ASSESSMENT OF HEALTH RELATED PHYSICAL FITNESS AND MOTOR SKILL ABILITY OF 9-11 YEAR OLD SCHOOL CHILDREN IN NAIROBI COUNTY, KENYA

BY

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JUNE, 2016
DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

I dedicate this thesis to my beloved mother Millicent Ogila, thank you for educating me. My sisters Sheila and Pauline and my brother John and friends, thank you for your continued support. My late brother and father, Stephen and Ben respectively, thank you for making me the person I am today. I also want to thank everyone who helped me in one way or another to successfully finish this program, I salute you all.
ACKNOWLEDGEMENT

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<td>ANOVA</td>
<td>Analysis Of Variance</td>
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<td>BMI</td>
<td>Body Mass Index</td>
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<td>CAPL</td>
<td>Canadian Assessment of Physical Literacy</td>
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<td>CDC</td>
<td>Center for Disease Control and Prevention</td>
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<td>CHD</td>
<td>Coronary Heart Disease</td>
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<td>ISCOLE</td>
<td>International Study of Childhood Obesity, Lifestyle and the Environment</td>
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<tr>
<td>KNBS</td>
<td>Kenya National Bureau of Statistics</td>
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<tr>
<td>MET</td>
<td>Metabolic Equivalent</td>
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<td>NCD</td>
<td>Non-Communicable Diseases</td>
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<td>Physical Education</td>
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<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
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OPERATIONAL DEFINITIONS OF TERMS

Definitions of Terms

**Able Bodied Pupils:** Pupils who do not have any disabilities that would hinder them from taking part in vigorous physical activity.

**Achieving:** A 9-11 year old child in Nairobi County who nearly met the recommended minimum guidelines for the variable being measured.

**Beginning:** A 9-11 year old child in Nairobi County who had a very low level of the variable being measured.

**Body Mass Index (BMI):** This is defined as the individual's body weight in kilograms divided by the square of his or her height in meters. This is the formula universally used and the unit of measure is kg/m\(^2\).

**Child:** A male or female individual attending primary school in Nairobi County, Kenya.

**Excelling:** A 9-11 year old child in Nairobi County who was meeting the recommended minimum guidelines for the variable being measured.

**Health-related Physical Fitness:** State of physical and physiological characteristics that defines the risk levels for the premature development of morbid conditions. This presents a relationship with sedentary mode of life of school aged children in Nairobi County.

**Motor skill ability:** proficiency in common gross motor skill including object control and locomotor skill development.

**Obesity:** BMI of school children in Nairobi County above the 95\(^{th}\) percentile for their sex and age (9-11 years) on the WHO 2007 Standards growth chart percentile ranks.
**Overweight:** BMI of between 85\textsuperscript{th} and 95\textsuperscript{th} percentile for sex and age on WHO (World Health Organization) growth chart percentile ranks.

**Physical Activity:** Any bodily movement created by skeletal muscles that results in energy expenditure and is positively associated with physical fitness.

**Physical Literacy:** A construct which captures the essence of what a quality physical education or a quality community activity program aims to achieve. It is the foundation of characteristics, attributes, behaviours, awareness, knowledge and understanding related to healthy active living and the promotion of physical recreation opportunities.

**Progressing:** A 9-11 year old child in Nairobi County who had accumulated some level of proficiency in the variable being measured although they need to improve.

**Sedentary:** Any waking behaviour characterized by an energy expenditure $\leq$1.5 METs (Metabolic Equivalent) while in a sitting or reclining posture.
ABSTRACT

Physical activity (PA) is recognized as an important determinant for chronic lifestyle diseases. According to the World Health Organization (WHO) PA is one of the major underlying causes of Non-Communicable Diseases (NCDs) leading to significant global burden of death, disease and disability among children and adults. There are many factors that influence PA among school children, including physical fitness and motor skill development. Health-related physical fitness includes cardio-respiratory fitness, muscular strength and endurance, flexibility and body composition. Motor skills include elements of locomotor and object-control movements. The aim of the study was to assess health-related physical fitness components and motor skill ability among 9-11 year old school children in Nairobi County, Kenya. A cross-sectional descriptive survey design was used. A total of 199 (106 female and 93 male) school children were tested. The following variables were measured using standardized procedures, children’s height and weight, low back flexibility, muscular strength, static abdominal muscular endurance, aerobic fitness and motor skill ability. These factors are thought to influence the quantity and quality of PA thus justifying their inclusion. The study targeted school children in both public (n=104) and private schools (n=95). Ethical clearance was obtained from the Kenyatta University Ethics Review Board. Research permits were obtained from the Ministry of Education and Nairobi City Council. Consent was sought from the parents of children who took part in the study, the children also provided assent to participate. Data were analyzed using descriptive statistics using SPSS version 17.0. Independent T-tests were used to compare differences in the means of variables. Chi-square tests were used to establish the relationship between categorical variables. BMI cut-offs were based on the recommended 2010 WHO international cut-offs. The results have been presented in tables. A p-value of <0.05 was considered significant. The average age was 9.9 years. Aerobic endurance was significantly associated with sex (p=0.004 [χ² = 13.396]) with boys performing better than girls. Flexibility was significantly associated with sex p<0.0001 (χ² = 25.33), girls were more flexible than boys. Children with good motor skill ability were the more physically fit compared to their counterparts. The prevalence of overweight and obesity was 24.2%. Males showed a better motor performance than females. Regarding motor skills, 28.6% of the children were at the beginning level, 55.3% progressing, only 4% and 3% were achieving and excelling respectively. 38.2% had very low cardiovascular fitness, 31.7% progressing, 11.6% were achieving and 9.5% excelled, 46.2% had low torso muscular endurance while only 2.5% were excelling. Overall, the children had average scores in motor skill ability, aerobic endurance, muscle strength, muscle endurance, and body composition. Their performance in flexibility was above average. Improving children's motor skill ability may be a good target for increasing PA in youth. A longitudinal study exploring the relationship between changes in health-related fitness and motor skill ability should be carried out so as to establish the effect of time on the variables. Also, a similar study targeting rural children and peri-urban kids could also be interesting.
CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Development and refinement of movement skills through a variety of PA is a normal part of growth and functional development (Malina et al., 2004). Fundamental movement patterns develop during preschool ages and with maturation and growth, these movement skills progressively become integrated and coordinated into more difficult PA performances that characterize different free play and games through school years (Strong et al., 2005).

Two variables of interest to this study are motor competence and physical fitness. However, while they are sometimes considered to be determinants of PA, they are also described as PA outcomes. High levels of physical fitness and motor skill ability are sometimes assumed to result from a high PA level (Castelli & Valley, 2007). While motor competence and physical fitness are personal attributes, PA is a behavior and as such is determined by more psychosocial influences than the first two (Rowland, 2005). Studies show strong associations between aerobic fitness and reduced cardiovascular disease risk in children and adolescents (Wedderkopp et al., 2003). The association is less clear with PA. The reciprocity of PA–health related fitness–motor skill ability relationship is not clearly understood and often overlooked. For example, without some level of motor skill ability and physical fitness, children are limited in the amount and range of PA they can undertake (Bouffard et al., 1996).

Motor skill ability is often defined in terms of proficiency in common gross motor skill including object control and locomotor skill development. The relationship between motor skill ability and PA will strengthen over developmental time (Stodden et al., 2008). In
general, children with very poor coordination or motor skills are less active (Bouffard et al., 1996) and less fit (Hands & Larkin, 2006) than typically developing peers. On the other hand, children with high levels of motor competence are more physically active, fitter and less sedentary (Castelli & Valley, 2007).

Physical fitness comprises a number of components (aerobic endurance, muscle strength, muscle endurance, flexibility, and body composition) and there is no clear and consistent association between all measures of fitness and PA. While many studies have found PA strongly related to aerobic fitness (Raudsepp & Jurimae, 1998; Castelli & Valley, 2007), only weak relationships have been observed with other measures of health-related fitness (Pate et al., 1990; Sallis et al., 1993) including body fatness (Parsons et al., 1999). Anecdotal evidence and media reports suggest that a PA transition is emerging in many developing countries (Ang’awa, 2009; Njung’e, 2009; IRIN, 2009). The problem appears to be related to urbanization (Ziraba et al., 2009), reduced lifestyle-embedded PA, and an increase in sedentary behaviour (Duda et al., 2009).

Data on the habitual PA and physical fitness among children particularly among populations in developing countries is on the rise. The PA transition has been identified as a behavioural shift from traditionally active lifestyle to more industrialised and sedentary lifestyle (Muthuri et al., 2014; Onywera et al., 2012). Exacerbating the fight against the PA transition and commensurate rise in childhood obesity is the strong socio-cultural beliefs in many developing countries that obesity, or “roundness,” is something to be revered and a sign of wealth and prestige (Onywera, 2010). The study had the objective of assessing the motor skill ability and health related variables in 9-11 year old children in Nairobi County using a protocol called the Canadian Assessment of Physical Literacy (CAPL).
CAPL is the first comprehensive test battery that can accurately and reliably assess all four core domains of physical literacy. Physical literacy is the capacity of an individual to adopt and maintain a physically active lifestyle. It is conceived to result from a multi-dimensional interaction of factors that facilitate lifelong healthy PA behaviour. As such, it is a constellation of skills, knowledge, and attitudes that when combined together enable a physically active lifestyle, in the same way that reading, writing and other skills are combined for language literacy (CAPL, 2013).

Figure 1.1: The Core Domains of Physical Literacy

SOURCE: Adapted from the CAPL Manual 2012

The four core domains of physical literacy as shown in the Figure above are:

- PA Behaviour (objectively measured daily PA, self-reported sedentary activity).
- Physical fitness (endurance, strength, flexibility, body composition).
- Motor skill (kicking, throwing, skipping, hopping, sliding, running and catching).
- Cognition (knowledge, attitudes/motivation).

This study involved children aged between 9 and 11 years because they do not yet have fully mature gross motor abilities, they are generally prepubertal, and are able to read and follow instructions.
1.2 Statement of the Problem

There is currently paucity of comprehensive, objective, empirical or valid measurement protocol to assess motor skill ability among children in Kenya. This absence limits and diminishes the potential impact of quality physical education in Kenyan schools. With the increase in sedentary lifestyles, the dangers associated with it also increase. Being able to assess the current situation in respect to health-related fitness and motor skill ability will therefore go a long way into mitigating the current situation. Further, no study on the prevalence of health-related physical fitness components and motor skills ability of school children has been done in Kenya to date; this study might help to fill these gaps. The CAPL protocol was adopted from Canada and adopted to the Kenyan context.

1.3 Purpose of the Study

The study aimed to assess health-related physical fitness components and motor skills ability among 9-11 year-old school children in Nairobi County, Kenya.

1.4 Objectives

This study was guided by the following objectives:

i) To assess the ability to perform selected motor skills required in active play in relation to technique and speed among 9-11 year-old school children in Nairobi County, Kenya.

ii) To determine levels of selected health-related physical fitness components, including aerobic endurance, muscle strength, muscular endurance, flexibility and body composition of 9-11 year-old school children in Nairobi County, Kenya.
iii) To compare motor skill abilities and health-related fitness between boys and girls in Nairobi County, Kenya.

1.5 Research Questions

The following were the proposed research questions:

i) What are the children’s abilities to perform selected motor skills required in active play in relation to technique and speed among 9-11 year-old school children in Nairobi County, Kenya?

ii) What are the levels of the selected health-related physical fitness components (aerobic endurance, muscle strength, muscle endurance, flexibility, and body composition) of 9-11 year-old school children in Nairobi County, Kenya?

iii) How do motor skill abilities and health-related fitness components differ between boys and girls?

1.6 Significance of the Study

This study may contribute to the understanding of the current motor skill ability and health-related physical fitness of school children in Nairobi County, Kenya. The findings from the study might also act as a guide to physical education curriculum developers (influence policy and practice) for designing a curriculum that incorporates PA in the curriculum which would help improve (or preserve) the fitness and motor skills of the children. This study will also contribute to the general body of knowledge in PA.
1.7 Delimitations of the Study
The study was delimited to able bodied pupils aged between 9 and 11 years who provided assent and consent to participate and attended either public or private primary schools in Nairobi County, Kenya.

