The relationship between object control skills, health-related physical fitness and physical activity in 9- to 10-year old girls: The NW-CHILD study

M Visagie

21663033

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Supervisor: Dr D Coetzee

Assistant supervisor: Prof AE Pienaar

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PREFACE

Thanks to our Creator for the power and grace with which I am blessed.

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CONTRIBUTION OF AUTHORS

This dissertation is presented in article format. The study was planned and completed by three authors. The contribution of each author is explained in table format, with the explanation of the role of each co-author in the study. The co-authors hereby consent that the articles in this dissertation can be submitted for compliance with the requirements of a Magister Artium in Kinderkinetics.

Name and surname of author	Role of the author in this study
Ms. Marilette Visagie (MV) (BA Honours Kinderkinetics)	MV, DC and AP were responsible for the completion of this study. MV is the first author, DC the second author and AP the third author in both articles
Dr. Dané Coetzee (DC) (PhD Human Movement Science)	DC was the supervisor in this study, and was responsible for overseeing all aspects of this study. DC contributed significantly in terms of writing the articles.
Prof. Anita E. Pienaar (AP) (PhD Human Movement Science)	AP was the assistant supervisor. AP contributed significantly in terms of writing the articles.

Affirmation by supervisor and assistant supervisor

I declare that the articles above have been approved and my role in the study as set out above is correct and reflects my part in the study. I further authorise that the articles, as part of the dissertation of Ms Marilette Visagie, may be published.

Dr Dané Coetzee

Prof Anita E. Pienaar

OPSOMMING

DIE VERBAND TUSSEN OBJEKKONTROLE VAARDIGHEDE, GESONDHEIDS-VERWANTE FISIEKE FIKSHEID, EN FISIEKE AKTIWITEIT IN NEGE TOT TIEN-JARIGE DOGTERS: NW-CHILD STUDIE

Verskeie navorsers rapporteer dat objekkontrole vaardighede, gesondheidsverwante fisieke fiksheid en fisieke aktiwiteit nie optimaal by kinders ontwikkel is nie. Dit blyk ook uit die literatuur dat kinders, veral dogters, nie meer so aktief is nie. Hierdie tendense is kommerwekkend, aangesien dit belangrike faktore is wat ’n rol speel in die gesondheid sowel as sportontwikkeling later in die kind se lewe.

Eerstens is daar in hierdie verhandeling 'n poging aangewend om die verband tussen die objekkontrole vaardighede en gesondheidsverwante fisieke fiksheid in nege tot tien-jarige dogters in die Noordwesprovinsie van Suid-Afrika te ondersoek. Tweedens is die verband tussen objekkontrole vaardighede en fisieke aktiwiteitsvlakke en patrone in nege tot tien-jarige dogters in die Noordwes Provinsie van Suid-Afrika ondersoek.

Data is ingesamel deur middel van 'n gestratifiseerde ewekansige steekproef waar 408 dogters, met 'n gemiddelde ouderdom van 9,86 jaar (±0,42) geselekteer is, wat aan die NW-CHILD studie deelgeneem het. Die "Bruininks-Oseretsky Test van Motor Proficiency-2" (BOT-2) (Bruininks & Bruininks, 2005), se krag-subtoets (standverspring, opstote, opsitte, muursit en “V-up”) is gebruik om die dogters se krag te evalueer, die "Test of Gross Motor Development-2" (TGMD-2) (Ulrich, 2000) is gebruik om die dogters se objekkontrole vaardighede vas te stel, en die FITNESSGRAM (Meredith & Welk, 2008) is gebruik om die dogters se kardiovaskulêre uithouvermoë te bepaal. Die “Children’s Leisure Activities Study Survey” (CLASS) (Telford *et al.*, 2004) is gebruik om die fisieke aktiwiteitspatrone van die dogters te meet en liggaamslengte, liggaamsmassa en drie velvoue (subskapulêr, triseps en kuit) is gemeet volgens standaard kinantropometriese protokolle. Die STATISTICA sagteware pakket is gebruik om die data te analiseer.

Klein maar betekenisvolle korrelasies is gevind tussen objekkontrole vaardighede en krag, aërobiese fiksheid en die liggaamsamestelling van die groep. Volgens die “healthy fitness zone” (HFZ) klassifikasie is 49.62% (n=198) van die meisies gekategoriseer as in die HFZ met betrekking tot hulle liggaamsmassa indeks (LMI) en 54.14% (n=216) met betrekking tot die FAT%. Dit toon aan dat objekkontrole vaardighede beïnvloed is deur faktore wat kan bydra tot

die gesondheid van jong meisies. Deelname aan fisieke aktiwiteit behoort dus aangemoedig te word. Toepaslike ontwikkeling van objekkontrole en kragvaardighede in meisies word aanbeveel om vertraging in sportdeelname te voorkom.

Die verdere ondersoek het gekyk na rasverskille in die uitvoering van aktiwiteite. Negentig wit en 318 swart meisies met ’n gemiddelde ouderdom van 9.86 jaar het hieraan deelgeneem. Objekkontrole vaardighede is getoets en praktiese betekenisvolle ($p \leq 0.001$) verskille is gevind tussen die wit en swart meisies waar die wit meisies meer deelgeneem het aan tien van die gemiddelde intensiteit fisieke aktiwiteite as die swart meisies en die swart meisies meer deelgeneem het aan drie van hierdie aktiwiteite. Aktiweite waaraan blanke dogters meestal deelneem, dra by tot matige en hoër intensiteit.

Sleutelterme: Objekkontrolevaardighede, Gesondheidsverwante Fisieke Fiksheid en Fisieke Aktiwiteit, meisies.

SUMMARY

RELATIONSHIP BETWEEN OBJECT CONTROL SKILLS, HEALTH-RELATED PHYSICAL FITNESS AND PHYSICAL ACTIVITY OF 9- TO 10-YEAR OLD GIRLS: THE NW-CHILD STUDY

Several researchers report that object control skills, health-related physical fitness and physical activity are not optimally developed in children. It is also evident from the literature that children, especially girls, are not active enough these days. These trends are disturbing as these are important factors that play a role in the health and sports development later in the child's life.

Firstly, this dissertation attempts to examine the relationship between object control skills and health-related physical fitness in nine to ten-year old girls in the North-West Province of South Africa. Secondly, the relationship between object control skills and physical activity levels and patterns in nine to ten-year old girls in the North-West Province of South Africa was investigated.

Data were collected by means of a stratified randomised sample of 408 girls with a mean age of 9,86 years (±0,42) who participated in the NW-CHILD study. The Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) (Bruininks & Bruininks, 2005) strength sub-test (standing long jump, push-ups, sit-ups, wall sit and V-up) was used to determine the girls' strength, the Test of Gross Motor Development-2 (TGMD-2) (Ulrich, 2000) was used to determine the learners' object control skills and the FITNESSGRAM (Meredith & Welk, 2008) was used to evaluate the girls' cardiovascular endurance. The Children's Leisure Activities Study Survey (CLASS) was used to evaluate the physical activity pattern of the girls. Stature, body mass and skinfolds (subscapular, triceps and calf) were measured according to standard kinantropometric protocols. The STATISTICA software package was used to analyse the data.

Small but significant correlations were found between object control skills and strength, aerobic fitness and the body composition of the group. According to the healty fitness zone (HFZ) classification, 49.62% (n=198) of girls were categorised as being in the HFZ with regard to their BMI and 54.14% (n=216) in the HFZ with regards to the FAT%. This indicates that object control skills are influenced by factors that can contribute to the health of young girls. Participation in physical activities should therefore be increased. Appropriate development of object control skills (OC) and strength skills in girls is recommended to prevent delays in sports participation.

Further investigation involved racial differences in activity performances. Ninety white and 318 black girls with a mean age of 9.86 years participated in this study. OC skills were assessed. Statistically ($p \leq 0.001$) and practically significant differences between the white and black girls were found, where the white girls participated more in ten of the moderate intensity physical activities than the black girls and the black girls participated more in three of these activities. Activities in which white girls mostly participated contributed significantly to higher moderate to high intensity.

Key words: Object Control Skills, Health Related Physical Fitness, Physical Activity, girls.

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LIST OF ABBREVIATIONS

MVPA	Moderate and vigorous physical activities
BMI	Body mass index
BOT-2	Bruininks-Oseretsky Test of Motor Proficiency second edition
CLASS	Child Leisure Activities Study Survey
FAT%	Fat percentage
FMS	Fundamental motor skills
HFZ	Healthy Fitness Zones
HRF	Health-related physical fitness
MVPA	Moderate to Vigorous Physical Activity
NWU	North-West University
OC	Object control skills
PACER	Progressive Aerobic Cardiovascular Endurance Run
TGMD-2	Test of Gross Motor Development second edition
WHO	World Health Organisation
SES	Sosio-economic status

CHAPTER 1

CHAPTER 1: INTRODUCTION

1.1 Introduction

During the pre-school and primary school years, it seems as if children are not as active as in the past, and their fundamental motor skills (FMS) are poorly developed (Goodway & Branta, 2003:36). According to Timmons *et al.* (2007:124) children tend to engage in brief amounts of physical activity and spend very little time at a physical activity intensity level that could be considered as vigorous. Various researchers have indicated that the critical period to develop these FMS, that are classified as locomotor skills (running, skipping, hopping, galloping, sliding), object control skills (throwing, kicking, catching, bouncing, striking, rolling) and stability skills (bending, stretching, twisting, turning, swinging, balancing, landing/stopping) (Haywood & Getchell, 2005:140; Pienaar, 2014:8), are used during the pre-school and primary school years (Hardy *et al.*, 2010:503; Siahkouhian *et al.*, 2011:1354). In this regard, Gallahue and Ozmun (2006:49) stated that these skills are further needed for children to interact with and to explore their environment. According to Clark and Medcalfe (2002:170), physical activity and FMS can be seen as the foundation for further sports and movement development. During the ages of two to seven years, physical activity and physical fitness play an important role in a child's development (Smith, 2010:6).

In 2014, fifteen countries released a Report Card on Physical Activity for children and youth. The results which are categorised were as follows: Australia (D-), Canada (D), Chana (D), Colombia (D), Engeland (D+), Finland (D), Ireland (D-), Kenya (C), Mexico (C+), Mozambique (B), New Zealand (B), Nigeria (C), Scotland (F), South Africa (D) and United States (D-) (Canada Report Card, 2014). South Africa showed an overall decline from a C-grading in 2010 to a D-grading in 2014 for their physical activity (South Africa Report Card, 2014). A possible reason for this decline is that 23% of girls, between ten and fourteen are overweight or obese and spend more and more time in front of televition screens. Grades were assigned to each indicator ranging from an A (80–100%), B (70–79%), C (60–69%), D (50–59%), and F (<50%).

1.2 Problem statement

Children between the ages of seven and 11 years are in the sports-related movement development phase, which is characterised by the refinement of the FMS (Pienaar, 2014:21). During this phase, children become more interested in sports and performance standards (Pienaar, 2014:21). Children who cannot run, jump, catch and throw properly limit their opportunities for participating in physical activities later in their lives (Payne & Isaacs, 2007:300). A study done by Howen *et al.* (2010:291, 296) on children from the Netherlands, between the ages of six and twelve years, showed that if the FMS have been mastered, more time was spent in non-sedentary activities compared to children with lower motor skills. For optimal motor development, physical fitness (the maintenance of a basic body functions that help a person to do his/her day-to-day activities) is needed (Monyeki & Kemper, 2007:13). Children with better motor skills experience physical activity and physical fitness as more enjoyable and fun (Shenouda *et al*., 2011:1).

Corbin and Pangrazi (1992:27) indicated that physical fitness is divided into performance and health-related dimensions. The components of health-related physical fitness include body composition (the amount of muscle, fat, bone, and other vital parts of the body), flexibility (the range of motion in a joint), cardiovascular endurance (the ability of the circulatory and respiratory systems to supply energy during physical activity and eliminate fatigue), muscular strength (the total amount of external force a muscle can exert) and muscular endurance (ability of muscle groups to exert external force for extended periods of time). The World Health Organisation (WHO, 2013a:xx) defines physical activity as any movement produced by skeletal muscles where energy is required. Physical activities are also classified according to intensity (the rate at which the activity is carried out or the extent of the effort required to an activity or exercise to perform) (WHO, 2013b:xx), and can be sub-divided into physical inactivity or sedentary movement (Bar-Or & Rowland, 2004:388), moderate intensity physical activity, and high intensity physical activity (WHO, 2013b:xx).

Adequate physical activity and fitness are important for children due to the benefits that these have on growth and development as well as physical, social and psychological health, and it also lays a foundation for a lifetime of health through active living (Jandrić, 2010:85; Strong *et al.,* 2005:733). Girls' physical fitness tends to decline during early childhood and can lead to the maintenance of their basic body functions in day-to-day activities (Monyeki & Kemper, 2007:13). McGuire's (2007:34) research, on 284 boys and 295 girls in Grades 4 to 5

in the greater Vancouver region, found that physical fitness reaches a plateau in girls at around 12 to 14 years. A major reason why physical fitness and physical activity must be included in early childhood is to promote physical health (Smith, 2010:6). Low physical activity levels and a sedentary lifestyle during the early years could be a predictor of health problems later in life (Dehghan *et al.*, 2005:24), and are linked to childhood obesity that is associated with increased health risks that can impair physical health (Hassan *et al.*, 2003:1227).

According to the WHO (2013a:xx), five to 12-year old children should spend at least 60 minutes or more on age-appropriate physical activity each day. This daily physical activity should include moderate and vigorous intensity physical activities that are designed to achieve optimal health, wellness, fitness and performance benefits (National Association of Sport and Physical Education, 2004:11). The WHO (2013b:xx) further indicates that age is the dominant biological determinant of physical activity in girls, and physical activity levels steadily decline from approximately six years of age until adolescence, when activity levels drop more steeply. In a study done in 2008, researchers found that Grade 5 boys were twice as active as girls, doing moderate-to-vigorous or vigorous physical activities (Rowlands *et al.*, 2008:317). During an investigation of nine to 15-year old children in Iceland it was found that girls were less physically active than boys, and the types of activities they engage in tend to be of lower intensity (Arnardóttir, 2008:iv). Research found that children with low motor competence (locomotor skills and object control skills), are not that physically active, resulting in lower physical fitness levels (Cairney *et al.*, 2011:1198).

Researchers have indicated in the literature that object control skills play an important role in children's physical activities choices (Barnett *et al.*, 2008:10; Cook, 2005:15). Research done by Cook (2005:12) on 1 294 kindergarten children in Victoria reported that object control skills were significantly correlated with moderate activity done over a weekend, vigorous activity done on a daily basis and over a weekend, and moderate-to-vigorous intensity physical activity (MVPA) done daily and over a weekend. Object control skills accounted for 11,4% of weekend physical activity, 9,5% and 9,9% of the variance in daily and weekend vigorous activity, and 9,9% and 16,8% of variance in daily and weekend MVPA, respectively. Barnett *et al*. (2008:10) studied 1 054 children in eighteen selected primary schools in New South Wales, Australia, and reported that children with high proficiency in object control had a 20% greater chance of participating in MVPA in adolescence, compared

to the <5% chance for those with low levels of childhood object control proficiency. The findings of Barnett *et al.* (2008:10) agree with those of Cook (2005:12).

Cohen *et al.* (2014) did a study on 460 children (8.5±0.6 years, 54% girls) and found that object control skills were significantly associated with moderate to vigorous physical activity during lunch times and school holidays. The type of games and equipment provided for children during their lunch times and breaks may be a good indicator of the type of activities these children engage in (Cohen *et al.*, 2014:7). Treuth *et al.* (1998:1134) performed a study on 12 healthy obese girls in Birmingham, Alabama, and reported a positive relationship between the strength of thes girls and a high physical activity level. In a study done on 290 girls between the ages of 13 and 15 in 16 different schools in the North-West Province, Engelbrecht *et al*. (2004:45) found that 70,3% of the girls had low-intensity activity levels. These researchers further studied the relationships between physical activity and fitness and the effect of different racial backgrounds (Engelbrecht *et al*., 2004:48). They reported that white girls achieved the highest scores in strength and arm-strength endurance, due to their activity choices such as swimming and aerobics. Engelbrecht *et al.* (2004:50) further found that the physical activity levels and patterns of girls from different racial groups showed a positive relationship with their physical fitness.

There is still some controversy in the literature regarding the different physical activities that girls like to participate in (Engelbrecht *et al*., 2004:48; Guèvremont *et al.*, 2008:66; Howell *et al.,* 1999:163; Jardus *et al*., 2010:349). Research done by Howell *et al*. (1999:163) on Grade 4 girls in Poway, California, reported that these girls participated more in individual activities such as running, jogging, dance, bicycling and gymnastics than in group activities. Guèvremont *et al.* (2008:66) did research in Canada on six to 17-year old children found that they mostly participated in non-sporting activities (which included lessons in music, art and drama) or activities in clubs or in the community such as Brownies, Scouts and photography. In this regard, Jardus *et al*. (2010:349) did a study on five to eighteen-year old children in Israel that agrees with the findings of Guèvremont *et al.* (2008:66). They also indicated that girls were more likely to participate in informal activities such as reading, talking on the phone or building puzzles (Guèvremont *et al.*,2008:66).

According to the literature, there have been limited studies done in South Africa (SA) on the relationship between object control, physical fitness and physical activity in primary school girls. This study could add significant value to the study field of physical fitness and physical

activity of nine to 10-year old girls in the North-West Province of South Africa. A better understanding of the nature of this relationship could be applied to maintain and develop sufficient object control skills, physical fitness and physical activity in their health and well-being. This study can highlight shortcomings in respect of girls' development of their object control skills that can be improved through Kinderkinetics programmes. Improving these skills will again lead to the improvement of the girls' sports skills.

From the above-mentioned literature, it is clear that limited data exist in SA regarding the relationship between object control skills, health-related physical fitness and physical activity in nine to 10-year old girls. In the light of the background, the following research questions are intended to be answered by this study: 1) What is the relationship between object control skills and health-related physical fitness of nine to 10-year old girls in the North-West Province of South Africa? and 2) What is the relationship between physical activity levels and object control skills in nine- to 10-year old girls in the North-West Province of South Africa, taking ethnical differences in activity performances into consideration? Answering these questions will provide an extensive profile of the object control skills, health-related physical fitness and physical activity in girls in the nine to 10-year age group, adding to scientific knowledge in this field. Findings can furthermore be used for the planning of strategies for improvement of identified problem areas and it will provide guidelines for Kinderkineticists and other health workers (teachers and coaches) with regard to the design of programmes that will improve developmental deficits related to object control skills, health-related physical fitness and physical activity.

1.3 Objectives

The objectives of this study are to:

- examine the relationship between object control skills and health-related physical fitness of nine to 10-year old girls in the North-West Province of South Africa; and to
- determine whether a relationship exists between object control skills and physical activity levels in nine to 10-year old girls in the North-West Province of South Africa, taking ethnical differences in activity performances into consideration.

1.4 Research hypotheses

This study is based on the following hypotheses:

- There will be a significant relationship between object control skills and health-related physical fitness of nine to 10-year old girls in the North-West Province of South Africa.
- There will be a significant relationship between object control skills and physical activity levels and patterns of nine to 10-year old girls in the North-West Province of South Africa when ethnical differences were taken into consideration during the activity performances.

1.5 Proposed chapters

This dissertation is presented in the article format. The structure of the dissertation is as follows:

- Chapter 1 contains the introduction, problem statement and purpose of the study. References used in this chapter follows immediately after this chapter. The references are done according to the new NWU Harvard style, as prescribed by the North-West University and follow directly after the chapter.
- Chapter 2 contains the literature review with the title: **The relationship between object control skills, physical fitness and physical activity in nine to ten-year old girls.** The references are presented according to the new NWU Harvard style, as prescribed by the North-West University, and follow directly after the chapter.
- Chapter 3 is the research article with the title "**The relationship between object control skills and health-related physical fitness in nine to ten-year old girls in the North-West Province of South Africa: The NW-CHILD study"** and will be submitted for possible publication to the *Journal of pediatric exercise science*. This article was prepared according to the journal's guidelines. The author guidelines of this Journal are placed in Appendix C. For uniformity some changes were made to the guidelines of the journal in this dissertation. The alignment, line spacing, font, font size and numbering were adjusted to be the same as the rest of the dissertation, being justified and presented in one-and-a-half spacing, Times New Roman and 12-point font size. The tables were inserted as part of the text and not at the end of the article as required by the journal guidelines. The

above changes make the dissertation easier to read and match the rest of the dissertation structure.

- Chapter 4 is also presented in article format with the title **"The relationship between object control skills and physical activity levels and patterns in nine to ten-year old girls in the North-West Province of South Africa: The NW-CHILD study".** This article will be submitted for possible publication to the *Journal of early child development and care*, and was prepared according to this journal's guidelines. The author's guidelines of this journal are placed in Appendix D. For uniformity and technical purposes of this dissertation, some changes were made to the guidelines of the journal. The alignment, line spacing, numbering, font and font size were adjusted to be the same as the rest of the dissertation, which is justified and presented in one-and-a-half spacing, Times New Roman and 12-point font size. The references are presented according to the *American Psychological Association*, as also required by the journal. The above changes make the dissertation easier to read and match the rest of the dissertation structure.

- Chapter 5 contains the summary, conclusions and recommendations of this study.

- The Test of Gross Motor Development second edition (TGMD-2), FITNESSGRAM, Bruininks-Oseretsky Test of Motor Proficiency second edition (BOT-2), and the Children's Leisure Activities Study Survey (CLASS) were used for the collection of data. The CLASS survey is in Appendix E. The informed consent forms that were used during the study are placed in Appendix B. The TGMD-2, FITNESSGRAM, BOT-2, are copyright-protected and therefore not included in the Appendix.

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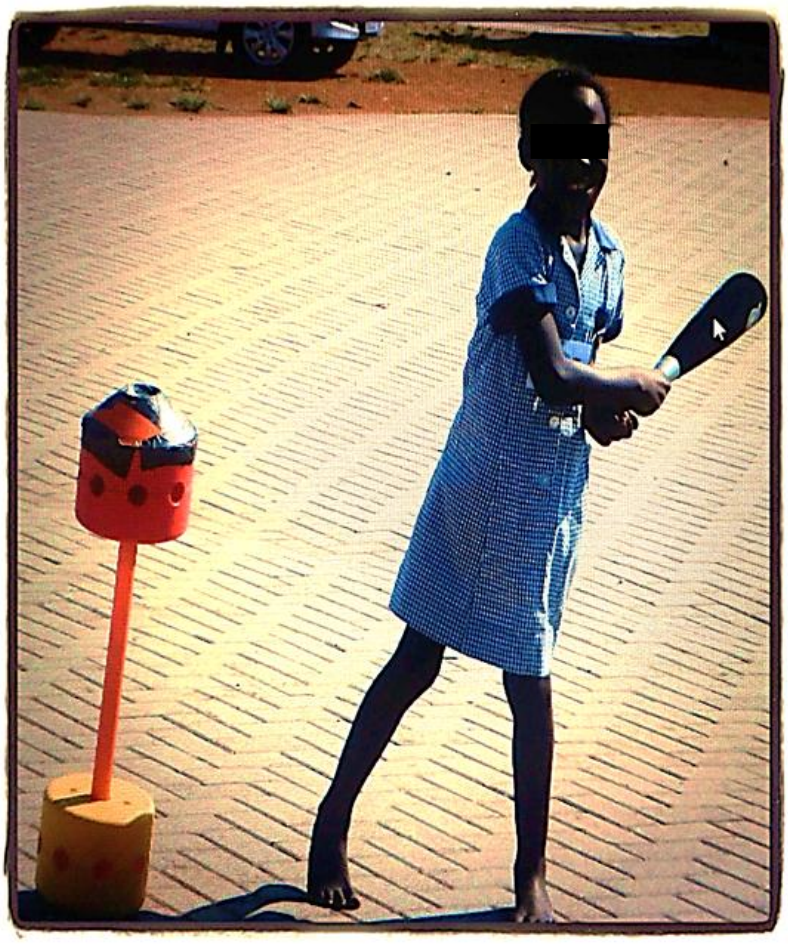
CHAPTER 2



CHAPTER 2: LITERATURE REVIEW: THE RELATIONSHIP BETWEEN OBJECT CONTROL SKILLS, HEALTH-RELATED PHYSICAL FITNESS AND PHYSICAL ACTIVITY IN CHILDREN

2.1 Introduction

The early childhood years, from about two years of age to about seven, constitute the period during which children's motor skills (known as fundamental motor skills) developed rapidly (Pienaar, 2014:8). These fundamental motor skills (FMS) can be divided into three components: locomotor skills (running, hopping, jumping, galloping and sliding), object control skills (throwing, kicking, catching, striking, rolling and dribbling) and stability skills (bending, stretching, twisting, swinging, balancing, landing/stopping) (Haywood & Getchell, 2005:140; Pienaar, 2012:8). The "Test of Gross Motor Development-2" (TGMD-2) is used to evaluate the mastery of two of the sub-sections of fundamental skills, viz. locomotor skills and object control skills in children between the ages of three and ten years (Ulrich, 2000:3).

