover, it was found that more children from urban low-income settings displayed a statistically significant prevalence of overweight and obesity. Draper *et al.* (2019) describe these overweight and obesity trends as a result of the nutrition transition within urban low-income settings and the obesogenic environment that allows for easy convenience of cheap and processed foods sold at informal shops. These pre-packaged and highly processed foods are commonly nutritiously poor, with copious amounts of sodium and trans fats, known to increase body weight (Popkin *et al.*, 2021; Barros *et al.*, 2022). Despite South Africa's double burden of malnutrition, the absence of thin and severely thin children in the present study may be a likely result of the NSNP implemented at quintile 1 to 3 schools. This government initiative provides learners with one nutritious meal per day. Naidoo et al. (2022) further report that the more recent introduction of breakfast at these schools has contributed to reduced stunting and lower rates of overweight and obesity. Moreover, there has been an application of more schools providing fruits alongside these meals for learners, therefore enhancing the programme's nutritional impact.

Sex differences in BMI status

The findings for both BMI and BAZ were observed to be similar across the sexes in the present study. Although girls presented with a higher BMI and BAZ average than boys, these findings were not statistically significant. However, greater and statistically significant variability in BMI and BAZ was reported for girls compared to boys (BMI: $p<0.0001$ and BAZ: $p<0.05$). Comparably, other South African studies reported minimal BMI differences between the sexes for preschoolers (Tomaz, Prioreschi, *et al.*, 2019) and grade 1 learners (van Stryp *et al.*, 2022). These insignificant differences in fat mass are attributed to the characteristics of prepubescent children. Concerning the nutritional status of children, this study found a higher percentage of boys were of normal weight status (boys: 43%, girls: 37%), while a higher percentage of girls were categorised as overweight and obese compared to boys (boys: 8.1%, girls: 13.1%). These results are supported by Gerber *et al.* (2022) on grade 1 to 4 learners with a similar SES demographic within the same region which reported that boys were more likely to be of normal weight status and that a higher proportion of girls were classified as overweight or obese. The high proportion of girls categorised as overweight and obese in the present study may be attributed to lower PA levels among girls compared to boys (Table 4.5 and Table 4.6). According to Stodden and colleagues' conceptual model (Figure 2.2), it is proposed that unhealthy weight status or obesity is associated with lower PA levels in combination with poor motor competence and fitness in children (Stodden *et al.*, 2008). Although the nutritional distribution between sexes was not statistically significant ($p>0.05$), the increased prevalence of overweight and obesity observed among girls at this age is a precursor to the UNICEF findings that report significant rates of overweight and obesity persisting from adolescence into adulthood (Unicef, 2022).

5.3.2. Objective 2: To determine the interrelationship between FMS proficiency and PA status of grade 1 learners

As highlighted in section 2.5., children's PA statuses and their subsequent desire to engage in PA impacts their motor development, more specifically, FMS. In the present study (Table 4.9 to Table 4.12), a positive and significant relationship was observed between VPA and the locomotor subset, specifically the horizontal jump across all categories of PA [total time, weekday, school day and weekday leisure ($p<0.05$)]. According to the author's best knowledge, no study has found a significant and positive association between locomotor skills and higher-intensity PA, such as VPA. A plausible explanation for the positive relationship between locomotor skill proficiency and higher levels of PA, such as VPA, can be explained by the performance criteria of these skills. This includes the propulsive nature of locomotor skills, requiring significant movement of body mass against gravity, with particular reference to the horizontal jump, which was observed to correlate with VPA across all categories of PA significantly ($p <0.05$) and demand full body and forceful movements (Appendix A). Mukherjee *et al.* (2017) supports these findings, further suggesting that the substantial forces required to lift the body off the ground during the horizontal jump are associated with lower limb muscle strength, particularly thigh strength and power. This muscular strength and power are also associated with the ability to perform VPA, which serve as prerequisites for most locomotive-centred activities. Additionally, locomotor skills form the foundation of everyday movements; as children progress through the various developmental stages, these skills are performed autonomously, resulting in increased intensity as progression occurs (i.e., VPA) (Gallahue *et al.*, 2012). Therefore, incorporating strengthening exercises and VPA-focused activities as recommended by the WHO, could enhance children's locomotor skills (World Health Organization, 2020)

Weak positive associations were reported between the ball skills subset and VPA across all categories of PA [total time ($r=0.2742$; $p=0.0140$), weekday (VPA: $r=0.2546$; $p=0.0230$, MVPA: $r=0.2294$, $p=0.0410$), school day ($r=0.2321$; $p=0.0380$, and weekday leisure ($r=0.2251$; $p=0.0450$)], suggesting greater time spent in VPA is correlated with greater performance in ball skill proficiency. The present study concurs with the study by Hall *et* *al.*, (2018) which found children's MVPA to correlate positively with overall motor competence (Table 4.14) and ball skills (Table 4.9). The results indicated that children who achieved and exceeded 60 minutes of MVPA daily, as per the WHO recommendations, scored significantly better in ball skills. These findings are in agreement with the study by Cohen *et al.* (2014) which investigated the relationship between FMS and MVPA during key periods of the day among children living in low-income communities in Australia. This study found that the children's object control skill proficiency correlated positively and significantly with MVPA during lunchtime and recess (break time) at school. These outcomes result from the activities and equipment made available to children during these school periods. Game-like activities such as soccer are popular recess activities requiring children to engage in higher PA levels and increase object control competency (Cohen *et al.*, 2014). Likely explanations for the reported positive and significant associations between the ball skills subset and VPA in the present study, could be the child's skill level; children who possess greater ball skill competency are more likely to participate in various game-like activities, sports and PA, sequentially affording higher levels of PA (Stodden *et al.*, 2008). Lastly, the biological demands from performing ball skills proficiently culminate in eccentric and concentric muscle contractions, which increase the demand on muscles and joints, subsequently facilitating increased muscle strength and power output used during PA (Cattuzzo *et al.*, 2016). Therefore, including ball skills in interventions can promote greater intensities of PA and opportunities to engage in numerous types of recreational activities, organised sports and active play.

Contradictory findings were reported for a national study that investigated children of similar socioeconomic demographics and found no significant correlation between PA and gross motor skills ($p>0.05$) (Tomaz, Prioreschi, *et al.*, 2019). Although two other South African studies had included PA and FMS among the measured variables, the relationship between the two was not reported on (Cook *et al.*, 2019; Tomaz, Prioreschi, *et al.*, 2019). Ultimately, the limited national research that addresses the relationship between PA and FMS remains limited and prevents further conclusions from being made to the present study.

5.3.3. Objective 3: To determine the interrelationship between FMS proficiency and BMI of grade 1 learners

This study found no significant correlation between FMS and BMI (including locomotor and ball skill subsets as well as GMI (Table 4.16 and Table 4.17), apart from one FMS item (underhand throw) exhibiting a weak and negative association with BMI. These findings align with a South African study that investigated the relationship between adiposity, PA and gross motor skills (measured using the TGMD-2) among preschoolers across three economic settings (Draper *et al.*, 2019). Although a weak but significant negative correlation was identified for the ball skill subset with BMI and BAZ scores among participants in the urban low-income setting, the overall study found no association between adiposity and gross motor proficiency. Consistent with the present study's results, Tomaz, Prioreschi, *et al.* (2019), in another South African study, also found no significant relationship between BMI and gross motor proficiency, also measured using the TGMD-2, among preschoolers in a low-middle-income setting.

However, contrary findings were also reported in the literature, where FMS was found to be inversely associated with a high BMI status (Logan *et al.*, 2011; Khalaj & Amri, 2014; Barnett, Lai, Veldman, Hardy, Cliff, Morgan, *et al.*, 2016). An early study conducted by Morano *et al.* (2011) identified overweight children as displaying poorer movement competence across locomotor and object control skills compared to normal-weight children. More recently, a study observed that children aged five to 11 exhibited decreased locomotor scores in relation to a higher BMI status (Maïano *et al.*, 2022). Concurrently, Siahkouhian *et al.* (2011) and Bryant *et al.* (2014) found that increases in children's BMI were negatively and significantly correlated with locomotor skills, attributing these findings to the greater difficulty overweight and obese children experience in performing complex body movement proficiently, due to an increased body mass. Bryant *et al.* (2014) further proposed that poor locomotor skill performance among overweight participants could result from a decreased range of motion at the leg joints due to increased adipose tissue and discomfort from moving their limbs.

Meanwhile, a South African study that investigated the relationship between body composition and motor competence of grade 1 learners in the North-West Province found overweight and obese children to have performed significantly poorer in fine motor skills, balancing, running speed, agility and strength than their normal-weight peers (Kemp & Pienaar, 2013). Kahts *et al.* (2017), reported a similar trend, where girls of similar demographics in the same region as the present study exhibited an unfavourable relationship between BMI and running and jumping. The lack of significant associations observed between FMS and BMI in the present study could plausibly be attributed to the relatively small sample size and the low prevalence of overweight and obesity reported (Table 4.8). Ultimately, the consistent association between locomotor skills and high BMI reported across South African and international literature highlights the gap for locomotor-based interventions to reduce high-weight statuses and subsequently lead to lower BMI among children. In particular, utilising the formative years in primary schools, whereby children aged six to seven are provided with ample opportunity to master and become more proficient in FMS and subsequently target overweight and obesity before it transcends into adolescence and adulthood.

5.4. SUMMARY OF FINDINGS

The preceding section discussed the study's results in relation to empirical research. This section will summarise the research findings according to the present study's objectives stipulated in Chapter 1.

With regards to FMS status

- No participant attained mastery in all 13 FMS items. The highest number of mastered skills was seven, achieved by 3.03% of the sample.
- The greatest mastered ball skill was the stationary dribble (58% mastery), followed by the kick (20% mastery) and two-hand catch (19% mastery).
- The greatest mastered locomotor skill was the slide (25% mastery), followed by the run (21% mastery) and horizontal jump (15%).
- The two-hand strike was the poorest performed skill (95% poor) among participants.
- Boys performed significantly better in one-hand forehand strike (p=0.0070), kick (p=0.0071), and overhand throw (p=0.0446) compared to girls.

- Boys performed significantly better in the raw scores for the ball skills subset ($p=0.007$) than girls, scoring 7.8% higher in this category. However, no significant differences between sexes were found for locomotor skills raw scores ($p>0.05$) and GMI ($p>0.05$).
- Girls demonstrated significantly better achievements in the mastery categories for the run ($p=0.0442$) and gallop ($p=0.0199$), with the odds of girls achieving mastery or near mastery, rather than poor performance, being approximately 1.5 times higher than those of boys (run: OR=1.5 and gallop: OR=1.47).
- Boys demonstrated significant distributions for mastery in the one-hand forehand strike ($p=0.0083$) and kick ($p=0.0096$) they were 3.8 times more likely to achieve mastery or near mastery in these skills than girls (OR=0.27).

With regards to PA status

- The average daily MVPA across total days among the sample was 86.4 minutes.
- PA during school contributed the most to children's MVPA (89.4 minutes daily). 77.9% of the sample achieved the WHO PA recommended guidelines while being at school.
- Boys were nearly three times more likely to meet daily PA recommendations across all seven days than girls (OR=2.93). Boys were also approximately four times more likely to achieve PA recommendations at school compared to girls (OR=3.88).
- For all categories of MVPA, boys were significantly more physically active than girls ($p<0.05$).

With regards to BMI status

- The average BMI and BAZ among the sample were 16.26 kg/m2 and 0.38, respectively.
- 77.8% of the sample were of normal weight status, 14.1% were overweight, and 8.1% were obese. No child was reported to be thin or severely thin.
- Girls presented with a greater BMI and BAZ average. The variability in BMI ($p<0.001$) and BAZ ($p<0.05$) was significantly greater than in boys.

- Girls presented with higher percentages in the obese category than boys (12.8% vs 3.8%)

With regards to PA and FMS relationship

- During total time, a weak negative correlation was found between sedentary time and run (r=-0.2446; p=0.0290) and locomotor subset (r = -0.2378; p=0.0340).
- Ball skills subset was positively and significantly correlated with increased time spent in MPA (r=0.2254; p=0.0440), MVPA (r=0.2598; p=0.0200) and VPA (r=0.2742; p=0.0140)
- A positive and significant correlation was reported between VPA and horizontal jump and locomotor subset for total, weekday and school day time ($p<0.05$).
- Across all categories, VPA was positively and significantly associated with the ball skills subset: total time (r=0.2742; p=0.0140), weekday (r=0.2546; p=0.0230), school day (r=0.2321; p=0.0380), and weekday leisure (r=0.2251; p=0.0450).
- The GMI and weekday MVPA were significantly correlated ($p<0.05$). Every 10-point increase in GMI resulted in an 8.3-minute increase in daily weekday MVPA.
- For all categories of MVPA, GMI was positively and significantly correlated ($p<0.05$).