1.8 Limitations of the Study
The study was limited by the fact that there exists paucity of information and local studies therefore research instruments from developed countries were used to strengthen the study. The researcher attempted as much as possible to adapt the research instruments to the local setting. This study did not assess or have control over the participants’ past experience, genetic predisposition, maturity level and environment. These are likely to affect the variables under study. Absenteeism and the inability of some children to complete some tests led to missing scores, this was beyond the control of the researcher.

1.9 Assumptions of the Study
This study was carried out based on the assumption that the participants did their best during the testing and that the testers were unbiased in their measurement procedures.

1.10 Conceptual Framework
Seefeldt (1980) indicated that there might be a “critical threshold” of motor skill competence, above which children will be active and successfully apply motor competence to lifetime PA, but below which they would be less successful and ultimately drop out at higher rates. Further, it suggested that young children’s PA might drive the development of their motor skill ability (Stodden et al., 2008). Increased PA provides more opportunities
to promote neuro-motor developments, which in turn, promotes motor skill development (Fisher et al., 2005).

Overall, young children demonstrate various levels of motor skill competence primarily because of differences in experience (Stodden et al., 2008). These differences are the result of many factors including the environment, the presence of structured physical education, social economic status, parental influence, climate and genetics (Vanhees et al., 2005). It is hypothesized that a positive spiral of engagement will take place among moderately and highly skilled children. Children with higher perceived and actual motor skill ability will more likely persist in PA, especially those they perceive as fun and intrinsically rewarding (Fisher et al., 2005). Health-related fitness might also play a mediating role in the relationship between PA and motor skill ability. Acquisition of motor skill ability in early childhood serves to promote physical fitness because time spent initially developing these skills promotes increased PA and neuromuscular development.

Children who are more physically fit later in childhood will be more likely to maintain PA for longer periods of time and continue to improve their motor skill competencies. In effect, the relationship between motor skill ability and physical fitness becomes more reciprocal during childhood and adolescence. Children who do not have adequate levels of motor skill ability will be less likely to continue to be physically active into middle and later childhood, thus, will be less likely develop or maintain aspects of health-related fitness.

Over time, there could be a positive spiral of engagement with increased motor skill ability, PA, and higher levels of health-related physical fitness promoting a healthy weight status. Concurrently, there may be a negative spiral of disengagement in PA with low motor skill
ability, and low levels of health-related physical fitness leading to increased risk of obesity.

This will then feed back into the model as summarized in the figure below.

Figure 1.2: Model of Relationships Among PA, Motor Skills, Health-related Fitness (HRF) and Healthy Body Weight.

**SOURCE:** Adapted from Stodden et al. (2008).

**CHAPTER TWO: LITERATURE REVIEW**

2.1 Physical Activity and Health

Childhood obesity and physical inactivity continue to be serious public health concerns across the globe. These problems are increasingly affecting both developing and developed countries, albeit at different rates. In most African countries, Kenya included, the problem seems to be aggravated by the rapid nutrition and PA transition currently taking place (Onywera et al., 2010). This transition is mainly caused by an increase in the use of energy-
saving devices, participation in insufficient amounts of PA at home and at the school environment, and increased availability and consumption of cheap high calorie, nutrient-poor foods (Onywera et al., 2010).

On a global scale, of the 57 million deaths in 2008, 36 million, or 63%, were due to non-communicable diseases (NCDs), principally cardiovascular diseases, diabetes, cancers and chronic respiratory diseases. As the impact of NCDs increases, and as the population ages, annual NCD deaths are projected to continue to rise worldwide. The greatest increase is expected to be seen in low and middle-income regions (WHO, 2010). While popular belief presumes that NCDs afflict mostly high-income populations, the evidence tells a very different story. Nearly 80% of NCD deaths occur in low and middle-income countries and NCDs are the most frequent causes of death in most countries, except in Africa. Even in African nations, NCDs are rising rapidly and are projected to exceed communicable, maternal, perinatal, and nutritional diseases as the most common causes of death by 2030 (WHO, 2010).

Mortality and morbidity data reveal the growing and disproportionate impact of the NCD epidemic in lower resource settings. Over 80% of cardiovascular and diabetes deaths, and almost 90% of deaths from chronic obstructive pulmonary disease, occur in low- and middle-income countries. More than two thirds of all cancer deaths occur in low- and middle-income countries. NCDs also kill at a younger age in low- and middle-income countries, where 29% of NCD deaths occur among people under the age of 60, compared to 13% in high-income countries. The estimated percentage increase in cancer incidence by 2030 will be greater in low- (82%) and lower-middle-income countries (70%) compared
with the upper-middle- (58%) and high-income countries (40%) (WHO, 2010). A large percentage of NCDs are preventable through an increase in PA and a healthy diet (WHO, 2010).

The epidemiological evidence of the positive effects of PA on health has been widely reported and confirmed in recent global reviews (Bull et al., 2004). PA is an essential component of any strategy that aims to seriously address the problems of sedentary living and obesity among children and adults. Active living contributes to individual’s physical and mental health and in addition it also improves social cohesion and community well-being. Opportunities for being physically active are not limited to sports and organized recreation. They exist everywhere – where people live and work, in neighborhoods and in educational and health establishments (WHO, 2006a).

Accumulating evidence suggests that childhood PA could reduce the prevalence of cardiovascular disease risk factors in children and retard the development of atherosclerosis later in life (Kavey et al., 2003). However, children also gain other immediate benefits from adequate levels of PA, for example enhanced bone health (MacKelvie et al., 2003), accelerated development of motor skills (Shephard & Lavallée, 1994) and increased self-esteem (Ekelan et al., 2004).

The harmful effects of physical inactivity and obesity on the health of children and youth are well-known. It must be a foremost responsibility to act to preserve healthy active living behaviours for their well-being, particularly the right to enjoy regular PA for the maintenance of a healthy body weight (Tremblay et al., 2010). An important function of PA is to help regulate energy balance. Weight gain takes place when energy intake (calories
consumed) exceeds the total daily amount of energy expended for a prolonged period (Maziak et al., 2008). The current adult trends of physical inactivity will likely worsen as children adopt lifestyles conducive to chronic diseases.

2.2 Importance of Promoting Physical Activity in Schools

From preschool to university, children and young people spend many hours in a school setting. This is also where they are likely to learn and develop many of the attitudes, values and skills related to active living that will last a lifetime. There is strong evidence that school-based P.E. is effective in increasing levels of PA and fitness (Kahn et al., 2002). Unfortunately, physical education has been given reduced priority and curriculum time in the past decade (Hardman & Marshall, 2005), and students (especially girls) in intermediate schools have been shown to be less active during school breaks (Limstrand, 2003).

Many students are now driven or dropped by busses to school instead of commuting on foot or on a bicycle. In some cities, schools are now closed after class hours for alleged safety and fiscal reasons. This means that children, youth and other community members do not have access to an important neighbourhood facility for PA, sport clubs and active recreation. Overall, these trends could lead to a significant reduction in school-related PA. Active commuting to and from school is important for increasing active living and burning excess calories because it happens at least twice a day on all school going days. Providing active and safe routes to school has been particularly effective in many countries (WHO, 2006b). It has also been noted that the school setting represents an ideal location for studies
on childhood lifestyle given the large amount of time children spend in school (Fox et al., 2004).

In summary, the benefits of PA have been shown to be effective across the lifespan, among the young and old alike. PA has been shown to improve educational attainment in children as well as prevent obesity (CDC, 2010).

2.3 Motor skills and Participation in Sports Among Children

Right from birth, children learn to control their body movements and interact with the world around them. This learning process is called motor skill development. Motor skills can be divided into three types; locomotor skills which include running, hopping and jumping; object control skills which include throwing, catching and kicking; and finally stability and balance.

PA is important for motor skill development, especially for improving locomotor skills. Research has found that children that spend the most time in moderate to vigorous PA tend to have the best motor skills while children who are least active have the worst motor skills (Brian et al., 2006). This may be because physically active children spend more time learning and improving new motor skills. Children with better motor skills may also find PA easier and more fun. Children with better motor abilities may find it easier to be physically active and may be more likely to engage in PA compared with peers with poor motor competence (Brian et al., 2006).

Children with the poorest motor skills may be the most sedentary. Conversely, children who are the most coordinated may be the most physically active (Fisher et al., 2005). Some
studies have also shown that children who are overweight are more likely to be less physically competent than leaner children (Taylor et al., 2002). Although motor skill has been consistently related to both PA and body weight, there are important limitations to these studies. Much of this research has relied on self-report rather than objective measures of PA and has not considered the effects of children’s self-perception and self-adequacy for PA (Brian et al., 2006).

Previous studies have also shown that motor skill ability is related to better performance in various cognitive abilities, including inhibitory control, working memory, attention, and academic performance (Haapala et al., 2014).

2.4 The Importance of Improving Health-Related Fitness Components Among Children

Physical fitness can also be thought of as an integrated measure of most, if not all, the body functions involved in the performance of daily PA and/or physical exercise (Ortega et al., 2008). Health related physical fitness includes cardio respiratory endurance, muscular strength and endurance, body composition and flexibility (Howley, 2001). These characteristics are often referred to as health-related components (Powell et al., 1998), and are associated with disease prevention and health promotion.

Childhood and adolescence are important stages of life, since remarkable physiological and psychological changes take place at these ages. Furthermore, lifestyles and healthy/unhealthy behaviors are formed during these years, which may influence adult behavior and health status. Low physical fitness in children has been associated with impaired health indicators such as increased body fatness (Dencker et al., 2006) and high
abdominal adiposity (Ortega et al., 2007; Brunet et al., 2007), several cardiovascular disease risk factors (Buchheit et al., 2007; Thomas et al., 2003), hypertension (Katzmarzyk et al., 2001; Ruiz et al., 2006) and low PA (Dencker et al., 2006). Therefore, it is important to promote high levels of fitness in children and youth.

A number of studies have drawn attention to increases in fatness (Olds and Harten, 2001) and declines in aerobic fitness (Tomkinson et al., 2003) in school children. The implications of decreasing fitness levels in children are considerable. Children are losing the metabolic effects of fitness that might protect them from excessive weight gain as well as other metabolic ill health risk factors (Stratton et al., 2007). The risks of poor fitness and obesity are cumulative and may be carried from childhood to adulthood (Eriksson et al., 2003). This situation is extremely worrying for future public health. Given that fitness is an important component of metabolic health (Eisenmann et al., 2005) and a strong independent predictor of premature death (Blair et al., 1996), examining the fitness levels of children could be useful for stimulating interventions to improve fitness among the children. Physical fitness is not just a help to sport and physical education, it is also a major factor in leading a happier and fuller life (Rudolf et al., 2001; Grund et al., 2001). For the individual child, being fit can help to develop a positive attitude enabling the child to achieve a self-awareness of their physical state and thus become more motivated to maintain or improve their fitness (Wright et al., 2007).

2.5 Summary of Literature Review

From the literature reviewed it is clear that childhood obesity continues to be a serious public health concern across the globe. Nutritional and PA transitions are largely to blame. The transitions are as a result of the increased use of energy saving devices, increased
inactivity and increased availability of cheap high calorie nutrient poor foods. A large percentage of NCDs are preventable through increase in PA and a healthy diet (WHO, 2010).

There is evidence that school-based physical education (P.E.) is effective in increasing levels of PA and fitness. Unfortunately, P.E. has been given reduced priority and curriculum time in the past decade in some countries. This has led to a reduction in school-related PA.

PA is important for motor development. Research has found that children who spend the most time in moderate to vigorous PA tend to have the highest motor skills. Children who are more physically fit earlier in childhood will be more likely to maintain PA for longer periods of time. It is therefore important to encourage children to play and increase their health related fitness which will reduce the risk of developing NCD’s.

Several researchers (Epstein et al., 1984; Strong et al., 2005) have theorized that chronic disease prevention begins in childhood. Osteoporosis, diabetes and coronary heart disease are the most salient examples of diseases that may be preventable if individuals are sufficiently active during their youth. Relationships between being active when young, and reduced risk of developing breast cancer are also emerging (Lagerros et al., 2004).