Children between the ages of seven and 10 years fall into the sports-related movement development phase, characterized by the expansion and refinement of FMS (Pienaar, 2012:21). During this phase children become more interested in sports and achievement standards (Pienaar, 2012:21), for example an overhand throw, catching and striking actions to the more specialized sports-specific skills is applicable to sports codes such as cricket, basketball and softball (Booth *et al.,* 2006:93). At the age of nine to 11 a child's laterality and hand-eye co-ordination should be established, and his or her manipulation skills (such as throwing and catching) should now be improving to the extent that the child is ready for the promotion of techniques (Booth *et al.,* 2006:93). Fundamental movement skills and sports skills help a child to execute a movement with confidence and control. There are various advantages linked to good development of movement skills, such as the mastery of motor skills, balance, strength, posture, and co-ordination and this helps to improves self-confidence, social skills and self-image (Davis & Burton, 1991:160).

During the early childhood years, that is, from the ages of two to seven, physical fitness and physical activity constitute an important part of a child's development (Smith, 2010:6). Low physical activity levels and an inactive lifestyle, as a result of, among others, high levels of television viewing and computer usage and public transport can become a predictor for health problems in later life (Dehghan *et al.,* 2005:24). Health problems are linked to heightened

health risks and become detrimental to physical health (Hassan *et al.,* 2003:1227), and the opportunity to develop skills is inhibited (Hills *et al.,* 2007:540). During the middle childhood years, at about the age of nine or 10, puberty begins in most girls, and changes during this period in body fat and body size can have a big influence on fitness tests and achievement (Meredith & Welk, 2008:63). Boys show a clear increase in muscular mass (pre-puberty boys, often younger than fourteen), strength and endurance and a decrease in subcutaneous fact in arms and legs (Meredith & Welk, 2008:63). Girls on the other hand reveal much smaller increases in growth and endurance, while body fat increases more when compared to boys (pre-pubertal girls, often younger than twelve) (Meredith & Welk, 2008:63; Patrick *et al.,* 2007:9).

The purposes of this study have been, in the first place, to establish the relationship between object control skills and health-related physical fitness in nine to 10-year-old girls in the North-West Province of South Africa, and secondly to determine the relationship between object control skills and physical activity levels in nine to 10-year-old girls in the North-West Province of South Africa. It is therefore important, with a view to the above research objectives, to investigate related literature and to report this in the literature review. In the first place the literature review deals with the developmental periods of children, the phases into which object control can be divided, definitions of object control, the status of object control skills in girls of nine and ten and the factors that could impact on the development of object control skills. In the second place definitions and descriptions of health-related physical fitness, components of health-related physical fitness, the present state of health-related physical fitness levels of nine and 10-year-old girls, relationship between the different health-related physical fitness components, and relationship between health-related physical fitness and object control skills will be looked at. In the final instance physical fitness will be defined and demands made in this context will be analysed. The activity patterns of nine and 10-year-old girls are analysed and the relationship between physical activity and object control skills discussed.

2.2 Definitions

This study refers throughout to the terms *object control skills, physical fitness* and *physical activity*. Each of these terms will subsequently be defined.

Object control skills are defined as the requirement to be able to control equipment (for example, bats, rackets or hoops) or objects (such as balls), with the appropriate speed, or by hand or foot (Department of Education, 2013:15). Examples in this regard are throwing, catching, kicking, striking, rolling and dribbling (Department of Education, 2013:15).

Health-related physical fitness refers to the areas that have to do with general health, as well as the execution of daily tasks and activities (Wuest & Bucher, 2003:253). Physical fitness is further divided into health-related physical fitness components and motor or achievement related fitness skills (Corbin & Pangrazi, 1992:97). This will be discussed later in this chapter.

Physical activity can be defined as any bodily movement that is initiated when skeletal muscles and energy usage are required (WHO, 2013a:xx).

Subsequently the developmental periods of childhood will be discussed.

2.3 Developmental periods of children

Although the development of skills of children is an ongoing process, it is useful to divide it into stages along the lines of and qualities associated with features that most individuals develop in each specific stage (Louw *et al.*, 2007:6). This study focuses on motor skills, viz. object control skills, health-related physical fitness as well as physical activities and patterns among girls of a specific age, viz. nine and 10-year-old girls. For that reason it is important to briefly discuss the different stages of motor development.

Physical growth and development, according to Louw *et al.* (2007:6) occur in the following developmental period: **prenatal stage** (from impregnation to birth), **neonatal stage** (first two to four weeks of life), **baby years** (birth to two years) and **childhood years** (two to 12 years). The childhood years can be further divided into the **toddler years** (two to five years) and the **middle childhood years** (six to 12 years). Subsequently the focus will be on the developmental phase during the middle childhood years, because this developmental period is the target population of this dissertation.

2.3.1 Middle childhood years (six to twelve years):

The middle childhood years are known as the period of relative calm and stability, with due consideration of the rapid development taking place during the early preschool period and

later adolescence (Louw *et al.*, 2007:215). One of the outstanding characteristics of physical development during the middle childhood years is the rapid growth of arms and legs in relation to the torso and this necessitates almost daily adjustments of eye, hand and foot co-ordination (Louw *et al.*, 2007:216; Du Toit & Kruger, 1991:108). Learning and refining a variety of psychological and FMS are the most outstanding developmental characteristics of the middle childhood years. These skills develop as a result of an increase in strength, co-ordination and muscular control in the middle childhood years. Several researchers also believe that balance and graceful physical movement also improve visibly during this phase. It can be expected that children will participate in activities that require the application of motor skills, because they like running, jumping, hopping, cycling, skating, swimming, kicking balls, dancing and participating in a variety of sports codes. Children in their middle childhood years do not have the same strength, endurance and speed as adolescents or adults, but their co-ordination, timing and concentration are often just as good (Louw *et al.*, 2007:216).

With reference to gross motor activities, such as running, jumping and throwing, boys usually develop more rapidly than girls (Louw *et al.*, 2007:216; Bukatko & Daehler, 1998:177), and these differences are usually attributed to boys having more muscular tissue than girls and are therefore stronger (Louw *et al.*, 2007:216).

The environment in which a child grow up play an important role in his or her development, therefore the Bronfenbrenner and Dynamic Systems Theories will be discussed.

2.3.2 Theories that describe childhood development:

2.3.2.1 Bronfenbrenner's socio-ecological systems theory of development

Bronfenbrenner (1979:514) developed his ecological system theory in an effort to define human development and to understand it within the context of the system of relationships constituting the person's environment (Johnson, 2008:2). This model indicates that the development of the individual occurs at levels of social relationships, comprising different sections. Bronfenbrenner (1979:514) distinguishes initially four systems, viz. the micro, meso, exo and macro-systems of social development, and later added a fifth aspect, viz. the chronosystem which envelops the change and interaction among these systems (Bronfenbrenner, 1979:331; Johnson, 2008:2; Van Staden, 2009:26). Each of the subsections will now be discussed briefly:

- **Micro-system.** The micro-system is defined as the patterns of activities, roles and interpersonal relationship that are experienced by the developing person in a specific physical environment, and which contains other persons with character, temperament, personality and belief systems (Bronfenbrenner, 1995:227). The micro-system consists of the child himself, his/her gender, age, health, as well as the role that he/she plays and has a direct influence on his/her development (Hirsto, 2001:29; Johnson, 2008:2; Le Roux:2014:40).

- **Meso-system.** The meso-system is the environment in which the child finds him/herself. It can be the church, home, friends and school. According to Johnson (2008:2) the meso-system can also be seen as a dynamic interaction between, for example, child and parents. According to Bronfenbrenner (1995:227) the meso-system simply constitutes a linkage with the micro-system.

- **Eco-system.** The eco-system represents the greater social system and involves events, decisions over which the child has no influence, for example health services, social services, family, friends – where fixed norms and standards and social networks occur that are influenced by the community (Johnson, 2008:3).

- **Macro-system**. The macro-system can be seen as the "blueprint" of a given culture, sub-culture, or broad social context, and consists of overarching patterns of values, beliefs, ways of life, opportunities and resources within which these occur (Johnson, 2008:3). According to Le Roux (2014:40), the development of the child occurs within this specific context, where each system has its own role, norms and values which might have an influence on the development of the child. This assumption is supported by Maphatane (1994:24), who indicates that the socio-economic situation within which a child grows up plays a decisive role in his or her development as a whole.

- **Chrono-system.** According to Johnson (2008:3), the chrono-system represents a time-based dimension that influences the functioning of all the foregoing levels. The chrono-system can refer to both short and long-term time dimensions of the individual, as well as socio–historical dimensions of the macro-system were he or she finds him or herself in (Bronfenbrenner, 1979:331; Johnson, 2008:3; van Staden, 2009:26).

2.3.2.2 Dynamic system theory

The dynamic system theory represents movement development and co-ordination as a process, which limits the variables of a system in a behavioural unit (Johnson, 2008:3).

- The **first principle** of the dynamic system theory is the self-organizing complex system. This is where behavioural patterns can occur spontaneously out of the co-operation and self-organization of various sub-systems or components (Ulrich, 1997:321). The co-operation of sub-systems is the so-called organized structure, and as described by Newell (1986:350), behaviour is shaped out of the self-organization of the physical systems, the nature of the person's environments, and the demands of the task at hand.

- The **second principle** in the dynamic system theory is the idea of an "attractor state", stable and unstable, that refers to the preferential behavioural patterns that a system "wants" to execute under certain conditions (Ulrich, 1997:321). A stable "attractor" has a high probability of occurring and when it is disturbed, the system will rapidly return to a stable pattern and the interruption is minimal. Furthermore, new behaviours or movements can emerge when the stable "attractor" weakens to the point where another "attractor" can influence behaviour (Schöner & Kelso, 1988:1519).

- The **third principle** states that changes in the "attractor state" and the emergence of new behaviour occur over time as a complex system gradually changes. If the system changes as a result of the transition in the "attractor state", there is a relatively sudden reorganization of the system in a new pattern. The reorganization is referred to as a non-linear shift in the phase (Ulrich, 1997:321). The components of a system responsible for phase shifts in movement patterns are known as control parameters. Control parameters cause a system to reach a point where the present pattern fails to work as well as it used to work. Behaviour becomes unstable for a period of time, and the system investigates new possibilities before discovery of a new, more efficient pattern becomes visible (Ulrich, 1997:321). These control parameters can be internal or external to the system.

The development of the child is done within these specific systems, where each system contains its own role, norms and rules, which have an influence on the development of the child, therefore the development of the object control skills will be discussed.

2.4 Object control skills

Subsequently a literature review is presented of the different phases of development where FMS in terms of object control skills/manipulation skills, as well as the development of these at the ages of nine and ten.

2.4.1 Phases of motor development under which object control skills can be divided

According to Gallahue and Ozmun (2006:50) children's motor development can be divided into four phases, viz. the r*eflexive movement phase, first movement phase, fundamental movement phase and sports-related movement phase* (see Figure 2.1). Each of the four phases is discussed briefly.

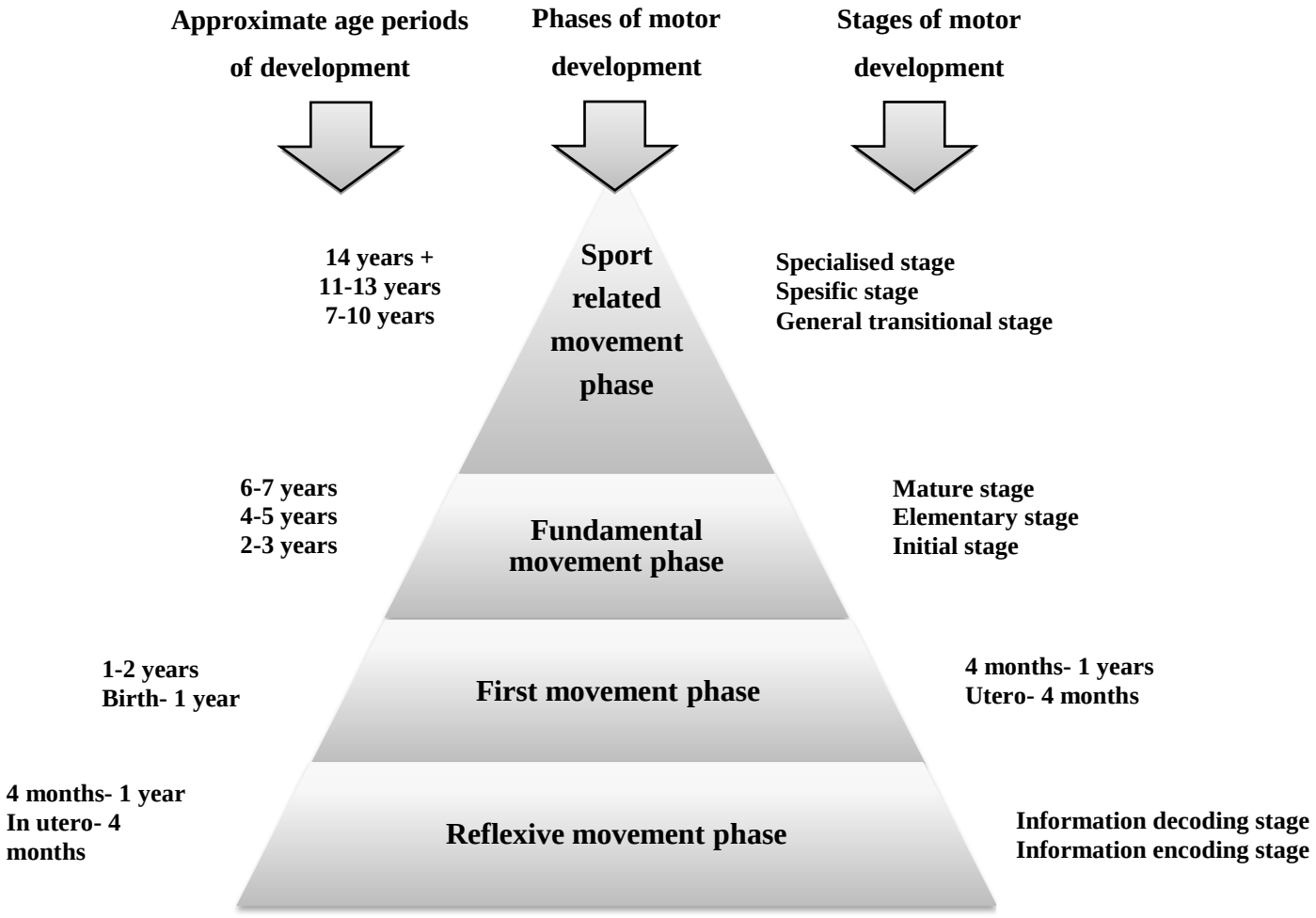


Figure 2.1: Phases of motor development as composed by Gallahue and Ozmun (2006:49)

2.4.1.1 Reflexive movement phase

This phase already begins during the pre-natal stage and continues until after birth. An inner need for movement and sensory functions is already observable as early as during birth (Pienaar, 2012:7). All movement occurs in the form of reflexes that are involuntary, such as the sucking reflex and the Moro reflexes (Gallahue & Ozmun, 2006:50). This phase and the first developmental phase develop simultaneously (Pienaar, 2012:7).

2.4.1.2 First movement phase

This phase lasts from the period after birth to about the age of two. Stability skills that include control of the neck, head and torso during sitting and standing include activities such as locomotor skills (crawling and walking) and manipulation skills (such as grabbing and rolling of a ball) that occur during the first movement phase. During this movement phase babies have little control over small muscular movement and maturing of hand-eye co-ordination is reflected through the improvement and development of small muscular movements (Pienaar, 2012:8). The reflexive and the first movement phases are directed at babies and toddlers and are essential building blocks for the fundamental and more specialized movement phases that children develop in their early childhood years (Gallahue & Ozmun, 2006:51).

2.4.1.3 Fundamental movement phase

The development and refinement of posture, locomotor and manipulation skills that already started in the first two years of life develop further during this phase (Pienaar, 2012:8). During the fundamental movement phase, movements are mastered at three levels, viz. the initial phase, the elementary phase and the mature phase. The **initial phase (two to three years)** is characterized by a series of unco-ordinated movements, with limited use of the body and of space. Movements are still limited and are not made with fluidity, coming across as rigid movements (Pienaar *et al.,* 2012:8; Gallahue & Ozmun, 2006:52). The second phase, the **elementary phase (four to five years)** is characterized by children having better control and rhythmic co-ordination in the execution of their movements. Patterns of movement are generally limited or exaggerated although they come across as more co-ordinated in the execution of their movements than during the initial phase (Pienaar *et al.,* 2012:8; Gallahue & Ozmun, 2006:52). The last phase, the **mature phase (six to seven years)** is characterized by co-ordinated and controlled movements (Pienaar *et al.,* 2012:8; Gallahue & Ozmun,

2006:52). Gallahue and Ozmun (2006:52) confirm that most fundamental movement should already have been mastered at the age of six. Object control skills that require visual copying and intercepting of an object, such as catching or striking a ball, develop later as a result of the type of visual-motor requirements that these skills need (Gallahue & Ozmun, 2006:52).

2.4.1.4 Sports-related movement skills

This phase stretches from about the age of seven to about fourteen plus. The sports-related movement phase is further divided into the transition phase (seven to 10 years), the specific phase (eleven to thirteen years) and the specialized phase (14 years and older). The **transition phase** is characterized by children in Grades 1, 2 and 3 **(seven to 10 years, known as the middle childhood years)** (Pienaar, 2012:8). This phase is characterized by the expansion and refinement of locomotor, manipulation and stability skills. Children become more interested in sport and performance and the development of the fundamental skills is now of such a nature that they can be applied in related sport-specific games, that is, the striking skill is refined through use of specific sports implements, such as a golf club, baseball bat, tennis racket or hockey stick (Gallahue & Ozmun, 2006:53). The second phase, viz. the **specific phase,** is characterized by the late childhood years and early adolescence **(11 to 13 years)** (Pienaar, 2012:24). When children reach this phase they show mature patterns of behaviour in the execution of motor skills. It is also in this phase that children begin to be interested in certain sports codes that will emphasize their strong points. The focus in this phase is on the improvement of techniques and style of the skill through repeated practice (Pienaar, 2012:24). The final phase, viz. the **specialized phase (14 years and older)** is characterized by the specialization in a specific sports code chosen in accordance with the child's abilities, interest and the availability of coaching. Refinement of techniques takes place in this phase (Pienaar, 2012:21, 24).

Following the above explanation of the different phases of motor development, the development of object control skills will subsequently be discussed in detail.

2.4.2 Definition and development of object control skills

Fundamental movement pattern is a term used to describe organized sequences of basic movement patterns (Pienaar, 2012:6). Object control skills fall in one of the categories in which FMS are grouped in *Object control skills* consist of activities such as throwing, catching, kicking, striking and dribbling (Department of Education, 2013:15). The Test of

Gross Motor Development - 2nd edition (TGMD-2) is a test battery used to evaluate the object control skills of children between the ages of three and ten (Ulrich, 2000:3). *Object control skills* do not develop automatically in children and the opportunity for practicing and coaching in these skills is important for children when they need to master an advanced movement pattern. These skills require complex visual-motor adjustments and for that reason they develop as locomotor skills later in a child's life (Gallahue & Ozmun, 2006:191). Ulrich (2000:49) and Payne and Issacs (2008:328) describe the development and qualitative execution of the various object control skills/manipulation skills as follows.

2.4.2.1 Development of the striking action

The striking action begins to develop between the ages of two and three, with an improvement between three and seven years of age. A mature pattern develops between the ages of seven and nine years (Payne & Issacs, 2008:349). According to Gallahue and Ozmun (2006:191) the striking action should already have been mastered between the ages of five to seven. During the striking action, the dominant hand should be placed above the non-dominant hand, where there should then be a clear shoulder and hip rotation during the striking of the ball. The weight should also be placed on the front foot and the bat should make contact with the ball (Siahkouhian *et al.*, 2011:1357; Ulrich, 2000:49).

2.4.2.2 Development of the dribbling skill

Early development of dribbling is observable in children between the ages of five to eight years (Payne & Isaacs, 2008:351). During the dribbling skill, the ball should not move above hip height, and the ball should be dribbled with the fingertips (Ulrich, 2000:49). The ball has to be dribbled in front of the body and not move to the sides. According to Gallahue and Ozmun (2006:236), the dribbling skill is a complex fundamental skill seeing that it requires good depth perception and figural background.

2.4.2.3 Development of catching

Early development of the catching pattern can already be observed at the ages of 1,5 to 3,5 years of age with an improvement in the catching pattern at the age of five (Payne & Issacs, 2008:341). An adult catching pattern is observable between the ages of 5,5 to seven years (Payne & Issacs, 2008:341). Gallahue and Ozmun (2006:191) indicate in this context that the mastery of the mature catching pattern should be visible at the ages of six to seven. When it

comes to the *catching* of a ball there should be a preparatory phase where the hand is stretched out in front of the body with the elbows bent. In the mature phase the ball may only be caught in the hands, and no contact made with the body (Siahkouhian *et al.*, 2011:1357; Ulrich, 2000:50).

2.4.2.4 Development of kicking

The first observation of kicking can already be made at a very early age (1,5 to four years of age) and a mature kicking pattern can develop by the age of 6,5 to 8,5 years (Payne & Issacs, 2008:353). According to Gallahue and Ozmun (2006:191) the kicking action should already have been mastered at the age of five to six. During the kicking skill there should be a fast, ongoing run-up to the ball, with a lengthened stride before contact is made with the ball. The non-dominant foot should be somewhat behind the ball. The ball is then kicked with the dominant foot (toes or the side of the foot) (Siahkouhian *et al.*, 2011:1357; Ulrich, 2000:50).

2.4.2.5 Development of overhand throwing

The starting pattern of the overhand throw develops between the ages of 1,5 to three years. The mature throwing pattern should be developed by the ages of 5,5 to 8,5 years (Payne & Issacs, 2008:330). Gallahue and Ozmun (2006:191) indicate that the mastery of the mature throwing pattern should be visible by the ages of four to six. During the overhand throw there should be a downward movement with the hand or arm, and there should be a clear shoulder and hip rotation to the point where the side not involved in the throw will point towards the wall. In the action, the weight is transferred to the opposite foot from the hand used for throwing (Siahkouhian *et al.*, 2011:1357; Ulrich, 2000:51).

2.4.2.6 Development of underhand roll

During the underhand roll the ball should be swung backwards and there should be a movement with the opposite foot to the hand being used into a position where the knees are bent. The ball should thus be rolled as close as possible to the ground (Ulrich, 2000:51). Gallahue and Ozmun (2006:190) indicate that the mastery of the mature roll should be visible at the ages of six to seven.

The above ages can be regarded as average ages at which children should master certain object control skills. It has to be kept in mind, however, that all children do not develop and

grow at the same rate (Pangrazi & Carbin, 2000:46). Children who develop more quickly (known as early developers) move more quickly in biological terms through the different developmental periods and are usually more skillful in the execution of basic motor skills than the slower developers (known as late developers) (Pangrazi & Carbin, 2000:46; Branta, 1982:38). A possible reason for this can be found in their longer legs, more muscular mass and larger output of strength (Branta, 1982:38; Louw *et al.*, 2007:216).

Subsequently an overview will be given of the status of object control manipulation skills of nine and ten year old girls.

2.4.3 The status of object control skills girls between nine and ten years of age

The mastery of FMS should take place during the foundation phase (Grades R to 3 or six to 10 years of age) of the child's school career (Krüger, 2002:82). Butterfield *et al.* (2012:264) and Pienaar *et al*. (2013:7) have evaluated several sub-components of the TGMD-2. Butterfield *et al.* (2012:264) did a study on four of the six sub-components of the object control skills (catching, throwing, kicking and hitting of a ball) in three to 10-year old children, while Pienaar *et al.* (2013:7) evaluated all six object control skills (throwing, catching, kicking, striking, dribbling and rolling) of nine to 10-year old children in the North-West Province of South Africa. There is still controversy in the literature about when 10-year olds master the object control skills, and for that reason various research findings will be discussed in this regard.