With regards to BMI and FMS relationship

- Among the total sample, a weak negative correlation was observed between BMI and the underhand throw (r =- 0.2383; p=0.0180).
- No significant differences between sexes were reported for BMI and FMS, locomotor and ball subsets. ($p>0.05$).
- No significant relationship was found between GMI and BMI ($p>0.05$)

5.5. CONCLUSIONS

The aim of this study was to examine the status and interrelationships among FMS, PA and BMI. This chapter provided a culmination of results obtained from these measured variables in relation to the literature presented in Chapter 2. Despite theoretical models suggesting that children should be proficient in FMS at the age of seven, the findings of this study reveal particularly low performance and mastery among the FMS items of grade 1 learners. Compared to international and national studies, lower raw scores and mastery percentages were observed, irrespective of socioeconomic differences. In contrast, grade 1 learners demonstrated good PA levels, with the majority meeting the daily PA recommendations across all categories. Similarly, based on the WHO guidelines for BAZ, 77.8% of the sample was classified as having a normal weight status. These PA and nutritional findings results surpass those reported in the 2022 Healthy Active Kids Report Card of South Africa (Naidoo *et al.*, 2022). These trends are further emphasised by the observed sex disparities in each of the measured variables. Subsequently, girls were found to score significantly lower than boys in ball skills raw scores (35.31 vs 38.06), report significantly less time spent in MVPA for all PA categories ($p<0.05$) and display a higher prevalence of obesity than boys (12.8% vs 3.8%). These findings highlight the critical need for interventions focused on increasing PA participation, promoting healthy eating habits, and improving FMS proficiency among girls. Such interventions should be prioritised in the early primary school years, especially within low-income communities, to help close the gap between sexes in motor skill development and overall health outcomes.

Furthermore, the correlation analysis revealed no significant relationship between children's BMI and FMS proficiency per FMS item and GMI. However, significant and positive relationships were observed between VPA and ball skills across all PA categories, as well as between VPA and locomotor for weekday, school day and total time. Ultimately, these findings indicate the reciprocal role of PA and FMS, aligning with Stodden and colleagues' theoretical model (Stodden *et al.*, 2008). The positive relationship found in this study underscores the potential for increased PA to improve FMS proficiency within South African contexts, where structural constraints and barriers often hinder children's motor skill development through formal learning practices.

5.6. LIMITATIONS

The possible limitations associated with this study that should be considered are presented below.

- This study was conducted in one low-income community of Gqeberha, with a sample limited to Black African children in grade 1. These findings have limited generalisability to other studies, even those involving communities with similar socioeconomic statuses.
- Due to the relatively small sample size, the statistical power was not strong enough to detect a possible association between BMI and FMS.
- This study used the TGMD-3 test which does not include a test for stability, one of the components of FMS.

Notwithstanding these limitations, the results of this study remain pertinent and contribute to the gap in research regarding the knowledge of FMS, PA and BMI of grade 1 learners residing in a low-income community of Gqeberha, as well as the correlations between these variables.

5.7. RECOMMENDATIONS

- PE should be purposefully taught at schools so that children are allowed structured opportunities for the development and mastery of developmentally appropriate FMS. Although part of the Life Skills learning area in the Foundation Phase curriculum, PE is often neglected in schools situated in disadvantaged settings. Local Departments of Education should conduct regular monitoring and evaluations to ensure PE is not neglected at schools within these communities.
- In-service training of foundation phase teachers is needed (through accredited short learning programmes) on the theory of motor development and FMS, as well as on the effective delivery of quality PE lessons that promote skills development and the teaching of FMS. Simultaneously, the pre-service training of teachers should ensure that prospective teachers are adequately trained to deliver quality PE to support the development and mastery of developmentally appropriate FMS.
- Schools should be provided with the necessary facilities and equipment to support the teaching of quality PE in under-resourced settings.

- Longitudinal studies are needed to investigate the effect of school-based long-term PA interventions on children’s FMS proficiency, across the range of socioeconomic settings and tracking progress from the start to the end of primary school. Establishing these long-term partnerships will primarily benefit schools in low-income communities by providing ongoing support for PE delivery, access to structured activity programs, and professional development opportunities for teachers. Moreover, schools will receive the necessary resources and insights to sustain effective PE practices beyond the research timeframe, fostering lasting educational and health benefits for children.

REFERENCES

Abutabenjeh, S. & Jaradat, R. 2018. Clarification of research design, research methods, and research methodology: A guide for public administration researchers and practitioners. *Teaching Public Administration*. 36(3):237–258. DOI: 10.1177/0144739418775787.

Africa, E., Duncan, M. & Bath, L. 2024. Fundamental movement skill proficiency of selected South African Montessorian pre-schoolers. *Journal of Early Childhood Research*. 22(4):1–12. DOI: 10.1177/1476718X241241141.

Aggarwal, R. & Ranganathan, P. 2019. Study designs: Part 2 - Descriptive studies. *Perspectives in Clinical Research*. 10(1):34–36. DOI: 10.4103/picr.PICR_154_18.

American College of Sports Medicine. 2021. *ACSM'S Guidelines for Exercise Testing and Prescription*. 11th ed. Lippincott Williams & Wilkins.

Androutsos, O. & Zampelas, A. 2022. Body Composition in Children: What Does It Tell Us So Far? *Children*. 9(8):1199. DOI: 10.3390/children9081199.

Arundell, L., Ridgers, N.D., Veitch, J., Salmon, J., Hinkley, T. & Timperio, A. 2013. 5-year changes in afterschool physical activity and sedentary behavior. *American Journal of Preventive Medicine*. 44(6):605–611. DOI: 10.1016/j.amepre.2013.01.029.

Aubert, S., Barnes, J.D., Abdeta, C., Nader, P.A., Adeniyi, A.F., Aguilar-Farias, N., Tenesaca, D.S.A., Bhawra, J., Brazo-Sayavera, J., Cardon, G., Chang, C.K., Delisle Nyström, C., Demetriou, Y., Draper, C.E., Edwards, L., Emeljanovas, A., Gába, A., Galaviz, K.I., González, S.A., Herrera-Cuenca, M., Huang, W.Y., Ibrahim, I.A.E., Jürimäe, J., Kämppi, K., Katapally, T.R., Katewongsa, P., Katzmarzyk, P.T., Khan, A., Korcz, A., Kim, Y.S., Lambert, E., Lee, E.Y., Löf, M., Loney, T., López-Taylor, J., Liu, Y., Makaza, D., Manyanga, T., Mileva, B., Morrison, S.A., Mota, J., Nyawornota, V.K., Ocansey, R., Reilly, J.J., Roman-Viñas, B., Silva, D.A.S., Saonuam, P., Scriven, J., Seghers, J., Schranz, N., Skovgaard, T., Smith, M., Standage, M., Starc, G., Stratton, G., Subedi, N., Takken, T., Tammelin, T., Tanaka, C., Thivel, D., Tladi, D., Tyler, R., Uddin, R., Williams, A., Wong, S.H.S., Wu, C.L., Zembura, P. & Tremblay, M.S. 2022. Global Matrix 4.0 Physical Activity Report Card Grades for Children and Adolescents: Results and Analyses From 57 Countries. *Journal of Physical Activity and Health*. 19(11):700–728.

Baard, M. & McKersie, J.M. 2014. Body mass index and associated physical activity levels in 7 - 10-year-old children in primary schools in Port Elizabeth. *South African Journal of Sports Medicine*. 26(4):115–118. DOI: 10.7196/sajsm.551.

Bardid, F., Huyben, F., Lenoir, M., Seghers, J., De Martelaer, K., Goodway, J.D. & Deconinck, F.J.A. 2016. Assessing fundamental motor skills in Belgian children aged 3-8 years highlights differences to US reference sample. *Acta Paediatrica, International Journal of Paediatrics*. 105(6):281–290. DOI: 10.1111/apa.13380.

Bardid, F., Vannozzi, G., Logan, S.W., Hardy, L.L. & Barnett, L.M. 2019. A hitchhiker's guide to assessing young people's motor competence: Deciding what method to use. *Journal of Science and Medicine in Sport*. 22(3):311–318. DOI: 10.1016/j.jsams.2018.08.007.

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. *Journal of Adolescent Health*. 44(1):252–259. DOI: 10.1016/j.jadohealth.2008.07.004.

Barnett, L.M., Lai, S.K., Veldman, S.L.C., Hardy, L.L., Cliff, D.P., Morgan, P.J., Zask, A., Lubans, D.R., Shultz, S.P., Ridgers, N.D., Rush, E., Brown, H.L. & Okely, A.D. 2016. Correlates of Gross Motor Competence in Children and Adolescents: A Systematic Review and Meta-Analysis. *Sports Medicine*. 46(11):1–26. DOI: 10.1007/s40279-016-0495-z.

Barreira, T. V, Schuna, J.M., Tudor-Locke, C., Chaput, J.-P., Church, T.S., Fogelholm, M., Hu, G., Kuriyan, R., Kurpad, A., Lambert, E. V, Maher, C., Maia, J., Matsudo, V., Olds, T., Onywera, V., Sarmiento, O.L., Standage, M., Tremblay, M.S., Zhao, P. & Katzmarzyk, P.T. 2015. Reliability of accelerometer-determined physical activity and sedentary behavior in school-aged children: a 12-country study. *International Journal of Obesity Supplements*. 5(2):29–35. DOI: 10.1038/ijosup.2015.16.

Barros, W.M.A., Silva, K.G. da, Silva, R.K.P., Souza, A.P. da S., Silva, A.B.J. da, Silva, M.R.M., Fernandes, M.S. de S., Souza, S.L. de & Souza, V. de O.N. 2022. Effects of Overweight/Obesity on Motor Performance in Children: A Systematic Review. *Frontiers in Endocrinology*. 12:1–14. DOI: 10.3389/fendo.2021.759165.

Bolger, L.A., Bolger, L.E., O'Neill, C., Coughlan, E., Lacey, S., O'Brien, W. & Burns, C. 2019. Fundamental Movement Skill Proficiency and Health Among a Cohort of Irish Primary School Children. *Research Quarterly for Exercise and Sport*. 90(1):24–35. DOI: 10.1080/02701367.2018.1563271.

Bolger, L.E., Bolger, L.A., Neill, C.O., Coughlan, E., O'Brien, W., Lacey, S. & Burns, C. 2018. Age and sex differences in fundamental movement skills among a cohort of Irish school children. *Journal of Motor Learning and Development*. 6(1):81–100. DOI: 10.1123/jmld.2017-0003.

Bolger, L.E., Bolger, L.A., O'Neill, C., Coughlan, E., O'Brien, W., Lacey, S., Burns, C. & Bardid, F. 2020. Global levels of fundamental motor skills in children: A systematic review. *Journal of Sports Sciences*. 39(7):717–753. DOI: 10.1080/02640414.2020.1841405.

Bonney, E., Ferguson, G. & Smits-Engelsman, B. 2018. Relationship between body mass index, cardiorespiratory and musculoskeletal fitness among south african adolescent girls. *International Journal of Environmental Research and Public Health*. 15(6):1087. DOI: 10.3390/ijerph15061087.

Bruijns, B.A., Truelove, S., Johnson, A.M., Gilliland, J. & Tucker, P. 2020. Infants' and toddlers' physical activity and sedentary time as measured by accelerometry: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*. 17:1–14. DOI: 10.1186/s12966-020-0912-4.

Bruininks, R.. & Bruininks, B.. 2005. *Bruininks-Oseretsky Test of Motor Proficiency*. second ed. AGS Publishing.

Bryant, E.S., Duncan, M.J. & Birch, S.L. 2014. Fundamental movement skills and weight status in British primary school children. *European Journal of Sport Science*. 14(7):730–736. DOI: 10.1080/17461391.2013.870232.

Burkholder, G.J., Cox, K.A., Crawford, L.M. & Hitchcock, J.H. 2019. *Research Design and Methods: An Applied Guide for the Scholar-Practitioner*. SAGE Publications.

Capio, C.M., Sit, C.H.P., Eguia, K.F., Abernethy, B. & Masters, R.S.W. 2015. Fundamental movement skills training to promote physical activity in children with and without disability:

A pilot study. *Journal of Sport and Health Science*. 4(3):235–243. DOI: 10.1016/j.jshs.2014.08.001.

Carson, V., Rinaldi, R.L., Torrance, B., Maximova, K., Ball, G.D.C., Majumdar, S.R., Plotnikoff, R.C., Veugelers, P., Boulé, N.G., Wozny, P., McCargar, L., Downs, S., Daymont, C., Lewanczuk, R. & McGavock, J. 2014. Vigorous physical activity and longitudinal associations with cardiometabolic risk factors in youth. *International Journal of Obesity*. 38(1):16–21. DOI: 10.1038/ijo.2013.135.

Caspersen, C.J., Powell, K.E. & Christenson, G.M. 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health reports (Washington, D.C.: 1974)*. 100(2):126–31. Available: http://www.ncbi.nlm.nih.gov/pubmed/3920711.