A systematic review carried out by Muthuri et al. (2014) showed improvements in fitness parameters in sub Saharan African school-aged children over time, which may be as a result of an increase in the proportion of children participating in formal/organized sports or activities in schools. The listed activities have enabled these children to improve certain physical fitness skills that may not be learned through informal activities, random play, and
self-directed activities engaged in more by the rural living and lower socio-economic status children. Children in sub Saharan Africa performed better in aerobic fitness measures but worse in anaerobic fitness tests or measures of musculoskeletal fitness and strength as compared to Western reference groups (Aandstad et al., 2006; Benefice, 1998). It would be interesting to compare the performance of Kenyan children with their other counterparts in Africa and across the globe.

While obesity is the most visible sign of inactivity, PA is inversely related to many other chronic diseases and conditions that have their origins in the first two decades of the human life. There is little doubt that regular engagement in PA improves the quality of life (Kolt et al., 2006). The search through the available literature showed that there was no study done in Kenya that provides clear evidence of the association between health-related fitness components and motor skill ability among Kenyan school going children.

A few studies have been conducted in Africa in respect to motor skill and health-related fitness with the example of the study by Monyeki et al. (2007), which was conducted in South Africa. The study conducted by Christensen et al. (2008), focused on the Obesity in Kenya populations. However, there is no record of studies on health-related physical fitness and motor skill ability that have been conducted on the Kenyan school children.

From the review of literature as well as related studies that have been conducted on the area of health-related fitness and motor skill ability, there are distinct gaps that this study elicited and attempted to fill.
CHAPTER THREE: METHODOLOGY

3.1 Research Design

The study used a cross-sectional descriptive design. Data collected were mainly quantitative in nature. Quantitative research approaches are used in gathering facts which can be captured in a numerical format (Williams, 2007). The survey design was appropriate to describe motor skill abilities and the health-related fitness components of primary school
children in Nairobi County. A cross sectional study design was suitable for exploring associations among variables of interest while also being economical and easy to manage within a limited time frame (Polit, Beck & Hungler, 2001).

3.2 Research Variables
The independent variables of the study included age and gender while the dependant variables were motor skill abilities of the school children and the health-related fitness components namely, the level of cardio respiratory endurance, muscle strength and endurance, flexibility and body composition.

3.3 Location of the Study
The study location was primary schools (both public and private) in Nairobi County, Kenya. Nairobi County was selected as the location of the study due to the representativeness of urban population. Nairobi County is the most cosmopolitan County in Kenya (United Nations University, 2011).

3.4 Target Population
The study population included school children in Nairobi County sampled from public and private schools. The target population was estimated to be about 160,879 children. According to the nationwide census carried out in 2009, there are 78,788 boys and 82,091 girls in Nairobi County aged between 9 and 11 years (KNBS, 2010).

3.4.1 Inclusion Criteria – the study included able bodied children aged 9 to 11 years of both sexes from selected schools and only those whose parent/guardian gave consent.
3.4.2 Exclusion Criteria – the study did not include children who were not medically fit to take part in vigorous PA. This was assessed using two questions in the consent form to be completed by the parent/guardian which are as follows:

1. Does your child have a diagnosed medical condition that prevents them from participating in intense exercise?
2. Has a doctor ever told you that it would be unsafe for your child to do intense exercise?

A yes to either question screened out participants from the physical fitness testing procedures.

3.5 Sampling Techniques

The sampling entailed a list of all private and public day schools in the eight sub counties in Nairobi County. A convenience sampling protocol was used while trying to ensure stratification by type of school (public versus private) and socio-economic status (estimated by financial requirement by the school) and location by constituencies in Nairobi. Permission was obtained from school administrators. Only schools that agreed to take part were recruited for the study. The study worked with class four and five pupils (depending on the school). Only those who returned a fully completed consent form and assent to participate were recruited for data collection. Eight schools were selected, each school had approximately twenty five participants.

3.6 Sample Size

The sample size was 199 students. The sample size was calculated using the Fisher formula as explained in Mugenda and Mugenda (1999) as follows:

\[ n = \frac{z^2pq}{d^2} \]
20

Where \( n = \) the desired sample size (if the target population is greater than 10,000)

\[ z = \text{the standard normal deviate at the required confidence level.} \]

\[ p = \text{the proportion in the population estimated to have characteristics being measured.} \]

\[ q = 1 - p. \text{ (p and q are the set population proportions).} \]

\[ d = \text{the level of statistical significance set.} \]

\[
    n = \frac{1.96^2 \times 0.85 \times 0.15 \times 1}{0.05^2} = 195.92
\]

The actual sample size used in the study was 199 respondents.

3.7 Data Collection Instruments

Motor skill

Motor skill was assessed by skill performance and time to complete an obstacle course adapted from the CAPL manual. The validated obstacle course was used to assess the motor skills of the students. The objective of this testing was to assess motor skills required to participate in physically active peer play in a format that simulates the movement and skill variation that typically occurs.

Details on how to prepare, administer and score the test are provided in Appendix A.

Physical fitness

The domain of physical fitness was evaluated through 7 activities adapted from the CAPL manual that assessed cardio-respiratory endurance, muscle strength, muscle endurance, flexibility and body composition. These included the following;
a) Shuttle run endurance test assessed cardiovascular endurance of the participants, a
detailed description on how to prepare, administer and score the test is outlined in
Appendix B.
b) Assessment of height test measured standing height of the participants. A detailed
description of how to prepare for the test, administer, score and set up for it is outlined
in Appendix C.
c) Assessment of weight test measured body mass. A description of how to prepare for the
test, administer, measure and set up is outlined in Appendix D.
d) Assessment of grip strength measured static grip strength. A description of preparation,
administration, measurement and set up for it is outlined in Appendix E.
e) Plank assessment of torso strength test assessed abdominal and core muscle strength. A
description of how to prepare for the test, administer, measure and set up for it is outlined
in Appendix F.
f) Sit and reach assessment of flexibility test measured trunk and hamstring flexibility. A
description of how to prepare for the test, administer, measure and set up for it is outlined
in Appendix G.

3.7.1 Data Organization and Scoring

3.7.1.1 Body Mass Index (BMI)

BMI was calculated from weight (kg) and height (cm) measurements to determine whether
an individual's weight is appropriate for their height. WHO growth reference charts consist
of a series of percentile curves illustrating the distribution of measurements (WHO, 2010)
and guidelines for BMI, age and sex (Appendix O & P for girls & boys respectively) were
used to interpret the BMI results with the percentiles listed in Table 3.1 used as cutoff points.

### Table 3.1 WHO BMI Cutoffs

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>BMI Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th percentile and below</td>
<td>Underweight</td>
</tr>
<tr>
<td>5th percentile up to and including the 85th percentile</td>
<td>Normal weight</td>
</tr>
<tr>
<td>85th percentile up to and including the 95th percentile</td>
<td>Overweight</td>
</tr>
<tr>
<td>Above the 95th percentile</td>
<td>Obese</td>
</tr>
</tbody>
</table>

Source: (WHO, 2008)

### 3.7.1.2 Motor Skill and Physical Fitness Domain

Motor skill and fitness measures were ranked among 1 of 4 categories: Beginning, Progressing, Achieving and Excelling. The Achieving category identifies participants who have achieved a score associated with sufficient level of mastery of the given domain. Excelling scores demonstrate a high level of mastery of the given domain. Beginning and progressing scores are participants who have not yet achieved an acceptable level of mastery.

### 3.7.1.3 Motor Skill Ability

Motor skill ability was assessed through performance of an obstacle course. Both the time to complete the course and a criterion-referenced assessment of skill performance (0-14) are assessed. The time and the skill score were assigned equal weighting, as it considered that the more physically literate individual will be able to find the balance between speed
and accuracy. Therefore both skill and time are equally important measures of successful completion of the obstacle course. The overall obstacle course is scored in the same way for every participant, regardless of how old they are. However, the interpretation and category that the participant’s score is subsequently aligned is dependent on the participant’s age, recognizing that older participants are expected to perform better than younger participants so will usually achieve higher scores.

3.7.1.4 Obstacle Course Skill Score

The point distribution between skills performed is as follows:

1. 2-foot Jump (0-2)
2. Sliding (0-3)
3. Catching (0-1)
4. Throwing (0-2)
5. Skipping (0-2)
6. 1-foot Hop (0-2)
7. Kicking (0-2)

The skill score is simply the total number of skills that were correctly performed, so the skill score will range from 0-14.

3.7.1.5 Obstacle Course Time Score

Table 3.2 Obstacle Course Time Score

| Time (sec) | <14 | 14<15 | 15<16 | 16<17 | 17<18 | 18<19 | 19<20 | 20<21 | 21<22 | 22<24 | 24<26 | 26<28 | 28<30 | ≥ 30 |
|-----------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Score out of 14 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

Source: (CAPL, 2013)
Using previously collected CAPL data, time norms for the obstacle course were created and broken down into 14 categories, each of which are assigned a numerical value. Faster times are assigned a higher value as shown in Table 3.2 above.

The scoring tables of the motor skill ability, aerobic endurance, flexibility, muscle strength and muscular endurance are as shown in tables 3.3-3.6 in appendix Q.

3.8 Pre-test
A pre-test was carried out in one primary school in the target region to ensure that data collection tools and procedures worked well in preparation for the actual study.

3.9 Reliability and Validity
Reliability refers to the likelihood that a data measure or survey instrument to provide the same result when it is used by a different researcher or in a different test. Validity refers to an assessment of whether the data collected are accurate relative to some objective standard or measure (Kimberlin & Winterstein, 2008). The body composition assessment tools (measuring height, weight and waist circumference) have been used in other studies and shown to be valid and reliable (Ellen et al., 2006; Kamau, 2008). The tests of health-related fitness components (pacer 20m test, sit and reach, hand grip and plank assessment) have also been used by Boyer et al. (2013). Esteban-Cornejo et al., 2014 also used similar tests. The CAPL (2012) has also shown that the obstacle course is a reliable and valid instrument of measuring motor skill ability.

3.10 Data Collection Procedure
Data collection took place during the 2012 school year. Parent/Guardian informed consent forms (Appendix I) were issued to the children to take to their parent/guardian for consent
while the child signed their own assent form (Appendix H). The children who provided assent and consent were recruited into the study.

Testing took place at the school compound for approximately 25 children per school. A total of seven schools were used in the study. The participants began at the anthropometrics station where weight and height measurements were taken.

Upon completion of anthropometrics, participants were gathered by the researcher and with the help of the assistants, were given instructions about the pacer 20m test, sit and reach assessment of flexibility test, assessment of grip strength test, plank assessment of torso strength and obstacle course test. Demonstrations were done and the participants were then assessed and the information was recorded. Detailed procedures of each measurement are presented in the appendices.

### 3.11 Data Analysis and Presentation

Data were cleaned, coded and entered using excel and imported to SPSS version 17 for analysis. Descriptive statistics included percentages, means and standard deviations for selected motor skills required in the obstacle course and the selected health related physical fitness components (endurance, strength, flexibility and body composition). Body Mass Index (BMI) cut-offs were based on the recommended 2010 WHO international cut-offs (WHO, 2010). Chi square tests were used to assess relationships between groups for instance between boys, girls and BMI groups. A p-value of <0.05 was considered significant. Independent T-tests were used to compare differences in the means of variables. Results were presented in tables and figures.
3.12 Logistical and Ethical Considerations

Clearance to conduct the study was obtained from the Graduate School, Kenyatta University (Appendix K). Research authorization permits were obtained from the National Council for Science and Technology and the Nairobi City Council Department of Education (Appendix M and N respectively). Ethical approval was also obtained from the Kenyatta University Ethics Committee prior to data collection (Appendix L). The parents gave their consent by signing the consent form while the child assented by signing the assent form (Appendix I and H respectively). The participants and parents were assured of confidentiality and that only anonymized data would be used for research and reporting purposes.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the findings of the study. The analyzed data are presented in tables and figures and statistical significance is identified where appropriate. This section shows the results obtained from the performance of motor skill ability obstacle course test, plank test, sit and reach test, grip strength test, pacer 20m test and body composition in relation to sex and age. The Chi-Square test was used to measure sex differences between the variables. Independent T-tests were used to compare differences in the means of variables. The study set out to assess the health related physical fitness and motor skill ability of 9-11 year-old school children in Nairobi county, Kenya.
4.2 Characteristics of Participants

4.2.1 Demographic Information

The study obtained basic information about the school children’s age and sex for descriptive purposes. A total of 199 respondents were involved in the study. As shown in Figure 4.1, there were 67 (33.7%) nine year-old children, 99 (49.7%) were ten years old, 27 (13.6%) were eleven years old and 6 (3%) were twelve years old. The mean age was 9.9 years. There were more females than males in the study as shown in Table 4.1 below.