2.4.3.1 Catching pattern

Butterfield *et al.* (2012:264) did a study in Maine on 186 children (81 girls and 105 boys), between the ages of five and fourteen. The purpose of the study was to determine the age and gender differences between the different object control skills of these children. The above-mentioned researchers found that at the age of 10, 80,5% of the children demonstrated a mature catching pattern, while 72,2% of the children had reached a mature kicking pattern. Only 47% of the girls had mastered mature throwing pattern at the age of 10 years, while only 44,7% of 10-year-old girls had demonstrated a mature striking action (Butterfield *et al.*, 2012:269). According to Ulrich (2000:19), only 90,3% of nine-year-olds and 93% of 10-year-olds mastered the catching pattern. To link up with this, Pienaar *et al.* (2013:13) found that 93% nine to 10 year-old girls and 96% of nine to ten year-old boys in the North-West Province had reached a mature catching pattern.

2.4.3.2 Throwing skill

Fredrickson and Harrison (2005:91) research conducted on 202 girls (between 10 and 17 years of age) in the Middle-East, with the purpose of evaluating the girls' throwing skills. These researchers found that all the girls demonstrated a form of preparatory backward movement and hip rotation and added to that there was little difference between the girls' stepping forward, hip action and fore-arm action. In the South-East of Maine, Loovis and Butterfield (1993:459) collected data of 381 boys and 338 girls whose ages ranged between four and 14 years. The purpose of their study was to determine what influence age, gender, balance and sports participation had on the development of the throwing action. These researchers reported that the throwing skill improved with increased age, but a decrease had been visible in the throwing action in Grade 4 girls (Loovis & Butterfield, 1993:463). Ulrich (2000:19) research concurred with the above studies by confirming that 78,25% nine-year-old children and 79,75% of the 10-year-old children revealed a mature pattern in overhand throwing. Pienaar *et al.* (2013:15) did research that also indicated that 76,8% of the nine to 10 year-old girls and 81,9% of the nine to 10-year-old boys showed mastery of the throwing skills.

2.4.3.3 Striking action

The striking action has further been studied by Loovis and Butterfield (1995:597) on 380 boys and 337 girls between the ages of four to 14 years, and they found that gender and age do have an influence on the sideways striking action. These researchers found that although girls showed a constant development from nursery school up to and including Grade 5, their developmental tempo was slower than that of boys. During the nursery school years only half the number of girls compared to the boys demonstrated an adult sideways striking action. Loovis and Butterfield (1995:597) further indicated that girls' striking action generally showed a three-year developmental backlog compared to boys. According to Ulrich (2000:19) 80,6% of nine-year-olds and 81,8% of 10-year-olds showed mastery of the striking action, while Pienaar *et al.* (2013:14) found an 83,9% mastery on their study of nine to 10 year-old girls and 89,6% of boys.

2.4.3.4 Kicking action

Further studies were done on 379 boys and 337 girls between the ages of four and 14, with the purpose of determining what influence age, gender, balance and sports participation have

on the development of the kicking action (Loovis & Butterfield, 1994:691). The percentage of girls with mature kicking patterns was lower than that of boys in primary school (seven to 13 years). The opposite also occurred while the girls in the nursery school (four to six years) had better developed kicking patterns than the boys (Loovis & Butterfield, 1994:691). Following the achievement of a high point of 59% mastery in Grade 4 by the girls, the mastery of the kicking action by girls slightly increased from 53% to 55% from Grades 5 to 8 (Loovis & Butterfield, 1994:692). Ulrich (2000:19) indicated that 87,75% of nine-year-olds and 91% of 10-year-olds showed an adult mastery of the kicking skill. Pienaar *et al.* (2013:16) also indicated that 89% of the nine to 10-year-old girls and 95,4% of boys had reached an adult kicking pattern.

2.4.3.5 Dribbling skill

According to Ulrich (2000:19) only 87% of nine year-olds and 90,25% of ten year-olds mastered the dribbling skill, while Pienaar *et al.* (2013:18) found an 83,8% mastery among girls and 88,6% among boys in the same age group.

2.4.3.6 Underhand roll

Ulrich (2000:19) indicated that only 77,5% of nine-year olds and 80,5% of 10-year olds could master the underhand role or were already in the mature phase of mastery. Pienaar *et al.* (2013:18) found a 75,4% mastery among girls and an 80,1% among boys in the same age group.

From the above it is clear that the mastery of object control skills does not take place as rapidly any more as had been determined by Ulrich (2000:19). Table 2.1 indicates the mastery of percentage of each component of the six object control skills as outlined by Ulrich (2000:19).

Table 2.1: Percentage of children demonstrating mastery on object control sub-test skills at ages three through 10 (Ulrich, 2000:19)

Skill	Percentage mastery of each performance criterion	Age
Striking a stationary ball	80% of children grip the bat with their dominant hand above their non-dominant hand when striking a stationary ball off a batting tee.	4
	75% of the children's non-preferred side of their body faces the imaginary tosser and their feet are parallel when striking a stationary ball off a batting tee.	7
	78% of children show any hip and shoulder rotation when striking a stationary ball off a batting tee.	8
	68% of children's body weight is transferred to their front foot when striking a stationary ball off a batting tee.	10
	74% of children contact the ball with their bat when striking a stationary ball off a batting tee.	10
Stationary dribble	84% of children contact the ball with one hand about belt level when dribbling stationary.	9
	79% of children push the ball with their fingertips (not a slap) when dribbling stationary.	8
	84% of children have the ball contact the surface in front of or to the outside of their foot on their preferred side when dribbling stationary.	6
	79% of children maintain control of the ball for four consecutive bounces without having to move their feet to retrieve it when dribbling stationary	7
Catch	83% of children have a preparation phase where their hands are in front of their body and their elbows flexed when catching.	5
	82% of children have their arms extended while reaching for the ball as it arrives when catching.	6
	80% of children are able to catch the ball with only their hands when catching.	8
Kick	77% of children have a rapid continuous approach to the ball when kicking.	5
	73% of children have an elongated stride or leap immediately prior to contacting the ball when kicking.	10
	87% of children have their non-kicking foot placed even with or slightly in back of the ball when kicking.	5
	84% of children kick the ball with the instep of the preferred foot	

Skill	Percentage mastery of each performance criterion	Age
	(shoelaces) or toe when kicking.	5
Overhand throw	79% of children have a windup that is initiated with a downward movement of hand/arm when throwing overhand.	8
	76% of children rotate their hips and shoulders to a point where their non-throwing side faces the wall during overhand throwing.	10
	76% of children transfer their weight by stepping with the foot opposite of their throwing hand when overhand throwing.	9
	82% of children follow-through beyond ball release diagonally across the body toward their non-preferred side when overhand throwing.	8
Underhand roll	81% of children have their preferred hand swing down and back, reaching behind the trunk while their chest faces the cones when rolling underhand.	6
	76% of children stride forward with the foot opposite of their preferred hand toward the cones when rolling underhand.	9
	75% of children bend their knees to lower their body when underhand rolling.	8
	67% of children release the ball close to the floor so the ball does not bounce more than four inches high when rolling underhand.	10

The development and refinement of movement patterns and movement skills are influenced in complex ways. Both the process and product outcomes of movements are linked to the individual's socio-economic background and experiences and hereditary qualities (Gallahue & Ozmun, 2006:62). Factors that influence movement skills will subsequently be discussed.

2.4.4 Factors giving rise to a decline in object control skills in girls

Various factors have an effect on object control skills of children. According to Raychaudhuri and Sanyal (2012:S193) the children's school environment as well as their parental home is an important determiner of a child's active or sedentary lifestyle and its development. Accordingly factors linked with this study are briefly discussed from the literature that includes increased sedentary behaviour, age, gender, health, physical activities, opportunity for participation and the environment.

2.4.4.1 Sedentary behaviour

According to Hills *et al.* (2007:540) there is at present an observable trend of an inactive lifestyle among children. This can be ascribed to susceptibility to a technologically changing environment and issues involving the safety of the environment in which they grow up (Hills *et al*., 2007:540). A possible implication of a more security-conscious culture is that parents are increasingly protective towards their children during transport to school and extramural activities which leads to a sedentary behaviour (Hills *et al*., 2007:540). The increase in a sedentary lifestyle in the early childhood years can be a predictor of health risks in later life (Dehghan *et al.,* 2005:24). Contemporary children are more exposed to risk factors such as coronary heart diseases, hypertension, diabetes and obesity as a result of their inactive lifestyle (Poulsen & Ziviani, 2004:69). Pienaar and Kemp's (2014:174) research on 816 (419 boys and 397 girls) Grade 1-learners in the North-West Province, indicated that most learners in the North-West Province tested below average (49,63%) and average (48,16%), in terms of their motor skills and only a small percentage (0,61%) tested above average. These researchers are of the opinion that the possible reasons for these trends can be the result of the fact that children who play indoors more and do not participate as actively in sports activities or any form of physical activities appear more sedentary (Hills *et al*., 2007:540; Pienaar & Kemp, 2014:174). The Sport and Fitness Foundation (WSFF) of England reported the key findings about the participation in sport and physical activity by young girls and women. They indicated that the decrease in girls' participation in sport begins earlier than in the case of boys (nine to 12 as opposed to 13 to 16). Girls' decrease in sports activities does not only begin earlier, but it is also more dramatic, and this is the reason behind the larger differences between the genders in the older age groups. Between the ages of five to eight and 17 to 19 the girls' activity levels decrease by 66% (from 91% to 31%), while boys' activity levels decreased from 91% to 49% (WSFF, 2010:3).

2.4.4.2 Age and gender

According to the literature a great deal of research has been done to investigate the influence of age and gender on the development of motor skills in children (Ikeda *et al.,* 2009:14; Singh *et al.,* 2010:154; Malina, 2004:62).

Van Beurden *et al.* (2002:247) conducted their study on 1 045 rural Australian children, consisting of 515 Grade 3- and 530 Grade 4-learners. They found that there was a difference

in the motor development of boys and girls. These leaners' FMS were evaluated, and the results indicated that the boys did better than the girls in object control skills, such as catching and kicking, while no gender differences were found in the execution of locomotor skills (Van Beurden *et al.*, 2002:247). Berk's (2012:180) research findings are in accord with Van Beurden *et al.'s* (2002:247) findings, which indicate that gender differences during the middle childhood years play a big role in object control skills. Berk (2012:180) found that boys did significantly better in kicking, dribbling and catching than the girls, and was also of the opinion that boys did better in all the object control skills than girls, because fathers tended to play more ball games with their sons rather than their daughters. Hardy *et al.* (2010:506) did a study on preschool children, and also found that boys obtained a higher total object control score than girls, as well as a higher score for each of the following object control skills viz. striking, kicking and overhand throwing. Girls in contrast only did better in the catching skill compared with the boys (Hardy *et al.*, 2010:506). Pienaar & Kemp's (2014:175) study on Grade 1 learners in the North-West Province in South Africa, found that boys generally showed better object control skills as well as strength in these skills than girls in the same age group. These researcher's ascribes these differences to the fact that boys have higher levels of physical activity as they grow older and that boys indulge more in activities requiring strength, as well as the fact that they tend to play outside more (Kemp & Pienaar, 2014:175).

According to Gallahue and Donnelly (2003:725), boys participate in more ball sports than girls, and therefore boys are exposed to more opportunities to develop their kicking, catching and throwing skills. Girls, on the other hand, tend more to participate in activities such as dancing, which do not promote object control skills (Gallahue & Donnell, 2003:725). From the above it emerges that gender differences in object control skills can be a possible indicator of what the different activities are in which children typically participate at different ages.

2.4.4.3 Physical activity levels of the child

Cook's (2005:12) study on 1 294 toddlers in Victoria, Australia, reported that object control skills do correlate positively with moderate physical activity levels of toddlers over weekends (11,4%). Furthermore, the results also indicated positive correlations between high intensity activities (9,5% and 9,9% respectively), when executed on a daily basis, and during the weekend, as well as moderate to high intensity physical activity (9,9% and 16,8%) done on

both a daily basis and over a weekend. From the latter it can be deduced that children tend to participate more in high intensity physical activities, including ball sports, over a weekend. Barnett *et al*. (2008:10) conducted research on 1 054 children, with an average age of 10,1 years, from 18 selected primary schools in New South Wales, Australia. These researchers reported that children with a high skill levels in object control, have a 20% better chance to participate in moderate-to-high intensity physical activities during adolescence, in comparison with the < 5% chance for those who had not mastered object control skills fully in their childhood years (Barnett *et al*., 2008:10).

Williams *et al.* (2008:1426) did a study on three and four-year-olds with the purpose of determining the link between motor skills and physical activities in preschool children. Williams and his co-workers (2008:1426) found that object control skills did not show a strong link with physical activity levels of children. The findings of LeGear *et al.* (2012:4) are in accord with those of Williams *et al.* (2008:1426). LeGear *et al*. (2012:4) further found that girls with an average age of five years and nine months had physical activity levels related to their locomotor skills, but not their object control skills.

Hardy *et al.* (2012:390) did a study on Grades 2, 4, 6, 8 and 10 children with the purpose of determining what the demographic and health-related physical fitness of school-going children with a low mastery of FMS was. Hardy *et al*. (2012:395) found that low mastery of FMS was associated with weaker health outcomes, including low cardio-respiratory fitness, low physical activity, overweight and obesity. Hardy *et al*. (2012:395) also found that low mastery of FMS could be associated with a series of socio-demographic characteristics, including gender and socio-economic class.

2.4.4.4 Opportunity for participation

Object control skills do not develop automatically in children, and for this reason opportunities for exercising and encouragement are essential for children to enable them to master more advanced movement patterns (Gallahue & Ozmun, 2006:181).

Children who are regarded as being disadvantaged do not receive the necessary support from their environment and their parents that is necessary for the development of FMS (Goodway & Branta, 2003:37; Goodway & Rudisill, 1996:288). Furthermore research regarding the social-economic circumstances in which the child grows up play a big role in the general development of children (Draper *et al.,* 2012:148; Goodway & Rudisill, 1996:289). It is clear

from the arguments of the mentioned researchers that opportunities for skills development are essential. The school environment can also exert an influence on children's activity levels during vacations and school breaks (Ridgers *et al.*, 2012:326). Ridgers and his co-researchers (2012:326) found that the provision of facilities and equipment such as balls and skipping ropes contributed to increased levels of physical activity among children during breaks. It would appear that access to a variety of facilities, spaces and equipment can encourage physical activity and in this way created supportive environments that can promote physical activity (Ridgers *et al.*, 2012:326).

Various researchers have already found that socio-economic conditions can have a significant influence on the development of the child (Draper *et al*., 2012:148, Martina *et al*., 2009:236). Girls from economically disadvantaged backgrounds, from different race groups and with disabilities can face obstacles with regard to physical activity and sport. Poor families cannot afford investing in membership of health clubs or buy equipment. Disadvantaged families can also not afford the cost of transporting girls to and from the home and school (Martina *et al*., 2009:236). Single parents (mostly mothers) are at times dependent on older girls to help with household chores such as cooking, and they have to help their smaller siblings get home from school, therefore their involvement with extramural activities is severely limited. Girls in disadvantaged conditions are furthermore exposed to violence, single-parent families and drug abuse (Martina *et al*., 2009:236). The lack of physical activity and sports participation can be added to this list. Economically disadvantaged girls also tend more to grow up in unsafe and unhealthy environments and girls growing up in such conditions often do not have access to expert training and education in sport (The President's Council on Physical Fitness and Sports Report, xxiv).

The Department of Basic Education in SA divides schools in five categories or Quintiles depending on the level of poverty in the relevant school. Quintile 1 is classified as the least well-off schools while Quintile 5 is classified as the best-off schools (Hall & Giese, 2009:37). Le Roux (2014:90) did a study on 880 Grade 1-learners in the North-West Province of South Africa. The purpose of the study had been to determine whether socio-economic conditions exerted an influence on the ball-game directed sports skills of Grade 1-learners. This researcher's results indicated that lower socio-economic conditions (Quintiles 1-3) had a negative influence on the development of most ball-game directed sports skills of the Grade 1-learners (Le Roux, 2014:90). The study also indicated that children in lower socio-

economic conditions did better in kicking skills than children in higher socio-economic conditions. Le Roux (2014:90) ascribes this finding to the opportunities and exposure of playing street soccer from an early age.

According to the WHO (2012:5), physical education in schools has the potential to be a powerful force against a sedentary way of life. The importance of physical education and school sport is widely recognised as essential, not only because it contributes to the immediate advantageous effects on physical fitness, but in the preparation of children for a physically active and thus healthier lifestyle WHO (2012:5). Disadvantaged schools are limited by a lack of expertise and physical resources with regard to physical education and school sport (Walter, 2011:787).

2.4.4.5 Environment

Environmental influences include factors such as the opportunity to exercise, domestic circumstances and the resources available at the school.

During the early childhood years, children spend a lot of time in interaction with their environment by means of movement such as crawling, walking and jumping, and this is a critical developmental period in the child's development of gross motor skills (Ulrich, 2000:2). It is also known that the development of a child occurs according to a genetic pattern as well as through the influence of environmental factors. In the first place the family and home environment within which the child grows up plays an important role in the learning and motor development of the child (Son *et al.*, 2010:1103; Venetsanou & Kambas, 2010:319; Yeung *et al*., 2009:424). A family's income and economic conditions have a powerful effect on children's development (Yeung *et al*., 2009:425). A lower income affects children mainly through their home environments and the upbringing that they receive in ways that impede optimal development. Poverty-stricken children receive less stimulation and learning materials than higher-income children (Son *et al.*, 2010:1103).

With regard to the amount of time spent by children nowadays in school it goes without saying that a teacher also plays a significant role in the motor development of children. Pre-school centres as well as primary schools with adequate equipment and appropriate care, as well as a specific educational approach for the relevant age group, offer more opportunities for a suitable development of children's motor abilities (Venetsanou & Kambas, 2010:322, 324). Educators should be aware of the importance of both the early identification of possible

risk factors that impede normal development, as well as knowledge about appropriate movement programmes (Chairopoulou, 1997:62). According to the results that Uys and Pienaar (2010:140) obtained from children between the ages of four to 71 months in the Potchefstroom environment in SA, it emerges that the low socio-economic status (SES) group of children perform worse in the evaluation of their overall motor development in comparison with the high SES group of children. These researchers found that the children in the low SES group showed better results in the balancing and object manipulation sub-components, as evaluated by the PDMS-2. Uys and Pienaar (2010:140) ascribes the better balancing and object manipulation of this group to the fact that they are less exposed to technology and tend to play outside more where there is more space to kick balls and to catch, and so they tend to be able to execute these skills better. Children who are exposed to environments where natural obstacles occur on which children can climb and clamber generally show an improvement in large muscular development (Uys & Pienaar, 2010:140). The research done by Uys and Pienaar (2010:140) also found that children from a high SES had poorer mastery of manipulation skills which might be attributed to the long times that these children play indoors.

Apart from education the community within which a child grows up also plays an important role in the child's motor development. The environment of the child must be laid out in such a way that optimal motor development is possible, regardless of the age of the child (Chairopoulou, 1997:62). The community, streets and playgrounds are not always a safe environment to play and to execute motor activities (Goodway & Branta, 2003:37).

Children living in blocks of flats in urban environments have limited space and this prevents motor skills (such as locomotor skills and object control skills) from being executed (Venetsanou & Kambas, 2010:321). Opposed to this, children from a higher SES environment have a larger variety of toys than children growing up in lower SES environments (Venetsanou & Kambas, 2010:321). According to Bar-Or *et al.* (1998:4), toys such as computer games also determine the activity levels of the child and leads to a sedentary lifestyl.

2.5 Health-related physical fitness

Execution of any movement, whether it is the first movement phase, the fundamental movement phase or the sports-related phase, requires varying degrees of muscular strength,

muscular endurance, cardiorespiratory endurance, flexibility and body composition, and for that reason the issue of health-related physical fitness will subsequently be discussed (Gallahue & Ozmun, 2006:252). A definition of what health-related physical fitness is, the different components of health-related physical fitness as well as the status of development of these components in girls between the ages of nine and 10 will be provided.

2.5.1 Defining health-related physical fitness

Physical fitness refers to the maintenance of basic bodily functions that help to enable people to fulfill their day-to-day activities (Monyeki & Kemper, 2007:13). *Health-related physical fitness* also refers to the areas that have to do with general health as well as completing daily tasks and activities (Wuest & Bucher, 2003:253). According to Corbin and Pangrazi (1992:97) and Gallahue and Donnelly (2003:83), physical fitness can be sub-divided into health-related physical fitness components (muscular strength, muscular endurance, cardio-respiratory endurance, suppleness and body composition) and motor or achievement-related fitness skills (balance, co-ordination, nimbleness, speed and power rapidity). For the purposes of this study the focus will only be on health-related physical fitness. The components of health-related physical fitness will be briefly defined.

2.5.2 Components of health-related physical fitness

Health-related physical fitness, according to Pienaar (2012:32), consists of five components, viz. muscular strength, muscular endurance, cardio-respiratory endurance, flexibility and body composition. *Muscular strength* can be defined as the maximal rendering of strength during a single muscular output (Centers of Disease Control and Prevention (CDC), 2014:18; Pienaar, 2012:32). *Muscular endurance* refers to the ability of muscles or groups of muscles to maintain maximal strength over a long period and can be improved through exercises such as sit-ups. *Cardio-respiratory endurance* is described as adequate functioning of the circulatory and respiratory systems that provide enough energy and oxygen to the muscles activities such as long-distance running, swimming and cycling are activities that promote cardio-respiratory endurance. *Flexibility* refers to the range of movement of a joint, while *body composition* finally can be defined as the ratio between fat mass and fat-free mass of the body (CDC, 2014:18; Pienaar, 2012:32;).

The FITNESSGRAM is a test battery that is used to evaluate health-related physical fitness in children between the ages of four to fifteen years of age. The FITNESSGRAM makes use of

"Healthy Fitness Zones" (HFZs) to evaluate the fitness levels of an individual. The HFZ represents the minimum levels of fitness needed to provide protection against a sedentary lifestyle. When girls between the ages of nine and ten can run between 15 and 41 lengths in the Progressive Aerobic Cardiovascular Endurance Run (PACER) test, and have a fat percentage of between 17% to 32%, with a BMI of between 16,6 and 23,5, they are classified as being within the HFZ (Meredith & Welk, 2008:116).

The health-related physical fitness levels of nine to 19-year old girls will be briefly discussed.

2.5.3 Health-related physical fitness levels of nine to ten-year old girls

According to Van Rooyen (1993:7) the period between eight and 12 years of age is the most important period in a child's life during which physical and motor fitness develop. To promote health-related physical fitness, it is necessary to inculcate an active lifestyle from a young age (Pino-Ortega, 2010:374).

Any execution of a motor skill, such as throwing a ball, requires a degree of health-related physical fitness (muscular strength, muscular endurance, cardio-vascular endurance and suppleness), as well as motor fitness skills of the torso, arms and legs (Clark, 1994:245; Gallahue & Ozmun, 2006:252). Gallahue and Ozmun (2006:252) also confirmed a link between health-directed physical fitness skills and motor skills, such as hand-eye and hand-foot co-ordination, and these physical skills are important for successful participation in sport. Of all the health-related physical fitness components cardio-vascular endurance has the biggest effect on lifelong health (Haywood & Getchell, 2005:240).

Truter *et al.* (2010:227) did a study in Potchefstroom were they obtained anthropometric (Body Mass Index [BMI], fat percentage) and health-related physical fitness (cardio-vascular endurance, body composition, muscular strength, muscular endurance, flexibility) measurements of 280 children between the ages of nine- to 12 years (128 boys and 152 girls). These children were evaluated with the FITNESSGRAM and the Bruininks-Oseretsky Test of Motor Proficiency 2nd edition (BOT-2). The study reported a negative correlation with a medium practical significance between cardio-vascular endurance, leg strength and arm strength (Truter *et al.*, 2010:227). Abdominal muscular strength showed no correlation with BMI (Truter *et al.*, 2010:229). Significant differences were found between the normal weight, overweight and obese groups in the PACER sub-test, where the cardio-vascular endurance of the children was evaluated, while differences in the standing long jump and knee push-ups

were significant between the normal weight and the obese group of children. According to Truter *et al.* (2010:232), it could be concluded that aerobic capacity and muscular endurance decreased as the BMI increased.