Cattuzzo, M.T., dos Santos Henrique, R., Ré, A.H.N., de Oliveira, I.S., Melo, B.M., de Sousa Moura, M., de Araújo, R.C. & Stodden, D. 2016. Motor competence and health related physical fitness in youth: A systematic review. *Journal of Science and Medicine in Sport*. 19(2):123–129. DOI: 10.1016/j.jsams.2014.12.004.

Cech, D. & Martin, S.T. 2012. *Functional Movement Development Across the Life Span*. Third ed. DOI: 10.1016/C2009-0-60730-3.

Charlton, R., Gravenor, M.B., Rees, A., Knox, G., Hill, R., Rahman, M.A., Jones, K., Christian, D., Baker, J.S., Stratton, G. & Brophy, S. 2014. Factors associated with low fitness in adolescents - A mixed methods study. *BMC Public Health*. 14(1):1–10. DOI: 10.1186/1471-2458-14-764.

Christopher, A. 1987. Apartheid Planning in South Africa. *The Geographical Journal*. 153(2):195–204. Available: https://doi.org/10.2307/634871.

Cliff, D.P., Okely, A.D., Smith, L.M. & McKeen, K. 2009. Relationships between fundamental movement skills and objectively measured physical activity in preschool children. *Pediatric Exercise Science*. 21(4):436–449. DOI: 10.1123/pes.21.4.436.

Cohen, J. 1988. *Statistical power analysis for the behavioural sciences.* Second ed. Hillside: NJ: Lawrence Erlbaum Associates, Publishers.

Cohen, K.E., Morgan, P.J., Plotnikoff, R.C., Callister, R. & Lubans, D.R. 2014. Fundamental movement skills and physical activity among children living in low-income communities: A cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity*. 11(1):1–9. DOI: 10.1186/1479-5868-11-49.

Cook, C.J., Howard, S.J., Scerif, G., Twine, R., Kahn, K., Norris, S.A. & Draper, C.E. 2019. Associations of physical activity and gross motor skills with executive function in preschool children from low-income South African settings. *Developmental Science*. 22(5). DOI: 10.1111/desc.12820.

Cools, W., Martelaer, K. de, Samaey, C. & Andries, C. 2009. Movement skill assessment of typically developing preschool children: a review of seven movement skill assessment tools. *Journal of sports science & medicine*. 8(2):154–68. Available: http://www.ncbi.nlm.nih.gov/pubmed/24149522.

Cools, W., de Kristine, M., Samaey, C. & Andries, C. 2011. Fundamental movement skill performance of preschool children in relation to family context. *Journal of Sports*

Sciences. 29(7):649–660. DOI: 10.1080/02640414.2010.551540.

Crouter, S.E., Horton, M. & Bassett, D.R. 2013. Validity of ActiGraph child-specific equations during various physical activities. *Medicine and Science in Sports and Exercise*. 45(7):1403–1409. DOI: 10.1249/MSS.0b013e318285f03b.

Danquah, F.I., Ansu-Mensah, M., Bawontuo, V., Yeboah, M., Udoh, R.H., Tahiru, M. & Kuupiel, D. 2020. Risk factors and morbidities associated with childhood obesity in sub-Saharan Africa: A systematic scoping review. *BMC Nutrition*. 6:1–14. DOI: 10.1186/s40795-020-00364-5.

Darin-Mattsson, A., Fors, S. & Kåreholt, I. 2017. Different indicators of socioeconomic status and their relative importance as determinants of health in old age. *International Journal for Equity in Health*. 16(1):173. DOI: 10.1186/s12939-017-0670-3.

Deitz, J.C., Kartin, D. & Kopp, K. 2007. Review of the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2). *Physical and Occupational Therapy in Pediatrics*. 27(4):87–102. DOI: 10.1300/J006v27n04_06.

De Onis, M. & Lobstein, T. 2010. Defining obesity risk status in the general childhood population: Which cut-offs should we use? *International Journal of Pediatric Obesity*. 5(6):458–460. DOI: 10.3109/17477161003615583.

De Onis, M., Onyango, A.W., Borghi, E., Siyam, A., Nishida, C. & Siekmann, J. 2007. Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization*. 85(9):660–667. DOI: 10.2471/BLT.07.043497.

De Vos, A., Strydom, H., Fouche, C. & Delport, C. 2011. *Research at Grass Roots: For the Social Service Professions*. 4th ed. Pretoria.

de Waal, E. 2019. Fundamental Movement Skills and Academic Performance of 5- to 6-Year-Old Preschoolers. *Early Childhood Education Journal*. 47(6):455–464. DOI: 10.1007/s10643-019-00936-6.

de Waal, E. & Pienaar, A.E. 2021. Influences of persistent overweight on perceptual-motor proficiency of primary school children: the North-West CHILD longitudinal study: Persistent overweight and perceptual-motor proficiency in children. *BMC Pediatrics*. 21(1):1–10. DOI: 10.1186/s12887-021-02708-x.

Dobell, A., Pringle, A., Faghy, M.A. & Roscoe, C.M.P. 2020. Fundamental movement skills and accelerometer-measured physical activity levels during early childhood: A systematic review. *Children*. 7(11):1–26. DOI: 10.3390/children7110224.

Draper, C.E., Tomaz, S.A., Bassett, S.H., Burnett, C., Christie, C.J., Cozett, C., De Milander, M., Krog, S., Monyeki, A., Naidoo, N., Naidoo, R., Prioreschi, A., Walter, C., Watson, E. & Lambert, E. V. 2018. Results from South Africa's 2018 report card on physical activity for children and youth. *Journal of Physical Activity and Health*. 15(2):406–408. DOI: 10.1123/JPAH.2018-0517.

Draper, C.E., Tomaz, S.A., Jones, R.A., Hinkley, T., Twine, R., Kahn, K. & Norris, S.A. 2019. Cross-sectional associations of physical activity and gross motor proficiency with adiposity in South African children of pre-school age. *Public Health Nutrition*. 22(4):14–23. DOI: 10.1017/S1368980018003579.

Duncan, M.J., Roscoe, C.M.P., Faghy, M., Tallis, J. & Eyre, E.L.J. 2019. Estimating physical activity in children aged 8-11 years using accelerometry: Contributions from fundamental movement skills and different accelerometer placements. *Frontiers in Physiology*. 10(242):1–9. DOI: 10.3389/fphys.2019.00242.

Duncan, M.J., Roscoe, C.M.P., Noon, M., Clark, C.C.T., O'Brien, W. & Eyre, E.L.J. 2020. Run, jump, throw and catch: How proficient are children attending English schools at the fundamental motor skills identified as key within the school curriculum? *European Physical Education Review*. 26(4):1–13. DOI: 10.1177/1356336X19888953.

Duncan, M.J., Martins, C., Ribeiro Bandeira, P.F., Issartel, J., Peers, C., Belton, S., O'Connor, N.E. & Behan, S. 2022. TGMD-3 short version: Evidence of validity and associations with sex in Irish children. *Journal of Sports Sciences*. 40(2):138–145. DOI: 10.1080/02640414.2021.1978161.

Eyre, E.L.J., Adeyemi, L.J., Cook, K., Noon, M., Tallis, J. & Duncan, M. 2022. Barriers and Facilitators to Physical Activity and FMS in Children Living in Deprived Areas in the UK: Qualitative Study. *International Journal of Environmental Research and Public Health*. 19(3):1–17. DOI: 10.3390/ijerph19031717.

Faber, M., Laurie, S., Maduna, M., Magudulela, T. & Muehlhoff, E. 2014. Is the school food environment conducive to healthy eating in poorly resourced South African schools? *Public Health Nutrition*. 17(6):1214–1223. DOI: 10.1017/S1368980013002279.

Field, S.C., Esposito Bosma, C.B. & Temple, V.A. 2019. Comparability of the test of gross motor development-second edition and the test of gross motor development-third edition. *Journal of Motor Learning and Development*. 8(1):107–125. DOI: 10.1123/jmld.2018-0058.

Foweather, L., Knowles, Z., Ridgers, N.D., O'Dwyer, M. V., Foulkes, J.D. & Stratton, G. 2015. Fundamental movement skills in relation to weekday and weekend physical activity in preschool children. *Journal of Science and Medicine in Sport*. 18(6):691–696. DOI: 10.1016/j.jsams.2014.09.014.

Francis, D. & Webster, E. 2019. Poverty and inequality in South Africa: critical reflections. *Development Southern Africa*. 36(6):788–802. DOI: 10.1080/0376835X.2019.1666703.

Freedson, P.S., Melanson, E. & Sirard, J. 1998. Calibration of the Computer Science and Applications, Inc. accelerometer. *Medicine and Science in Sports and Exercise*. 30(5):777–781. DOI: 10.1097/00005768-199805000-00021.

Gabbard, C. 2011. *Lifelong motor development*. 6th Editio ed. W.. Brown (ed.).

Gallahue, D.L. & Ozmun, J.C. 2006. *Understanding Motor Development: Infants, Children, Adolescents, Adults*. sixth ed. New York: McGraw-Hill.

Gallahue, D.L., Ozmun, J.C. & Goodway, J.D. 2012. *Understanding motor development: infants, children, adolescents, adults*. Seventh ed ed. Boston (MA): McGraw-Hill.

Garn, A.C. & Webster, E.K. 2021. Bifactor structure and model reliability of the Test of Gross Motor Development — 3rd edition. *Journal of Science and Medicine in Sport*. 24(1):67–73. DOI: 10.1016/j.jsams.2020.08.009.

Gerber, M., Ayekoé, S.A., Beckmann, J., Bonfoh, B., Kouassi, K.B., Gba, B.C., Traoré, S.G., Coulibaly, J.T., Daouda, D., du Randt, R., Finda, M.F., Minja, E.G., Gall, S., Mollel, G.J., Lang, C., Long, K.Z., Masanja, H., Müller, I., Nqweniso, S., Okumu, F.O., Probst-Hensch, N., Pühse, U., Steinmann, P., Walter, C. & Utzinger, J. 2021. Moderate-to-Vigorous Physical Activity Is Associated With Cardiorespiratory Fitness Among Primary Schoolchildren Living in Côte d'Ivoire, South Africa, and Tanzania. *Frontiers in Public Health*. 9:1–15. DOI: 10.3389/fpubh.2021.671782.

Gerber, M., Lang, C., Beckmann, J., du Randt, R., Long, K.Z., Müller, I., Nienaber, M., Probst-Hensch, N., Steinmann, P., Pühse, U., Utzinger, J., Nqweniso, S. & Walter, C. 2022. Physical Activity, Sedentary Behaviour, Weight Status, and Body Composition among South African Primary Schoolchildren. *International Journal of Environmental Research and Public Health*. 19(18):1–16. DOI: 10.3390/ijerph191811836.

Girish, M., Bhattad, S., Ughade, S., Mujawar, N. & Gaikwad, K. 2014. Physical activity as a clinical tool in the assessment of malnutrition. *Indian Pediatrics*. 51(6):478–480. DOI: 10.1007/s13312-014-0431-y.

Gomwe, H., Seekoe, E., Lyoka, P., Marange, C.S. & Mafa, D. 2022. Physical activity and sedentary behaviour of primary school learners in the Eastern Cape province of South Africa. *South African Family Practice*. 64(1):1–8. DOI: 10.4102/safp.v64i1.5381.

González-álvarez, M.A., Lázaro-Alquézar, A. & Simón-Fernández, M.B. 2020. Global trends in child obesity: Are figures converging? *International Journal of Environmental Research and Public Health*. 17(24):1–20. DOI: 10.3390/ijerph17249252.

Goodway, J.D., Ozmun, J.C. & Gallahue, D.L. 2019. *Understanding Motor Development: Infants, Children, Adolescents, Adults*. Eighth ed. Jones & Bartlett Learning.

Gordon, T., Booysen, F. & Mbonigaba, J. 2020. Socio-economic inequalities in the multiple dimensions of access to healthcare: The case of South Africa. *BMC Public Health*. 20(1):1–13. DOI: 10.1186/s12889-020-8368-7.

Govender, I., Rangiah, S., Kaswa, R. & Nzaumvila, D. 2021. Erratum to: Malnutrition in children under the age of 5 years in a primary health care setting (S Afr Fam Pract. 2021;63(1), a5337. 10.4102/safp.v63i1.5337). *South African Family Practice*. 63(1):1–7. DOI: 10.4102/SAFP.V63I1.5416.

Gu, X. 2016. Fundamental motor skill, physical activity, and sedentary behavior in socioeconomically disadvantaged kindergarteners. *Psychology, Health and Medicine*. 21(7):871–881. DOI: 10.1080/13548506.2015.1125007.

Hadwin, K.J., Wood, G., Payne, S., Mackintosh, C. & Par, J.V.V. 2023. Strengths and weaknesses of the MABC-2 as a diagnostic tool for developmental coordination disorder: An online survey of occupational therapists and physiotherapists. *PLoS ONE*. 18(6):1–12. DOI: 10.1371/journal.pone.0286751.

Hall, C.J.S., Eyre, E.L.J., Oxford, S.W. & Duncan, M.J. 2018. Relationships between motor competence, physical activity, and obesity in British preschool aged children. *Journal of Functional Morphology and Kinesiology*. 3(4):1–8. DOI: 10.3390/jfmk3040057.