Table 4.1 Sex of Participants

<table>
<thead>
<tr>
<th>Sex of participants</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>93</td>
<td>46.7%</td>
<td>46.7%</td>
</tr>
<tr>
<td>Female</td>
<td>106</td>
<td>53.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

4.2.2 Descriptive Information

Table 4.2 below presents the average scores for the various study variables. Girls had a higher mean BMI score (51.56), a higher low back flexibility and Motor skill ability (23.32) means score compared to boys. However, boys had higher mean hand grip strength (17.16), muscular endurance (42.11) and number of laps complete (25.36) for the pacer aerobics endurance test compared to girls.

Table 4.2 Average Scores of Study Variables

<table>
<thead>
<tr>
<th>Gender</th>
<th>BMI Percentile</th>
<th>Low back flexibility (sit and reach test)</th>
<th>Muscle strength (Hand grip test)</th>
<th>Motor skill ability (Ave. age 9)</th>
<th>Muscle Endurance (Plank test)</th>
<th>Aerobic endurance (Pacer test laps completed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>47.36</td>
<td>35.1</td>
<td>17.16</td>
<td>22.06</td>
<td>42.11</td>
<td>25.36</td>
</tr>
<tr>
<td>Girls</td>
<td>51.56</td>
<td>39.2</td>
<td>15.08</td>
<td>23.32</td>
<td>37.18</td>
<td>16.33</td>
</tr>
</tbody>
</table>
4.3 Motor Skills

The results of the motor skill ability testing are shown below.

**Beginning:** This level shows that the child’s motor skill is very low. Fifty seven (31.5%) children had very low motor skills according to the results.

**Progressing:** Children in this level have accumulated some levels of motor skill but they need to increase their motor skill. 110 (60.8%) children were in this category.

**Achieving:** Children in this level are nearly meeting the recommended minimum guidelines for motor skill. Only 8 (4.4%) children were in this category.

**Excelling:** Children in this level are exceeding the recommended motor skill levels. However, there is always more to do. The recommended guidelines simply state the minimum amount of motor skill that is good for a child’s health. Only 6 (3.3%) children were in this category. The table below summarizes the results.

**Table 4.2 Summary of Motor Skill Ability Participants**

<table>
<thead>
<tr>
<th>Average</th>
<th>49.46</th>
<th>37.15</th>
<th>16.12</th>
<th>22.69</th>
<th>39.65</th>
<th>20.85</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>Motor Skill Ability Level</th>
<th>Gender</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
</tr>
<tr>
<td>Beginning</td>
<td>27</td>
<td>30</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>32.1%</td>
<td>30.9%</td>
<td>31.5%</td>
</tr>
<tr>
<td>Progressing</td>
<td>51</td>
<td>59</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>60.7%</td>
<td>60.8%</td>
<td>60.8%</td>
</tr>
<tr>
<td>Achieving</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>4.7%</td>
<td>4.1%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Excelling</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2.3%</td>
<td>4.1%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Total</td>
<td>84</td>
<td>97</td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

### 4.3.1 Association Between Motor Skill Ability and Sex of Participants

Sex was not significantly associated with motor skill ability of the children with the level of significance of 0.924, \( \chi^2 = 0.475 \) for CAPL categories. However when t-tests were run on the absolute data there was a significant association between sex and motor skill ability with a level of significance of 0.048, showing boys performed better than girls in motor skill ability.

### 4.4 Health-related Physical Fitness

Aerobic endurance, Muscle strength, Muscular endurance, Flexibility and Body composition were measured and results show below.

#### 4.4.1 Aerobic Endurance

Aerobic endurance (cardiovascular fitness) was measured using the shuttle run test. The best performing child completed 75 laps while the least fit child finished after only 4 laps.

**Interpretation of Child’s Score:**
Beginning: Children in this level had very low cardiovascular fitness. There were 76 (41.9%) children who were in this level.

Progressing: Children in this level had accumulated some levels of cardiovascular fitness but they needed to increase their endurance. Here there were 63 (34.8%) children.

Achieving: Children in this level were nearly meeting the recommended minimum guidelines for cardiovascular fitness. 23 (12.7%) children were in this category.

Excelling: Children in this level were meeting the recommended cardiovascular fitness levels. However, there is always more to do. The recommended guidelines simply state the minimum amount of aerobic endurance good for a child’s health. Only 19 (10.5%) children were excelling in terms of cardiovascular fitness as shown below.

Table 4.3 Summary of Aerobic Endurance of Participants

<table>
<thead>
<tr>
<th>Pacer 20 scores of Participants Level</th>
<th>Gender of participants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Beginning</td>
<td>25</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>29.7%</td>
<td>52.6%</td>
</tr>
<tr>
<td>Progressing</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>36.9%</td>
<td>32.9%</td>
</tr>
<tr>
<td>Achieving</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>16.7%</td>
<td>9.3%</td>
</tr>
<tr>
<td>Excelling</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>16.7%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Total</td>
<td>84</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

4.4.1.1 Association Between Aerobic Endurance of Participants and Sex

Aerobic endurance was significantly associated with the sex of the children when CAPL categories were used. Boys performed better than girls in this test. The level of significance
was $0.004 (\chi^2 = 13.396)$. The same was also realized when T-tests were run on the absolute data. The level of significance in the absolute data was $P<0.001$.

4.4.2 Muscle Strength

**Interpretation of Child’s Grip Strength Score:**

**Beginning:** Children in this level 68 (36.7%) had very low grip strength.

**Progressing:** Seventy six children (41.1%) had accumulated some levels of grip strength however they needed to increase their upper body strength.

**Achieving:** Children in this level nearly met the recommended minimum guidelines for grip strength. There were 33 (17.8%) children in this category.

**Excelling:** The children in this level were meeting the recommended grip strength levels. However, there is always more to do. Only 8 (4.3%) children excelled. The summary on the grip strength is shown below

**Table 4.4 Summary of Participants’ Grip Score.**

<table>
<thead>
<tr>
<th>Grip score of participants Level</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Beginning</td>
<td>29</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>34.9%</td>
<td>38.2%</td>
</tr>
<tr>
<td>Progressing</td>
<td>32</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>38.6%</td>
<td>43.1%</td>
</tr>
<tr>
<td>Achieving</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>24.1%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Excelling</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2.4%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Total</td>
<td>83</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

4.4.2.1 Association Between Grip Score and Sex of Participants

The participants’ performance in the grip test was not significantly associated with the sex of the child, for both CAPL categories and absolute data.
4.4.3 Muscular Endurance

Muscle endurance, specifically abdominal muscle strength was measured using the Plank test – a core strength exercise commonly used in sport training: holding a Push Up position while resting on toes and forearms for as long as one can.

Interpretation of Child’s Score:

**Beginning:** Children in this category have very low abdominal-muscular endurance, 92 (49.5%) children were in this category.

**Progressing:** Children in this level had accumulated some levels of abdominal-muscular endurance but they needed to increase their plank hold time. 75 (40.3%) children were in this category.

**Achieving:** These children are nearly meeting the recommended minimum guidelines for torso muscular endurance. Fourteen (7.5%) of the children were in this category.

**Excelling:** These children are meeting the recommended torso muscular endurance levels. However, there is always more to do. Only 5 (2.7%) children excelled. A summary of the results is shown below.

Table 4.5 Summary of Participants’ Muscle Endurance
4.4.3.1 Association Between Plank Score and Sex of Participants

The participants’ performance in the plank test was not significantly associated with the sex of the participants, the level of significance was 0.498 ($\chi^2 = 2.376$) in the CAPL category. However when T-tests were run on the absolute data, the level of significance in the absolute data was 0.043, boys performing better than girls.

4.4.4 Flexibility

**Interpretation of Child’s Flexibility Score:**

**Beginning:** Children in this category have very low flexibility. Twenty three children (12.3%) were in this level.

**Progressing:** Children in this level had accumulated some levels of flexibility; they need to increase their flexibility 45 (24.1%) children were in this category.

**Achieving:** Children in this level were nearly meeting the recommended minimum guidelines for flexibility. Seventy one (37.9%) children were in this category.
**Excelling:** Children in this level were meeting the recommended flexibility levels. However, there is always more to do. Forty eight (25.7%) children excelled. The summary is shown below

**Table 4.6 Summary of Participants’ Sit and Reach Scores**

<table>
<thead>
<tr>
<th>Sit and reach score of the participants</th>
<th>Gender</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beginning</td>
<td>14</td>
<td>9</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>16.5%</td>
<td>8.8%</td>
<td></td>
<td>12.3%</td>
</tr>
<tr>
<td>Progressing</td>
<td>33</td>
<td>12</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>38.8%</td>
<td>11.7%</td>
<td></td>
<td>24.1%</td>
</tr>
<tr>
<td>Achieving</td>
<td>24</td>
<td>47</td>
<td></td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>28.2%</td>
<td>46.2%</td>
<td></td>
<td>37.9%</td>
</tr>
<tr>
<td>Excelling</td>
<td>14</td>
<td>34</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>16.5%</td>
<td>33.3%</td>
<td></td>
<td>25.7%</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>102</td>
<td></td>
<td>187</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**4.4.4.1 Association Between Sit and Reach Score and Sex of Participants**

The sit and reach score was significantly associated with the sex of the participants. Girls performed better than boys as the results below indicate. The level of significance was $p<0.0001$ ($\chi^2 = 25.33$). The same was also realized when T-tests were run on the absolute data. The level of significance in the absolute data was $P<0.001$.

**4.4.5 Body Composition**

Nine (4.5%) of the children were underweight. Majority of the children 141(71.2%) had normal weight. Twenty five (12.6%) children were overweight and 23 (11.6%) children were obese. The summary is shown below.

**Table 4.7 Summary of Participants’ BMI Status**
4.4.6 Association Between BMI Status and the Sex of Participants

The sex of the participants was not significantly associated with the BMI category of the children the level of significance being 0.202 ($\chi^2 = 4.619$) in the CAPL category. However when the T-tests were run on the absolute data, the level of significance in the absolute data was 0.048, with girls having a higher BMI.

4.4.7 Association Between BMI Status and Motor Skill and Fitness Scores of Participants

The BMI status of the participants was not significantly associated with motor skill ability, grip strength, plank score (muscle endurance) or the sit and reach test (flexibility) scores of participants with all of the p values exceeding 0.05 but was significantly associated with aerobic endurance (Pacer 20 m), participants with a high had lower aerobic endurance, with $\chi^2 = 18.042$ with a p value of 0.035. It was worth noting that the number of participants who are overweight or obese and with achieving or excelling level in motor skill ability is very small.