Toriola *et al.* (2012:795) did a study on 283 children (111 boys and 172 girls) with an average age of 14,9. The purpose of the study was to determine the health-related physical fitness, body composition and physical activity of adolescent learners. This study formed part of the "Physical Activity and Health Longitudinal Study" (PAHLS). Toriola *et al.* (2012:805) indicated that girls performed better than boys in torso flexibility, and these findings accord with previous studies which also indicate that girls show greater suppleness than boys at any age (Monyeki *et al.,* 2005:882). Furthermore, Toriola *et al.* (2012:804) also found that girls this age had a higher fat percentage than boys, as well as larger triceps skinfolds, sub-scapular skinfolds, and a total sum of skinfolds and percentage body fat.

2.5.4 Links between the different health-related physical fitness components

The links between different health-related physical fitness components will be discussed now:

Sandercock *et al.* (2010:47) conducted a study on children between the ages of 10 to 10,9 years. The research was done in 1998 (N = 303; 158 boys and 145 girls) and again in 2008 (N = 315; 158 boys and 157 girls) in England. These researchers found that there was a significant negative correlation between body composition and cardiorespiratory fitness in ten-year-old children. The above results are supported by Saghand *et al.* (2013:1276) who also conducted a study on 19 to 25-year-old female students at Yazd University, Teheran, Iran. These researchers reported a significant negative correlation between body composition and cardiorespiratory fitness. Huang and Malina (2010:410) study on 102 765 Taiwanese children (50 940 girls, 51 825 boys) between the ages of nine and 18 years, found that a higher BMI could be associated with a weaker performance in sit-ups. In their study, they also evaluated the link between BMI and four physical fitness factors (sit and reach, standing long jump, sit-ups and 800/1600m run/walk) and reported a positive correlation between BMI and flexibility. Saghand *et al*. (2013:1276) support these findings, because they also found a positive link between suppleness and BMI in their study. Esco *et al.'s* (2010:276) finding is in conflict with that of Huang and Malina (2010:410), because they reported a negative link between BMI and sit-ups. Truter *et al.'s* (2010:232) study on 280 children (128 boys and 152

girls) between the ages of nine and ten found that girls in the different BMI classes did significantly worse in their abdominal muscular strength than the boys. The researchers maintain that a possible reason for the weaker performance could be found in the fact that the girls had a larger waist circumference. Data collected by Hands *et al*. (2008:661) on 771 girls and 814 boys with an average age of 14,1 years, which formed part of the Western Australian Pregnancy Cohort Raine Study indicated that a lower BMI was advantageous for doing sit-ups.

In the preceding discussion, literature was discussed that analysed the development of object control skills and health-related physical fitness separately. Subsequently, literature findings about possible links between health-related physical fitness and object control skills will be elucidated.

2.5.5 Link between health-related physical fitness and object control skills

Children who do well in object control skills and locomotor skills normally have higher levels of sports aptitude and this in turn leads to them being more active teenagers (Clark & Medcalfe, 2002:170). The primary focus of the following model is the dynamic and synergistic links between motor skills and health-related physical fitness (see Figure 2.2).

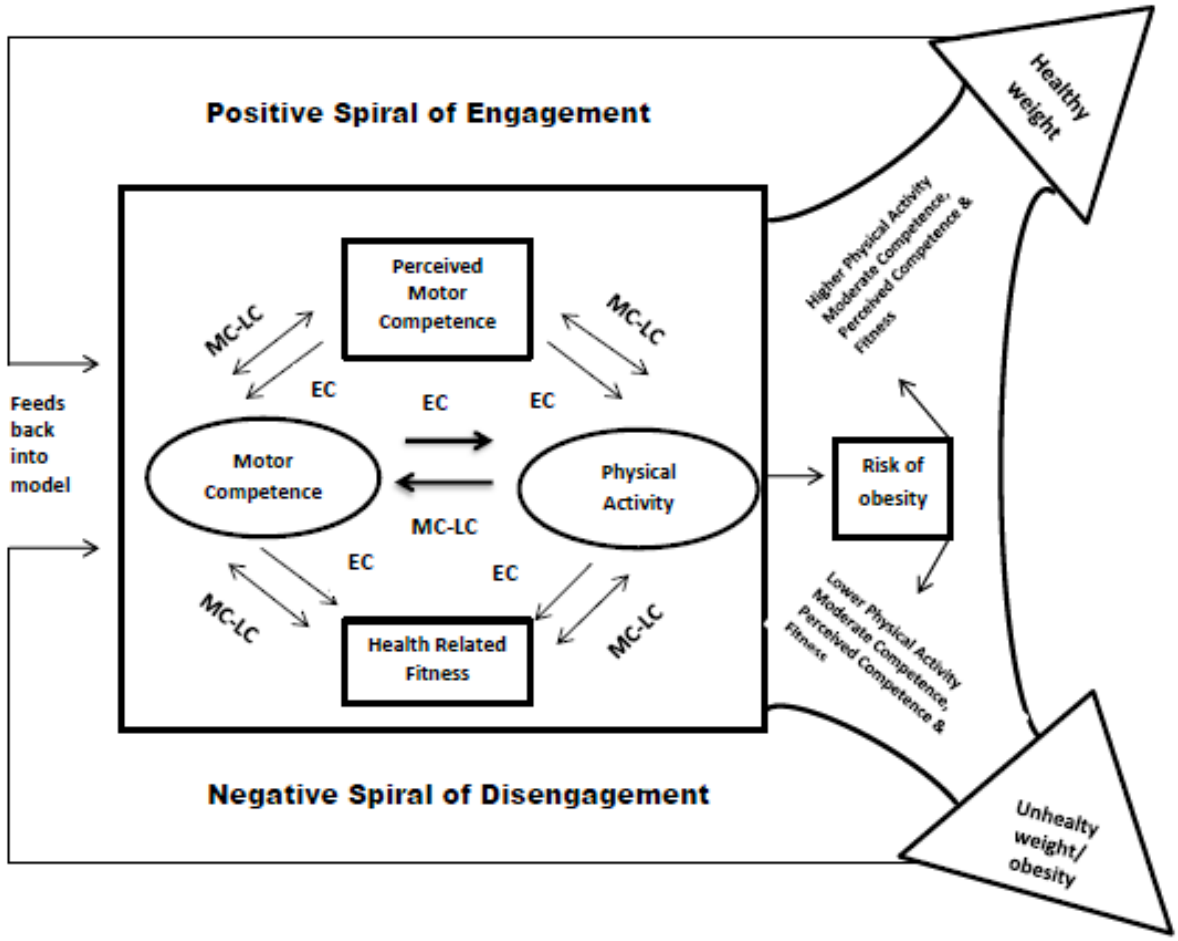


Figure 2.2: **Conceptual model of developmental factors influencing physical activity (Stodden & Goodway, 2007:34). EC=Early childhood, MC= Middle childhood, LC=Late childhood**

Stodden and Goodway (2007:34) confirm that motor skills, health-related physical fitness and obesity are three important variables. The effects that these variables have on each other are illustrated in the model. The link between these variables either leads to a positive or a negative spiral linkage in physical activity. It also influences the ongoing development of fundamental motor skills. Observations of motor skills and health-related physical fitness have shown that it can either worsen the negative spiral or improve the positive spiral (Stodden & Goodway, 2007:34). Observed motor competence is the mediating variable that is differentially influenced by the developing relationship between real motor competency and physical activity (Stodden *et al*., 2014:232). According to Figure 2.2, it is clear that observed motor competency does not correlate strongly with real motor competency or

physical activity during the early childhood year, but from the early to the middle childhood years children shift to higher levels of cognitive development and can compare themselves more accurately with their peers. This shift will mean that children with lower actual motor competency will also demonstrate lower perceived motor competency and will therefore be less physically active. Children with a higher perceived motor competency and actual motor competency will tend to persist more in physical activities (Stodden *et al*., 2014:232).

Children with poor motor skills regard themselves as somebody with few motor competencies, and often prefer not to become involved in physical activities, are less fit and move further down the negative spiral of physical activity and sport (Stodden & Goodway, 2007:34).

Kemp and Pienaar (2010:112) conducted research on 816 learners, with an average age of 6,84 years, with the purpose of determining the relationship between body composition and motor and physical skills and object control skills of Grade 1-learners, in the North-West Province of South Africa. Only the main component of the TGMD-2 object control skills was used for this study. These researchers found that body composition did not have a negative influence on the object control skills of the sample group. According to Kemp and Pienaar (2010:112), a possible explanation for this phenomenon could be because object control skills do not require a lot of displacement of body mass. These researchers' findings are in accordance with those of Okely *et al.* (2004:283) who did their study with Grades 4, 6, 8 and 10 children. However, there is still some contradiction in the literature regarding the link between health-related physical fitness and object control skills (this is according to Morano *et al.* (2011:45), who conducted a study on children from South Italy with an average age of 4.5 years). These researchers found a relationship between body compositions and object control skills

Stodden *et al.* (2013:224) evaluated 79 men and 109 women between the ages of 18 to 25 years. They evaluated three FMS (throwing, kicking, and standing long jump) and six health-related physical fitness components (twelve minutes running/walking, sit-ups, gripping strength, leg strength, percentage body fat, and sitting and reaching flexibility). These researchers found that the motor skills scores correlated moderately to strongly with five of the fitness components (twelve minutes running/walking, sit-ups, gripping strength, leg strength, percentage body fat) (r=0,48-0,74), with the exception of sit-and reach flexibility (r≤0,17). The FITNESSGRAM protocols were used for the testing aspects of physical fitness

(PACER, push-ups, sit-ups, and fat percentage). Gripping strength was included as an additional measurement of torso strength. The same procedure as in the foregoing study (Stodden *et al*., 2013:224) was used to investigate the three FMSs. These researchers found that throwing and standing long jump could predict to a considerable extent the fitness variance in nine to 10-year-olds (28%), 11 to 12-year-olds (23%) and 13 to 14-year-olds (46%).

2.6 Physical activity

Subsequently, a definition is provided of what physical activity is, a description of the type of activities that nine to 10-year-old girls participate in, as well as activity patterns of nine to 10-year-old girls, as reported in the literature.

2.6.1 Definition of physical activity (PA)

Physical activity (PA) can be defined as any bodily movement that is engendered by skeletal muscles and energy usage (WHO, 2013a:xx), and is further classified according to intensity, which refers to the rate at which the activity is executed, or the extent of exertion needed to execute an activity or exercise (WHO, 2013b:xx). High intensity physical activity (activities that require large inputs of energy, cause rapid breathing and cause the heartbeat to increase dramatically), moderate intensity physical activity (activities requiring a moderate amount of input and which cause the heart rate to accelerate visibly), and sedentary or physical inactivity (absence of movement) are sub-sections of which physical activities consist (WHO, 2013b:xx). Sedentary or physical inactivity can be classified as norm-based approaches where the individual is compared with age group peers with regard to the amount of physical activities executed, and it is also classified as a criterion-based approach where the child is classified as inactive if he or she does not reach the specific level of daily physical activity. The correct prescriptions with regard to the type of activity, duration, frequency and the intensity of exercise are important in the context of the child's fitness (Bar-Or & Rowland, 2004:388). Accordingly, the different PA recommendations of various interested organizations such as WHO, CDC and American College of Sports Medicine will be outlined in Table 2.2.

Table 2.2: Physical activity guidelines for young children

	World Health Organization http://www.who.int/mediacentre/factsheets/fs385/en/	**Centers of Disease Control and Prevention (CDC)** (http://www.cdc.gov/healthyyouth/physicalactivity/guidelines.htm)	**The American College of Sports Medicine (ACSMA)** www.acsmorg/physicalactivity
Age	**Fife- to 17-year olds**	**Six- to 17-year olds**	**Six- to 17-year olds**
Frequency of activities	High intensity activities must be executed at least three days per week and moderate activities must be executed daily.	High intensity activities must be executed at least three times per week and moderate activities must be executed daily.	High intensity activities must be executed at least three days per week and moderate activities at least daily
Intensity	60 minutes per day on moderate to high intensity physical activities	60 minutes per day for moderate to high intensity physical activities.	60 minutes per day on moderate to high intensity physical activities.
Type of activity	Activities that strengthen muscles and bones	Aerobic exercises, activities that strengthen bones and muscles	Aerobic exercises such as running, dancing and skipping

Now that the physical activity guidelines of children have been studied, we will look at nine to 10-year-old girls and whether they comply with the stated guidelines.

2.6.2 Activity patterns of nine to ten-year old girls

The WHO (2013b) indicated that age was a biological determinant of physical activity in girls. Sallis *et al.* (1993:394) are of the opinion that that there has been a decrease of 50%-75% in PA from six to 18-year old girls. These findings are supported by the WHO (2013a:xx) who indicated that physical activity levels of girls decreased from the age of six years until adolescence. Daily physical activities are important for optimal development in children and have many advantages. This includes improvement of body composition, better

sleeping patterns, promotion of social and cognitive skills and the establishment of the foundation for healthy behaviour which will help with the prevention of the risk for chronic diseases such as coronary heart diseases, in adulthood (Gallahue & Ozmun, 1995:205; Janssen *et al.*, 2004:1187).

Recent studies in SA proved that the levels of physical inactivity and obesity are on the increase (Armstrong *et al.*, 2011:839; McVeigh *et al.*, 2004:985). The most recent research summarized in the "Healthy Active Kids SA 2014 Report Card" indicated that SA obtained a D (50-59%) in the general physical activity category (Draper *et al.*, 2014:100). The explanation of the symbol is as follows: Inadequate promotion of health and prevention of chronic diseases as a result of a shortage of research. This reflects behaviours, environments and policies that put children and youth in a higher risk group for future diseases or otherwise the proofs are inadequate for purposes of interpretation (Healthy Active Kids: South Africa Report Card, 2010:2).

Important findings of the 2014 report card on physical activity for children and young people in various countries reported as follows. In Australia only 20% of five to 17-year olds comply with the Australian physical activity guidelines for children, which recommends at least 60 minutes of daily moderate to high intensity physical activity (Australian Health Survey, 2011-13:10). Studies of England indicate that 33% of the boys and 21% of the girls between the ages of four to 15 years in England comply with the physical activity guidelines for children that indicate that a child should participate for at least 60 minutes per day in moderate to high intensity physical activity (Health Survey for England, 2008:10). Scottish teenagers (eleven to fifteen-year olds) indicate low levels of moderate to high intensity physical activity where only 19% of the boys and 11% of the girls comply with the physical activity guidelines, of which at least 60 minutes of the daily activities must demand moderate to high intensity (Currie *et al.*, 2012:ix). Almost half of the South African children are inactive with children who participate <60 minutes per day to moderate to high intensity activities (Healthy Active Kids: South Africa Report Card, 2010:2). Sedentary behaviour remains a problem with children who spend just less than three hours per day on television viewing.

Walter (2011:786) did a study on a total of 112 children (53 boys and 59 girls), between Grades 3 and 6 (eight to 12-years-olds) in three disadvantaged schools in SA. The researcher's results indicated that girls appeared to be more sedentary during physical

activities in school times, whereas boys were far more active through playing games such as chasing each other and playing soccer. Girls' post-school physical activities do include activities such as household tasks, but their preferred games are sedentary in nature. Walter (2011:786) proposes that moderate to high intensity activities must become a priority at schools, seeing that this might be the child's only exposure to sport and exercise.

McVeigh *et al.* (2004:982) did a study based on 381 South African children, and found that higher socio-economic conditions contributed to higher physical activity levels among children, which in turn contributed to better sports skills. The results of the study also indicated that there were significant racial differences in the type of activity patterns engaged in by the children. McVeigh *et al.'s* (2004:987) results further indicated that white children are more active than black children, tend to participate more in physical education at school, and watch less television than black children (McVeigh *et al.*, 2004:987).

In a study done on 290 girls between the ages of 13 and 15 years, in 16 different schools in the North-West Province, Engelbrecht *et al.* (2004:45) found that 70,3% of the girls showed low intensity activity levels. These researchers also investigated the ethnical differences as well as the possible links between physical activity and physical fitness (Engelbrecht *et al.*, 2004:48), and reported that white girls revealed the highest scores in strength and arm strength endurance, as a result of their activity choices, such as swimming and aerobics. According to Engelbrecht *et al.* (2004:50) the physical activity levels and patterns of girls from different population groups showed a positive relationship with their physical fitness.

Micklesfield *et al.* (2014:8) did a study on 381 children between the ages of 11 and twelve years of age, and 14 and 15 years of age in a disadvantaged part of the Mpumalanga Province in South Africa. These researchers' findings yielded the following: disadvantaged South African children's SES status is associated with more time spent on sedentary behaviour such as watching television and reading, and less time is spent on walking generally and participation in moderate to high intensity physical activity in school and club sport. These researchers further found that boys on average spent 196 minutes per day on physical activity in comparison with the 154 minutes that girls were physically active per day. It was also found that in spite of boys spending more time than girls on high-intensity sport, girls spent more time on school and club sports codes that required moderate intensity (Micklesfield *et al.*, 2014:10).

To determine what physical activity choices children executed during the week, weekends and school vacations, Howall *et al*. (1999:161) did a study on 1 041 Grade 4-learners in Poway, California. These researchers reported that running, jogging and walking were the activities that were mostly done over weekends and in school vacations by boys and girls. These researchers are also of the opinion that girls in Grade 4 tended more towards individual activities such as walking, running, jogging, dancing, cycling and gymnastics, where the highest percentage of girls indicated that they liked to participate in swimming and track and field events during the summer months (Howell *et al.,* 1999:163). Howell *et al.* (1999:166) came to the conclusion in their study that Grade 4 girls' top six physical activities were the following: walking, running, jogging, dancing, cycling and gymnastics.

Research done by Pate *et al.* (2002:303) on 400 children in Grades 1 to 12 (200 girls and 200 boys) was significant. These children were further categorized in age groups as follows: Grades 1 to 3, Grades 4 to 6, Grades 7 to 9 and Grades 8 to 12. This study indicated a strong age-related decrease in physical activity. The largest decrease in physical activity was reported during middle adolescence (Grades 7 to 9), which is more or less the time when children leave primary school and go to high school, and this trend was particularly observed among girls (Caspersen *et al.,* 2000:1607).

In Britain a study was undertaken by Steele *et al*. (2010:1) with 1568 children between the ages of nine and 10 years. The study results confirmed that high intensity physical activity only makes up one-third of the total amount of moderate to high intensity physical activity, with an average of four minutes per hour (6% of an hour's time). In contrast, 35 to 50 minutes of each hour are spent on sedentary activities such as, watching TV and playing computer games (60-80% of an hour), both during the week and over weekends (Steele *et al.,* 2010:5).

Guèvremont *et al.* (2008:66) did a study in Canada on six to 17-year-old children with the purpose of determining what the level of participation in extra-curricular activities was. The six to nine-year-old girls reported that they mostly participated in non-sporting activities (including lessons in music, art and drama) or activities presented in clubs or in the community (such as Brownies, scouts, photography) (Guèvremont *et al.*, 2008:66). Jardus *et al.* (2010:349) did a study on five to 18-year-olds in Israel, and the results confirmed that girls tend to participate more in informal activity such as reading, talking on the telephone or building puzzles. These activities occur more spontaneously with little planning and only a

few rules (Jardus *et al.*, 2010:345). The Sport and Fitness Foundation (WSFF) of England reported that five to 10-year-old girls spent most of their time on activities such as swimming, cycling and walking (WSFF, 2010:6), while 11 to 15-year-old girls spent more time on netball, gym and walking (WSFF, 2010:6).

2.6.3 Link between physical activity and object control skills

In New South Wales in Australia eighteen selected primary schools participated in a study in which 1 054 children had been involved. Barnett *et al*. (2008:10) reported that children with good object control skills had a 20% bigger chance to participate in moderate to high intensity physical activities (MVPA) during adolescence, in comparison with the <5% chance for those who showed poor object control mastery in their childhood years.

According to Cohen *et al*. (2014:2) who did a study on 460 primary school children in Grades 3 and 4 of low income communities in the Newcastle region, Australia, reported that the object control skills showed a statistically significant link with moderate to high intensity physical activity during lunch times and school vacations. These findings can be an indication of the type of activities and equipment offered to children during these time periods. Games and activities such as soccer and basketball are popular playtime activities requiring a lot of physical fitness and high levels of object control skills. These researchers are of the opinion that the development of object control skills can be a possible way of developing moderate to high intensity physical activity in children (Cohen *et al.*, 2014:2,7,8).

Barnett *et al.* (2013:9) research on nursery school children in Australia with an average age of four years found that children, especially girls who participate in dance activities, spend less time on their object control skills and for that reason the type of skills did not develop fully. The reason for the above finding is that dance does not involve any form of object control as other sports codes do (Barnett *et al.*, 2013:9).

Barnett *et al*. (2015:2) also did a study on 102 children (56% boys, 44% girls) and found that the mastery of object control skills is associated with physical activity, and remarked that object control skills indicated a significant link with moderate to high levels of physical activity (MVPA).

2.7 Conclusion

The preceding literature survey had the purpose of investigating the link between object control skills, health-related physical fitness and physical activity, and to isolate what it is that affects the object control skills of nine to 10-year-old girls as well as health-related physical fitness and physical activity. From the literature it can be deduced generally that there are various factors that can influence the development of object control skills, which in its turn can have a negative influence on the development of health-related physical fitness and physical activity. The literature indicates that object control skills indicate a statistically significant link with moderate to high intensity physical activity during lunchtimes and school holidays. Furthermore it emerges from the literature that the mastery of object control skills does not occur as early as indicated by researchers. It is also clearly visible that contemporary children are not as active any more, and that only a small percentage of children's physical activities comply with the guidelines. The literature indicated that optimal motor development, especially between the ages of two to seven years is important, seeing that skills that develop during these periods develop an important part of the skills foundation upon which more specialized sports skills are developed which are needed for lifelong participation in sport and physical activity.

With these literature findings and the background provided the results of the study will accordingly be discussed in Chapters 3 and 4.

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CHAPTER 3

CHAPTER 3: ARTICLE 1

The relationship between object control skills and health-related physical fitness in nine to 10-year old girls in the North-West Province of South Africa: The NW-CHILD study

Authors: Marilette Visagie, Dané Coetzee & Anita E. Pienaar

Physical Activity, Sport and Recreation (PHaSRec), Faculty of Health Sciences, Potchefstroom Campus, North-West University, South Africa

Miss. Marilette Visagie
(B.A. Hons. Kinderkinetics)
School for Biokinetics, Recreation and Sports Science
Private Bag X 6001
Potchefstroom
2520

North-West University, Potchefstroom campus
Telephone: 072 502 1330
Faks: (018) 299 1796
Email: visagie.marilette@gmail.com

Dr. Dané Coetzee
PhD. Human Movement Science
Telephone: (018) 299 1792
Fax: (018) 299 1825
Email: 12129941@nwu.ac.za

Prof Anita Pienaar
PhD. Human Movement Science
Telephone: (018) 299 1796
Fax: (018) 299 1825
Email: Anita.Pienaar@nwu.ac.za

CORRESPONDING AUTHOR: DR. DANÉ COETZEE

ABSTRACT

This study examined the relationship between object control skills (OC) and health-related physical fitness (HRF) in nine to 10-year old girls in the North-West Province of South Africa. A sample of 408 girls with a mean age of 9.86 years participated in this study. OC skills were assessed using the Test of Gross Motor Development-2, strength was tested using the Bruininks-Oseretsky Test of Motor Proficiency– 2nd Edition and the BMI and fat % was calculated from the height (m) and weight (kg) [weight/height^2] measures of each participant. The Progressive Aerobic Cardiovascular Endurance Run (PACER) measured cardiovascular endurance. Small but significant correlations were found between object control skills and strength, aerobic fitness and the body composition of the selected group. According to the HFZ classification, 49.62% (n=198) of girls were categorised as being in the HFZ with regard to their BMI and 54.14% (n=216) in the HFZ with regards to the fat %. This indicates that object control skills are influenced by factors that can contribute to the health of young girls. Appropriate development of OC and strength skills in girls is recommended to prevent delays in sport participation.

Key words: Physical fitness, motor proficiency, children, object control, strength, girls.

The relationship between object control skills and health-related physical fitness in nine to 10-year old girls in the North-West Province of South Africa: The NW-CHILD study

3.1 Introduction

Fundamental movement patterns are organized sequences of basic movement patterns (18). Object control skills can be described as the handling and controlling of objects with the hand, foot or implements (e.g. bats, racquets or hoops) with the correct speed or control (8). Examples include throwing, catching, kicking, rolling, striking and dribbling (8). During the sports-related movement development phase which is between seven to 10 years of age (18), children become more interested in sports and performance standards (18), and the overhand throwing, catching and hitting actions are developed in this phase into more specialized sport-specific skills which are applied in sports codes such as cricket, basketball and softball (3).