Hänggi, J.M., Phillips, L.R.S. & Rowlands, A. V. 2013. Validation of the GT3X ActiGraph in children and comparison with the GT1M ActiGraph. *Journal of Science and Medicine in Sport*. 16(1):40–44. DOI: 10.1016/j.jsams.2012.05.012.

Hardy, L.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/j.jsams.2009.05.010.

Hills, A.P., King, N.A. & Armstrong, T.P. 2007. The contribution of physical activity and sedentary behaviours to the growth and development of children and adolescents: Implications for overweight and obesity. *Sports Medicine*. 37(6):533–545. DOI: 10.2165/00007256-200737060-00006.

Hlatshwayo, M., Dloto, A. & Mutekwe, P. 2023. THE SOLIDARITY ECONOMY OF MARGINALIZED COMMUNITIES IN SOUTH AFRICA: AN ANALYSIS OF BUYING AND SAVINGS CLUBS IN GQEBERHA. *Journal of Management : Small and Medium Enterprises (SMEs)*. 16(3):441–457. DOI: 10.35508/jom.v16i3.11452.

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(4):383–391. DOI: 10.1016/j.psychsport.2014.03.005.

Van Der Horst, K., Paw, M.J.C.A., 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(8):1241–1250. DOI: 10.1249/mss.0b013e318059bf35.

Idamokoro, M., Pienaar, A.E., Gerber, B. & van Gent, M.M. 2024. Positive effects of a 9-week programme on fundamental movement skills of rural school children. *South African Journal of Childhood Education*. 14(1):1–15. DOI: 10.4102/sajce.v14i1.1497.

IOM (Institute of Medicine). 2013. Educating the Student Body: Taking Physical Activity and Physical Education to School, in H.W.I. Kohl & H.D. Cook (eds.). *National Academies Press*, Washington (DC): National Academies Press (US). 98–103.

Jírovec, J., Musálek, M. & Mess, F. 2019. Test of motor proficiency second edition (BOT-2): Compatibility of the complete and short form and its usefulness for middle-age school children. *Frontiers in Pediatrics*. 7(153):1–7. DOI: 10.3389/fped.2019.00153.

Joschtel, B., Gomersall, S.R., Tweedy, S., Petsky, H., Chang, A.B. & Trost, S.G. 2021. Fundamental movement skill proficiency and objectively measured physical activity in children with bronchiectasis: a cross-sectional study. *BMC Pulmonary Medicine*. 21(6):1–7. DOI: 10.1186/s12890-021-01637-w.

Kahts, S.., du Randt, R. & Venter, D. 2017. Body mass index and fundamental movement skill proficiency in South African girls of lower socio-economic status. *African Journal for Physical Activity and Health Sciences*. 1(1):32–43. Available: https://hdl.handle.net/10520/EJC-c19a198be%0APDF%0A.

Kambas, A. & Aggeloussis, N. 2006. Construct validity of the Bruininks-Oseretsky Test of Motor Proficiency-short form for a sample of greek preschool and primary school children. *Perceptual and Motor Skills*. 102(1):65–72. DOI: 10.2466/PMS.102.1.65-72.

Kambas, A., Michalopoulou, M., Fatouros, I.G., Christoforidis, C., Manthou, E., Giannakidou, D., Venetsanou, F., Haberer, E., Chatzinikolaou, A., Gourgoulis, V. & Zimmer, R. 2012. The relationship between motor proficiency and pedometer-determined physical activity in young children. *Pediatric Exercise Science*. 24(1):34–44. DOI: 10.1123/pes.24.1.34.

Kemp, C. & Pienaar, A.E. 2013. Relationship between the body composition and motor and physical competence of Grade 1 learners in South Africa. *Journal of Sports Medicine and Physical Fitness*. 53(6):635–643. Available: http://hdl.handle.net/10394/14443.

Khalaj, N. & Amri, S. 2014. Mastery of gross motor skills in preschool and early elementary school obese children. *Early Child Development and Care*. 184(5):795–802. DOI: 10.1080/03004430.2013.820724.

Kuritz, A., Mall, C., Schnitzius, M. & Mess, F. 2020. Physical Activity and Sedentary Behavior of Children in Afterschool Programs: An Accelerometer-Based Analysis in Full-Day and Half-Day Elementary Schools in Germany. *Frontiers in Public Health*. 8:1–10. DOI: 10.3389/fpubh.2020.00463.

Kuriyan, R. 2018. Body composition techniques. *Indian Journal of Medical Research*. 148(5):648–658. DOI: 10.4103/ijmr.IJMR_1777_18.

Lander, N., Eather, N., Morgan, P.J., Salmon, J. & Barnett, L.M. 2017. Characteristics of Teacher Training in School-Based Physical Education Interventions to Improve Fundamental Movement Skills and/or Physical Activity: A Systematic Review. *Sports Medicine*. 47(1):135–161. DOI: 10.1007/s40279-016-0561-6.

Lawson, C., Eyre, E.L.J., Tallis, J. & Duncan, M.J. 2021. Fundamental Movement Skill Proficiency Among British Primary School Children: Analysis at a Behavioral Component Level. *Perceptual and Motor Skills*. 128(2):625–648. DOI: 10.1177/0031512521990330.

Legbara, K. & Selepe, M. 2017. Nutrition knowledge of food handlers for National School Nutrition Programme (NSNP) in Esikhaleni and Kwa- Dlangezwa schools. *African Journal of Hospitality, Tourism and Leisure*. 6(4):1–14. Available: http://www.ajhtl.com.

Lobstein, T. & Brinsden, H. 2019. *Atlas of childhood obesity*. Available: https://www.worldobesity.org/membersarea/global-atlas-on-childhood-obesity [2024, November 29].

Logan, S.W., Scrabis-Fletcher, K., Modlesky, C. & Getchell, N. 2011. The relationship between motor skill proficiency and body mass index in preschool children. *Research Quarterly for Exercise and Sport*. 82(3):442–448. DOI: 10.1080/02701367.2011.10599776.

Logan, S.W., Ross, S.M., Chee, K., Stodden, D.F. & Robinson, L.E. 2018. Fundamental motor skills: A systematic review of terminology. *Journal of Sports Sciences*. 36(7):781–796. DOI: 10.1080/02640414.2017.1340660.

Lynch, B.A., Kaufman, T.K., Rajjo, T.I., Mohammed, K., Kumar, S., Murad, M.H., Gentile, N.E., Koepp, G.A., McCrady-Spitzer, S.K. & Levine, J.A. 2019. Accuracy of Accelerometers for Measuring Physical Activity and Levels of Sedentary Behavior in Children: A Systematic Review. *Journal of Primary Care and Community Health*. 10(1):1–8. DOI: 10.1177/2150132719874252.

Macagnano, E. V. 2002. Peri-urban areas of South African cities: Innovative technologies for sustainability, in C. Brebbia, J. Martin-Duque, & L. Wadhwa (eds.). *Advances in Architecture Series*. 153–162. DOI: 10.2495/URS020151.

Maguire, E.R., Burgoine, T., Penney, T.L., Forouhi, N.G. & Monsivais, P. 2017. Does exposure to the food environment differ by socioeconomic position? Comparing area-based and person-centred metrics in the Fenland Study, UK. *International Journal of Health Geographics*. 16(1):33. DOI: 10.1186/s12942-017-0106-8.

Maïano, C., Morin, A.J.S., April, J., Webster, E.K., Hue, O., Dugas, C. & Ulrich, D. 2022. Psychometric Properties of a French-Canadian Version of the Test of Gross Motor

Development-Third Edition (TGMD-3): A Bifactor Structural Equation Modeling Approach. *Measurement in Physical Education and Exercise Science*. 26:51–62. DOI: 10.1080/1091367X.2021.1946541.

Masanovic, B., Gardasevic, J., Marques, A., Peralta, M., Demetriou, Y., Sturm, D.J. & Popovic, S. 2020. Trends in Physical Fitness Among School-Aged Children and Adolescents: A Systematic Review. *Frontiers in Pediatrics*. 8(1):1–11. DOI: 10.3389/fped.2020.627529.

Mast, M., Körtzinger, I., König, E. & Müller, M.J. 1998. Gender differences in fat mass of 5-7-year old children. *International Journal of Obesity*. 22(9):878–884. DOI: 10.1038/sj.ijo.0800675.

May, J., Witten, C. & Lake, L. 2020. *Food and nutrition security: South African Child Gauge 2020.* DOI: 10.4018/978-1-7998-9586-2.ch014.

McNamee, M. 2001. Introduction: Whose Ethics, Which Research? *Journal of the Philosophy of Education*. 35(3):309–327. DOI: 10.1111/1467-9752.00229.

Mistry, K.B., Minkovitz, C.S., Riley, A.W., Johnson, S.B., Grason, H.A., Dubay, L.C. & Guyer, B. 2012. A new framework for childhood health promotion: The role of policies and programs in building capacity and foundations of early childhood health. *American Journal of Public Health*. 102(9):1688–1696. DOI: 10.2105/AJPH.2012.300687.

Mitchell, J.A., Dowda, M., Pate, R.R., Kordas, K., Froberg, K., Sardinha, L.B., Kolle, E. & Page, A. 2017. Physical Activity and Pediatric Obesity: A Quantile Regression Analysis. *Medicine and Science in Sports and Exercise*. 49(3):466–473. DOI: 10.1249/MSS.0000000000001129.

Modjadji, P. & Madiba, S. 2019. The double burden of malnutrition in a rural health and demographic surveillance system site in South Africa: A study of primary schoolchildren and their mothers. *BMC Public Health*. 19(1):1–11. DOI: 10.1186/s12889-019-7412-y.

Mohammadi, F., Bahram, A., Khalaji, H. & Ghadiri, F. 2017. Determining Motor Development Status of 3-10 years old Children in Ahvaz City Using TGMD-3 Test. *International Journal of Basic Science in Medicine*. 2(3):139–146. DOI: 10.15171/ijbsm.2017.26.

Monyeki, M.A. 2014. Physical activity and health in children: How much do we know? *African Journal for Physical, Health Education, Recreation & Dance*. 20(21):323–342. Available: https://hdl.handle.net/10520/EJC155189.

Moore, J.B., Beets, M.W., Kaczynski, A.T., Besenyi, G.M., Morris, S.F. & Kolbe, M.B. 2014. Sex moderates associations between perceptions of the physical and social environments and physical activity in youth. *American Journal of Health Promotion*. 29(2):132–135. DOI: 10.4278/ajhp.121023-ARB-516.

Morano, M., Colella, D. & Caroli, M. 2011. Gross motor skill performance in a sample of overweight and non-overweight preschool children. *International Journal of Pediatric Obesity*. 6(2):42–46. DOI: 10.3109/17477166.2011.613665.

Morley, D., Till, K., Ogilvie, P. & Turner, G. 2015. Influences of gender and socioeconomic status on the motor proficiency of children in the UK. *Human Movement Science*. 44:150–156. DOI: 10.1016/j.humov.2015.08.022.

Morris, A. 1998. Continuity or rupture: The City, post-apartheid. *Social Research*. 65(4):759–775. Available: https://www.jstor.org/stable/40971286.

Moselakgomo, V.K., Monyeki, M.A. & Toriola, A.L. 2014. Physical activity, body composition and physical fitness status of primary school children in Mpumalanga and Limpopo provinces of South Africa. *African Journal for Physical*. 20(2:1):343–356. Available: http://hdl.handle.net/10394/15263.

Moyo, C., Mishi, S. & Ncwadi, R. 2022. Human capital development, poverty and income inequality in the Eastern Cape province. *Development Studies Research*. 9(1):36–47. DOI: 10.1080/21665095.2022.2032236.

Mukherjee, S., Ting Jamie, L.C. & Fong, L.H. 2017. Fundamental Motor Skill Proficiency of 6- to 9-Year-Old Singaporean Children. *Perceptual and Motor Skills*. 124(3):584–600. DOI: 10.1177/0031512517703005.

Müller, I., Schindler, C., Adams, L., Endes, K., Gall, S., Gerber, M., Htun, N.S.N., Nqweniso, S., Joubert, N., Probst-Hensch, N., du Randt, R., Seelig, H., Smith, D., Steinmann, P., Utzinger, J., Yap, P., Walter, C. & Pühse, U. 2019. Effect of a multidimensional physical activity intervention on body mass index, skinfolds and fitness in south african children: Results from a cluster-randomised controlled trial. *International Journal of Environmental Research and Public Health*. DOI: 10.3390/ijerph16020232.

Myer, L., Ehrlich, R.I. & Susser, E.S. 2004. Social epidemiology in South Africa. *Epidemiologic Reviews*. 26:112–123. DOI: 10.1093/epirev/mxh004.

Nagy, Á.V., Wilhelm, M., Domokos, M., Győri, F. & Berki, T. 2023. Assessment Tools Measuring Fundamental Movement Skills of Primary School Children: A Narrative Review in Methodological Perspective. *Sports*. 11(9):1–15. DOI: 10.3390/sports11090178.