Table 4.8 Summary of Relationship Between Motor Skill Ability and BMI Status
### Motor skill ability and BMI status

<table>
<thead>
<tr>
<th>Motor skill ability</th>
<th>Underweight</th>
<th>Normal Weight</th>
<th>Overweight</th>
<th>Obese</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>3</td>
<td>43</td>
<td>6</td>
<td>5</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>5.3%</td>
<td>75.4%</td>
<td>10.5%</td>
<td>8.8%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Progressing</td>
<td>5</td>
<td>80</td>
<td>14</td>
<td>11</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>4.5%</td>
<td>72.7%</td>
<td>12.7%</td>
<td>10.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Achieving</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>.0%</td>
<td>37.5%</td>
<td>25.0%</td>
<td>37.5%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Excelling</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>.0%</td>
<td>83.3%</td>
<td>.0%</td>
<td>16.7%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>131</td>
<td>22</td>
<td>20</td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>4.4%</td>
<td>72.4%</td>
<td>12.2%</td>
<td>11.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

#### 4.4.8 Association Between Age of the Participants and Motor Skill, Fitness and BMI Scores of Participants

The age of the participants was not significantly associated with aerobic endurance (pacer 20), plank score (muscle endurance) or the sit and reach test (flexibility) scores of participants. However there was a significant association between the age of the participants with motor skill ability and grip strength, the older ones being stronger, with \( \chi^2 = 40.45 \); p-value of 0.001 for motor skill ability and \( \chi^2 = 140.93 \); with a p-value of 0.018 for grip strength. Though not significant, the table below tends to show that a good number of participants who had a low level of motor skill ability also most likely had a low fitness status (plank score).
Table 4.9 Summary of Relationship Between Motor Skill Ability and Fitness Status (Plank Score)

<table>
<thead>
<tr>
<th>Motor Skill Ability</th>
<th>Plank score of participants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beginning</td>
<td>Progressing</td>
</tr>
<tr>
<td>Beginning</td>
<td>28</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>49.1%</td>
<td>36.8%</td>
</tr>
<tr>
<td>Progressing</td>
<td>54</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>49.1%</td>
<td>40.9%</td>
</tr>
<tr>
<td>Achieving</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>50.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Excelling</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>33.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Total</td>
<td>88</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>48.6%</td>
<td>40.9%</td>
</tr>
</tbody>
</table>
CHAPTER 5: DISCUSSION

5.1 Motor Skill Ability and Gender of Participants

The study revealed that there is no significant difference in motor skill ability between boys and girls. Although it is generally expected that boys would have better motor skills than girls. Such differences could be attributed to boys possessing greater perceived and actual motor competence. Boys also tend to receive more practicing opportunities and encouragement (Okely, Booth & Paterson, 2001b), and having more PA role models compared to girls (Biskup & Pfister, 1999). Several studies done in Africa have observed that boys tend to have higher levels of PA (closely associated with motor skill ability) compared to girls irrespective of age (Peltzer, 2010; Dapi et al., 2011; Toriola & Monyeki, 2012). This could be explained by the fact that majority of the children who took part in the study were pre pubescent hence their muscular and motor development were still at almost similar levels in both boys and girls involved in the study.

5.2 Health-related Physical Fitness

The results showed that health-related physical fitness of the children was performed averagely for most tests. These included muscular strength, muscular endurance and aerobic endurance. The performance was above average in flexibility in both boys and girls. These results may be explained by the likelihood that much of the PA being accomplished by children and adolescents is not of sufficient volume and intensity to improve health-related fitness which includes, body composition, cardio-respiratory fitness, muscular endurance, muscular strength and flexibility (Armstrong & McManus, 1994).
The results tend to suggest that there is a weak relationship between motor skill ability and fitness among children. Improved motor skill ability has also been associated with health-related outcomes such as higher participation in PA (Okely et al., 2001a), higher cardio-respiratory fitness (Okely et al., 2001b) and a healthy BMI status (Graf et al., 2004; Logan & Getchell 2010). Therefore, if the motor skill ability of the children is improved it is also likely that the fitness levels of the children may also improve.

5.3 Aerobic Endurance and Sex of Participants

In this study, boys were found to have a significantly higher aerobic capacity and performed better on measures of aerobic fitness compared to girls (both chi square and t-tests). This concurs with other studies (Monyeki et al., 2005; Monyeki et al., 2007; Armstrong, Lambert & Lambert, 2011), that also used the pacer 20m test. The overall results were slightly below average for both sexes. Emphasis should be placed to improve aerobic fitness in children. A systematic review carried out by Ruiz et al. (2009) concluded that there is strong evidence to suggest that the higher the levels of cardio-respiratory fitness in children and adolescents, the healthier their cardio-vascular profile is later in life. In addition, a healthier body composition during childhood and adolescence is associated with a healthier cardiovascular profile and a lower risk of NCDs later in life.

5.4 Muscle Strength and Sex of Participants

Surprisingly, results from chi square tests showed that the difference in muscular strength was insignificant across the sexes. This was unexpected. However, t-tests revealed significant differences in the mean muscular strength between boys and girls. Boys are often expected to exhibit higher levels of muscular strength than girls. Results showing that
boys have a higher grip strength compared to girls have also been shown by (Corlett, 1988; Onyewadume, 2006: Heroux et al., 2013).

Improvement of muscle strength from childhood to adolescence was also inversely associated with changes in the total number of fat cells (adipocytes) (Ruiz et al., 2009). Also, according to Metter et al. (2002), the handgrip strength test can give useful information on muscle, nerve, bone or joint disorders. In adults, the test has been proposed as a possible predictor of mortality and the expectancy of being able to live independently especially during old age. These studies exemplify the importance of improving muscle strength in children who score poorly like the study suggests.

5.5 Muscle Endurance and Sex of Participants

Muscular endurance was measured using the plank test. The strength of an individual’s abdominal muscles has been shown to be significantly associated with lower back pain in adults (Nourbakhsh & Arab, 2002). Improving one’s abdominal muscle strength has been shown to not only reduce lower back pain but also to prevent further injury recurrence in athletes (Trainor & Trainor, 2004), and young adults (Arokoski et al., 2001). Hence having muscles that are strong and can endure sustained PA is important in children and adults alike. It is therefore important to improve the overall muscular strength in children. Children performed quite poorly in this test with majority being in the beginner’s level as shown in the previous chapter. Both chi square and t-test results showed no significant differences between boys and girls in terms of muscular endurance. Interventions need to be put up to reverse this situation.
5.6 Flexibility and Sex of Participants

As shown in the previous chapter females were significantly more flexible than their male counterparts. This finding supports previous evidence that girls (women in general) are more flexible than boys (men) (Michaud et al., 1999; Monyeki et al., 2005; Travill, 2007; Toriola & Monyeki, 2012). There is growing evidence about the benefits of good flexibility, some of which include, improved range of motion and function in the relevant muscle group, improved athletic performance, reduced injury risk, prevention and reduction of post-exercise soreness and improved coordination. Some studies have shown that decreased hamstring flexibility is a risk factor for the development of patellofemoral pain, hamstring strain injury and patella tendinopathy (Pope et al., 2000). Literature shows that poor flexibility and subsequent injury has been proven in several musculo-tendinous units, including the Achilles tendon and plantar fascia (Kibler et al., 1991). Hypo-flexibility is known reduce the child’s capacity to perform some skills efficiently and could lead to injury and long-term musculoskeletal problems. Thus the importance of a good level of flexibility especially from a young age cannot be overstated.

5.7 BMI Status and the Sex of Participants

The results showed that majority of the children had a normal BMI status, though it is worth noting that the number of children who were overweight and obese was quite high. The high prevalence in overweight and obesity in children could probably be related to the increase in internet use which is most prevalent in the evenings and during weekends probably because the children had more free time in their hands and a greater choice of activities in which to engage during that time (Cummings & Vandewater, 2007).
In addition, Trost et al. (2008) observed that boys were 2 to 3 times more likely than girls to participate in sporting activities for 1 hour per day regardless of SES or weight status, which supports other studies comparing boys’ and girls’ PA and sport participation in structured and unstructured contexts.

There was no significant relationship (both chi square and t-tests) in respect to gender and the BMI status of the children. Also there was also no significant relationship between BMI status and motor skill ability. Emerging evidence from some studies suggests that overweight or obese children tend to exhibit less competence of motor skill ability (Graf et al., 2004; Williams et al., 2008; Logan & Getchell 2010) and are less physically active (Trost et al., 2003; Bayer et al., 2008). Thus, the development of motor skill ability in children could play a pivotal role in the prevention of childhood obesity.
CHAPTER 6: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

This thesis has presented the main findings of the research project which focused on health-related physical fitness and motor skill ability of 9-11 year old school children in Nairobi County, Kenya. The study looked at the relationships that exist between these variables. There was no significant difference in motor skill ability, aerobic endurance, musculoskeletal endurance, and strength measures between boys and girls; however, girls performed better in flexibility measures of fitness. These findings are supported by a systematic review carried out by Muthuri et al. (2014). Age had no significant difference for aerobic endurance, musculoskeletal endurance, and flexibility measures except for motor skill ability and grip strength. BMI status of the participants was not significantly associated with motor skill ability, grip strength, muscle endurance or the sit and reach test flexibility but was significantly associated with aerobic endurance. Out of all the assessments, the children performed best in flexibility measures.

6.2 Findings and Implications

Although males are generally found to be fitter than females according to the literature (Bronson et al., 2001) the findings of this study indicate no significant difference. These characteristics may be more visible as children progress into puberty (Huddleston et al., 2002) hence probably explaining the indifference of performances between the pre-pubertal boys and girls in this study.
6.2.1 Strengths and Limitations of the Study.

This study had several strengths. The demographic profile of the county is representative for the whole of Nairobi County. Nairobi County presents a population that is quite cosmopolitan, which represents the urban children population in the country (United Nations University, 2011).

The tests used in the study were objective; they involved actual measurement of the different skills and abilities thus providing high quality data. The research assistants that were engaged in the study also underwent extensive training to ensure that the readings made during the study were accurate and that the variance between the different research assistants was insignificant.

The study however had a few limitations, the cross-sectional nature of this study restricted the ability to make cause and effect inferences. Results of the variables collected are subject to change with time. Thus caution needs to be exercised when interpreting the results of cross-sectional study in the absence of longitudinal data.

6.3 Conclusions

Besides biology and socio-cultural roles, the better physical and functional ability generally exhibited by boys may be explained by their higher motivation to participate in physical activities (Muthuri et al., 2014). Regular PA is an important element of a healthy lifestyle for children and adults, it is one domain of health and wellness over which each individual has a great degree of control. Children should be encouraged to engage in PA on a regular basis and to incorporate PA into their daily living to ensure that they carry these habits into their adult life. Although prevalence of overweight and obesity was not very high among
the study population, it continues to pose a constant threat to the health status of children due to the increased risks associated with being overweight.

A large proportion of children (boys and girls) were rated as non-proficient in motor skill ability and most health related physical fitness components. The results suggest that there is significant potential to improve fundamental motor skill competence and fitness among children of this age group. The low levels of proficiency in most skills observed is of concern given that children have the capacity to master most fundamental skills usually by 8 years of age. However, the development of fundamental movement skills is not outright, in order to reach proficiency in motor skills, children need frequent encouragement; access to equipment and facilities; high quality of instruction using developmentally-appropriate activities; opportunities to practice and refine the skills; and an appropriate environment for learning.

6.4 Recommendations

6.4.1 Recommendations for Practice

In order to improve their levels of physical fitness and motor skill abilities, the children should strive to do at least an hour of PA every day. Aerobic activity should make up most of a child's PA each day. This can include either moderate-intensity aerobic activity, such as brisk walking, or vigorous-intensity activity, such as running. Also being sure to include vigorous-intensity aerobic activity on at least three days per week. Muscle-strengthening activities (such as gymnastics) and bone-strengthening activities (such as swimming, running or rope skipping) are also recommended on at least three days each week (CDC, 2009).

The high levels of overweight and obesity in the study point to a need for behaviour change related to improved lifestyle through increased PA and improved dietary practices. This
would help to prevent the development of overweight and obesity among the children, or manage it for those who are already overweight or obese. This could be through increasing their PA, both planned and unplanned, for instance by walking to and from school or enrolling in facilities that offer planned PA like organized sports. For the children who are in the lower socio-economic groups, and who cannot afford these facilities, walking or jogging would be viable for them.

The low levels of fitness and motor skill ability shown in this study could be an indication that this could be the situation even in other geographical locations and population groups. Hence there is need for concerted effort to promote PA especially in schools. Interventions on lifestyle changes should especially target the people in the upper socio-economic groups, and those who are better off in terms of socio-economic status. Other studies have also showed that rural children are more physically active than their urban counterparts (Onyweru et al., 2012; Ojiambo et al., 2012).

In order to increase the levels of health related physical fitness and motor skill ability depending on sex differences, strategies which focus on activities that help each sex to overcome their constraints to PA should be developed.

It is also important to raise awareness of the importance of health related physical fitness and motor skill ability among young Kenyan children. Campaigns (through media) about leisure time PA and other types of daily living PA such as walking should be encouraged especially in the school setting. Incorporating PA in everyday activities would be extremely valuable in this campaign. Research has also found a relationship between fitness and academic performance (IOM, 2013). A study carried out by Esteban-Cornejo et al. in 2014 also showed that motor ability is strongly associated with academic performance. This
further demonstrates the importance of improving fitness levels and motor skills among children.