The sports-related movement development phase is characterised by the broadening and refinement of the fundamental movement skills (FMS) (18). Children who thus cannot run, jump, catch and throw proficiently, limit their opportunities for engagement in physical activities later in their lives (17). Gallahue and Ozmun (9) report a relationship between health-related physical fitness and motor skills, which are both important for successful participation in sport. Health-related physical fitness refers to the abilities that are important for general health, as well as the execution of daily tasks and activities (24), and consists of five components, namely muscular strength, muscular endurance, cardio-respiratory endurance, flexibility and body composition (18).

Researchers describe the period between eight and 12 years of age as the most important period during which physical development of a child takes place (18). This period can also be seen as the period during which physical and motor fitness improves the most (23). Promoting health-related physical fitness and an active lifestyle is needed from a young age (17). Barnett *et al.* (1) reported a relationship between well-mastered FMS and higher levels of physical activity in school children. Physical activity and FMS therefore form the foundation for further sport and movement development (6). During middle childhood, which is the period, between nine to 10 years of age, girls are moving into the pubertal stage (14) of development. During this period changes in body fat and body size can have major influences on performance fitness tests (14). Boys show a marked increase in muscle mass, strength and endurance and a decrease in subcutaneous fat in the arms and legs, while girls show smaller increases in strength, power and endurance and body fat when compared to boys (14).

Any execution of a motor skill also requires a measure of health-related physical fitness and motor fitness skills (9).

The windows of opportunity for the mastery and development of OCS are described in detail by Payne and Isaacs (17) and Seefeldt and Haubenstricker (20). These researchers reported that to be able to strike a stationary ball, children should already show mature mastery of this skill between the ages of seven to nine years, boys at 7.3 year and girls 8.2 years (23) Early development of the dribbling skill is seen in children at the age of five to eight years (17), while the catching skill ought to be correctly executed by the age of 5.5- to seven years (17), 6.9 years for boys and 6.5 years for girls (20). The kicking skill ought to be mastered between the ages of 6.5- to 8.5, at 7.3 years in boys and 8.2 years in girls, while Payne and Isaacs (17) further indicated that the throwing skill should show mastery at the age of 5.5- to 8.5 years, at 5.4 years in boys and 8.5 years in girls (20).

Only a few studies have been published regarding the mastery of object control skills by children between the ages of six and 13 years of age (5,19). Butterfield *et al*. (5) conducted a study on four of the six sub-components of the object control skills (catching, throwing, kicking and hitting a ball) of the TGMD-2-test battery, and found that at 10 years of age, 80.5% of the children showed a mature catching pattern (girls showed a 54% mastery), while 72.2% of the children showed a mature kicking pattern (5). These mastery levels are slightly lower than the findings of Pienaar *et al.* (19) on nine to 10-year old children in the North-West province of South Africa. These researchers (19) reported a 96.2% mastery for catching and a 92.4% mastery for kicking in these children. Pienaar *et al*. (19) fiound the following percentage mastery in girls: a 83.9% mastery in striking a stationary ball, 76.8% mastery in overhand throwing, catching showed a 89% mastery, 83.8% mastery in stationary dribble, 93% mastery in kicking and a 75.4% mastery in underhand rolling. Loovis and Butterfield (12) found that only 47% of the girls reflect a mature throwing pattern at the age of 10 years, while Ulrich found a 44.7% mastery of the striking skill in 10-year old girls (24). Pienaar *et al.* (19) found a 79.5% mastery for throwing, and 86.8% mastery for striking in contrast with Loovis and Butterfield's (12) percentages.

Kemp and Pienaar (11) conducted a study on 816 participants with a mean age of 6.84 years. These researchers investigated the relationship between body compositions, motor and physical skills and object control skills of Grade 1 learners in the North-West Province of South Africa. Their results indicated that poor body composition was not negatively associated with object control skills, and they argued that a possible reason is that most object control skills do not require any displacement of body mass (11). This finding is consistent

with the findings of Okely *et al*. (16) who found that overall FMS proficiency is associated with a healthy body composition in Grades 4, 6, 8 and 10 children in New South Wales. The results of Morano *et al.* (15) are in contradiction with the above-mentioned results because these researchers found that an increased BMI correlated with poorer gross motor development, and no gender differences were found in this research. Morano *et al*. (15) conducted a study in the South of Italy, on children (38 boys and 42 girls) aged four to five years.

After an in-depth literature research, it appears that there is limited research on the relationship between object control skills and health-related physical fitness in girls. Therefore, the aim of this study was to determine the relationship between object control skills and health-related physical fitness in nine to 10-year old girls in the North-West Province of South Africa.

3.2 Methods

3.2.1 Research design

The study is based on a longitudinal research design (NW-CHILD study) over a period of six years (2010-2016), which consists of a baseline on two follow-up measurements. The baseline data were collected in 2010. The first follow-up measurements were collected in 2013, and the last follow-up measurement will be collected in 2016 on a selected group of learners living in different regions in the North-West Province of South Africa. For the purposes of this study, only the first follow-up measurement (2013) data of the girls were used.

3.2.2 Participants.

This research forms part of the NW-CHILD (Child-Health-Integrated-with Learning and Development) study. The research group was selected by means of a stratified random sample in conjunction with the Statistical Consultation Services of the North-West University. A list of names of schools in the North West Province was obtained from the Department of Education of the North West Province to determine the research sample. This list of schools was grouped into eight educational districts, each representing twelve to 22 regions with approximately 20 schools (minimum twelve, maximum 47) per region. Regions and schools were randomly selected with regard to population density and school status (Quintile 1, i.e. schools from poor economic sectors, to Quintile 5, i.e. schools from higher

economic sectors). A total of 20 schools were involved in this study, from four school districts with a minimum of 40 children per school and with an equal gender distribution. For the purposes of this study only the data of the girls tested in 2013 (N=406) were used. This group had a mean age of 9.86 (SD=0.42). Of the 406 girls, 89 were white and 317 were black, mixed race and Indian. The mixed group and Indians are put together with the black group because there were too few mixed race and Indian participants. For the full description of participants of 2010, see Kemp and Pienaar (2010).

3.3 Measuring instruments

3.3.1 Test of Gross Motor Development (TGMD-2)

The TGMD-2 is a norm-referenced measure designed to test the gross motor functioning of children from three to 10 years old (24). This test consists of twelve motor skills, and is divided into two sub-tests, namely locomotor (run, hop, gallop, leap, horizontal jump and slide) and object control (striking a stationary ball, stationary dribble, catch, kick, overhand throw, and underhand roll) skills. For the purposes of this study, only the object control sub-test was used. Each of these FMS has three to five performances criteria. For example, there are five performance criteria for striking a stationary ball: 1) “Dominant hand grips bat above non-dominant hand”; 2) “Non-preferred side of the body faces the imaginary tossed ball with feet parallel”; 3) “Hip and shoulder rotation during swing”; 4) “Transfers body weight to front foot”; and 5) “Bat contacts ball”. Marks were allocated as follows: one point was awarded for each correct execution of the specific skills and zero for a failed attempt. The child got two attempts to perform each skill. A visual demonstration of each skill was provided by the tester before it was assessed. The scores for each of the two attempts for each performance criterion were added together. To get the skill score, all the total scores for each criterion were added together. At the end of the object control sub-test, the six skill scores were added up to determine the sub-test raw score of 48 points. The child’s age, gender and raw score were used to calculate the standard score and percentile rank. The descriptive categories of the TGMD-2’s are as followed: excellent (17-20), good (15-16), above average (13-14), average (8-12), below average (6-7), poor (4-5) and very poor (1-3). A standard score between 1 and 3 is therefore considered to be very low mastery of the object control skill, while a score of 17 to 20 is considered very good mastery of the object control skill. The TGMD-2 has proven that it is reliable in three areas, namely Content-Description Validity, Criterion-Prediction Validity and Construct-Identification Validity. This test has

been found to be reliable in all demographic sub-groups with quotients reaching or exceeding 0.87. A coefficient of 0.88 shows that the TGMD-2 scores are stable over time and for test score reliability a coefficient of 0.98 was found. The TGMD-2 therefore evidences a high degree of reliability (24).

3.3.2 FITNESSGRAM

The FITNESSGRAM is designed to evaluate four to 15-year old children in terms of their physical fitness levels (14). The FITNESSGRAM measures five components of physical fitness, namely aerobic capacity, body composition, muscular strength, muscular endurance and flexibility. For the purpose of this study, only the PACER and body composition were used. The reliability and validity of the PACER is .95 and .92 and the body composition .96.and 9.5 (14).

The PACER (Progressive Aerobic Cardiovascular Endurance Run) is a fitness test that becomes progressively more difficult. The purpose of this test is to run as long as possible back and forth over a distance of 20 meters, at a specific pace that gets faster every minute. The test is stopped when a child fails a second time to touch the line before the beep sound is heard. The total score represents the total number of completed 20-meter distances the child ran (14). A single beep will be heard at the end of each round. A triple beep will be heard at the end of each minute. The triple beep is a reminder to the child that the pace will speed up or get faster. According to the Cooper Institute for Aerobics Research, the PACER has a high content (logical) validity (14).

Body composition was measured by means of Body Mass Index (BMI) and Fat % that is measured in the FITNESSGRAM and consists of triceps and medial calf skinfolds. For the triceps skinfold, the calliper is applied 1 cm distally from the left thumb and index finger and it is a vertical skinfold at the mid-acromial-radial line on the posterior surface of the right arm. If the medial calf skinfold is taken, the calliper is applied 1cm distally to the left thumb and index finger; it is a vertical skinfold on the relaxed medial right calf at the estimated level of the greatest circumference. This is easier to do when the subject’s leg is flexed to an angle of 90° at the knee; this is done by placing the foot on a box. BMI is an indication of the relationship between the child's weight and length. The body mass index is calculated as follows: Weight (kg) / Length^2 (cm) (13).

The FITNESSGRAM uses Healthy Fitness Zones (HFZs) to evaluate fitness performance. For tis study, the FITNESSGRAM 2nd edition was used. The HFZ represents the minimum levels of fitness that offer protection against the diseases that result from sedentary living.

When girls aged nine to ten run between fifteen and 41 laps in the pacer test, have a percentage body fat between seventeen and 32%, and if they have a body mass index of between 16.6 and 23.5, they are classified as being in the HFZ (14).

3.3.3 Bruininks-Oseretsky Test of Motor Proficiency–2nd Edition (BOT-2)

The BOT-2 is a test battery that measures the motor proficiency of children between the ages of four and 21 (4). The complete battery of the BOT-2 consists of 53 items. The BOT-2 assesses skills in four motor components and consists of fine motor skills (divided into fine motor precision and fine motor integration); fine manual control (manual dexterity and upper limb coordination); manual coordination (bilateral coordination and balance) and body coordination (running speed and agility and strength). The short form has fourteen test items selected from the complete form (4).

For the purpose of this study, only the strength sub-tests were used. The strength sub-test of the BOT-2 consists of the standing long jump, where the learner stands behind a line. The learner jumps forward and lands on both feet. The number of inches the learner jumps is recorded (4). During knee push-ups, the girls kneel on their knees with their bodies leaning forward and hands underneath their shoulders. Ankles should be crossed and feet off the floor. The learner lowers herself to the floor by bending her arms at least 90° and pushes back until the arms are straight. The numbers of correct push-ups that are performed in 30 seconds are recorded (4). A learner lies on her back on the floor with knees bent at 90° during sit-ups. The sit-ups are performed by rising head, shoulders and shoulder blades off the floor, reaching for the knees and lowering the body back to the floor. The scorer record the number of correct sit-ups performed in 30 seconds (4). In the wall sit, the learner leans back against the wall with feet flat on the floor, lowering herself into a sitting position, knees bent at 90°. The number of seconds the learner maintains the proper position up to 60 seconds is recorded (4). V-up is when the learner lies down on the floor, with arms extended forward and legs bent. The head, chest, arms and legs are lifted off the floor. The number of seconds the learner can hold a proper v-up form is recorded (4).The raw score for each testing item was recorded as well as a total point score for each sub-component. From the total points score, a standard score and percentile are recorded. Each test item's raw score is different; it can be a number of points, number of seconds or the number of correct activities that are performed (4). The descriptive categories corresponding to the standard scores are as follows: well above average (70 or greater), above average (60-69), average (41-59), below average (31-

40) and well below average (30 or less) (4). The complete form has a reliability of r=0.75 and the short form r=0.80 (4).

3.4 Procedures

3.4.1 Research procedure

Ethical approval was obtained from the Ethics Committee of the North-West University, Potchefstroom Campus (Ethical No. NWU-0070-09-A1), as well as the Department of Basic Education of the North-West Province. A formal meeting was arranged with the principal of each school where the purpose and protocol of the study were explained. Informed consent was obtained from the parents of each of the 60 randomly selected Grade 1 learners in 2010 before participating in the study. An informed consent was obtained again in 2013 from a parent/legal guardian when the learners were in Grades 3 and 4. The purpose of this study was verbally explained to all participants in 2010 and was explained to them again in 2013. The participants had the chance to ask any questions about the research procedures and were asked to complete an assent form. The learner could withdraw from the research at any time. Learners whose parents/legal guardian gave consent to participate, were evaluated in terms of their object control skills, physical fitness and physical activity. Instructions were translated by external and trained translators for the participants if English was not their first language.

3.4.2 Statistical analysis

The STATISTICA software package (21) was used to analyse the data. For descriptive purposes, data were, firstly, analysed using means (M), standard deviations (SD), and minimum and maximum values. Secondly, the Spearman rank order correlation was used to determine the relationship between health-related physical fitness and object control skills of nine to 10-year old girls. The following guidelines were used to interpret the strength of the relationship that was found: $r \approx 0.1$ (a small effect), $r \approx 0.3$ (medium effect) and $r \geq 0$ (a large effect) (22). The Pearson Chi-square served to indicate the significance of the results and the accepted level of statistical significance was set at $p \leq 0.05$. Lastly a two-way variance table was used to analyse the correlation between different object control skills and health-related physical fitness components. The strength of the correlations is represented by the phi-coefficient with $w \approx 0.1$ (a small effect), $w \approx 0.3$ (a medium effect) and $w \geq 0.5$ (a large effect) (22). The number of participants tested differed slightly because not all the girls completed all the tests because some were involved in other activities during the testing day and had to

leave earlier. The reason for the fewer participants in the PACER test is because that some of the children were sick and not able to run.

3.5 Results

Table 3.1 displays the descriptive characteristics of the variables that were used in the study. The reasons for these differences are that some children had to go home early, wanted to participate in a team sport or did not feel well and could not perform all the physical activities. The group of 408 girls had a mean age of 9.86 (SD=0.42). The BMI (N=407) was 17.34 (SD=3.91) and had a mean fat percentage of 20.39% (SD=8.51). A mean score of 19.40 (SD=9.64) was found in the PACER test. The mean raw score for the five strength measurements was 25.58 (SD=3.49), while the object control skills showed a mean raw score of 40.11 (SD=3.49).

A Spearman rank order correlation was used to determine the correlation between the different object control skills (striking a stationary ball, stationary dribble, catching, kicking, overhand throwing and underhand rolling) and the strength activities (standing long jump, push-ups, wall sit and V-up) and the results are presented in Table 3.2.

Table 3.1: Descriptive statistics of study variables

VARIABLES	N	MEAN (SD)	MIN	MAX
AGE OF GIRLS	408	9.86 (±0.42)	8.20	11.05
HEALTH-RELATED PHYSICAL FITNESS COMPONENTS				
BODY COMPOSITION				
BMI	407	17.34 (±3.91)	12.26	61.24
FAT%	402	20.39 (±8.51)	5.40	59.10
CARDIOVASCULAR ENDURANCE				
PACER	403	19.40 (±9.64)	2.00	59.00
STRENGTH				
Standing long jump	408	42.04 (±7.81)	17.80	65.50
Push-ups	408	16.42 (±5.23)	0.00	37.00
Sit-ups	408	15.77 (±5.96)	0.00	34.00
Wall sit	408	55.93 (±9.93)	6.00	60.00
V-up	408	53.07 (±13.78)	0.00	60.00
Raw score	408	25.58 (±3.49)	9.00	34.00
OBJECT CONTROL SKILLS				
Striking a stationary ball	404	8.36 (±1.58)	2.00	10.00
Stationary dribble	404	6.69 (±1.72)	0.00	8.00
Catch	404	5.78 (±0.55)	2.00	6.00
Kick	404	7.12(±1.16)	1.00	8.00
Overhand throw	404	6.12(±1.64)	0.00	8.00
Underhand roll	404	6.03(±1.45)	2.00	8.00
Raw score	404	40.11(±4.34)	4.00	48.00
Standard score	404	9.73(±2.35)	4.00	15.00
Percentile	404	46.25(±25.47)	2.00	96.00

N= population; Min= minimum; Max= maximum; SD= Standard Deviation; N= population; Fat%= fat percentage

Table 3.2 indicates that only three (stationary dribble, catching and underhand rolling) of the six object control skills showed any correlation with the different strength sub-items. With regard to striking a stationary ball, kicking and overhand throwing, no correlations ($r \leq 0.1$) were found with the various strength activities. Stationary dribble showed a correlation with a small ($r \geq 0.1$) practical and statistical ($p \leq 0.05$) significance with three (standing long jump ($r=0.16$), sit-ups ($r=0.15$) and V-ups ($r=0.16$)) of the strength activities. Catching showed a small practical and statistical correlation with sit-ups ($r=0.14$). With regard to the underhand roll, a small practical and statistical correlation was found with the push-ups ($r=0.12$), sit-ups ($r=0.14$) and V-up ($r=0.17$). The object control standard score showed a small practical and statistically significant correlation with standing long jump ($r=0.21$) and V-up ($r=0.13$). The highest correlation occurred between the underhand roll and V-up ($r=0.17$). Wall-sit showed no correlation with any of the object control skills.

Table 3.2: Correlations between the object control skills and the strength activities

OBJECT CONTROL SKILLS	STRENGTH COMPONENTS				
	Standing Long jump	Push-ups	Sit-ups	Wall sit	V-up
Striking a stationary ball	0.08	0.07	0.02	0.01	0.05
Stationary dribble	0.16#*	0.03	0.15#*	0.00	0.16#*
Catch	-0.06	0.08	0.14#*	0.01	0.05
Kick	0.09	-0.05	-0.03	0.03	-0.04
Overhand throw	0.08	0.09	0.00	0.01	0.00
Underhand roll	0.05	0.12#*	0.14#*	0.02	0.17#*
Object control Standard score	0.21#*	0.09	0.07	0.03	0.13#*

Practically significant correlation r≈0.1# Statistically significant=p≤0.05*

Spearman rank order correlations were further use to interpret the relationships between the object control skills and body composition and cardiovascular endurance (Table 3.3). Only one of the object control skills (underhand roll) showed a small practical and statistically significant ($p \leq 0.05$ & $r \geq 0.1$) relationship with body composition (BMI and FAT%) and cardiovascular endurance (PACER). The underhand roll showed a small negative correlation with BMI (r=-0.13) and FAT% (r=-0.17), while the PACER showed a small practical and statistically significant relationship (r=0.21 & $p \leq 0.05$). No correlations ($r \leq 0.1$) were found between striking a stationary ball, catching, kicking and overhand throwing, with regard to body composition and cardiovascular endurance. A small practical and statistical correlation was found between the stationary dribble (r=0.16) and the object control standard score (r=0.15) with the PACER.

Table 3.3: Correlations between the object control skills with body composition and cardiovascular endurance

OBJECT CONTROL SKILLS	BODY COMPOSITION AND CARDIOVASCULAR ENDURANCE		
	BMI	FAT%	PACER
Striking a stationary ball	-0.07	-0.09	0.05*
Stationary dribble	0.03	0.06	0.16#*
Catch	0.03	0.03	0.10
Kick	-0.06	-0.05	-0.01
Overhand throw	-0.03	-0.04	0.05*
Underhand roll	-0.13#*	-0.17#*	0.21#*
Object control Standard score	-0.07	-0.07	0.15#*

Significance accepted: p≤0.05*; r≥0.1#= small practical significance; BMI= Body Mass Index; FAT%= Fat percentage; PACER= Progressive Aerobic Cardiovascular Endurance Run

A two-way table analysis was used to determine the relationship between the healthy fitness zone (HFZ) categories that the participants were categorized in for scores obtained by the use of the PACER, BMI and FAT% and the results are presented in Table 3.4. The results show that 50.38% (n=201) of the group were classified in the "needs improvement - Health risk" zone while 49.62% (n=198) were categorised as being in the HFZ with regard to their BMI. The FAT% of the participants 45.86% (n=183) fell in the "needs improvement-Health risk" category and 54.14% (n=216) in the HFZ. The cardiovascular endurance of 35.24% (n=142) of the participants was under the HFZ, 63.03% (n=254) was in the HFZ while 1.74% (n =7) fell above the HFZ.

Table 3.4: Percentage of participants in the different Healthy Fitness Zone (HFZ) for the PACER, BMI and Fat%

CATEGORIES	BMI HFZ		FAT% HFZ		PACER HFZ	
	N	%	N	%	N	%
1 (NI-HR)	201	50.38	183	45.86	142	35.24
2 (HFZ)	198	49.62	216	54.14	254	63.03
3 (A-HFZ)	0	0.00	0	0.00	7	1.74
TOTAL	399		399		403	

N= population; %= Percentage in each group; 1= "Needs Improvement–HEALTH RISK (NI-HR); 2="Healthy Fitness Zone (HFZ)"; 3=Above the HFZ; BMI=Body mass index; FAT%=fat percentage

A two-way table was further used to indicate the relationship between the different object control skills classes and different cardiovascular endurance categories, body composition (BMI & FAT%) and strength of the participants (Table 3.5). The participants were classified in cardiovascular endurance and body composition (BMI and FAT%) and divided into three HFZ classes, object control skills in five categories and strength in four classes. No participants were categorised in the very poor or well-below categories for object control skills and strength, therefore these categories are left out of the analysis.

Table 3.5 indicates a relationship between body composition (BMI and FAT% categories) and mastery of object control categories. Most of the participants (n=276) achieved an average score (class 4) in the object control skills. Of these, 146 (37.15%) participants fell in the needs improvement: Health Risk Zone for BMI and 130 (33.08%) fell in the Healthy Fitness Zone. The comparison of FAT% and object control skills classes indicated that 276 of the participants had achieved an average mastery in the object control skills, with 131 (33.33%) classified in needs improvement: Health Risk Zone and 145 (36.93%) classified in Healthy Fitness Zone of the FAT% HFZ.

Table 3.5: Relationship between different categories of cardiovascular endurance, body composition and strength and object control skills

Variables	OBJECT CONTROL SKILL CATEGORIES										
CATEGORIES	2		3		4		5		6		
	N	%	N	%	N	%	N	%	N	%	TOTAL
BODY COMPOSITION											
BMI HFZ											
1 (NI-HR)	2	0.50	29	7.38	146	37.15	16	4.07	6	1.53	199
2 (HFZ)	5	1.27	30	7.63	130	33.08	26	6.62	3	0.76	194
TOTAL	7		59		276		42		9		(N=393)
FAT% HFZ											
1 (NI-HR	2	0.51	23	5.85	131	33.33	18	4.58	7	1.78	181
2 (HFZ)	5	1.23	36	9.1	145	36.90	24	6.12	2	0.51	212
TOTAL	7		59		276		42		9		(N=393)
CARDIOVASCULAR ENDURANCE											
PACER HFZ											
1 (NI-HR)	3	0.75	31	7.81	91	22.92	12	3.03	3	0.75	140
2 (HFZ)	3	0.75	27	6.80	184	46.35	30	7.56	6	1.51	250
3 (A-HFZ)	0	0.00	1	0.25	6	1.51	0	0.00	0	0.00	7
TOTAL	6		59		281		42		9		(N=397)
STRENGTH											
2	1	0.25	2	0.50	3	0.75	0	0.00	0	0.00	6
3	6	1.49	48	11.94	193	48.00	30	7.46	7	1.74	284
4	1	0.25	8	1.99	87	21.64	12	2.99	1	0.25	109
5	0	0.00	1	0.25	1	0.25	0	0.00	1	0.25	3
TOTAL	8		59		284		42		9		(N=402)

Healthy fitness zone (HFZ): 1=Needs Improvement–HEALTH RISK (NI-HR); 2=Healthy Fitness Zone (HFZ); 3=Above the HFZ (A-HFZ)
Object control skills: 1=Very poor; 2=Poor; 3=Below average; 4=Average; 5= Above average; 6=Superior
Strength: 2=Below average; 3=Average; 4=Above average; 5= well above average
Practical significance: $w>0.1^{\#}$, Statistical significant: $p=\leq 0.05$*
Object control skill x PACER HFZ: ($w=0.17^{\#}$ & $p=0.17$),
Object control skill x BMI HFZ ($w=0.12^{\#}$ & $p=0.24$),
Object control skill x FAT% HFZ: ($w=0.12^{\#}$ & $p=0.19$),
Object control skill x strength categories: ($w=0.28^{\#}$ & $p=0.001^{*}$)

Table 3.5 further shows that the relationship between the object control categories and the PACER HFZ, the highest number of participants (70.78%) showed an average mastery (class 4) of the object control skills and fell in the HFZ (62.97%). Of the 281 participants, 91 (22.92%) showed needs improvement: Health Risk (class 1) and 184 (46.35%) participants' object control skills were classified as being in the HFZ (class 2) of the PACER. The analysis of the relationship between the object control classes and strength classes indicates that the highest number of participants (70.65%) showed average mastery (class 4) of object control skills and average mastery (n=284) regarding their strength classes. Of the 284 participants,

193 (48%) were categorised as average, class 3 and 87 (21.64%) were categorised as above average, class 4 regarding their strength. Although there were no statistical differences, small practically significant differences were found between the object control skills and the BMI HFZ (w=0.12 & p=0.24), FAT% HFZ (w=0.12 & p=0.19) and PACER HFZ (w=0.17 & p=0.17). Statistically (p=0.001) and practically (w=0.28) significant differences could only be found between the object control skills and the strength categories.