Naidoo, R., Christie, C.J., Lambert, E., Nyawose, Z., Bassett, S., Monyeki, A., Janse van Rensburg, C., Cozett, C., Naidoo, N. & Gradidge, P. 2022. *Healthy Active Kids South Africa 2022 Report Card.* Available: https://www.activehealthykids.org/south-africa/.

Ndhlovu, G.N. & Tanga, P.T. 2021. Youth and Gang Violence in African Townships: Exploring the Link to Exclusion from Recreational Facilities. *Southern African Journal of Social Work and Social Development*. 33(3):687. DOI: 10.25159/2415-5829/7687.

Newell, K.M. 1986. Constraints on the Development of Coordination, in M.. Wade & H.T.. Whiting (eds.). *Motor Development in Children: Aspects of Coordination and Control*, Amsterdam. 341–360. DOI: 10.1007/978-94-009-4460-2_19.

Nilsen, A.K.O., Anderssen, S.A., Loftesnes, J.M., Johannessen, K., Ylvisaaker, E. & Aadland, E. 2020. The multivariate physical activity signature associated with fundamental motor skills in preschoolers. *Journal of Sports Sciences*. 38(3):264–272. DOI: 10.1080/02640414.2019.1694128.

Noor, S., Tajik, O. & Golzar, J. 2022. Simple Random Sampling. *International Journal of Education & Language Studies*. 1(2):78–82. DOI: 10.22034/ijels.2022.162982.

Nqweniso, S., du Randt, R., Adams, L., Degen, J., Gall, S., Gerber, M., Joubert, N., Müller, I., Smith, D., Seelig, H., Steinmann, P., Probst-Hensch, N., Utzinger, J., Pühse, U. & Walter, C. 2021. Effect of school-based interventions on body composition of grade-4 children from lower socioeconomic communities in Gqeberha, South Africa. *SAJCH South African Journal of Child Health*. 15(2):89–98. DOI: 10.7196/SAJCH.2021.v15.i2.1762.

Nqweniso, S., Walter, C., du Randt, R., Adams, L., Beckmann, J., Degen, J., Gall, S., Joubert, N., Lang, C., Long, K.Z., Müller, I., Nienaber, M., Pühse, U., Seelig, H., Smith, D., Steinmann, P., Utzinger, J. & Gerber, M. 2021. Physical activity, cardiorespiratory fitness and clustered cardiovascular risk in south African primary schoolchildren from disadvantaged communities: A cross-sectional study. *International Journal of Environmental Research and Public Health*. 18(4):2080. DOI: 10.3390/ijerph18042080.

Palmer, K.K., Chinn, K.M., Scott-Andrews, K.Q. & Robinson, L.E. 2021. An Intervention-Related Comparison of Preschoolers' Scores on the TGMD-2 and TGMD-3. *Perceptual and Motor Skills*. 128(4):1354–1372. DOI: 10.1177/00315125211013217.

Parrish, A.M., Tremblay, M.S., Carson, S., Veldman, S.L.C., Cliff, D., Vella, S., Chong, K.H., Nacher, M., Del Pozo Cruz, B., Ellis, Y., Aubert, S., Spaven, B., Sameeha, M.J., Zhang, Z. & Okely, A.D. 2020. Comparing and assessing physical activity guidelines for children and adolescents: A systematic literature review and analysis. *International Journal of Behavioral Nutrition and Physical Activity*. 17(1):1–22. DOI: 10.1186/s12966-020-0914-2.

Pienaar, A.E. & Kemp, C. 2014. Motor proficiency profile of grade 1 learners in the North West province of South Africa: NW-child study. *South African Journal for Research in Sport, Physical Education and Recreation*. 36(1):167–182. Available: https://hdl.handle.net/10520/EJC151472.

Pienaar, A.E., van Reenen, I. & Weber, A.M. 2016. Sex differences in fundamental movement skills of a selected group of 6-year-old South African children. *Early Child Development and Care*. 186(12):1994–2008. DOI: 10.1080/03004430.2016.1146263.

Pienaar, A.E., Monyeki, M.A., Coetzee, D., Gerber, B., du Plessis, W., du Plessis, A.M. & Kruger, R. 2022. Age and Sex Differences in the State and Relationships between Process and Product Assessments of Fundamental-Motor Skills in Five to Eight-Year-Olds: The ExAMIN Youth SA Study. *International Journal of Environmental Research and Public Health*. 19:1–17. DOI: 10.3390/ijerph19159565.

Popkin, B.M., Barquera, S., Corvalan, C., Hofman, K.J., Monteiro, C., Ng, S.W., Swart, E.C. & Taillie, L.S. 2021. Towards unified and impactful policies to reduce ultra-processed food consumption and promote healthier eating. *The Lancet Diabetes and Endocrinology*. 9(7):462–470. DOI: 10.1016/S2213-8587(21)00078-4.

Qi, J., Yan, Y. & Yin, H. 2023. Screen time among school-aged children of aged 6–14: a systematic review. *Global Health Research and Policy*. 12(1):1–19. DOI: 10.1186/s41256-023-00297-z.

Rajput, D. & Van Deventer, K. 2010. An epoch of controversy within physical education and sport in post-apartheid South Africa: A review. *African Journal for Physical, Health Education, Recreation and Dance*. 16(1):140–158. DOI: 10.4314/ajpherd.v16i1.53322.

Rao, A.K. & Einstein, A. 2006. Cognition and Motor Skills, in A. Henderson & C. Pehoski (eds.). *Hand Function in the Child: Foundations for Remediation*, second edi ed. 101–113. DOI: 10.1016/B978-032303186-8.50009-5.

Remmers, T., Koolwijk, P., Fassaert, I., Nolles, J., de Groot, W., Vos, S.B., de Vries, S.I., Mombarg, R. & Van Kann, D.H.H. 2024. Investigating young children's physical activity through time and place. *International Journal of Health Geographics*. 23(1):1–13. DOI: 10.1186/s12942-024-00373-8.

Renault, F. & Quesada, R. 1993. Muscle complications of malnutrition in children: a clinical and electromyographic study. *Neurophysiologie Clinique / Clinical Neurophysiology*. 23(4):371–380. DOI: 10.1016/S0987-7053(05)80128-5.

Rey, E., Carballo-Fazanes, A., Varela-Casal, C. & Abelairas-Gómez, C. 2020. Reliability of the test of gross motor development: A systematic review. *PLoS ONE*. 15(7):1–26. DOI: 10.1371/journal.pone.0236070.

Ridgers, N.D., Stratton, G. & Fairclough, S.J. 2006. Physical activity levels of children during school playtime. *Sports Medicine*. 36(4):359–371. DOI: 10.2165/00007256-200636040-00005.

Roberton, M.A. 1989. Motor development: Recognizing our roots, charting our future. *Quest*. 41(3):213–223. DOI: 10.1080/00336297.1989.10483971.

Rowlands, A. V. 2007. Accelerometer assessment of physical activity in children: An update. *Pediatric Exercise Science*. 19(3):252–266. DOI: 10.1123/pes.19.3.252.

Salvini, M., Gall, S., Müller, I., Walter, C., du Randt, R., Steinmann, P., Utzinger, J., Pühse, U. & Gerber, M. 2018. Physical activity and health-related quality of life among schoolchildren from disadvantaged neighbourhoods in Port Elizabeth, South Africa. *Quality of Life Research*. 27(1):205–216. DOI: 10.1007/s11136-017-1707-1.

Sayed, Y. & Motala, S. 2012. Equity and “No Fee” Schools in South Africa: Challenges and Prospects. *Social Policy and Administration*. 46(6):672–687. DOI: 10.1111/j.1467-9515.2012.00862.x.

Seabra, A., Mendonça, D., Maia, J., Welk, G., Brustad, R., Fonseca, A.M. & Seabra, A.F. 2013. Gender, weight status and socioeconomic differences in psychosocial correlates of physical activity in schoolchildren. *Journal of Science and Medicine in Sport*. 16(4):320–326. DOI: 10.1016/j.jsams.2012.07.008.

Shah, B., Tombeau Cost, K., Fuller, A., Birken, C.S. & Anderson, L.N. 2020. Sex and gender differences in childhood obesity: Contributing to the research agenda. *BMJ Nutrition, Prevention and Health*. 3(2):387–390. DOI: 10.1136/bmjnph-2020-000074.

Shah, P.J., Boilson, M., Rutherford, M., Prior, S., Johnston, L., MacIver, D. & Forsyth, K. 2022. Neurodevelopmental disorders and neurodiversity: definition of terms from Scotland’s National Autism Implementation Team. *British Journal of Psychiatry*. 221:577–579. DOI: 10.1192/bjp.2022.43.

Shah, V. V., Brumbach, B.H., Pearson, S., Vasilyev, P., King, E., Carlson-Kuhta, P., Mancini, M., Horak, F.B., Sowalsky, K., McNames, J. & El-Gohary, M. 2023. Opal Actigraphy (Activity and Sleep) Measures Compared to ActiGraph: A Validation Study. *Sensors*. 23(4):1–13. DOI: 10.3390/s23042296.

Siahkouhian, M., Mahmoodi, H. & Salehi, M. 2011. Relationship between Fundamental Movement Skills and Body Mass Index in 7-To-8 Year-Old Children. *World Applied Sciences Journal*. 15(9):1354–1360.

Siervogel, R.M., Roche, A.F., Guo, S.M., Mukherjee, D. & Chumlea, W.C. 1991. Patterns of change in weight/stature2 from 2 to 18 years: findings from long-term serial data for children in the Fels longitudinal growth study. *International journal of obesity*. 15(7):479–85. Available: http://www.ncbi.nlm.nih.gov/pubmed/1845371.

Smits-Engelsman, B.C.M., Henderson, S.E. & Michels, C.G.J. 1998. The assessment of children with Developmental Coordination Disorders in the Netherlands: The relationship between the Movement Assessment Battery for Children and the Körperkoordinations Test für Kinder. *Human Movement Science*. 17(1):699–709. DOI: 10.1016/S0167-9457(98)00019-0.

Smits-Englesman, B., Verbecque, E., Denysschen, M. & Coetzee, D. 2022. Exploring Cultural Bias in Two Different Motor Competence Test Batteries When Used in African Children. *International Journal of Environmental Research and Public Health*. 19(11):1–13. DOI: 10.3390/ijerph19116788.

Statistics South Africa. 2003. Census 2001: Investigation into appropriate definitions of urban and rural areas for South Africa.

Statistics South Africa. 2024. *Quarterly Labour Force Survey-Quarter 1: 2024*. Available: https://www.statssa.gov.za/publications/P0211/Presentation QLFS Q1 2024.pdf.

Steene-Johannessen, J., Hansen, B.H., Dalene, K.E., Kolle, E., Northstone, K., Møller, N.C., Grøntved, A., Wedderkopp, N., Kriemler, S., Page, A.S., Puder, J.J., Reilly, J.J., Sardinha, L.B., Van Sluijs, E.M.F., Andersen, L.B., Van Der Ploeg, H., Ahrens, W., Flexeder, C., Standl, M., Shculz, H., Moreno, L.A., De Henauw, S., Michels, N., Cardon, G., Ortega, F.B., Ruiz, J., Aznar, S., Fogelholm, M., Decelis, A., Olesen, L.G., Hjorth, M.F., Santos, R., Vale, S., Christiansen, L.B., Jago, R., Basterfield, L., Owen, C.G., Nightingale, C.M., Eiben, G., Polito, A., Lauria, F., Vanhelst, J., Hadjigeorgiou, C., Konstabel, K., Molnár, D., Sprengeler, O., Manios, Y., Harro, J., Kafatos, A., Anderssen, S.A., Ekelund, U., Anderssen, S., Atkin, A.J., Cardon, G., Davey, R., Esliger, D.W., Hallal, P., Janz, K.F., Kriemler, S., Møller, N., Northstone, K., Pate, R., Puder, J.J., Salmon, J., Sherar, L.B. & Van Sluijs, E.M.F. 2020. Variations in accelerometry measured physical activity and sedentary time across Europe-harmonized analyses of 47,497 children and adolescents. *International Journal of Behavioral Nutrition and Physical Activity*. 17(1):1–14. DOI: 10.1186/s12966-020-00930-x.

Stodden, D.F., Langendorfer, S.J., Goodway, J.D., 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(2):290–306. DOI: 10.1080/00336297.2008.10483582.

Stodden, D.F., 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(3):397–403. DOI: 10.1080/02701367.2013.814910.

Strath, S.J., Kaminsky, L.A., Ainsworth, B.E., Ekelund, U., Freedson, P.S., Gary, R.A., Richardson, C.R., Smith, D.T. & Swartz, A.M. 2013. Guide to the Assessment of Physical Activity: Clinical and Research Applications. *Circulation*. 128:2259–2279. DOI: 10.1161/01.cir.0000435708.67487.da.

van Stryp, O., Duncan, M.J. & Africa, E. 2022. Fundamental movement skills proficiency amongst neurotypical grade one children in Cape Town, South Africa. *Sport Sciences for Health*. 18(2):933–938. DOI: 10.1007/s11332-021-00877-x.