**6.4.2 Recommendations for Policy**

The relatively high rate of overweight and obesity calls for public health interventions to reduce the prevalence of overweight and obesity among urban children in Kenya. Awareness programs about the consequences of overall and abdominal obesity including prevention activities should be made available in the schools and even incorporated into the curriculum. The government of Kenya, non-governmental organizations and other stakeholders should ensure that some effort is directed towards eradicating obesity because of the associated significant health risks especially as the children grow up. This problem needs to be emphasized and escalated to the responsible authorities as the prevalence of obesity keeps on increasing year after year (De Onis & Lobstein, 2010), and is likely to worsen unless appropriate preventive measures are put in place to curb it.

Solutions or interventions which are evidence-informed should then be put in place. For instance social facilities like community centers with exercise facilities where children can safely play could be availed. Improvement of infrastructure would create a more conducive environment for PA. These could be in the form of sidewalks where people can walk or jog, playing grounds, basketball courts among other infrastructures.

Primary schools and other education centers should implement ‘planned’ gross movement programmes as a strategy to promote physical development of children and also improve their motor skill abilities. Children should also be encouraged to take part in PA during after school holidays, a period during which they tend to gain weight.
6.4.3 Recommendations for Further Research

From a research standpoint, it’s important to continue to determine the most effective characteristics of motor skill interventions (for instance minutes of instruction time, instructional approaches) to shape policy and curriculum recommendations of structured movement programmes early in the child’s life. This will ensure that as they grow they will continue developing their motor skills and increase their chances of remaining healthy even as they continue to age.

This study could be replicated in other areas in Kenya both urban and rural, and a comparison made with the current study to establish if the problem of obesity is widespread and probably not a unique problem to Nairobi County. This would help in establishing the factors contributing to overweight and obesity among children in the other areas and hopefully come up with ways to mitigate it.

A similar study could also be carried out among children with disability to establish their levels of motor skill ability and health related physical fitness with the aim of improving their health and general quality of life.

A longitudinal study exploring the relationship between changes in health related fitness and motor skill ability should be carried out so as to investigate the nature of the relationships of the two after a given duration of time among school going children. A study linking health related fitness, motor skill ability and academic performance in the Kenyan population would also be worthwhile to compare and collaborate studies done in other countries.
Healthy Active Kids Kenya (2011) carried a review of studies done in Kenya and observed that there were very limited data on the number of Kenyan children that are physically active. PA greatly contributes to the improvement in motor skill ability and health-related fitness components thus further research needs to be carried out in the above areas to ensure that information that is up to date, representative and reliable.


Canadian Assessment of Physical Literacy Manual (2013). HALO research group, Ottawa, Canada.


IRIN. (October 10th, 2009). Africa struggles with the double burden of obesity and under nutrition. The Daily Nation.


APPENDIX A: How to Prepare for the Motor Skill Ability Test

Adapted from the CAPL manual.

**Equipment/space required:**

Open space (15 m x 5 m) with flat floor that is safe for running and changing direction

Gym floor tape, 6 Hoola hoops, 6 Pylons, 1 Soccer ball, 1 Softball, 1 Wall target (24” wide x 18” high)

**Preparation:**

Measuring and positioning the obstacle course as indicated in the diagram below with these steps:

1. Mount the wall target so that the top stands 1.5 metres above of the floor.
2. Position cones #5 and #6 at floor level 1m to the left and right of the centre of the wall target.
3. Measure 5 m from the target wall and tape a line on the floor.
4. Position cone #2 in line with cone #6 at the end of the taped line.
5. Measure 3 m, perpendicular to the taped line, from cone #2 to position cone #1
6. Measure 1 m from cone #1 to edge of hoops.
7. Place hoops so that centre line between hoops is aligned with cones #1 and #2.
8. Measure 1 m from centre of yellow hoop, perpendicular to the line of hoops, to place cone #4

9. Measure 1 m back from hoops/cone #4 and tape a line on the floor where others can wait or watch.

10. Measure 5 meters from cone #4 to place cone #3

Tape all hoops and cones securely to the floor to maintain position with impacts and minimize tripping hazards

**How to administer the test**

Demonstrate each skill to be performed and the order in which they are completed, while explaining the criteria for each skill.

Explain that each student will have 2 practice trials and then 4 trials that are timed.

Demonstrate the full obstacle course with proper speed.

Ensure that all students are wearing running shoes or appropriate footwear.

Examiner #1 times the participant and stands at the edge of the throwing line. The softball and soccer ball are at hand. Examiner #1 starts each trial by saying “ready, set, go”. Timing starts when the examiner says “go” and stops when the participant’s foot kicks the soccer ball. Examiner #1 throws the softball when the participant is ready to catch and places the soccer ball on the line after the participant has gone around cone #3. Examiner #1 records whether the throw and kick were done with the right or left arm/leg.

Examiner #2 scores the participant’s performance of each skill. One point is awarded for each skill performed correctly.

If the participant does not complete the course as outlined, no score is recorded.

Script and Actions for Demonstration:
Begin standing stationary in front of blue hoop.

“When you are ready to go, I will say “ready, set, go”. When I say “go” you can start hopping like a bunny through the hoops.

Complete three 2-foot hops from the blue to the orange to the purple hoop and then out past the purple hoop. Run to cone #1 and then turn sideways to face the examiner.

“The next part is sliding sideways. You should be facing this side so you can see the examiner.”

Slide sideways to cone #2 and touch the cone. Then reverse direction (remain facing the examiner) to slide back to cone #1 and touch that cone.

“See how my body is facing sideways and my feet are pointing sideways. When I change directions to go back to cone #1 I am still facing the same way. Make sure you touch the pylons each time”

Start to run toward the throwing line, catch the ball as it is thrown by the examiner, and throw it at the target.

“After I finish sliding, the examiner will throw the ball to me. I catch it and throw it at the target before I cross the line.”

Run outside of cone #3 and then skip from cone #3 to cone #4 before running around cone #4 and going back to the hoops.

“When I come to cone #3 I have to go outside of the cone and then skip to cone #4. Do your best athletic skipping. At cone #4 I run outside of the cone and then go back to the hoops.”

Land in each hoop on one foot.
“This time I have to land in all of the hoops by hopping on one foot. You can do the hoops in any order, but you have to land on one foot in each hoop.”

After landing in the last hoop, run to the kicking line and kick the ball toward the target.

“After you land on one foot in the last hoop just run to the soccer ball and kick it at the target on the wall. Once you kick the ball you are done.”

**Instructions for the participant**

*Stand at the edge of the blue hoop. Start jumping on two feet. Ready, set, go.*

*Slide sideways from cone #1 to cone #2 and then back to cone #1.*

*Catch the ball, throw the ball. Around cone #34 and skip to cone #4.*

*Hop on one foot in each hoop. Run and kick the soccer ball.*

**How to record the score**

Time is recorded to the nearest 0.1 second.

Scoring for the performance of the motor skills is one point for each of the following:

<table>
<thead>
<tr>
<th>Skill</th>
<th>Scoring</th>
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</thead>
<tbody>
<tr>
<td>2-foot jump</td>
<td>3 consecutive jumps on two feet. One landing in each hoop and no touching of the hoops. Uses arms to assist with performance of skill</td>
</tr>
<tr>
<td>Slide</td>
<td>Body and feet aligned sideways when sliding to the left Touches cone after sliding left (low centre of gravity + athletic position)</td>
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<tr>
<td></td>
<td>Body and feet aligned sideways when sliding to the right Touches cone after sliding right (low centre of gravity + athletic position)</td>
</tr>
<tr>
<td>Catch</td>
<td>Catches ball without trapping it against the body</td>
</tr>
<tr>
<td>Skill</td>
<td>Description</td>
</tr>
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</tr>
<tr>
<td>Throw</td>
<td>Uses overhand throw, ball hits target. Transfer weight and rotates body during throw.</td>
</tr>
<tr>
<td>1-foot hop</td>
<td>Lands on one foot in each hoop. Hops only once in each hoop and does not touch hoops. Uses arms effectively to assist in the performance of the skill.</td>
</tr>
<tr>
<td>Kick</td>
<td>Kicks ball within or touches cones, rapid and smooth approach to ball. Elongated stride and non-kicking foot beside or behind the ball.</td>
</tr>
</tbody>
</table>

**Obstacle course score sheet**

Test Date: ______________________________
APPENDIX B: How to Prepare for the Pacer 20m Test

Adapted from the CAPL manual.

The pacer 20m test involved running laps back and forth across the field, starting at a slow speed and gradually getting faster. The children continued running until they were too tired or did not wish to continue running at the faster speed.

Equipment/space required:

Tape measure
Tape measure
Stereo with CD player
20 pylons

Preparation:

Measure a distance of 15 m (or 20 m if available) and tape a line on the floor at each end.
Place pylons along the taped line. Match the color of the pylons in pairs across from each other so that each participant has their own colour of pylons and it is different from those on either side.
Place CD player midway between lines

How to administer the test
At this station run as long as you possibly can to the set pace. Once you hear the first beep you may leave this side and you must get to the other side before the next beep. As soon as you hear the next beep you run back to this side. Every time you hear a beep you run the other way. The beeps will gradually get faster so you have to run faster to keep up. We want you to keep going as long as you can get to the other side before you hear the beep. You need to pace yourself so that you do not get too tired too fast.

Demonstrate the test to the participants by playing the recording and performing 3 or 4 runs.

Proper Form:

✓ Participants run across the 15 meter (20 m) distance at a pace that increases
✓ Both feet must cross line by the time the beep sounds
✓ Participants must wait for the beep before running in the other direction
✓ Participants stop as soon as they fail to reach the line a second time
✓ First time participant does not reach line by beep, participant stops and immediately reverses

Instructions for the participant

Stand in a running position and make sure that you are behind the start line. At the sound of the first beep you should take off as soon as possible to ensure that you cross over the other side before the sound of the next beep. Once you get there, turn around and wait for the next beep. As soon as you hear the next beep start running again to get back to the other side. Continue to run back and forth until you do not make it over the before the beep
a second time. The second time that you do not make it over the line before the beep you are finished.

**How to record the score**

- The run from one end to the other (15m or 20m distance) is one lap
- Record the number of laps completed by the participant
- Count the first lap not completed by the beep but not the 2nd
- Foot on the line at beep is good, participant can continue
- Body doesn’t need to make the line as long as the foot is on the line

**Pacer 20m scoring sheet**

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<tr>
<th>Lane</th>
<th>Student ID</th>
<th>Laps Completed</th>
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Examiner:___________  School:__________  Date:__________
Source: (CAPL, 2013)
APPENDIX C: How to Prepare for the Standing Height Test

Adapted from the CAPL manual.

**Equipment/space required:**

- Stadiometer
- Privacy screen for testing area
- Smooth, level floor area for stadiometer

**Preparation:**

Place the stadiometer on a smooth, level section of the floor.

Erect a privacy screen around the stadiometer so that other participants cannot observe the assessment. Ensure participants have removed footwear (socks are kept on).

**How to administer the test**

Explain the test to the participants by demonstrating what they are to do and describing the test as follows:

*At this station we are going to see how tall you are. All you have to do is stand up straight and look straight ahead. Let your arms hang at your sides. Keep your feet together and your heels on the floor against the back of the platform. Then take a deep breath while I bring the arm down so it rests on your head.*

Proper Form:

☑ Students stands erect without footwear, arms hanging at the sides, feet together, and the heels and back in contact with the stadiometer

☑ Student looks straight ahead, stands up straight and takes a deep breath while measurement is taken
✓ Lower headboard until it depresses the hair and makes firm contact with head
✓ Check to ensure student’s heels remain in contact with floor
✓ Measure twice for consistency

**Instructions for the participant**

*Stand on the platform with your feet together and your heels against the back of the platform. Let your arms hang down and take a deep breath.*

<< After measurement is complete >> *You can breathe normally.*

**How to record the score**

✓ **Record height to the nearest mm**

**Height score sheet**

Test Date: ______________________ Test Location: ____________________________

*Stand on the platform with your feet together and your heels against the back of the platform. Let your arms hang down and take a deep breath.*

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<th>ID #</th>
<th>Examiner</th>
<th>Trial 1 (0.1 cm)</th>
<th>Trial 2 (0.1 cm)</th>
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Source: (CAPL, 2013)
APPENDIX D: How to Prepare for the Weight Assessment Test

Adapted from the CAPL manual.