3.6 Discussion

The purpose of this study was to investigate the relationship between object control skills and health-related physical fitness of nine to ten-year old girls in the North-West Province of South Africa.

From the results, it appears that there were significant correlations although only of small practical significance between object control skills and health-related physical fitness. Stationary dribble and the object control standard score showed a significant correlation with a small practical effect ($r \geq 0.1$) with the standing long jump. The underhand roll showed a correlation with a small practical effect ($r \geq 0.1$) with push-ups, sit-ups and the V-up. Body composition (BMI and FAT%) showed a negative correlation with only one of the six object control skills namely the underhand roll. In contrast to our findings, results of Kemp and Pienaar (11) found that body composition was not positively associated with object control skills and they argued that the reason for this finding might be that object control skills did not require any displacement of body mass.

Stationary dribble, underhand roll and the object control standard score all showed a small practical correlation ($r \geq 0.1$) with cardiovascular endurance (PACER). No studies could be found which supported or disagreed with the findings of these studies. In this study we can, however, see that the more physically active the participants were, the better their results were in their object control skills.

Regarding the cardiovascular endurance, as seen in the PACER, it is clear that the fitter the girls were, the better they scored in the object control skills. The current study's findings are consistent with those of Hardy *et al.* (10) who did a study on 8 000 elementary and high school children in New South Wales, Australia. These researchers (10) showed that low competency in FMS among school children was associated with poorer health outcomes, including low cardiovascular endurance. It was also observed from the results that girls with a higher FAT% find it more difficult to reach down in the underhand roll skill. The findings

of the current study are further also consistent with the results of Cliff *et al.* (7). They also found no child in the overweight/obese sample, seven to eight and nine to ten-year olds showed full mastery in the underhand roll. The implications of poor object control skill mastery for overweight and obese children are very important, because mastery of object control skills in childhood contributes to adolescent object control skill mastery (2). Childhood object control skill mastery leads to physical activity participation and fitness during adolescence (1). Therefore poor object control skills lead to inactivity because most sports codes require a form of object control skills.

3.7 Conclusion

This study provides valuable information regarding the possible relationship between object control skills and health-related physical fitness as no studies could be found that investigated significant relationships in nine year-old girls. Although no other studies could be found that measured the relationship between object control skills and health-related physical fitness, it is recommended that more studies should be performed in this area. It is also recommended that more attention should be given to the development of these skills.

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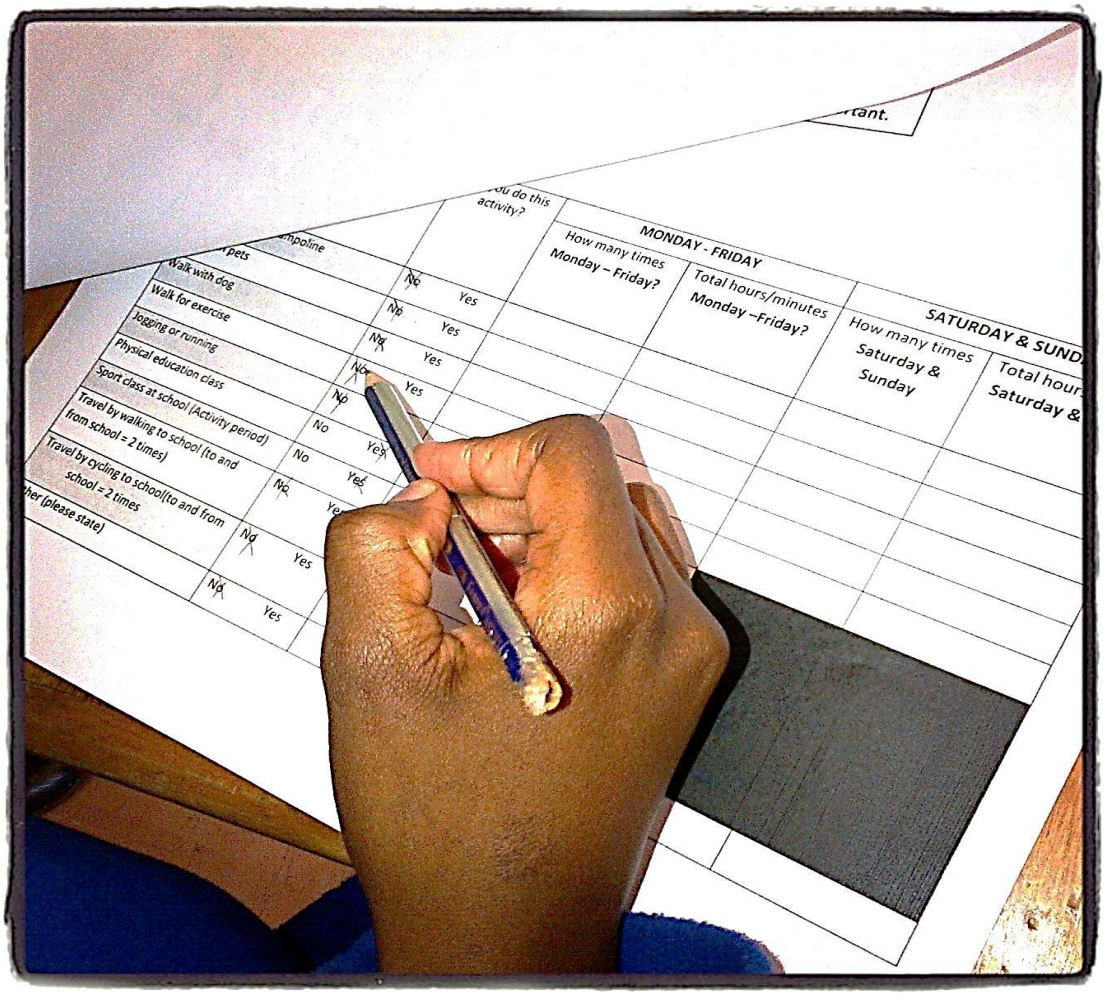
CHAPTER 4


MONDAY - FRIDAY
How many times Monday – Friday?
Total hours/minutes Monday –Friday?
SATURDAY & SUND
How many times Saturday & Sunday
Walk with dog
Walk for exercise
Jogging or running
Physical education class
Sport class at school (Activity period)
Travel by walking to school (to and from school = 2 times)
Travel by cycling to school(to and from school = 2 times
No
Yes

CHAPTER 4: ARTICLE 2

The relationship between object control skills and physical activity levels and patterns in nine- to 10-year old girls in the North-West Province of South Africa: The NW-CHILD study.

Authors: Marilette Visagie, Dané Coetzee & Anita E. Pienaar

Physical Activity, Sport and Recreation (PHaSRec), Faculty of Health Sciences, Potchefstroom Campus, North-West University, South Africa

Ms Marilette Visagie
(B.A. Hons. Kinderkinetics)
School for Biokinetics, Recreation and Sports Science
Private Bag X6001
Potchefstroom
2520

North-West University, Potchefstroom Campus
Telephone: 072 502 1330
Faks: (018) 299 1796
Email: visagie.marilette@gmail.com

Dr Dané Coetzee
(PhD. Human Movement Science)
Telephone: (018) 299 1792
Fax: (018) 299 1825
Email: 12129941@nwu.ac.za

Prof Anita E Pienaar
(PhD. Human Movement Science)
Telephone: (018) 299 1796
Fax: (018) 299 1796
Email: Anita.Pienaar@nwu.ac.za

CORRESPONDING AUTHOR: DR DANÉ COETZEE

ABSTRACT

This article describes the percentage participation in moderate and high intensity physical activities and whether a relationship exists between physical activity levels and object control skills in nine- to ten-year old girls (N=406) in the North-West Province of South Africa, taking into consideration ethnical differences in activity performances. Eighty nine white and 317 black girls with a mean age of 9.86 years participated in this study. Object control skills (OC) were assessed using the Test of Gross Motor Development-2 and physical activities and patterns were assessed using the Children's Leisure Activities Study Survey. Differences were found in the activity choices of white and black girls, where black girls spend a high percentage of their time (83.60%) doing household chores, walking, playing street soccer and skipping, while white girls engaged more in sports and non-sports activities. A significantly ($p \leq 0.00$, $d=0.83$, $d=0.50$) higher percentage of white girls participated in moderate and high intensity activities than black girls while similar percentages of time were spend in netball in both ethnic groups. Physical activity choices only showed a small relationship with object control skills at nine to 10-years-of age. Only participation in netball showed a small relationship ($r=0.11$) with the OC standard score. It is recommended that more exposure should be given to girls to be physically active by participating in activities that can improve object control skills and implementing the physical activity guidelines for children.

Key words: Physical activity, motor proficiency, girls, object control, socio-economic status.

The relationship between object control skills and physical activity levels and patterns in nine- to ten-year old girls in the North-West Province of South Africa: The NW-CHILD study

4.1 Introduction

Regular physical activity and physical fitness are important for children due to the beneficial effects that it has on growth and development as well as physical, social and psychological health, while it also lays a foundation for a lifetime of health through active living (Jandrić, 2010; Strong *et al.,* 2005). Physical activity involves fundamental movement skills (FMS) and depends on environmental influences (Van Biljon & Longhurst, 2001), and revolves around fun and joyful play at the ages from six to 12 years (Aznar-Laín *et al*., 2007). Low physical activity levels and a sedentary lifestyle during the early years could be a predictor of health problems later in life (Dehghan *et al.,* 2005), and are linked to childhood obesity associated with increased health risks that can impair physical health (Hassan *et al.,* 2003). During childhood, the opportunities for physical activity consist mainly of physical education classes, and physical activity during breaks and leisure-time, participation in sport and unorganized physical activity (Pahkala, 2009).

According to the World Health Organization (WHO, 2013a), children aged five to 12 years should spend at least 60 minutes or more on age-appropriate physical activity each day. This daily physical activity should include moderate and vigorous intensity physical activities designed to achieve optimal health, wellness, fitness and performance benefits (NASPE, 2004). The WHO (2013b) indicates that physical activity levels steadily decline from six years of age until adolescence, when activity levels drop more steeply.

Key findings from the 2014 Report Card on Physical Activity for Children and Young People indicated that only 20% of five to 17-year old Australian children meet the Australian Physical Activity Guidelines for Children and Youth, which recommend at least 60 minutes of daily moderate to vigorous-intensity physical activity (Australian Health Survey, 2011-12), only 33% of boys and 21% of girls aged four to 15 in Engeland met the UK Physical Activity Guidelines for Children, which recommend at least 60 minutes of moderate to vigorous-intensity physical activity per day (Health Survey for Engeland, 2008). According to Currie *et al.* (2010), Scottish adolescents had low levels of moderate to vigorous intensity physical activity; among 11 to 15-year olds, where only 19% of boys and 11% of girls meet the UK ‘Start Active Stay Active’ Physical Activity Guidelines, which recommend at least 60

minutes of daily moderate to vigorous-intensity physical activity. The report card of South African children further indicated that almost half of them are insufficiently active (< 60 minutes per day in moderate physical activity). Sedentary behaviour remains a problem in the physical fitness and physical activity, with 22% of South African boys and 27% girls spending just under three hours per day watching television (MRC, 2002).

Locomotor skills (e.g. running, hopping and jumping) and object control skills (e.g. catching, throwing and kicking) (Cliff *et al.,* 2009) are fundamental motor skills (FMS) that are important skills to determine physical active or inactive behaviour in children (Stodden *et al.,* 2008).

Barnett and colleagues (2009) conducted a study on 1 045 children from 18 randomly selected and stratified primary schools in New South Wales, Australia, with a mean age of 10.1 years (range from 7.9- to 11.9 years). These researchers found that being able to perform object control skills (such as catching, throwing and kicking) at the age of 10 was a significant factor in subsequent engagement in adolescent physical activity (Barnett *et al.,* 2009).

In the Newcastle region, NSW, Australia, Cohen *et al.* (2014) conducted a study of 460 children (8.5±0.6 years, 54% girls) and found that object control skills were significantly associated with moderate to vigorous physical activity during lunch time and recess breaks. According to Cohen and colleagues (2014) the type of games and equipment provided to children during lunch times and breaks may be indicative of the type of activities these children participate in.

Soccer and basketball were popular break-time activities which require high levels of object control skills and are highly active sports (Cohen *et al.,* 2014). Guèvremont *et al.* (2010) conducted research on six to 17-year old children in Canada and found that the type of activities which the children participate in were divided into three categories, namely sports activities (dance, gymnastics, aerobics, swimming, baseball, hockey, karate), non-sports activities (participation in any form of music, drama and art) and club or community groups (Brownies, scouts and photography). According to these researchers, girls were most likely to participate in non-sports activities such as drama, art and community activities (Guèvremont *et al.,* 2010).

Engelbrecht *et al*. (2004) conducted a study on 290 girls between 13 and 15 years, in the North-West Province. The results indicated that 70.3% of the girls had low-intensity activity levels. These researchers also investigated racial differences as well as the possible links

between physical activity and fitness (Engelbrecht *et al.*, 2004), and reported that white girls revealed the highest choices in swimming and aerobics.

McVeigh *et al.* (2004) conducted a study of 381 South African children, and found that higher socio-economic conditions contributed to higher physical activity levels in children, which in turn contribute to improved sports skills. In addition, results showed that there were statistically significant racial differences in the type of activity patterns that the children performed. White children were more active than black children, more likely to engage in movement education at school and they watch less television than black children (McVeigh *et al.*, 2004).

Little research could be found on the physical activity patterns of young South African girls, and the role that cultural and racial differences play in physical activity choices. The few studies that have been reported on South African children also identified differences between ethnical groups that were attributed to low socio-economic status such as household responsibilities that are expected from girls from an early age. Little information is available on activities in which girls participate, and the possible relationship it has with object control skills.

The aim of this study was to describe the percentage participation in moderate and high intensity physical activities and whether a relationship exists between physical activities and object control skills in nine to10-year old girls in the North-West Province of South Africa, taking into consideration ethnical differences in activity performances.

4.2 Method

4.2.1 Research design

The study is based on a longitudinal research design (NW-CHILD study) that runs over a period of six years (2010-2016), and consists of three follow-up measurements. The baseline data were collected in 2010. The first follow-up measurement was done in 2013, and the last follow-up measurement will be collected in 2016 on a selected group of learners living in different regions in the North-West Province of South Africa. For the purposes of this study, only the first follow-up measurement (2013) data of the girls were used.

4.2.2 Participants

This research forms part of the NW-CHILD (Child-Health-Integrated-with Learning and Development) study. The research group was selected by means of a stratified random

sample in conjunction with the Statistical Consultation Services of the North-West University. A list of names of schools in the North West Province was obtained from the Department of Education of the North West Province to determine the research sample. This list of schools was grouped into eight educational districts, each representing twelve to 22 regions with approximately 20 schools (minimum twelve, maximum 47) per region. Regions and schools were randomly selected with regard to population density and school status (Quintile 1, i.e. schools from poor economic sectors, to Quintile 5, i.e. schools from higher economic sectors). A total of 20 schools were involved in this study, from four school districts with a minimum of 40 children per school and with an equal gender distribution. For the purposes of this study only the data of the girls tested in 2013 (N=406) were used. This group had a mean age of 9.86 (SD=0.42). Of the 406 girls, 89 were white and 317 were black, mixed race and Indian. The mixed group and Indians are put together with the black group because there were too few mixed race and Indian participants. For the full description of participants of 2010, see Kemp and Pienaar (2010).

4.2.3 Measuring instruments

4.2.3.1 Test of Gross Motor Development (TGMD-2)

The TGMD-2 test is a norm-referenced test battery designed to test the gross motor functioning of children from three to 10 years old (Ulrich, 2000). This test consists of 12 motor skills, and is divided into two subtests, namely locomotor (run, hop, gallop, leap, horizontal jump and slide) and object control (striking a stationary ball, stationary dribble, catch, kick, overhand throw, and underhand roll) skills. For the purposes of this study, only the object control sub-test was used. Each of these fundamental motor skills has three to five performances criteria. For example, there are five performance criteria for striking a stationary ball: 1) “Dominant hand grips bat above non-dominant hand”; 2) “Non-preferred side of the body faces the imaginary tossed ball with feet parallel”; 3) “Hip and shoulder rotation during swing”; 4) “Transfers body weight to front foot”; and 5) “Bat contacts ball”. Marks were allocated as follows: one point awarded for each correct execution of the specific skills and zero for a failed attempt. The child got two attempts to perform at each skill. A visual demonstration of each skill was provided. The scores for the two attempts were added together. To obtain the skill score, all the total scores for each criterion were added together to determine the sub-test raw score of 48 points. The child’s age, gender and raw scores were used to calculate the standard score and percentile rank. The descriptive categories of the

TGMD-2 are: excellent (17-20), good (15-16), above average (13-14), average (8-12), below average (6-7), poor (4-5) and very poor (1-3). A standard score between 1 and 3 was therefore considered to show very low mastery of the object control skill, while a score of seventeen to 20 was considered very good mastery of the object control skill. The TGMD-2 has proven that it is reliable in three areas, namely content-description validity, criterion-prediction validity and construct-identification validity. This test has been found to be reliable in all demographic sub-groups with quotients reaching or exceeding 0.87. A coefficient of 0.88 shows that the TGMD-2 scores are stable over time and for test score reliability a coefficient of 0.98 was found. The TGMD-2 therefore evidences a high degree of reliability (Ulrich, 2000).

4.2.3.2 Children's Leisure Activities Study Survey (CLASS)

This self-reported questionnaire was developed by Telford *et al*. (2004) on Australian children to examine ten to 12-year old children's physical activity from Monday to Friday and also over the weekend, from Saturday to Sunday. This questionnaire includes questions regarding different types of physical activities. The participants were asked to circle yes or no, which indicates whether the child does a particular activity during a school week (Monday to Friday) and over a weekend (Saturday and Sunday). If the child circles yes, she had to report how many times a week as well as for how long (hours/minutes) this activity was performed (Telford *et al.*, 2004). To test the reliability of the CLASS questionnaire, the hours per week the activity was done was converted to a total of minutes that was performed per week. The questionnaire was adapted with regard to the type of activities nine to ten-year olds participated in in South Africa. The activities that were replaced were pilot-tested on nine to ten-year olds in Potchefstroom, North-West Province of South Africa. According to the total minutes, the activities are classified into moderate-intensity, vigorous-intensity and combined moderate and vigorous-physical activity. Nineteen of the 31 activities classified by Telford *et al.* (2004) represent moderate-intensity physical activities (softball or karate or judo or wrestling, cricket, bicycling, dance, hockey, gymnastics, physical education class, playground equipment, playing in playhouse, playing with pets, school sports class, athletics, skateboard, household chores, jumping on a trampoline, travelling to school by walking, travelling to school by bicycling, walking for exercise, and walking the dog), and twelve items represent vigorous physical activities (aerobics, rugby, basketball, running or jogging, netball, rollerblading, skipping, soccer or street soccer, swimming for fun, swimming laps, playing tag or chase, and playing tennis or hand tennis). The total numbers of yes and no

answers were added up to determine how many of the activities that the child participates in, represent moderate or vigorous physical activities. The reliability of the moderate and vigorous individual items in the CLASS self-report questionnaires ranged from 0.62 to 0.94 (Telford *et al.*, 2004). Haili *et al.* (2014) reports Cronbach's alpha values that ranged from 0.71 to 0.84, $p<0.05$ for the CLASS questionnaire on 108 (n=45 boys; n=63 girls) South African children and ICC (intra-class correlation coefficients) ranged from 0.73 to 0.95, $p<0.05$.

4.2.4 Procedure

4.2.4.1 Research procedure

Ethical approval was obtained from the Ethics Committee of the North-West University, Potchefstroom Campus (Ethical No. NWU-0070-09-A1), as well as the Department of Basic Education of the North-West Province. A formal meeting was arranged with the principal of each school where the purpose and protocol of the study were explained in 2010 and again in 2013. Informed consent was obtained from the parents of each of the 60 randomly selected grade 1 learners before participating in the study. An informed consent was obtained again in 2013 when the learners were in Grades 3 and 4. The purpose of this study was verbally explained to all participants in 2010 and was also explained to them again in 2013. The participants had the chance to ask any questions about the research procedures. Learners, whose parents/legal guardian consented that they could participate in the study, were also evaluated in terms of their object control skills, physical fitness and physical activity. Instructions were translated by trained translators for the participants if English was not their first language. The CLASS questionnaire was completed as follows: Children were sitting around a table, each with their own questionnaire in front of them. Each group had a Kinderkineticist and a translator. The Kinderkineticist explained the questionnaire step by step for the children, followed by the translation.

4.2.4.2 Statistical analysis

The STATISTICA software package (StatSoft, 2013) was used to analyse the data. Data were firstly analysed for descriptive purposes on the basis of means (M), standard deviations (SD) and minimum and maximum values.

The Spearman rank order correlation was used to determine the relationship between object control skills and physical activity levels and patterns of nine to ten-year old girls. The

strength of the relationship was set at r≈0.1 indicating a small effect, r≥0.3 a medium effect and r≥0.5 a large effect. The level of statistical significance of the Pearson Chi-square was set at p≤0.05. Two-way frequency tables were used to compare the classification index of the physical activity levels and the object control skills of the girls. The strength of the correlations is represented by the phi-coefficient with w≈0.1 indicating a small effect, w≈0.3 a medium effect and w≥0.5 a large effect (Steyn, 1998). Independent t-tests were used to analyse differences between the activity patterns and intensity activities of girls from different ethnical groups (black and white). The number of participants tested differed slightly because not all the girls completed all the tests because some were involved in other activities during the testing day and had to leave earlier.

4.3 Results

A two-way table was used to determine the number and percentage of girls who indicated whether they had participated in moderate and vigorous intensity activities (Table 4.1). Four hundred and six girls completed the CLASS questionnaire that consists of nineteen moderate intensity physical activities (softball or karate or judo or wrestling, cricket, bicycling, dance, hockey, gymnastics, physical education class, playground equipment, playing in playhouse, playing with pets, school sport class, athletics, skateboard, household chores, jumping on a trampoline, travelling to school by walking, travelling to school by bicycling, walking for exercise, and walking the dog) and twelve vigorous intensity physical activities (aerobics, rugby, basketball, running or jogging, netball, rollerblading, skipping, soccer or street soccer, swimming for fun, swimming laps, playing tag or chase, and playing tennis or hand tennis). In the group of girls, the highest number (77.33%, n=314) indicated that they were doing household shores and 278 (68.74%) indicated that they participated in physical education classes at school. The girls (58.62%, n=238) also indicated that they were playing in playhouses or in the street. Skipping (n=290) and netball (n=202) were the two vigorous intensity physical activities that the girls mostly participated in. Table 4.1 further indicated that cricket (98.77%), travelling to school by bicycling (98.77%) and rugby (98.28%) were the activities these girls least participated in.