Szczyrska, J., Jankowska, A., Brzeziński, M., Jankowski, M., Metelska, P. & Szlagatys-

Sidorkiewicz, A. 2020. Prevalence of overweight and obesity in 6–7-year-old children—a result of 9-year analysis of big city population in Poland. *International Journal of Environmental Research and Public Health*. 17(10):1–9. DOI: 10.3390/ijerph17103480.

Telford, R.M., Telford, R.D., Olive, L.S., Cochrane, T. & Davey, R. 2016. Why are girls less physically active than boys? Findings from the LOOK longitudinal study. *PLoS ONE*. 11(3):1–11. DOI: 10.1371/journal.pone.0150041.

The Belmont Report. 1979. Ethical Principles and Guidelines for the Protection of Human Subjects of Research. *In The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research.*

Thomas, J.R. & French, K.E. 1985. Gender Differences Across Age in Motor Performance. A Meta-Analysis. *Psychological Bulletin*. 98(2):260–282. DOI: 10.1037/0033-2909.98.2.260.

Tomaz, S.A., Jones, R.A., Hinkley, T., Bernstein, S.L., Twine, R., Kahn, K., Norris, S.A. & Draper, C.E. 2019. Gross motor skills of South African preschool-aged children across different income settings. *Journal of Science and Medicine in Sport*. 22(6):689–694. DOI: 10.1016/j.jsams.2018.12.009.

Tomaz, S.A., Prioreschi, A., Watson, E.D., McVeigh, J.A., Rae, D.E., Jones, R.A. & Draper, C.E. 2019. Body mass index, physical activity, sedentary behavior, sleep, and gross motor skill proficiency in preschool children from a low- To middle-income urban setting. *Journal of Physical Activity and Health*. 16(7):525–532. DOI: 10.1123/jpah.2018-0133.

Tomaz, S.A., Jones, R.A., Hinkley, T., Twine, R., Kahn, K., Norris, S.A. & Draper, C.E. 2019. Physical activity in early childhood education and care settings in a low-income, rural South African community: An observational study. *Rural and Remote Health*. DOI: 10.22605/RRH5249.

Tomaz, S.A., Okely, A.D., Van Heerden, A., Vilakazi, K., Samuels, M.L. & Draper, C.E. 2020. The South African 24-hour movement guidelines for birth to 5 years: Results from the stakeholder consultation. *Journal of Physical Activity and Health*. 17(1):126–137. DOI: 10.1123/jpah.2019-0188.

Toriola, O.M. & Monyeki, M.A. 2012. Health-related fitness, body composition and physical activity status among adolescent learners: The PAHL study. *Recreation and Dance (AJPHERD)*. 18(41):795–811. Available: https://hdl.handle.net/10520/EJC128341.

Tremblay, M.S., Barnes, J.D., González, S.A., Katzmarzyk, P.T., Onywera, V.O., Reilly, J.J., Tomkinson, G.R., Aguilar-Farias, N., Akinroye, K.K., Al-Kuwari, M.G., Amornsriwatanakul, A., Aubert, S., Belton, S., Gołdys, A., Herrera-Cuenca, M., Jeon, J.Y., Jürimäe, J., Katapally, T.R., Lambert, E. V., Larsen, L.R., Liu, Y., Löf, M., Loney, T., López y Taylor, J.R., Maddison, R., Manyanga, T., Morrison, S.A., Mota, J., Murphy, M.H., Nardo, N., Ocansey, R.T.A., Prista, A., Roman-Viñas, B., Schranz, N.K., Seghers, J., Sharif, R., Standage, M., Stratton, G., Takken, T., Tammelin, T.H., Tanaka, C., Tang, Y. & Wong, S.H. 2016. Global matrix 2.0: Report card grades on the physical activity of children and youth comparing 38 countries. *Journal of Physical Activity and Health*. 13(2):343–566. DOI: 10.1123/jpah.2016-0594.

Troiano, R.P., Berrigan, D., Dodd, K.W., Mâsse, L.C., Tilert, T. & Mcdowell, M. 2008. Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports* *and Exercise*. 40(1):181–188. DOI: 10.1249/mss.0b013e31815a51b3.

Ulrich, D. 2000a. *Test of gross motor development*. Second Edi ed. PRO-ED.

Ulrich, D.A. 1985. *Test of gross motor development*. PRO-ED.

Ulrich, D.A. 2000b. Test of Gross Motor Development 2: Examiner's Manual, 2nd edn. Austin: PRO-ED.

Ulrich, D.A. 2017. Introduction to the special section: Evaluation of the psychometric properties of the TGMD-3. *Journal of Motor Learning and Development*. 5(1):1–4. DOI: 10.1123/jmld.2017-0020.

Ulrich, D.A. 2019. *Test of gross motor development*. Third Edit ed. PRO-ED.

Unicef. 2022. *More than 31 per cent of 15–19-year-old females in South Africa live with overweight or obesity, threatening a noncommunicable diseases epidemic*. Available: https://www.unicef.org/southafrica/press-releases/more-31-cent-1519-year-old-females-south-africa-live-overweight-or-obesity [2024, December 12].

Utley, B. 1988. Book Review: Movement and Fundamental Motor Skills for Sensory Deprived Children. *Journal of the Association for Persons with Severe Handicaps*. 13(3):223–225. DOI: 10.1177/154079698801300314.

Uys, M., Bassett, S., Draper, C.E., Micklesfield, L., Monyeki, A., De Villiers, A. & Lambert, E. V. 2016. Results from South Africa's 2016 report card on physical activity for children and youth. *Journal of Physical Activity and Health*. 13(s2):265–273. DOI: 10.1123/jpah.2016-0409.

Valentini, N.C., Ramalho, M.H. & Oliveira, M.A. 2014. Movement Assessment Battery for Children-2: Translation, reliability, and validity for Brazilian children. *Research in Developmental Disabilities*. 35(3):733–740. DOI: 10.1016/j.ridd.2013.10.028.

Valentini, N.C., Nobre, G.C., Zanella, L.W., Pereira, K.G., Albuquerque, M.R. & Rudisill, M.E. 2021. Test of gross motor development-3 validity and reliability: A screening form. *Journal of Motor Learning and Development*. 9(3):438–455. DOI: 10.1123/JMLD.2020-0061.

Van Biljon, A., McKune, A.J., Dubose, K.D., Kolanisi, U. & Semple, S.J. 2018. Physical activity levels in urban-based south african learners: A cross-sectional study of 7 348 participants. *South African Medical Journal*. 108(2):126–131. DOI: 10.7196/SAMJ.2018.v108i2.12766

Van Deventer, K.J. 2004. A case for physical education / life orientation : the health of a nation : research article. *South African Journal for Research in Sport, Physical Education and Recreation*. 26(1):107–121. DOI: 10.4314/sajrs.v26i1.25881.

van Dyk, H. & White, C.J. 2019. Theory and practice of the quintile ranking of schools in South Africa: A financial management perspective. *South African Journal of Education*. 39(1):1–9. DOI: 10.15700/saje.v39ns1a1820.

Walter, C.M. 2011. In-school physical activity patterns of primary school learners from disadvantaged schools in South Africa. *African Journal for Physical Health Education, Recreation and Dance (AJPHERD) African Journal for Physical Health Education, recreation and Dance*. 17(4):780–789. Available: https://hdl.handle.net/10520/EJC19762.

Walter, C.M. 2014. Promoting physical activity: A low cost intervention programme for disadvantaged schools in Port Elizabeth, South Africa. *African Journal for Physical, Health Education, Recreation & Dance*. 20(21):357–371. Available: https://hdl.handle.net/10520/EJC155187.

Wang, C., Chan, J.S.Y., Ren, L. & Yan, J.H. 2016. Obesity Reduces Cognitive and Motor Functions across the Lifespan. *Neural Plasticity*. 1:1–13. DOI: 10.1155/2016/2473081.

Webster, E.K. & Ulrich, D.A. 2017. Evaluation of the psychometric properties of the Test of Gross Motor Development-third edition. *Journal of Motor Learning and Development*. 5(1):45–58. DOI: 10.1123/jmld.2016-0003.

Webster, E.K., Sur, I., Stevens, A. & Robinson, L.E. 2021. Associations between body composition and fundamental motor skill competency in children. *BMC Pediatrics*. 21(1):1–8. DOI: 10.1186/s12887-021-02912-9.

World Bank. 2022. *In Southern Africa, Leveling the Playing Field at Birth Critical to Reducing Inequality, Intergenerational Poverty*. Available: https://www.worldbank.org/en/region/afr/publication/in-southern-africa-leveling-the-playing-field-at-birth-critical-to-reducing-inequality-intergenerational-poverty [2024, November 29].

World Bank. 2023. *Overview: South Africa*. Available: https://www.worldbank.org/en/country/southafrica/overview.

World Health Organization. 2007. *Growth reference 5-19 years: BMI-for-age*. Available: https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age.

World Health Organization. 2017. *Physical Measurements Overview*.

World Health Organization. 2020. *Physical activity*. Available: https://www.who.int/news-room/fact-sheets/detail/physical-activity [2022, September 24].

World Health Organization. 2024a. *Physical activity*. Available: https://www.who.int/news-room/fact-sheets/detail/physical-activity#:~:text=In children and adolescents%2C physical,recommended levels of physical activity. [2024, December 02].

World Health Organization. 2024b. *Obesity and overweight*. Available: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight [2024, September 17].

Zarotis, G.F. 2020. The Importance of Movement for the Overall Development of the Child at Pre-School Age. *Journal of Advances in Sports and Physical Education*. 3(2):36–44. DOI: 10.36348/jaspe.2020.v03i02.003.