**Equipment/space required:**

Weigh scale
Partial cover for scale readout
Privacy screen for testing area
Smooth, level floor area for scale

**Preparation:**

Place the scale on a smooth, level section of the floor
Mount the partial cover over the scale readout so that the measurement cannot be seen by the participant.
Erect a privacy screen around the scale so that other participants cannot observe the assessment
Ensure participants have removed footwear (socks are kept on) and are dressed in light clothing

**How to administer the test**

Explain the test to the participants by demonstrating what they are to do and describing the test as follows:

*At this station we are going to see how much you weigh. All you have to do is stand on the scale with both feet. Keep still for a few seconds until I say you are done.*

Proper Form:

✓ Ensure scale is on flat surface
✓ Student should be in light clothing and without footwear

✓ Measure twice for consistency

Instructions for the participant

Stand on the scale with both feet and keep still until I say you are done.

How to record the score

✓ Record the weight to the nearest 0.1 kg

Weight score sheet

Test Date: _____________________________________________________________

Test Location: __________________________________________________________

Stand on the scale with both feet and keep still until I say you are done.

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<th>ID #</th>
<th>Examiner</th>
<th>Trial 1 (0.1 kg)</th>
<th>Trial 2 (0.1 kg)</th>
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Source: (CAPL, 2013)
APPENDIX E: How to Prepare for the Assessment of Grip Strength Test

Adapted from the CAPL manual.

Muscle strength, specifically isometric grip strength, was measured by squeezing a hand-grip dynamometer (gauge) with both the right and left hand each at a time. The average of the two tests was used to rank the children.

Equipment/space required:

Handgrip dynamometer adjusted to the size of the participant’s hand

Space for participant to hold dynamometer with arm extended slightly away from the body

How to administer the test

Demonstrate the test procedure while providing the following explanation:

*Take the machine into the palm of your hand and hold it so the scale is facing out. Make sure that you are gripping the machine between the base of your thumb and your fingers.*

*Take your arm and place it beside you and keep it as straight as possible. With control, gradually squeeze the machine as hard as you can while slowly saying the word “squeeeeeeeze”.*

Proper Form:

✓ Participant stands in upright position

✓ Dynamometer held in appropriate hand with scale facing tester

✓ Arms should be straight and slightly away from body so that the hands and dynamometer do not touch body

✓ Grip of dynamometer between fingers and palm at base of the thumb
✓ Adjust so that second joint of fingers is at approximately a right angle when gripping dynamometer
✓ Dynamometer held in line with forearm at level of the thigh
✓ Participant squeezes dynamometer firmly and gradually to build up to maximal force
✓ Participant exhales while slowly saying the word “squeeEEEze”

**Instructions for the participant**

_Hold the handle with just one hand. Keep your arm straight and hold it away from your body. Do not let the handle or your hand touch your body. Slowly squeeze the handle as hard as you can while saying the word “squeeEEEze”._

**How to record the score**

✓ **Record scores to the nearest 0.5 kg for both hands alternatively (two trials per hand)**
✓ **Combine the maximum score for each hand to calculate the total score**
✓ If proper form is not used, do not score result

**Grip Strength Score Sheet**

Test Date: ________________________________________________

Test Location: ______________________________________________

_Hold the handle with just one hand. Keep your arm straight and hold it away from your body. Do not let the handle or your hand touch your body. Slowly squeeze the handle as hard as you can while saying the word “squeeEEEze”._
<table>
<thead>
<tr>
<th>ID#</th>
<th>Examiner</th>
<th>Trial #1</th>
<th>Trial #2</th>
<th>Maximum Score</th>
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<td>Left</td>
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</table>

Source: (CAPL, 2013)
APPENDIX F: How to Prepare for the Plank Assessment of Torso Strength Test

Adapted from the CAPL manual.

Equipment/space required:
Mat that is longer than the participant’s body
Stopwatch that measures to 1 second intervals

Preparation:
Place the mat flat on the floor

How to administer the test

Demonstrate the test procedure while providing the following explanation:

Start down on your hands and knees. Then go from your hands onto your elbows. Fold your arms so that your elbows are apart the same distance as from your elbows to your finger tips. Then unfold your arms and hold your hands together against the floor. When your elbows and hands are in the proper position, lift your knees and straighten your legs so that only your toes are on the floor. Look at your hands and make a perfectly straight line with your body. Once your body is straight and off the floor from your toes to your elbows the time will start. We want you to hold this position for as long as you can. You cannot let your hips or shoulders sag down and you cannot lift your hips way up in the air. Make sure your elbows and toes stay on the mat. You will get one practice so that you know the position you have to maintain. After that we will time you. If your body bends we will give you one hint so that you can straighten up again, but the second time you bend we will stop timing.

Proper Form:
✓ Subject tucks shirt into shorts/pants
✓ Ensure elbows are directly beneath shoulders
✓ Subjects hold a prone position with no body touching the floor between the elbows and toes.
✓ Toes curled under, elbows forearm distance apart, hands clasped together on pushing on the mat
✓ Eyes should look at hands to maintain neutral spine from hips to head
✓ Pivot points are toes and elbows
✓ Feet together

Instructions for the participant

Start on your hands and knees. Lean on your elbows and fold your arms so that your finger tips touch your elbows.

<< When correct elbow spacing is achieved >>

Fold your hands together against the floor and straighten your legs. Look at your hands and make a perfectly straight line with your body.

<< Correct body position as required >>

Do you feel how your body is straight from your toes to your head? You can relax, but remember how that straight body position felt.

<< After an adequate rest period >>

This time I am going to time how long you can keep your body perfectly straight. Lean on your elbows and fold your arms so that your finger tips touch your elbows. Fold your hands together against the floor and straighten your legs. Look at your hands and make a perfectly straight line with your body.
<< Provide feedback on any changes to body position and encouragement to continue >>

How to record the score

✓ Start timing once the participant is in the correct position
✓ Track the amount of time held in the correct position
✓ Any break from a neutral spine (either hips to high or to low) give one warning
✓ Timing continues to elapse while participant corrects body position
✓ A second break from a neutral spine (either hips to high or to low) terminates the test
✓ Participant holds position for as long as possible (no time limit)

Plank torso strength score sheet

Test Date: ______________________________________________________________
Test Location: __________________________________________________________

Start on your hands and knees. Lean on your elbows and fold your arms so that your finger tips touch your elbows.

<< When correct elbow spacing is achieved >>

Fold your hands together against the floor and straighten your legs. Look at your hands and make a perfectly straight line with your body. Feet together.

<< Correct body position as required >>

Do you feel how your body is straight from your toes to your head? You can relax, but remember how that straight body position felt.

<< After an adequate rest period >>

This time I am going to time how long you can keep your body perfectly straight. Lean on your elbows and fold your arms so that your finger tips touch your elbows. Fold your hands
together against the floor and straighten your legs. Look at your hands and make a perfectly straight line with your body.

<< Provide feedback on any changes to body position and encouragement to continue >>

There’s no time cap for this test.

<table>
<thead>
<tr>
<th>ID #</th>
<th>Examiner</th>
<th>Score (sec)</th>
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Source: (CAPL, 2013)
APPENDIX G: How to Prepare for the Sit and Reach Flexibility Assessment Test

Adapted from the CAPL manual.

Flexibility, specifically lower back flexibility was measured using the Sit and Reach test.

It involved Reaching toward the toes while sitting with their legs straight.

**Equipment/space required:**

- Gym mat or floor space for participant to sit with legs extended
- Sit and reach flexometer with foot surface at 26 cm
- Flexometer measurements from 0 to 70 cm

**Preparation:**

- Place the mat flat on the floor (if available)
- Place the flexometer on the floor or mat
- Stabilize the flexometer measurements at 26 cm at the foot surface

**How to administer the test**

- Lead the participants in warm up exercises and preliminary stretches, such as the modified hurdler stretch, as required
- Have participants remove shoes (socks on)

When demonstrating, do not reach past toes but appear to give a maximal effort. Reaching past the toes will encourage participants to match your performance by bending their knees.

Demonstrate the test procedure while providing the following explanation:

*Sit down on the mat/floor with your legs stretched out in front of you. Make sure that your heels are flat against the surface and your toes are pointing up. Keep your knees straight. That is the hardest part of the test. Do not let your knees bend even a little. Put your arms
out straight and stack your hands together, on top of each other. Start moving your body by leaning forward from your hips. Go as far along the box as you can with your hands together and your knees straight. Once you can no longer bend forward hold it and count to 5.

Instructions for the participant

Sit down on the mat/floor with your legs stretched out straight. Put your heels flat against the surface with your toes pointing up. Keep your knees straight. Do not let your knees bend even a little. Arms straight and stack them on top of each other. Bend forward slowly and go as far as you can without bending your knees. Hold it and count to 5.

Proper Form:

- Starting position:
  - Student sits with legs straight and knees fully extended (no shoes)
  - Soles of feet flat against box with 6 inches between two feet
  - Examiner ensures flexometer is secured and cannot move

- Action:
  - Knees remain fully extended throughout test
  - Student bends from the hip and reaches forwards
  - Arms reach evenly with palms down and hands placed on top of each other
  - Back is kept straight and head is up during forward reach
  - Student pushes sliding marker with finger tips as far forward as possible
  - Position held steadily for at least two seconds
How to record the score

✓ Record readings in cm to the nearest ½ cm (two trials)
✓ Repeat test if knees bend or if a jerking motion occurs
✓ Watch for and correct improper form.

Sit and reach flexibility score sheet

Test Date: ________________________________________________________________

Test Location: ____________________________________________________________

Sit down on the mat/floor with your legs stretched out straight. Put your heels flat against the surface with your toes pointing up. Keep your knees straight. Do not let your knees bend even a little. Arms straight and stack your hands on top of each other. Bend forward slowly and go as far as you can without bending your knees. Hold and count to 5.

Source: (CAPL, 2013)

<table>
<thead>
<tr>
<th>ID #</th>
<th>Examiner</th>
<th>Trial #1 (0.5cm)</th>
<th>Trial #2 (0.5cm)</th>
<th>Maximum Score</th>
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APPENDIX H: Child Assent Form

CHILD ASSENT FORM
What is this research called?
The Assessment of Physical Literacy of Kenyan children.

Why are we doing this study?
We are doing this study so that we can measure your physical fitness and motor skills ability. It will help us to know physically fit children are and their levels of motor skill ability.

What will you do during the study?
You will do many activities that are like being in P.E. class. In the field we will ask you to try each of these tasks:

- Run through an obstacle course with jumping, throwing and kicking a ball.
- Squeeze a handle as hard as you can with each hand.
- Keep a straight body while leaning only on your toes and elbows.
- Reach toward your toes while sitting with your legs straight.
- Run laps back and forth across the playing ground, starting slowly and then getting faster.

All of the research activities will take place at your school and your teacher will be there too. The activities will be done in your classroom and in the playing ground. If you do not want to be in the research study that’s okay, you will just stay with your teacher.

Are there good or bad things about being in this study?
We do not expect bad things to happen to children who participate in this study. Since you will be running and doing other activities, you might fall or bump into something. It will be the same as P.E. (PE) class. We will not give you anything for being in this study but what we learn might help other children to be healthier one day.
Who will know that I am in this research study?

All of your written information will be stored safely, and your personal information will stay private. You don’t have to participate if you don’t want to, and the information we get won’t be shared with anyone except you and your parents. Being in this study will not change your marks, and you can decide to stop the study at any time.

CHILD ASSENT FORM

I, ______________________________________________________ (Your Name), agree to participate in this research study.

I have read and understood the study information or the information has been explained to me. I have been told all about the study and have had a chance to talk about it. I understand that I can change my mind and stop the study at any time. I also know that I do not have to answer questions or do things that make me uncomfortable. I know that my school marks will not be affected because I am doing this research. I have received a copy of the study information and consent form.