TABLE 4.1: Percentage of girls participating in moderate and vigorous intensity activities, ranked according to the highest % occurrence

PHYSICAL ACTIVITIES				
	YES		NO	
	n	%	n	%
MODERATE INTENSITY PHYSICAL ACTIVITIES				
Household chores	314	77.33	92	22.66
Physical education class	278	68.74	128	31.52
Playing in playhouse/street	238	58.62	168	41.38
Playground equipment	202	49.75	204	50.25
Bicycling	166	40.89	240	59.11
Travel to school by walking	160	39.41	246	60.59
Walking for exercise	161	39.65	245	60.34
Playing with pets	151	37.19	255	62.81
School sport class	122	30.04	284	69.95
Dance	111	27.34	295	72.66
Athletics	94	23.15	312	76.85
Trampoline	74	18.23	332	81.77
Walking the dog	61	15.02	345	84.98
Hockey	44	10.84	362	89.16
Gymnastics	20	4.92	386	95.07
Skateboard	21	5.17	385	94.83
Softball/Judo/Karate/wrestling	13	3.20	393	96.80
Travel to school by bicycling	5	1.23	401	98.77
Cricket	5	1.23	401	98.77
VIGOROUS INTENSITY PHYSICAL ACTIVITIES				
Skipping	290	71.43	116	28.57
Netball	202	49.75	204	50.25
Playing tag/chase	174	42.86	232	57.14
Swimming for fun	139	34.24	267	65.76
Running/jogging	113	27.83	293	72.16
Tennis/hand tennis	95	23.40	311	76.60
Soccer/street soccer	38	9.36	368	90.64
Rollerblading	27	6.65	379	93.35
Aerobics	22	5.42	384	94.58
Basketball	19	4.68	387	95.32
Swimming laps	10	2.46	396	97.54
Rugby	7	1.72	399	98.28

N=Population %=Percentage

A two-way table was used to demonstrate the significant differences in moderate and vigorous physical activities between ethnical groups (white and black) (Table 4.2).

Table 4.2 indicated statistically ($p \leq 0.001$) and practically significant differences between the white and black girls, where the white girls participated more in the following moderate intensity physical activities: playing on playground equipment (w=0.15), school sports class

(w=0.19), dance (w=0.13), walking the dog (w=0.14), hockey (w=0.31), gymnastics (w=0.18), skateboard (w=0.19), bicycling (w=0.32) and playing with pets and on the trampoline (w=0.37). If one look at the vigorous-intensity physical activities statistically ($p \leq 0.001$) and practically significant differences were found between the white and black girls, where the white girls again participated more than the black girls during playing tag/chase (w=0.12), swimming laps (w=0.11), and swimming for fun (w=0.46). Table 4.2 further indicated that there were statistically and practically significant differences between the white and black girls, where the black girls participated more in the following moderate intensity physical activities: in household chores (w=0.28), physical education classes (w=0.26), and travelling to school by walking (w=0.37) than the white girls. The black girls showed statistical and small practical higher participation (w=0.21) in skipping where the white girls showed a statistical and medium practical higher participation in rollerblading (w=0.41), of which both activities are high intensity physical activities.

TABLE 4.2: Significant differences in the % occurrence of activities classified between white and black girls in moderate and vigorous physical activities, ranked according to the biggest differences

	Ethnic groups						
	White (n=89)		Black (n=317)		Difference between races	Practical significant	
	%	n	%	n	%	p	w
Moderate intensity physical activities							
Playing with pets	**74.16**	66	26.81	85	47.35	**≤0.001***	**0.41$^{\#\#}$**
Travelling to school by walking	5.62	5	**48.90**	155	43.28	**≤0.001***	**0.37$^{\#\#}$**
Bicycling	**70.79**	63	32.49	103	38.3	**≤0.001***	**0.32$^{\#\#}$**
Trampoline	**44.94**	40	10.73	34	34.21	**≤0.001***	**0.37$^{\#\#}$**
Physical Education Class	46.07	41	**74.76**	237	28.69	**≤0.001***	**0.26$^{\#}$**
Household chores	55.06	49	**83.60**	265	28.54	**≤0.001***	**0.28$^{\#}$**
Hockey	**29.21**	26	5.68	18	23.53	**≤0.001***	**0.31$^{\#}$**
School sports class	**47.19**	42	25.24	80	21.95	**≤0.001***	**0.19$^{\#}$**
Playground equipment	**64.04**	57	45.74	145	18.3	**≤0.002***	**0.15$^{\#}$**
Dancing	**38.20**	34	24.29	77	13.91	**≤0.009***	**0.13$^{\#}$**
Walking the dog	**24.72**	22	12.30	39	12.42	**≤0.003***	**0.14$^{\#}$**
Skateboard	**13.48**	12	2.84	9	10.64	**≤0.001***	**0.19$^{\#}$**
Athletics	**31.46**	28	20.82	66	10.64	0.035	**0.10$^{\#}$**
Gymnastics	**12.36**	11	2.84	9	9.52	**≤0.001***	**0.18$^{\#}$**
Playing in playhouse or street	**64.04**	57	57.10	181	6.94	0.239	0.06
Walking for exercise	**42.70**	38	38.80	123	3.9	0.507	0.03
Softball/Judo/Karate/Wrestling	**5.62**	5	2.52	8	3.1	0.143	0.07
Travel to school by bicycling	1.12	1	**1.26**	4	0.14	0.917	0.01
Cricket	1.12	1	**1.26**	4	0.14	0.917	0.01
Vigorous-intensity physical activities							
Swimming for fun	**75.28**	67	22.71	72	52.57	**≤0.001***	**0.46$^{\#\#}$**
Rollerblading	**25.84**	23	1.26	4	24.58	**≤0.001***	**0.41$^{\#\#}$**
Skipping	53.93	48	**76.34**	242	22.41	**≤0.001***	**0.21$^{\#}$**
Playing tag/chase	**53.93**	48	39.75	126	14.18	**≤0.017***	**-0.12$^{\#}$**
Soccer/street soccer	5.62	5	**10.41**	33	4.79	0.170	0.06
Netball	46.07	41	**50.79**	161	4.72	0.431	0.03
Basketball	1.12	1	**5.68**	18	4.56	0.072	0.09
Swimming laps	**5.62**	5	1.58	5	4.04	**≤0.029***	**0.11$^{\#}$**
Running/ Jogging	24.72	22	**28.71**	91	3.99	0.458	0.03
Aerobics	**6.74**	6	5.05	16	1.69	0.533	-0.03
Tennis/hand tennis	22.47	20	**23.66**	75	1.19	0.815	0.01
Rugby	1.12	1	**1.89**	6	0.77	0.622	0.02

p≤0.05*= statistical significance; practical significance: w=0.01$^{\#}$, w=0.03$^{\#\#;}$ %=percentage; n=number of participants

Table 4.3 represents the descriptive statistics for the 6 object control skills that were tested in this study and the standard score. The total group of participants had a mean age of 9.86.

TABLE 4.3: Descriptive statistics of object control skills

Variables	N	Mean	SD	Min	Max
OBJECT CONTROL SKILLS					
Striking a stationary ball	404	8.36	1.58	2.00	10.00
Stationary dribble	404	6.69	1.72	0.00	8.00
Catch	404	5.78	0.55	2.00	6.00
Kick	404	7.12	1.16	1.00	8.00
Overhand throw	404	6.12	1.64	0.00	8.00
Underhand roll	404	6.03	1.45	2.00	8.00
Standard score	404	9.73	2.35	4.00	15.00

Min=minimum; Max=maximum; SD=Standard Deviation; N=population

A Spearman rank order correlation was used to determine the correlation between the object control skills (striking a stationary ball, stationary dribble, catch, kick, overhand throw and underhand roll) and moderate intensity activities.

Table 4.4 indicates that stationary dribble and kicking showed a correlation with a small practical significance ($r \geq 0.1$) with most of the moderate intensity activities that the group participated in. Stationary dribble showed small practical correlations with bicycling (r=0.16), playing on playground equipment (r=0.11), playing with pets (r=0.17), athletics (r=0.12) and a negative correlation for travel to school by walking (r=-0.10), while kicking showed a small practical correlation with household chores (r=0.10) and a negative correlation with hockey (r=-0.12), playing on playground equipment (r=-0.11), playing with pets (r=-0.20) and gymnastics (r=-0.10). These activities exhibited significant positive statistical significance ($p<0.05$) with object control skills, although these correlations were of small practical significance. With regard to catching and overhand throwing, no correlations were found with the various moderate intensity activities, where underhand roll showed only a small practical relationship with hockey (r=0.15) and playing with pets (r=0.10). In the object control standard score a small practical significance correlation was established between skateboarding (r=0.10) and a negative correlation between travelling to school by walking (r=-0.12). The total of the moderate intensity activities showed a small correlation with stationary dribble (r=0.18).

TABLE 4.4: Correlations between object control skills and moderate and vigorous intensity physical activities

PHYSICAL ACTIVITIES	OBJECT CONTROL SKILLS						
	Striking a stationary ball	**Stationary dribble**	**Catch**	**Kick**	**Overhand throw**	**Underhand roll**	**Object control Standard score**
Moderate intensity physical activities							
Household chores	0.07	-0.01	-0.01	**0.10**$^{\#}$*	-0.09	-0.08	-0.01
Physical Education Class	0.08	-0.09	0.06	0.07	-0.06	0.08	0.00
Playing in playhouse or street	-0.01	0.02	0.03	-0.00	-0.08	0.02	0.00
Playground equipment	0.04	**0.11**$^{\#}$*	0.04	**-0.11**$^{\#}$*	0.03	0.04	0.06
Bicycling	-0.02	**0.16**$^{\#}$*	0.05	-0.05	-0.00	-0.03	0.05
Travel to school by walking	-0.04	**-0.10**$^{\#}$*	-0.05	0.00	-0.02	-0.05	**-0.12**$^{\#}$*
Walking for exercise	0.02	0.06	-0.01	-0.05	-0.06	0.05	0.05
Playing with pets	-0.03	**0.17**$^{\#}$*	0.04	**-0.20**$^{\#}$*	-0.04	**0.10**$^{\#}$	-0.00
School sport class	-0.04	0.07	-0.06	0.03	-0.00	-0.07	0.00
Dance	-0.04	0.03	-0.03	-0.03	0.03	0.05	0.06
Athletics	-0.04	**0.12**$^{\#}$	0.07	-0.02	0.07	-0.00	0.06
Trampoline	-0.01	0.09	-0.05	-0.09*	-0.01	-0.05	0.01
Walking the dog	-0.04	**0.12**$^{\#}$	-0.07	-0.06	-0.02	-0.00	-0.00
Hockey	0.07	0.08	0.06	**-0.12**$^{\#}$*	0.00	**0.15**$^{\#}$*	0.06
Gymnastics	0.01	0.04	0.07	**-0.10**$^{\#}$	-0.04	0.02	0.04
Skateboard	**0.11**$^{\#}$*	0.03	0.03	0.04	-0.00	0.05	**0.10**$^{\#}$
Softball/Judo/Karate Wrestling	-0.01	-0.01	0.05	0.05	-0.01	-0.02	0.00
Travel to school by bicycling	0.06	0.03	0.04	0.05	0.06	-0.02	0.09*
Cricket	0.06	0.06	0.04	0.09	0.03	-0.02	0.09
Total Moderate activities	-0.02	**0.18**$^{\#}$*	-0.00	-0.02	0.04	0.01	0.08
Vigorous intensity physical activities							
Skipping	0.04	0.09	-0.00	-0.02	-0.05	-0.07	-0.01
Netball	0.00	0.00	0.02	-0.05	0.03	0.09	**0.11**$^{\#}$
Playing tag/chase	0.04	0.05	-0.00	-0.01	0.05	0.04	0.03
Swimming for fun	0.02	**0.15**$^{\#}$*	0.03	-0.07	-0.04	0.01	0.03
Running/ Jogging	0.03	0.03	-0.06	**0.10**$^{\#}$	0.02	0.00	0.07
Tennis/hand tennis	0.01	0.05	-0.01	0.06	0.08	-0.00	0.02

Soccer/street soccer	0.04	-0.09	-0.01	0.05	0.08	0.05	0.02
Rollerblading	-0.03	0.00	-0.05	-0.06	-0.01	0.05	-0.03
Aerobics	-0.02	-0.06	-0.04	-0.06	0.03	**-0.14**$^{\#}$*	-0.09
Basketball	0.04	-0.09	-0.06	0.02	-0.02	**-0.17**$^{\#}$*	-0.09
Swimming laps	-0.01	0.03	-0.00	-0.02	-0.05	-0.05	0.05
Rugby	0.04	-0.00	-0.05	0.03	**-0.10**$^{\#}$	-0.04	-0.09
Total Vigorous activities	0.04	**0.11**$^{\#}$	-0.05	-0.02	0.04	0.01	0.08

Statistical significance: p≤0.05*; Practical significance: r=0,1# small effect

A Spearman rank order analysis was also done to determine the correlations among the object control skills and moderate and vigorous intensity activities. The results are displayed in Table 4.4. The underhand roll showed a small negative correlation with aerobics (r=-0.14) and basketball (r=-0.17). Stationary dribble and bicycling showed the highest practically and statistically significant correlation between each other (r=0.16 & p≤0.05). With regard to striking a stationary ball and catching, no correlations (r≤0.1) were found between any of the vigorous intensity activities.

TABLE 4.5: Significance differences between moderate and vigorous physical activities between ethnic groups

Variables	White		Black		Statistical significance			
	M	SD	M	SD	df	t	p	d
Combined	10.98	3.26	8.19	3.26	404	6.96	**≤0.001***	**0.83$^{###}$**
Moderate activities yes	7.45	2.17	5.45	2.27	404	7.40	**≤0.001***	**0.83$^{###}$**
Vigorous activities yes	3.53	1.59	2.74	1.53	404	4.26	**≤0.001***	**0.50$^{##}$**

M=mean, SD=standard deviation, df=degrees of freedom, n=number of participants, p=≤0.05*; d=≥0.2$^{#}$ (small effect)$_{)}$; d=≥0.5$^{##}$ (medium effect); d=≥0.8$^{###}$ (large effect)

Lastly, independent t-tests were conducted to determine whether there were differences between white and black girls during the execution of moderate and vigorous physical activities (see Table 4.5). A practically significant difference with a medium effect (d≥0.5) was found between the percentage participation in vigorous physical activities of white girls and kicking in black girls. Participation in moderate and vigorous physical activities (combined) and moderate activities were statistically (p≤0.05) and practically significant with a large effect (d≥0.8) between the two groups, where the white girls showed more participation. The white children participated more than the black children in the moderate and vigorous activities (Combined) (M=10.98), moderate activities (M=7.45) and vigorous activities (M=3.53).

4.4 Discussion of results

The aim of this study was to describe the percentage participation in moderate and high intensity physical activities and whether a relationship exists between physical activities and object control skills in nine to 10-year old girls in the North-West Province of South Africa, taking into consideration ethnical differences in activity performances.

The results indicated differences in the activity choices of black and white girls. Black girls participated more in household chores, rope jumping and they were also more likely to travel to school. These findings are in line with a study conducted in rural Limpopo Province, in the Dikgale village, where adult women

were found to be highly active because they walked with increased intensity for long distances because of the transport limitations, and participated in household work (Cook *et al.*, 2011). Sedibe *et al.* (2014) also found that urban girls, 18 years of age and living in Soweto, participated in household chores. A possible reason for the participation of these activities by black girls is the inadequate sports facilities at schools as well as culturally-determined responsibilities. White girls indicated that they participated in bicycling, hockey, playing on playground equipment, playing with pets, trampolining and swimming for fun. This finding correlates with studies done by Howall *et al.* (1999) and Engelbrecht *et al.* (2004). A possible reason for this may be due to more opportunities and more equipment that are available to be more physically active. The current study's findings further indicated significantly higher participation patterns in white girls in moderate and vigorous activities compared to black girls, and this finding corresponds with Brodersen *et al.* (2007) and McVeigh *et al.* (2004) who also found that white girls were more physically active than black girls. The current study's results also found that overall nine to 10-year old girls were more likely to participate in non-sports activities with clear cultural differences in the choices of activities. This finding corresponds to the findings of Guévremont *et al.* (2008) who also found that girls were more likely to participate in non-sports activities, and were more interested in drama, art and community activities.

However, it appears from the results that there were small significant correlations between object control skills and moderate and vigorous intensity physical activity patterns. Stationary dribble showed a significant correlation with a small practical effect ($w \geq 0.1$) with bicycling, playing on playground equipment, playing with pets, athletics and walking the dog. Catching and overhand throwing have shown no relationship with one of the nineteen moderate intensity physical activities. Only netball comes in as a large percentage on an organized and structured level. Catching was the only OC skill that showed no significant correlation with any of the vigorous intensity physical activities. These results correspond to the results of Barnett *et al.* (2014), that found that OC skills competence was associated with physical activity, and found that actual OC skills proficiency showed significant results with morderate to vigorous physical activity (Barnett *et al.*, 2014). (2014). Cohen *et al.* (2014:7) also found in their study that OC skills were significantly associated with MVPA during lunch times and recess breaks and they attribute this finding to the type of games and equipment provided to children during lunch times and recess breaks such as soccer and basketball and requiring high levels of OC skill competency. A possible reason for the above findings could be because of the type of sports in which they participated during school hours. The better underhand rolls could perhaps be explained because in hockey the same actions are used as during the execution of an underhand roll. Both skills require bending your knees deeply, while the dribbling skills are used in netball practices.

The possible reasons for this lack of a strong association between OC skills and physical activities in the current study can perhaps be explained by the fact that a large number of the physical activities that girls in this study engaged in may not have much of an OC component, whereas older children's physical activity may be the result of participation in sports-related activities (in the more active children).

If we consider the moderate intensity physical activities, negative correlations were found between travel to school by walking, playing with pets, playground equipment, hockey and gymnastics. Three of the vigorous intensity physical activities, also showed a negative correlation with the OC skills, namely aerobics, basketball and rugby. A possible explanation for these results may be because aerobics does notrequire any form of OC skills. From the results it is clear that netball is the only activity that black and white girls participated in.

When are considers the white girls' performance, they did better than the black girls in the moderate and vigorous activities (combined), moderate activities and vigorous activities. A possible reason for this may be because parents of white girls can expose their children to extra stimulation programmes and can afford it, whereas most black girls are not exposed to different kind of sport at school because of their low socio-economic status that can lead to promoting an active lifestyle. Black girls are more active at an informal level, which is based more on play.

4.5 Conclusion

This study provides valuable information regarding the possible relationship between object control skills and physical activity levels and patterns of nine to 10-year old girls representing different ethnical groups. It confirmed that nine to 10-year old girls are physically active but that the activities that they engage in do have a very strong relationship with their object control skills.

This study did have some shortcomings, as it is only aimed at learners in the North-West Province, and it is essential to do further research in this regard in the other eight provinces of South Africa where other ethnical groups might engage in other activities. Further studies are recommended on this topic, because of the lack of information that exists on the type of activities young girls participate in, in order to better understand the physical habits of young children. The CLASS that the girls completed to identify the moderate and vigorous physical activities they mostly participated in, was difficult for them to complete without the assistance of a translator, although everything possible was done so that they could understand. It was also not possible to determine the time spent in moderate and high intensity physical activity (PA) because they were unable to provide valid estimated of the time that they spend in every activity. More direct measurements such as the use of accelerometers can assist in this shortcoming. It is

recommended that a parent or guardian can also assist with the completion of the survey to obtain the best possible results.

The development of motor skills, especially object control skills in young girls, can contribute to participation in physical activity and sport.

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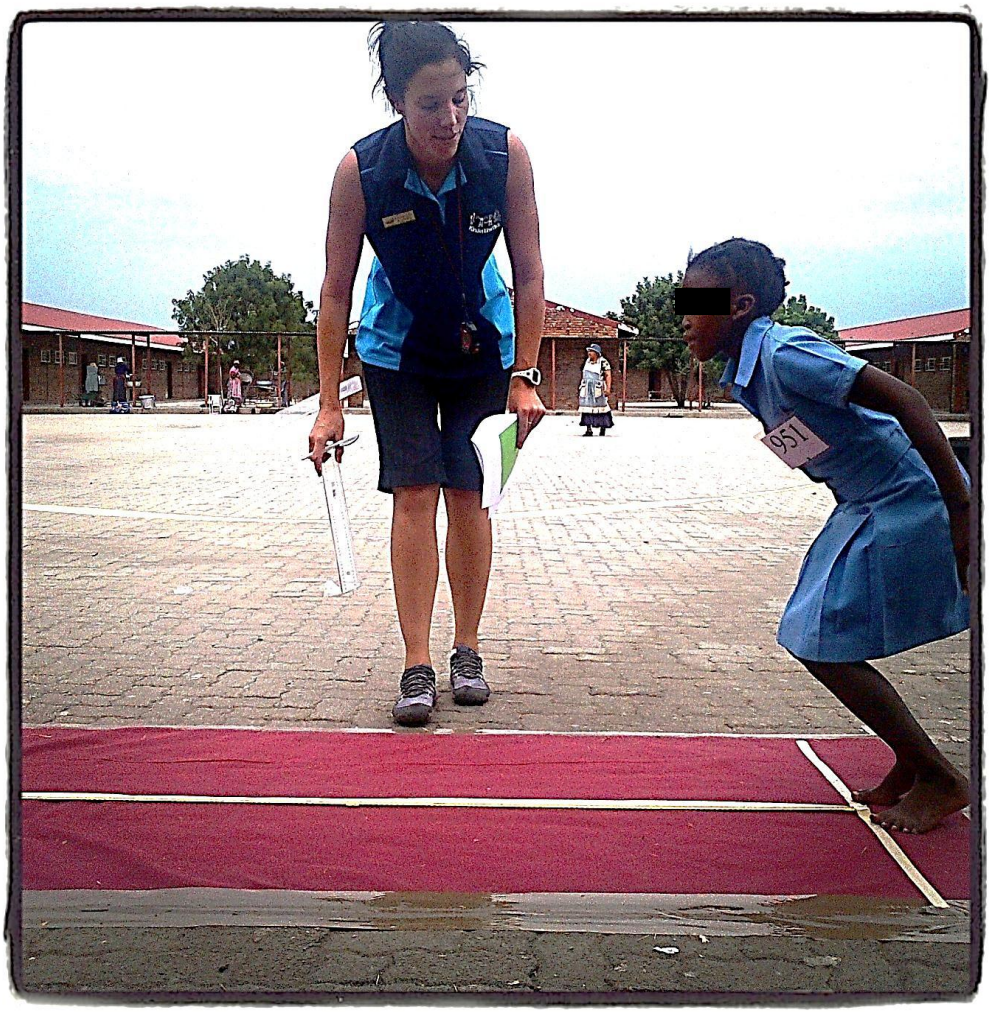
CHAPTER 5



CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

A summary of this dissertation is subsequently provided as discussed in the preceeding chapters, after which the main conclusions and recommendations will be made.

This dissertation had the following two goals. The first objective of this dissertation was to determine the relationship between object control skills, and health-related physical fitness of nine to 10-year old girls in the North-West Province of South Africa. Secondly, the objective was to describe the relationships between the physical activity levels and to determine whether a relationship existed between physical activity levels and object control skills of nine to 10-year old girls in the North-West Province of South Africa, taking racial differences in activity performances into consideration. The problem statement, objective and hypothesis of this study are presented in Chapter 1.

Chapter 2 consists of a literature review where the possible relationships between object control skills and health-related physical fitness, physical activity and physical activity patterns were fully investigated. This chapter also contains a description of various concepts related to the well-being and development of the child, namely developmental periods of children, phases of object control skill development, factors leading to the declining of object control skills in children, health-related physical fitness levels of girls and physical activity guidelines for children.

Firstly, the literature review aimed to demonstrate the possible relationship between object control skills and health-related physical fitness. It was established that there were limited studies to prove a relationship and it was concluded that any execution of motor skills such as throwing a ball required a measure of health-related physical fitness (muscle strength, muscle endurance, cardiovascular endurance and flexibility). Furthermore, it became clear that there were some factors such as increased sedentary behaviour, age and gender of children, physical activity patterns of the child, an opportunity to participate and the environment the child was located in, that played an important role in the development of motor skills.

Secondly, the literature was reviewed regarding the possible relationship between object control skills and physical activity and patterns of a selected group of girls. The literature review showed that children, who did well in object control skills, usually have higher levels of sporting skills that can lead to a child being a more active teenager. It was also shown that physical activity, physical fitness and motor development were very important for children due to the beneficial effects on growth and development as well as

physical, social and psychological health, and it also lays a foundation for a lifetime of health through active living. The literature review indicated that physical inactivity was a worldwide problem, where just a small percentage of children meet the daily physical activity recommendations. The literature findings further indicated that the more active the child is, the more proficient their object control skills were.