LIST OF APPENDICES

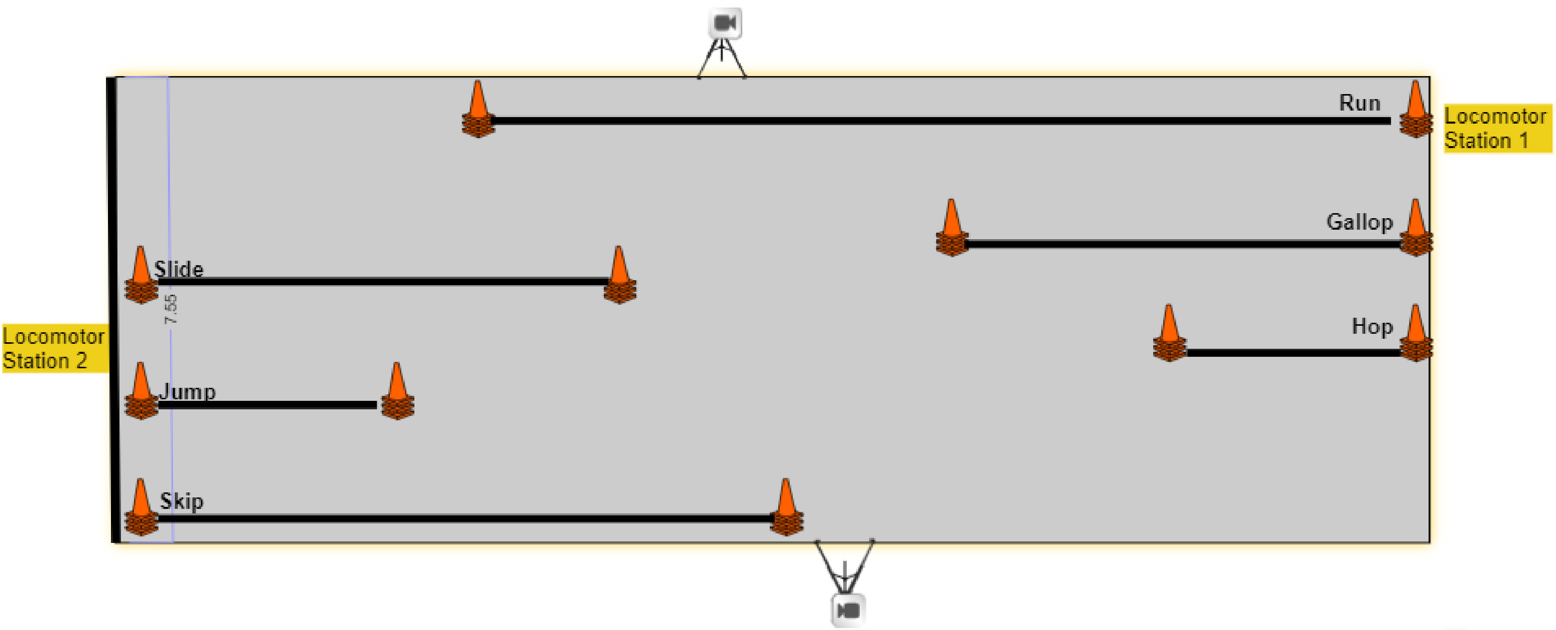
APPENDIX A: TGMD-3 DESCRIPTION

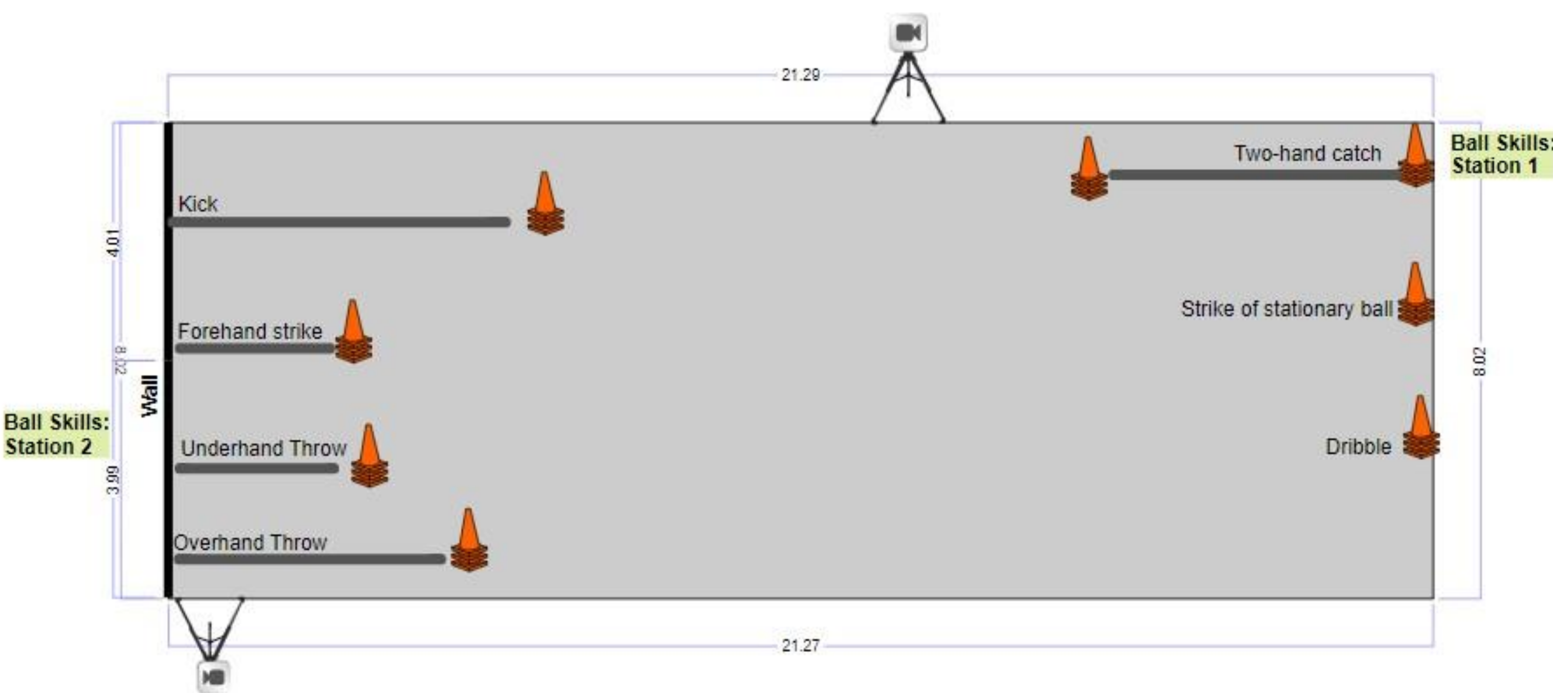
Locomotor Skills			
Skill	**Materials**	**Directions**	**Performance Criteria**
Run	60 ft (18.3m) of clear space and 2 cones	Place 2 cones 50ft (15.2m) apart. Make sure there is at least 8-10 ft (2.4-3.1ft) of space beyond cone for a safe stopping distance. Tell the child to run as fast as they can from one cone to the other when you say "Go". Repeat for a second trial.	1. Arms move in opposition to leg with elbows bent 2. Brief period where both feet are off the surface 3. Narrow foot placement landing on heel or toe (i.e., not flat-footed) 4. Non-support leg bent about 90 degrees so foot is close to buttocks
Gallop	25 ft (7.6 m) of clear space, and 2 cones or markers	Place two cones 25 feet apart. Tell the child to gallop from one cone to the other cone and stop. Repeat a second trial.	1. Arms flexed and swinging forward 2. A step forward with the lead foot, followed with the trailing foot landing beside or a little behind the lead foot (not in front of the lead foot) 3. Brief period when both feet come off the surface 4. Maintains a rhythmic pattern for four consecutive gallops
Hop	A minimum of 15 ft (4.6 m) of clear space, and two cones or markers	Place two cones 15 feet apart. Tell the child to hop four times on his/her preferred foot (established before testing) and then three times on the other foot. Repeat a second trial.	1. Non-hopping leg swings forward in pendular fashion to produce force 2. Foot of non-hopping leg remains behind hopping leg (does not cross in front of) 3. Arms flexed and swing forward to produce force 4. Hops four consecutive times on the preferred foot before stopping
Skip	A minimum of 30 ft (9.1 m) of clear space, and two cones and markers	Place two cones 30 feet apart. Mark off two lines at least 30 feet apart with cones/markers. Tell the child to skip from one cone to the other cone. Repeat a second trial.	1. A step forward followed by a hop on the same foot 2. Arms are flexed and move in opposition to legs to produce force 3. Completes four continuous rhythmical alternating skips
Horizontal Jump	A minimum of 10 ft (3.1 m) of clear space, and tape or markers	Mark off a starting line on the floor, mat, or carpet. Position the child start behind the line. Tell the child to jump as far. Repeat a second trial	1. Prior to takeoff, both knees are flexed and arms are extended behind the back 2. Arms extend forcefully forward and upward reaching full extension above the head

			3. Both feet come off the floor together and land together 4. Both arms are forced downward during landing
Slide	A minimum of 25 ft (7.6 m) of clear space, a straight line, and two cones or markers	Place two cones 25 feet apart on a straight line. Tell the child to slide from one cone to the other cone. Let the child decide which direction to slide in first. Ask the child to slide back to the starting point. Repeat a second trial	1. Body turned sideways so shoulders remain aligned with the line on the floor (score on preferred side only) 2. A step sideways with lead foot followed by a slide of the trailing foot where both feet come off the surface briefly (score on preferred side only) 3. Four continuous slides to the preferred side 4. Four continuous slides to the preferred side.
		Ball Skills	
Skill	**Materials**	**Directions**	**Performance Criteria**
Two-hand strike of a stationary Ball	4-inch (10.2cm) plastic ball, a plastic bat, and a batting tee or other device to hold ball stationery	Place ball on batting tee at the child's waist level. Tell child to hit the ball hard, straight ahead. Repeat second trial.	1. Child's preferred hand grips bat above non-preferred hand 2. Child's non-preferred hip/shoulder faces straight ahead 3. Hip and shoulder rotate and derotate during swing 4. Steps with non-preferred foot 5. Hits ball, sending it ahead
One-hand forehand strike of self-bounced ball	A tennis ball, alight plastic paddle and a wall	Hand the plastic paddle and ball to child. Tell child to hold ball up and drop it (so it bounces about waist height); off the bounce, hit the ball toward the wall. Point toward the wall. Repeat a second trial	1. Child takes a backswing with the paddle when the ball is bounced. 2. Steps with non-preferred foot 3. Strikes the ball toward the wall 4. Paddle follows through toward non-preferred shoulder
One-hand Stationary Dribble	8-10inch (20.3 – 25.4 cm) playground ball for ages 3-5 years; a basketball for children ages 6-10 and a flat surface	Tell the child to bounce the ball using one hand, at least four times consecutively without moving his or her feet, and then stop by catching the ball. Repeat a second trial.	1. Contacts the ball with one hand at about waist level 2. Pushes the ball with fingertips (not slapping at ball) 3. Maintains control of ball for at least four consecutive bounces without moving the feet to retrieve the ball.
Two-hand Catch	4-inch (10.2 cm) plastic ball, 15	Mark off two lines 15 feet apart. The child stands on one line and the tosser stands on the other line.	1. Child's hands are positioned in front of the body with the elbows flexed

	feet (4.6 m) of clear space, and tape or a marker	Toss the ball underhand to the child aiming at the child's chest area. Tell the child to catch the ball with both hands. Count trials only in which toss is near the child's chest. Repeat a second trial.	2. Arms extend, reaching for the ball as it arrives 3. Ball is caught by hands only
Kick a stationary ball	8/10-inch (20.3 – 25.4 cm) plastic, playground, or soccer ball; tape or a marker a wall; and clear space for kicking	Mark off one line 20 feet (6.1m) away from a wall and a second one 8 feet (2.4 m) beyond the first line. Place the ball on the first line closest to the wall. Tell the child to run up and kick the ball hard toward the wall. Repeat for a second trial.	1. Rapid continuous approach to the ball 2. Child takes an elongated stride or leap just prior to ball contact 3. Non-kicking foot placed close to the ball 4. Kicks ball with instep of inside of the preferred foot (not the toes)
Overhand Throw	A Tennis ball, a wall, and 20 feet (6.1 m) of clear space	Attach a piece of tape on the floor 20 feet from the wall. Have the child stand behind the tape line facing the wall. Tell the child to throw the ball hard at the wall. Repeat a second trial.	1. Windup is initiated with the downward movement of hand and arm 2. Rotates hip and shoulder to a point where the non-throwing side faces the wall 3. Steps with the foot opposite the throwing hand toward the wall 4. Throwing hand follows through after the ball release, across the body toward the hip of the non-throwing side
Underhand Throw	A tennis ball, tape, a wall, and 15 feet (4.6 meters) of space	Attach a piece of tape 15 feet from the wall. Have the child stand behind the tape line, facing the wall. Tell the child to throw the ball underhand and hit the wall. Repeat a second trial.	1. Preferred hand swings down and back, reaching behind the trunk 2. Steps forward with foot opposite the throwing hand 3. Ball is tossed forward, hitting the wall without a bounce 4. Hand follows through after ball release to at least chest level.

APPENDIX B: TGMD-3 TESTING STATIONS LAYOUT





APPENDIX C: ACTIGRAPH LETTER

NELSON MANDELA UNIVERSITY

South Campus
Human Movement
Science department
Tel . +27 (0)41 504 4352
s220532516@mandela.ac.za

July 2024

Dear Parents

<u>Research Project on Children's Movement Skills and Physical Activity</u>

As per your child's participation in the study titled "Status and Interrelationship between Fundamental Movement Skill Proficiency, Physical Activity and Body Mass Index Status of Grade 1 Learners from a Low-income Community, Gqerberha". We will be measuring the physical activity patterns of children for 7 days.

Your child will be wearing a motion sensor (ActiGraph) for 7 full days, including the weekend (see photo on the right). The ActiGraph is a mechanical device which measures physical activity and does not present with any risks to them.

It is crucial that your child simply goes about their day and perform the activities that they would normally do (that is "forget" the monitor is on and tracking their activity) It would be very helpful if you could assist in the following procedures, ensure the device is worn continuously for 7 days (including weekends), even while sleeping. A reminder will be communicated to class teachers to inform children the day before, the device is collected at school.

It is important to note the following:

- The device should be worn around the right hip
- Only remove the device when bathing/showering
- When worn properly and kept dry, the monitor is quite sturdy and durable and therefore, should not be damaged.

It would be very much valued if you could assist by taking great care of the device against loss or damage. Thank you once again for being a part of the study which will add to our knowledge of the physical activity patterns of children.

Your support is greatly appreciated, Thank you.

Yours sincerely,
Mooveshni Dumalingam | Cell: 083 7047455

Please feel free to contact my research supervisors or myself, if you need any more information regarding this study or have any complaints or concerns on the following number and/or email addresses. Tel: 041 504 4881 | Email: cheryl.walter@mandela.ac.za; Felicitas.Nqweniso@mandela.ac.za; Danielle.Dolley@mandela.ac.za.

APPENDIX D: NMU ETHICS APPROVAL LETTER

NELSON MANDELA

UNIVERSITY

PO Box 77000, Nelson Mandela University, Port Elizabeth, 6031, South Africa mandela.ac.za

Chairperson: Research Ethics Committee (Human)
Tel: +27 (0)41 504 3624
Dalray.Gradidge@mandela.ac.za

NHREC registration nr: REC-042508-025

Ref: [H23-HEA-HMS-007] / Approval: 13 March 2024 – 13 March 2025

13 March 2024

Prof C Walter
Faculty: Health Sciences

Dear Prof Walter

FUNDAMENTAL MOVEMENT SKILL PROFICIENCY, PHYSICAL ACTIVITY AND BODY MASS INDEX OF GRADE 1 LEARNERS FROM A LOW-INCOME COMMUNITY IN GQEBERHA

PRP: Prof C Walter
PI: Ms M Dumalingam

Your above-entitled application served at the Research Ethics Committee (Human) (meeting of *21 February 2024)* for approval. The study is classified as a medium/high-risk study. The ethics clearance reference number is **H23-HEA-HMS-007** and approval is subject to the following conditions:

1. The immediate completion and return of the attached acknowledgement to Imtiaz.Khan@mandela.ac.za,
2. Approval for data collection is for 1 calendar year from date of receipt of this ethics approval letter.
3. The submission of an annual progress report by the PRP on the data collection activities of the study (form RECH-004 available on Research Ethics Committee (Human) portal) by 15 November this year for studies approved/extended in the period October of the previous year up to and including September of this year, or 15 November next year for studies approved/extended after September this year.
4. In the event of a requirement to extend the period of data collection (i.e., for a period in excess of 1 calendar year from date of approval), completion of an extension request is required (form RECH-005 available on Research Ethics Committee (Human) portal)
5. In the event of any changes made to the study (excluding extension of the study), RECH will have to approve such amendments and completion of an amendments form is required PRIOR to implementation (form RECH-006 available on Research Ethics Committee (Human) portal).
6. Immediate submission (and possible discontinuation of the study in the case of serious events) of a report to RECH in the event of any unanticipated problems, serious incidents or adverse events observed during the course of the study.
7. Immediate submission of a Study Termination Report to RECH (form RECH-008 available on Research Ethics Committee (Human) portal) upon expected or unexpected closure/termination of study.
8. Immediate submission of a report to RECH in the event of any study deviations, violations and/or exceptions.
9. Acknowledgement that the study could be subjected to passive and/or active monitoring without prior notice at the discretion of Research Ethics Committee (Human).

Please quote the ethics clearance reference number in all correspondence and enquiries related to the study. For speedy processing of email queries (to be directed to Imtiaz.Khan@mandela.ac.za), it is recommended that the ethics clearance reference number together with an indication of the query appear in the subject line of the email.

We wish you well with the study.

Yours sincerely

Dr D Gradidge
Chairperson: Research Ethics Committee (Human)

Cc: Department of Research Development
Faculty Administration: Health Sciences

APPENDIX E: DEPARTMENT OF EDUCATION ETHICS APPROVAL LETTER

Province of the
EASTERN CAPE
EDUCATION

OFFICE OF THE DIRECTOR: CORPORATE PLANNING, MONITORING, POLICY & RES. CO.
Steve Vukile Tshwete Complex, Zone 6 Zwelitsha, 5608, Private Bag X0032, Bhisho, 5605 REPUBLIC OF SOUTH AFRICA;
Enquiries: **Ms F. Pakade . Tel: 040 602 7071. Fax 086 602 2024. Email:** [illegible]
Website: www.eceducation.gov.za **Date: 26 April 2024**

Ms. Mooveshni Dumalingam
Bonxa AA
Ntabankulu
5130

Dear. Ms. Dumalingam

PERMISSION TO UNDERTAKE A MASTERS RESEARCH: FUNDAMENTAL MOVEMENT SKILL PROFICIENCY, PHYSICAL ACTIVITY AND BODY MASS INDEX OF GRADE 1 LEARNERS FROM A LOW-INCOME COMMUNITY IN GQEBERHA

1. Your application to conduct the above-mentioned research involving Grade 1 learners (aged 6-7 years) from selected Primary schools in Gqeberha (Nelson Mandela Bay) district under the jurisdiction of the Eastern Cape Department of Education (ECDoE) is hereby approved based on the following conditions:

   a. All financial implications will be borne by you. The Department will not be liable for any financial implications occurred during this research.

   b. Institutions and respondents must not be identifiable in any way from the results of the investigation.

   c. You are responsible to seek parent's consent for minors.

   d. No interruptions with educator time and task during school timeframes are allowed.

   e. Research may not be conducted during official contact time.

   f. Prior approval from the principal and the affected teacher/s must be obtained in writing if research at a school within a classroom are part and partial of the research.

   g. You must present a copy of the written approval letter of the Eastern Cape Department of Education (ECDoE) to the Cluster and District Directors before any research is undertaken at any institutions within that particular district.

   h. It is your responsibility to make all the arrangements concerning your research.

Page 1

Research Approval letter

i. Should you wish to extend the period of research after approval has been granted, an application to do this must be directed to Chief Director: Corporate Strategy Management prior to expiry date.

j. You are responsible for presenting the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis;

k. You will be responsible for presenting the findings to the Departmental Research Committee and/or Senior Management of the Department when and/or where necessary.

l. You are requested to inform in writing your presentation on your finding to the Chief Director: Corporate Strategy Management upon completion of your research.

m. You must comply with all the requirements as completed in the Terms and Conditions to conduct Research in the ECDoE document duly completed by you.

n. You must submit a signed copy of your commitment form and comply with your ethical undertaking.

o. You are required to submit on a six-monthly (bi-annual) basis, from the date of permission of the research, concise reports to the Chief Director: Corporate Strategy Management.

2. The Department reserves a right to withdraw the application for research should there be non-compliance to the approval letter and contract signed as indicated in the Terms and Conditions to conduct Research in the ECDoE and/or legal requirements to do so.

3. The Department will publish the completed Research on its website.

4. The Department wishes you well in your undertaking. You can contact the Mrs. Fundiswa Pakade on the numbers indicated in the letterhead or email fundiswa.pakade@ecdoe.gov.za should you need any assistance.

T. MASOEU
CHIEF DIRECTOR: CORPORATE STRATEGY MANAGEMENT
FOR ACTING HEAD OF DEPARTMENT: EDUCATION

APPENDIX F: INFORMATION SHEET

NELSON MANDELA UNIVERSITY

South Campus
Department of Human Movement Science
Tel. +27 (0)41 504 4881
s220532516@mandela.ac.za
Ethics Reference Number: H24-HEA-HMS-007

Name of Project: Fundamental Movement Skill Proficiency, Physical Activity and Body Mass Index Status of Grade 1 Learners from a Low-income Community, Gqerberha

I, Mooveshni Dumalingam am currently doing my Master in Human Movement Science. The current research project is in accordance with Nelson Mandela University, Gqeberha. Over the course of a week, a school-based investigation will be undertaken for children in grade 1 at your child's school. The project aims to assess what is the status of and the interrelationship between basic movement patterns, physical activity and body mass index status in children. Fundamental Movement skills (FMS) can be described as basic movements and are classified as locomotor (e.g., run, skip, jump), object-control (e.g., catch, throw, kick) and stability (e.g., twisting and bending)

The following information is intended to assist you in deciding whether you would like your child to participate or not in our data collection. We advise you to take your time. You may want to talk to anyone you feel comfortable with, before you decide. If you have any questions, please ask them now or feel free to use the contact information listed below at a later stage. For your child to be included in the study, if they meet the following criteria

- In grade 1. Aged between 6-7 years
- Signed informed consent sheet by parent/ guardian
- Not actively participating in other clinical trials that may influence the results of the study

Voluntary Participation

Your decision to have your child participate in this study is voluntary. It is your choice whether to have your child participate or not. If you choose not to consent, all school services for your child will still be provided and nothing will change. You may also choose to change your mind later and stop participating, even if you agreed earlier.

Data Assessment

Approximately 100 children across five schools in Zwide will take part in this study. The data assessment will take place in July 2024. Additionally, each class will be involved for no longer than ± 1 hour during each assessment period. The following measures will be taken:

Anthropometric data- These are non-invasive techniques which include weight, height and body composition.

Physical Activity- Physical activity levels will be assessed via accelerometry. Therefore, we will ask your child to wear an accelerometer device for 7 days around their hip.

Fundamental Movement Skills: Your child will be asked to perform a number of basic physical movements, this includes; run, gallop, hop, leap, skip, slide, horizontal jump, striking a stationary ball, stationary dribble, catch, overhand throw, kick and underhand roll which will be video recorded and assessed by a qualified research assistant.

Risks

All procedures and all activities are safe, executed by qualified professionals and will be explained to your child on the day of testing. The risks associated are no greater than those that would arise in a typical physical education lesson

Benefits

1. Valuable information that would be made available to the school and community at large, regarding interventions that can be implemented. Concerning movement skills and physical activity, providing teachers and coaches the opportunity to improve these skills during physical education lessons.
2. Improvements in FMS has the potential to improve health by increasing participation in physical activity, this includes; increasing cardiorespiratory fitness, and improve their cognitive and psychological function.
3. If your child is identified with a high or low weight status, they will be referred for consultation with the nearest dietitian.

Confidentiality

The information that we collect from this research project will be kept confidential. Information about your child that will be collected from the research will be put away and no one but the researchers will be able to see it. Any information about your child will have a number on it instead of his/her name. Only the researchers will know what his/her number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone except the lead researchers and responsible ethical committees (the latter if required). No child's name will appear in the results obtained, even though the projects findings will be made public.

Right to Refuse or Withdraw

It is ultimately your choice to allow your child partaking in this research, you do not have to agree, if you do not wish to do so. Refusing to allow your child to participate will not impact any school services for your child. You may also choose to change your mind later and stop participating, even if you agreed earlier. However, we would like to inform you that the data gathered before withdrawal can be used for reports and publications.

Who to Contact

Please feel free to contact my research supervisors, if you need any more information regarding this study.

Prof C. Walter (cheryl.walter@mandela.ac.za)

Dr S Nqweniso (Felicitas.Nqweniso@mandela.ac.za)

Dr D Dolley (Danielle.Dolley@mandela.ac.za)

If you feel that your concerns have not been adequately addressed or if you have further inquiries, please contact the Research Ethics Committee on Human Research (RECH) at rd@mandela.ac.za, further concerns may be expressed to the National Health Research Ethics Council (NHREC) at nhrec@health.gov.za, with the final recourse available to contact is the South African Health Products Regulatory Authority (SAPHRA) at enquiries@sahpra.org.za.

APPENDIX G: INFORMED CONSENT SHEET

NELSON MANDELA UNIVERSITY

Department of Human Movement Science
Tel. +27 (0)41 504 4352
s220532516@mandela.ac.za
Ethics Reference Number: H24-HEA-HMS-007

Name of Project: Fundamental Movement Skill Proficiency, Physical Activity and Body Mass Index Status of Grade 1 Learners from a Low-income Community, Gqerberha

Researcher: Mooveshni Dumalingam

- I have read all the information presented in the information sheet.
- I am well aware of the purpose of the study along with what the results will be used for.
- I have been made aware of the benefits and the possible risks related to the study
- I agree for my child to be video recorded for research basis, and understand it will not be released
- I am aware that any information pertaining to my child will be kept confidential, while the findings of the research study may be published, the identity of my child will remain anonymous.
- I know that participation is voluntary and at any point, myself or child can withdraw from the research study, without consequence.
- By signing this document, I agree for my child to participate in the above study

Print Name and Surname of Child: ____

Date of Birth of Child: ____

Gender of Child: ____

Home Address of Child: ____

School Name:____

Signature of Parent or Guardian ________________ Date______________________

dd/mm/yyyy

Please feel free to contact my research supervisors or myself, if you need any more information regarding this study or have any complaints or concerns on the following number and/or email addresses. Tel: 041 504 4881 | Email: cheryl.walter@mandela.ac.za; Felicitas.Nqweniso@mandela.ac.za; Danielle.Dolley@mandela.ac.za.

If you feel that your concerns have not been adequately addressed or if you have further inquiries, please contact the Research Ethics Committee on Human Research (RECH) at rd@mandela.ac.za , further concerns may be expressed to the National Health Research Ethics Council (NHREC) at nhrec@health.gov.za, with the final recourse available to contact is the South African Health Products Regulatory Authority (SAPHRA) at enquiries@sahpra.org.za .

APPENDIX H: ASSENT FORMS

NELSON MANDELA
UNIVERSITY

Title: Status and Interrelationship between Fundamental Movement Skill Proficiency, Physical Activity and Body Mass Index Status of Grade 1 Learners from a Low-income Community, Gqerberha

What is the study about and what will I have to do?

We want to see how you perform certain movements, (e.g., run, jump, catch and throw) and see how active you are. In order to do this, we will measure your height, weight and ask you to perform specific activities. This includes run, gallop, hop, skip, slide, horizontal jump, striking a stationary ball, stationary dribble, catch, overhand throw, kick and underhand roll. To measure your physical activity, you will be asked to wear belt around your hip for 7 days, which measures all your activity.

Can anything bad happen to me?

There are no risks or discomfort, if you participate. The activities you will complete are very similar to the movements you would have done in physical education at school.

Can anything good happen to me?

You are going to be helping us by providing information on how children perform certain movements, which will allow us to make it easier and better for future children to learn these skills and take part in all activities.

Will anyone know I am in the study?

Nobody will know that you were in the study. We will not list your name on any of the reports.

Who can I talk to about the study?

You can contact Mooveshni if you have any questions about the study. The number is 041 504 4881

What if I do not want to do this?

You are always free to leave the study at any time. If you decide to withdraw you will not get into trouble.

Do you understand this study and are you willing to participate?

YES	NO

Name and Surname…………………………………………………………