Chapter 3 was prepared in article format with the title "The relationship between object control skills and health-related physical fitness in nine to 10-year old girls in the North-West Province of South Africa: The NW-CHILD study" and will be presented for possible publication in the *Journal of Pediatric Exercise Science*. This article presents the results found regarding the relationship between object control skills and health-related physical fitness in nine and 10-year old girls in the North-West Province. The study involved 408 girls with a mean age of 9,86 years from 20 different schools in the North-West Province of South Africa, five different types of schools (Quintile 1, i.e. schools from poor economic sectors, to Quintile 5, i.e. schools from higher economic sectors). The strength sub-test which includes standing long jump, push-ups, sit-ups, wall sit and V-up, of the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) was used to determine the girls' strength, while the Test of Gross Motor Development-2 (TGMD-2) was used to determine the girls' object control skills. The FITNESSGRAM was used to evaluate the girls' cardiovascular endurance and body composition that included stature, body mass and skinfolds (sub-scapular, triceps and calf), were measured according to standard Kinantropometric protocols.

The STATISTICA software package was used to analyse the data. For descriptive purposes, data were, firstly, analysed using means ($\bar{X}$), standard deviations (SD), and minimum and maximum values. Secondly the Spearman rank order correlation was used to determine the relationship between health-related physical fitness and object control skills of nine to ten-year old girls. The following guideline for the strength of the relationship was used: r≈0,1 (a small effect), r≈0,3 (a medium effect) and r≥0,5 (a large effect). Lastly, a two-way variance table was used to analyse the different object control skills and health-related physical fitness components. The Pearson Chi-square served to indicate the significance of the results and the accepted level of statistical significance was set at p≤0,05. The strength of the correlations was represented by the phi-coefficient with w≈0,1 (a small effect), w≈0,3 (a medium effect) and w≥0,5 (a large effect).

Small correlations between the different strength skills and object control skills were found. Stationary dribble had a correlation of small practical significance (r≥0,1) with the standing long jump (r=0,16), sit-ups (r=0,15) and V-ups (r=0,16), while underhand roll showed a small correlation (r≥0,1) with push-ups (r=0,12), sit-ups (r=0,14) and V-up (r=0,17). Body composition showed small negative correlations with just one of the six object control skills namely underhand roll (r=-0.13). Cardiovascular endurance showed

a small correlation (r≥0,1) with stationary dribble, underhand roll and object control standard score. With regards to BMI, 49.62% (n=198) of the girls were categorised as being in the HFZ, 54.14% (n=216) were categorised in the HFZ with regard to FAT% and for cardiovascular endurance 63.03% (n=254) were categorised as in the HFZ and 1.74% (n=7) above the HFZ. The conclusion that can be made is that there is a small relationship existing between the performance of object control skills and strength activities with regard to nine to 10-year old girls.

Chapter 4 is also presented in the form of an article with the title "The relationship between object control skills and physical activity levels and patterns in nine to 10-year old girls in the North-West Province of South Africa: The NW-CHILD study" and will be submitted for possible publication in the *Journal of Early Child Development and Care.* This article presents the results found regarding the relationship between object control skills and physical activity levels and patterns of nine to 10-year old girls in the North-West Province. There were 406 girls with a mean age of 9,86 years (SD=0.42) from 20 different schools in the North-West Province, five different types of school (Quintile 1, i.e. schools from poor economic sectors, to Quintile 5, i.e. schools from higher economic sectors) represented in this study. The TGMD-2 was used to determine the learners' object control skills and the Children's Leisure Activities Study Survey (CLASS) was used to determine the moderate and vigorous intensity physical activities the girls participated in. Spearman rank order correlation was used to determine the relationship between object control skills and physical activity levels and patterns of nine to 10-year old girls. The strength of the relationship was set at r≥0,1, r≥0, and r≥0,5. The level of statistical significance was set at p≤0,05 with the Pearson Chi-square. Two-way frequency tables were used to compare the classification index of the physical activity levels and the object control skills of the girls. The strength of the correlations is represented by the phi-coefficient with w≈0.1, w≈0,3 and w≥0,5. Small correlations were found between the different moderate and vigorous physical activities and object control skills. Stationary dribble showed small practical correlations with bicycling (r=0.16), playing on playground equipment (r=0,13), playing with pets (r=0,16) and trampoline (r=0.09), and stationary dribble also showed a significant correlation with a small practical effect (w≥0,1) with seven of the nineteen moderate intensity physical activities and is the only object control skill that showed a significant correlation with a small practical effect (w≥0,1) with one of the vigorous intensity physical activities namely swimming for fun. Kicking showed a negative correlation with hockey (r=-0,18), playing on playground equipment (r=-0,15), playing with pets (r=-0,23) and trampoline (r=-0,11). Catching and overhand throwing showed no relationship with any of the nineteen moderate intensity physical activities. A correlation with a small practical effect (w≥0,1) was found between striking a stationary ball and skateboard and underhand rolling and hockey. There were also statistical (≤0.05) and a small practical significance (r=0.18) found between stationary dribble and the

total of the moderate intensity physical activities. When looking at the moderate intensity physical activities correlation with the object control skills, there were negative correlations between traveling to school by walking, playing with pets, trampoline, and traveling to school by bicycle. Two of the vigorous intensity physical activities also showed negative correlations with the object control skills namely underhand roll with aerobics (r=-0.14) and basketball (r=-0.17). The reason for this may be because aerobics does not require any form of object control skills.

This study's results lastly indicated that white girls performed statistically ($p \leq 0.01$) and practically ($d \geq 0.5$) better than the black girls during moderate and vigorous activities (combined) (M=10.98 vs. M=), moderate activities yes (M=7.45 vs. M=) and vigorous activities yes (M=3.53 vs. M=).

5.2 Conclusions

The conclusions of this study are based on the results obtained in the study.

5.2.1 Conclusion 1

Hypothesis 1 stated that there would be a significant relationship between the object control skills and health-related physical fitness in nine to 10-year old girls in the North-West Province of South Africa. The results revealed statistically significant ($p \leq 0.05$) differences with small practical relationships between object control skills and health-related physical fitness. Small correlations with the different strength skills and object control skills were also found, therefore this hypothesis is **accepted.**

5.2.2 Conclusion 2

Hypothesis 2 states that there would be a significant relationship between the object control skills and physical activity levels and patterns of nine to 10-year old girls in the North-West Province of South Africa when ethnical differences were taken into consideration during the activity performances. The results, however, showed small correlations between object control skills with the different moderate (softball or karate or judo or wrestling, cricket, bicycling, dance, hockey, gymnastics, physical education class, playground equipment, playing in playhouse, playing with pets, school sports class, athletics, skateboard, household chores, trampoline, travel to school by walking, travel to school by bicycling, walking for exercise, and walking the dog) and vigorous physical activities (aerobics, rugby, basketball, running or jogging, netball, rollerblading, skipping, soccer or street soccer, swimming for fun, swimming laps, playing tag or chase, and playing tennis or hand tennis), ethnicity and object control skills. From these results, the hypothesis can be **accepted.**

5.3 Recommendations and shortcomings

This study found that nine to 10-year old girls in the North-West Province of South Africa's gross motor skill development, specifically their object control skills, were below average if we look at other studies where mastery of object control skills already occurred at an earlier age. It was also found that the largest number of girls' strength skills as well as their object control skills tested average as measured by the TGMD-2 and BOT-2 test batteries respectively. Moreover, the results of the study showed that girls with a higher body mass composition showed a weaker mastery in the underhand role as measured by the TGMD-2 test battery. It was also found in the cuurent study that white girls participate more in some physical activities than black girls, whereas black girls participate in other activities more than white girls, as measured by the CLASS questionnaire. As discussed in the literature, early childhood forms an important part in the child's fundamental motor skills development. The suggestion was made that more knowledgeable people in the field of motor development should be placed in schools. This will allow physical activity and fitness and object control skills of the learners to be optimally developed and that delayed motor skills can be identified and addressed as soon possible. In this way sufficient object control skills, physical fitness and physical activity can be applied and maintained. This study can highlight some shortcomings in respect of girls' development of their object control skills. These shortcomings can be addressed through Kinderkinetics programmes, and by improving these skills will lead to the improvement of the girls’ sports skills.

Although all efforts were made to optimize the results of this dissertation, some limitations need to be acknowledged that could improve the outcome of this and other similar studies. The following limitations are acknowledged and recommendations for further research are subsequently indicated.

- Because of the large number of girls participating in this study and the fact that it was a randomized sample, this study has good generalizability, although it would be recommended that this research be done in the other eight provinces of South Africa to determine whether the results can be extrapolated to the rest of the country. The results of such a nature could give a better overall picture of the object control skills as well as the physical activity levels and patterns of South African children. This will also help to implement or improve future intervention programmes in this regard.

- This dissertation did not focus on gender differences. Further research is therefore recommended to determine the relationship between girls’ and boys’ object control skills, health-related physical fitness and physical activity patterns because there is still little known in the literature concerning these

differences in girls and boys. Follow-up studies will be of much value to see what happens with girls' physical activity levels over time.

- In this dissertation, it became clear that more studies should be carried out regarding the type of activities that girls aged nine to ten-years of age most participate in. Little literature on this subject could be found.

- The CLASS that was used to determine which activities the girls are more likely to participate in seemed to be too difficult for some of the girls to understand. The time the girls participate in the activities could not be given accurately therefor the total of time spend daily in physical activities could consequently not be calculated. It is recommended that a parent or guardian of the child must complete the questionnaire with the child to ensure better results.

- In determining the health-related physical fitness components of the girls, the researchers made use of the Bruininks Oseretsky test of Motor proficiency second edition (BOT-2) and the FITNESSGRAM test batteries. In further studies, the full FITNESSGRAMM test battery may be used to ensure that all health-related physical fitness components are fully evaluated, so that a more complete profile of the subjects' strength and endurance skills could be obtained.

- Girls aged nine-to 10-years of age spend most of their time in sedentary activities. It is recommended that more attention should be given to expose girls to physical activities in an enjoyable environment. It is also recommended that teachers be better trained to bring more fun into their physical education lessons.

APPENDIX

APPENDIX A:

Informed concent of the research project in Afrikaans and English

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOMKAMPUS

Kliniek vir Kinderkinetika
Bussie 616, PU vir CHO, Potchefstroom 2531.
Tel. (018) 299 1794/6

NAVORSINGSPROJEK – Omgewingsinvloede en gesondheidsrisikofaktore se effek op die Gesondheid, Sport en Akademiese vordering van kinders woonagtig in die NW provinsie van SA 'n 6-jaar opvolgondersoek

Hierdie navorsingsprojek is goedgekeur deur die Departement van Basiese Onderwys sowel as die Etiese komitee van die Noordwes-Universiteit, Potchefstroomkampus (NWU_00070-09-A1). Toestemming is ook by u skoolhoof verkry om voort te gaan met die navorsing.

U kind is deel van die groep wat geselekteer is om aan bogenoemde navorsingsprojek deel te neem, en het reeds die eerste metings in sy/haar graad 1 jaar in 2010 ondergaan. Die navorsingsprojek behels drie opvolgmeting op u kind oor die tydperkperk van sy/haar laerskooljare (graad ,1 2010), 2013 en in 2016).

Die doel van hierdie navorsingsprojek is:

om inligting te bekom oor laerskoolkinders se groei en liggaamsamestelling, perseptueel-motoriese, fisieke, visuele vermoëns, basiese sportvaardighede en fiksheid ten einde 'n profiel te kan daarstel van hierdie eienskappe van kinders woonagtig in die NW provinsie van SA, *maar meer* belangrik ook om strategieë te kan ontwikkel ter verbetering van geïdentifiseerde gesondheidsbevorderende, sportbevorderende en akademiese belemmerende faktore wat kinders tussen die ouderdom van 6 en 13 jaar se lewenskwaliteit en verdere ontwikkeling kan belemmer.

Alle toetsings en metings sal deur gekwalifiseerde navorsers uitgevoer word, is veilig om aan deel te neem, ouderdomgepas en verg min inspanning van die kind. Elke kind wat aan die studie deelneem word anoniem hanteer en kan sleg deur 'n proefpersoonnommer geïdentifiseer word.

Deur u kind tydens hierdie opvolgmeting weer aan die bogenoemde navorsingsprojek te laat deelneem, kan dit nie net vir u kind tot voordeel wees nie, maar ook vir ouers, onderwysers en ander kundiges, inligting verleen wat gebruik kan word om belemmerende faktore in kinders se ontwikkeling vroegtydig te identifiseer, maar ook kinders van hierdie ouderdom se ontwikkeling te optimaliseer. Ons vra dus dat u dit sterk sal oorweeg om hom/haar weer te laat deelneem aan die navorsing. U is uiteraard geregtig om u kind op enige stadium, sonder enige verduideliking, te onttrek van die studie. Terugvoering sal aan u kind se skool gegee word nadat alle toetsings wat op een oggend tydens skoolure, soos gereël met die skoolhoof sal geskied, afgehandel en die inligting verwerk is. Vind asseblief aan die agterkant van hierdie brief 'n vorm wat u asseblief moet teken en die volgende dag aan die skool moet terugbesorg. U kan enige tyd insae in die resultate van u kind vra. Vir enige verdere inligting oor die projek, is u welkom om my persoonlik te kontak by onderstaande kontakgegewens te kontak.

_____

Prof. A.E. Pienaar
Projekleier
(Skool vir Biokinetika, Rekreasie en Sportwetenskap)
(018) 299 1796 (W)

Stuur asseblief hierdie vorm die VOLGENDE DAG terug skool toe, hetsy dit ingevul is al dan nie.

_____✂_____✂_____✂_____

Ek as ouer verstaan dat ek onder geen verpligting is om my kind aan die navorsingsprojek te laat deelneem nie. Ek verstaan dat daar geen skade aan my kind berokken gaan word, hetsy fisies of geestelik nie. Ek verstaan ook dat daar geen kostes verbonde is aan die evaluering nie en dat dit ook nie sal inmeng met my kind se skoolaktiwiteite nie.

Hiermee gee ek _____

ouer/wettige voog van _____ (Kind se volle name en van)

_____ (Geboortedatum) toestemming dat hy/sy aan die navorsingsprojek mag deelneem.

_____ _____

Handtekening Datum

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOMKAMPUS

Kliniek vir Kinderkinetika
Bussie 616, PU vir CHO, Potchefstroom 2531.
Tel. (018) 299 1794/6

RESEARCH PROJECT – The effect of environmental influences and health risk factors on the Health, Sport and Academic progress of children living in the North-West Province of South Africa: A 6-year follow-up study

This study has the approval of the Department of Basic Education as well as the Ethical Committee of the North-West University, Potchefstroom Campus (NWU_00070-09-A1). Permission has also been obtained from your school principal to proceed with this research.

Your child is part of a group that has been selected to participate in this research project, and the first round of tests were performed when he/she was in grade 1 in 2010. The research project comprises three follow-up testing sessions over the course of his/her primary school years (grade 1, 2010, 2013 and in 2016).

The aim of the research project is:

> to obtain information on the growth and body composition, perceptual-motor, physical, visual abilities, basic sport skills and fitness of primary school children in the North-West Province of South Africa, but *more important* to develop strategies to improve identified health enhancing, sport promoting and academic restricting factors that influence the quality of life and optimal development of 6- to 13-year old children.

All tests and measurements will be performed by qualified researchers, is safe to participate in, age appropriate and is not taxing to the child. Each child that participates in the study will be anonymous and will be only identifiable by a test subject number.

By allowing your child to participate in this further testing in the abovementioned research project, it will not only be advantageous to your child, but also for parents, teachers and other specialists, as it will not only provide information that can be used to early identify restrictive factors in children's development, but also to aid in the optimal development of children of this age. We therefore request that you strongly consider allowing your child to participate in this study. You, however, have the right to withdraw your child from the study at any stage, without any explaination. Feedback will be given to your child's school principal after completion of the testing and after all the results have been analysed. Testing will occur one morning during school hours, as arranged with the school principal. The test results of your child will be available for your perusal at any time, on request. For any further information on the project, please feel free to contact me on the details below. Please find at the back of this page a form that you have to complete and send back to the school as soon as possible.

_____

Prof. Anita.E. Pienaar
Project leader
(School of Biokinetics, Recreation and Sport Science)
(018) 299 1796 (W)

Please send this form back to school the NEXT DAY, whether it is completed or not.

_____✂_____✂_____✂_____

I, as parent, understand that I am under no obligation to allow my child to participated in this research project. I understand that no harm will come to my child, either physically or mentally. I also understand that there are no costs involved in the evaluation and that these tests will not interfere with my child's school activities.

I _____ parent/legal guardian
of _____ (child's full name and surname)
_____ (Date of Birth) hereby give permission for him/her to participate in the research project.

_____ _____

Signature Date

APPENDIX B:

Guidelines for Authors:

Journal of Pediatric Exercise Science

Guide for Authors

Pediatric Exercise Science welcomes submissions of original research, topical reviews, commentaries, and letters-to-the editor which address issues surrounding the science of exercise in subjects less than 18 years old. In general, Pediatric Exercise Science does not publish material related to physical education curricula or pedagogy, sports medicine (including athletic injuries), or motor development.

The instructions below (revised November 2014) are intended to help authors prepare high-quality and readable manuscripts. Authors are encouraged to refer to a recent issue of the journal to ascertain the preferred layout, format, style, and appearance.

The manuscript should be double-spaced, including the abstract, references, and any block quotations. Manuscripts are subject to editing to eliminate sexist and biased language.

Manuscripts must be submitted electronically via Manuscript Central (mc.manuscriptcentral.com/hk_pes). Authors of manuscripts accepted for publication will be required to transfer copyright to Human Kinetics, Inc. Manuscript Central manages the electronic transfer of manuscripts throughout the article review process while providing step-by-step instructions and a user-friendly design. Please access the site and follow the directions for authors submitting manuscripts. Any problems that may be encountered can be resolved easily by selecting "Get Help Now" in the upper-right corner of any Manuscript Central screen. Please note that a blind review process is used to evaluate manuscripts. As such, any clues to the author's identity should be eliminated from the manuscript. The first page of the manuscript must not include author names or affiliations, but it should include the title of the paper and a preferred running head.

It is expected that the length of the body of the manuscript, including title page, abstract, text, and references, will be 15 to 20 double-spaced pages. Number the pages in the upper right corner beginning with the title page. Limit the abstract 200 words. A statement regarding institutional review board approval as well as obtaining informed consent/assent from parents/child subjects should be included in the Methods section. Figures and tables should be limited to a combined total of 5 and should not duplicate material in the text. Figure legends and tables should be included in the main document with the full text. Tables must be formatted by Word and must be editable. Please do not submit tables as images, PDFs, or separate files. Figures should be submitted separately in TIF, JPG, or PNG format.

The corresponding author is required to nominate two potential reviewers for the manuscript with suitable expertise in the area addressed by the manuscript. The journal is under no obligation to use any of the nominated reviewers.

Writing style should be concise and direct. Avoid using unnecessary jargon and abbreviations, but use an acronym or abbreviation if it is more commonly recognized than the spelled-out version of a term. Formats of numbers and units should follow the AMA Manual of Style, 10th edition. Measurements of length, height, mass, and volume should be reported in metric units (meter, kilogram). Only standard physiological abbreviations should be used. Avoid abbreviations in the title. The full wording should precede the first use of an abbreviation.

The reference style for Pediatric Exercise Science should follow the Vancouver style guidelines set by the International Committee of Medical Journal Editors (www.icmje.org/about.html) ,as they appear in the committee's Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication (www.icmje.org/urm_main.html). In the reference list, the citations should be listed in alphabetical order (rather than in the order of citation). In the text, references are identified by Arabic numerals in parentheses (1). Assure that all entries in the reference list are cited in the text and that all those in the text are included in the reference list. References should be limited to previously published works or those which are in press (accepted for publication). Usually the number of references should not exceed 50. An abstract properly identified may be cited only when it is the sole source. The reference list should be double-spaced. When the number of authors of a reference exceed seven, use the first three, followed by "et al.". The reference style should be:

Journal article:

Soldin OP, Mattison DR. Sex differences in pharmacokinetics and pharmacodynamics. Clin Pharmacokinet. 2009;48(3):143-57.

Book:

Heyward VH, Stolarczyk LM. Applied Body Composition Assessment. Champaign, IL: Human Kinetics, 1996.

Chapter in Edited Book:

Young LR, Altose MD. Respiratory responses to ventilatory loading. In: Hornbein TF, editor. Regulation of Breathing. New York: Dekker, 1981, pp. 905-964.

Authors are encouraged to consult the following website for more detailed examples: www.nlm.nih.gov/bsd/uniform_requirements.html

APPENDIX C:

Guidelines for Authors:

Journal of Early Child Development and Care

Manuscript preparation

1. General guidelines

- Manuscripts are accepted in English. British English spelling and punctuation are preferred. Please use single quotation marks, except where 'a quotation is "within" a quotation'. Long quotations of 40 words or more should be indented without quotation marks.
- A typical manuscript will be between 5000 and 8000 words including tables, references, captions, footnotes and endnotes. Manuscripts that greatly exceed this will be critically reviewed with respect to length. Authors should include a word count with their manuscript.
- Manuscripts should be compiled in the following order: title page; abstract; keywords; main text; acknowledgements; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figure caption(s) (as a list).
- Please supply all details required by any funding and grant-awarding bodies as an Acknowledgement on the title page of the manuscript, in a separate paragraph, as follows: • For single agency grants: "This work was supported by the [Funding Agency] under Grant [number xxxx]."
- For multiple agency grants: "This work was supported by the [Funding Agency 1] under Grant [number xxxx]; [Funding Agency 2] under Grant [number xxxx]; and [Funding Agency 3] under Grant [number xxxx].
- Abstracts of 100-150 words are required for all manuscripts submitted.
- Each manuscript should have 3 to 6 keywords.
- Search engine optimization (SEO) is a means of making your article more visible to anyone who might be looking for it. Please consult our guidance here.
- Section headings should be concise.
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APPENDIX D:

Children's Leisure Activities Study Survey (CLASS)

Name: _____ **Subject number:** _____

Children's Leisure Activities

Study Survey(CLASS)

Children's Questionnaire

Important

We are interested in what you do in your leisure time during atypical week.

There are no right or wrong answers – **this is not a test.**

Please answer all the questions as honestly and accurate as you can- this is very important.

Which of the following PHYSICAL activities do you USUALLY do during a typical WEEK

(from the start of the current school term, do NOT include school holidays)?

During a typical WEEK what activities do you usually do?	Do you do this activity?	MONDAY - FRIDAY		SATURDAY & SUNDAY	
		How many times Monday – Friday?	Total hours/minutes Monday – Friday?	How many times Saturday & Sunday	Total hours/minutes Saturday & Sunday
E.g. Bike riding	No ╳ Yes	2	40min	1	15min
Aerobics	No Yes				
Dance	No Yes				
Gymnastics	No Yes				
Tennis	No Yes				
Rugby	No Yes				
Soccer/ Street soccer	No Yes				

Basketball	No Yes				
Cricket	No Yes				
Netball	No Yes				
Baseball/ Softball	No Yes				
Swimming laps	No Yes				
Swimming for fun	No Yes				
Hockey	No Yes				
Tag/chasey	No Yes				
Skipping rope	No Yes				
Roller blades	No Yes				
Athletics	No Yes				

Skate boarding	No Yes				
Bike riding	No Yes				
Household chores	No Yes				
Play on playground equipment	No Yes				
Play in the street or yard	No Yes				

Bounce on the trampoline	No Yes				
Play with pets	No Yes				
Walk with dog	No Yes				
Walk for exercise	No Yes				
Jogging or running	No Yes				

Physical education class	No Yes				
Sport class at school	No Yes				
Travel by walking to school (to and from school = 2 times)	No Yes				
Ravel by cycling to school(to and from school = 2 times	No Yes				
Other (please state)	No Yes				

APPENDIX E:

Declaration

Declaration

This is to declare that I, Annette L Combrink

Accredited language editor and translator of the

South African Translators' institute

have language edited the dissertation by

Marilette Visagie

with the title

RELATIONSHIP BETWEEN OBJECT CONTROL SKILLS, HEALTH-RELATED PHYSICAL FITNESS AND PHYSICAL ACTIVITY OF NINE TO TEN-YEAR OLD GIRLS: THE NW-CHILD STUDY

Prof. Annette L Combrink
Accredited translator and language editor,
South African Translators' Institute
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Date: 27 October 2015