____________________  ________________________  ______________
Name of Participant   Signature of Participant       Date
APPENDIX I: Parent/Guardian Informed Consent Form

PARENT/GUARDIAN INFORMED CONSENT FORM

What is the title of this research study?

The Assessment of Physical Literacy of Kenyan children.

Who is doing this research?

Co-Principal Investigators:  Dr. Mark Tremblay, PhD.
CHEO Research Institute.
HALO Research Group.
(613) 737-7600 ext 4114
mtremblay@cheo.on.ca

Co-Principal Investigators      Dr. Vincent Onywera
Director, Center for Linkages & International Programs.
(CLIP)
Kenyatta University
P.O. Box 43844-00100 Nairobi- Kenya.
Tel: 020-801901 ext 57527
vonywera@gmail.com

Why are we doing this study?

We are doing this study so that we can measure your physical fitness and motor skills ability. It will help us to know physically fit children are and their levels of motor skill ability.

What will your child do during the study?

The study includes many activities that are similar to what your child would typically do during the school day. Before your child tries any of the study activities, we will ask your child whether they want to participate. Your child can say either “Yes” or “No”, and their choice will be respected even if you want your child to participate. If your child agrees to participate, we will record your child’s gender, date of birth and class. Your child will then be asked to complete each of the following tasks:
• Obstacle Course – includes jumping, running, hopping, catching, throwing and kicking balls while running.
• Grip Strength – squeezing a hand-grip dynamometer (gague).
• Plank – a core strength exercise commonly used in sport training: holding a Push up position while resting on toes and forearms.
• Sit and Reach - Reach toward the toes while sitting with their legs straight, to measure flexibility.
• Pacer 20m test - Run laps back and forth across the field, starting at a slow speed and gradually getting faster. They will continue running until they are too tired or do not wish to continue running at the faster speed.

Children who participate in this research will perform each of the study activities when the researchers come to their school. All of the research activities will take place at your child’s school and your child’s teacher will be present at all times. Most activities will take place in the playing ground during P.E. classes.

If you choose not to allow your child to participate in this study, your child will be supervised by their own teacher and engaged in appropriate school-focused activities while the other children in the class are completing the study.

**Pre-participation health screening**

PA and fitness testing are safe for most children. To ensure safe participation for your child we would like to know some specific information about your child’s health before we include them in this study.
Please answer the questions below by placing an “X” in the appropriate column. Please ask us to clarify if anything is unclear. If you answer yes to one of these questions, your child can still participate in the study, but not perform the Pacer 20m test.

<table>
<thead>
<tr>
<th>Does your child have a diagnosed medical condition that prevents them from participating in intense exercise?</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has a doctor ever told you that it would be unsafe for your child to do intense exercise?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The exercise that your child will do in this study is safe for children even if they have a common health condition such as asthma, diabetes or epilepsy. However, it is helpful for us to know which children have these conditions so that we can help them to exercise strenuously in the way that is best for them. If your child takes any medication for exercising (e.g., inhaler for asthma, sugar tablets for diabetes), please make sure they have the medication with them when they do the study. Please indicate below whether your child has any health conditions that might be influenced by strenuous exercise and provide us with details about any health concerns that you think are important for us to know about:

___ No, my child does not have a health condition influenced by exercise

___ Yes, my child does have a health condition influenced by exercise. What you need to know is:

________________________________________________________________________
________________________________________________________________________

Who can participate in this research?
The sample size was 200 students. Your child’s teacher and the principal of your child’s school are interested in having your child’s class participate in this research.

**Could something bad happen to my child during this study?**

We do not expect bad things to happen to children who participate in this study. All the activities for the study are similar to what your child does in P.E. class. As with any type of PA, there is a small risk of falling or getting hurt. However, all the research equipment is similar to what your child uses in P.E. and safety is our first priority. All study personnel are trained in First Aid and CPR, and in the event of an injury or emergency, standard school policies will be followed.

In the unlikely event that your child is injured as a direct result of participating in this research, the normal legal rules about compensation for the injury will apply. By signing this consent form you are in no way waiving your legal rights or releasing the investigator and the sponsor from their legal and professional responsibilities.

**Will my child or family get something for being in this study?**

You and your child will not be paid or given a reward for being in this study. Your child’s participation in this study is completely voluntary. You or your child are free to withdraw from this study at anytime, even after the research testing has been completed.

**Who will know that my child is in this research study?**

The information we collect about your child will not identify your child. We will use a coded identification number instead of your child’s name so that only the researchers will know who the information is about. The data collected in this study will be locked in a safe
place. All information from your child will be numbered and will not contain your child’s name. A list of names and matching code numbers will be stored separately.

It is intended that only the people involved in this research study will have access to the research information collected during this study. No information that could identify your child or your child’s school will be published. If we want to publish information that could identify your child or your child’s school, we will contact you and ask you to sign a separate consent form for the publication.

Who should I contact if I have questions about the research study?

If you have questions about this study please contact DR. Vincent Onywera on 020-801901 ext 57527 or by email at (vonywera@gmail.com).

Parent/Guardian informed consent

I, ______________________________________________________ the parent/guardian of ________________________________ give consent for my child to participate in this study.

I have read and understood the attached study information or had the attached information verbally explained to me. I have been fully informed of the details of the study and have had the opportunity to discuss my concerns. I understand that I am free to withdraw my child at any time or not answer questions that make us uncomfortable, and that my child’s educational status will not be affected if I do. I have received a copy of the study information and consent form.

____________________                 _____________________
Name of Parent/Guardian             Signature of Parent             Date
APPENDIX J: Map of Nairobi County.

Source: www.flickr.com/photos/albertkenyaniinima/6671840789/
APPENDIX K: Approval of Research Proposal

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

FROM: Dean, Graduate School
DATE: 18th February, 2013

TO: Odindo Francis Okinda
C/o Recreation Management and Exercise Science

REF: H108/21223/2010

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting of 13th February, 2013 approved your Research Proposal for the M.Sc. Degree Subject to editing the title to read, “Health Related Physical Fitness and Motor Skill Ability of 9-11 Year Old School Children in Nairobi County, Kenya”.

Thank you.

JOHN ODONGI
FOR: DEAN, GRADUATE SCHOOL

cc: Chairman, Department of Recreation Management and Exercise Science

Supervisors:

1. Dr. Vincent Ochieng Onywera
C/o Department of Recreation Management and Exercise Science
Kenyatta University.

2. Dr. Mark Tremblay
Professor of Paediatrics and Director of the Healthy Active living and Obesity Research Group.
Children’s Hospital of Eastern Ontario Research Institute
University of Ottawa, Canada
C/o Department of Recreation Management and Exercise Science
Kenyatta University.
APPENDIX L: Ethics Review Approval Letter for ISCOLE Kenya Study Site by Kenyatta University Ethics Review Committee

KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE

Fax: 8731242/8711575
Email: director-er@ku.ac.ke
Website: www.ku.ac.ke

Our Ref: KU/R/COMM/51/15

Date: March 8th, 2011

Dr. Vincent Onywera,
Dpt. of Recreation Management & Exercise,
Kenyatta University.

Dear Dr. Onywera,

APPLICATION NUMBER PKU005/104 OF 2011 - 'INTERNATIONAL STUDY OF CHILDHOOD OBESITY, LIFESTYLE AND THE ENVIRONMENT (ISCOLE)'.

1. IDENTIFICATION OF PROTOCOL

The application before the committee is with a research topic 'INTERNATIONAL STUDY OF CHILDHOOD OBESITY, LIFESTYLE AND THE ENVIRONMENT (ISCOLE)' dated 24th January 2011.

2. APPLICANT

Dr. Vincent Onywera
Dpt. of Recreation Management & Exercise,
Kenyatta University

3. SITE

KENYA

4. DECISION REACHED

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines, and is of the view that against the following elements of review,

i. Scientific design and conduct of study,
ii. Recruitment of research participant,
iii. Care and protection of research participants,
iv. Protection of research participant’s confidentiality,
v. Informed consent process,
vi. Community considerations.
APPROVED that the research proceeds for a period of ONE year.
The approval is for the period 8th March 2011 to 8th March 2012.

5. **ADVICE**
   i. Progress reports are submitted to the KU-ERC every six months and a full report is submitted at the end of the study,
   ii. Serious and unexpected adverse events related to the conduct of the study are reported to this board immediately they occur,
   iii. Notify the Kenyatta University Ethics Committee of any amendments to the protocol.

Please sign in the space provided below and return to KU-ERC a copy of the letter.

[NICHOLAS K. GIKONYO, PH.D.
CHAIRMAN ETHICS REVIEW COMMITTEE]

[Dr. Vincent Onywere] accepts the advice given and will fulfill the conditions therein.

Signature: [Signature] Dated this day of [March 21, 2011]

cc: Vice-Chancellor
    Director: Institute for Research Science and Technology

AT/
APPENDIX M: Research Authorization Letter for ISCOLE Kenya Study Site by
National Council for Science and Technology

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Our Ref: NCST/RRI/12/1/MED-011/81/4

Date: 5th July, 2011

Vincent Ochieng Onywera
Kenyatta University
P. O. Box 43844
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “International study of childhood obesity, lifestyle and environment (ISCOLE)” I am pleased to inform you that you have been authorized to undertake research in Nairobi Province for a period ending 30th June, 2014.

You are advised to report to the Provincial Commissioner & the Provincial Director of Education, Nairobi Province before embarking on the research project.

On completion of the research, you are expected to submit two hard copies and three soft copies of the research report/thesis to our office.

SAID HUSSEIN
FOR; SECRETARY/CEO

Copy to:
The Provincial Commissioner
Nairobi Province

The Provincial Director of Education
Nairobi Province
APPENDIX N: Research Authorization Letter for ISCOLE Kenya Study Site by City

Education Department, City Council of Nairobi

CITY EDUCATION DEPARTMENT

GL/NC/141/VOL IV/162

7th October, 2011

HEADTEACHERS
PRIMARY SCHOOLS
NAIROBI.

RE: RESEARCH AUTHORIZATION

This is to certify that VINCENT OCHIENG O NYERA, a lecturer in Kenyatta University has been

granted authority to conduct research in your school from January 2012 to July 2012.

The title of his research is “International Study of Childhood Obesity, Lifestyle and Environment

(ISCOLE).”

You are therefore requested to accord him necessary assistance as may be required in this exercise. Upon

completion of the study, a copy of the research report should be submitted to this office.

Catherine W. Gichuba
ASST. CHIEF ADVISOR TO SCHOOLS
FOR: DIRECTOR CITY EDUCATION

Cc Education Officers
APPENDIX O: Body Mass Index-for-Age Percentile Rank Chart for Girls

Figure A1: Girls WHO growth chart

Source: (WHO, 2008)
## APPENDIX P: Body Mass Index-for-Age Percentile Rank Chart for Boys

Figure A2: Boys WHO growth chart

Source: (WHO, 2008)
APPENDIX Q: Interpretation of Results, Motor Skill Ability, Plank Score, Grip Strength and Aerobic Endurance.

Interpretation of Child’s overall Obstacle Course (Motor Skill Ability) Score (Out of 28)

<table>
<thead>
<tr>
<th></th>
<th>Beginning</th>
<th>progressing</th>
<th>achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;14</td>
<td>14 to 18</td>
<td>19 to 23</td>
<td>≥ 23</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;17</td>
<td>17 to 21</td>
<td>22 to 24</td>
<td>≥ 25</td>
</tr>
<tr>
<td>10 years</td>
<td>&lt;19</td>
<td>19 to 23</td>
<td>24 to 26</td>
<td>≥ 27</td>
</tr>
<tr>
<td>11 years</td>
<td>&lt;20</td>
<td>20 to 24</td>
<td>25 to 27</td>
<td>≥ 28</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;21</td>
<td>21 to 24</td>
<td>25 to 27</td>
<td>≥ 28</td>
</tr>
</tbody>
</table>

Source: (CAPL, 2013)

Interpreting the Plank Score for Children (Units in Seconds)

<table>
<thead>
<tr>
<th></th>
<th>Beginning</th>
<th>Progressing</th>
<th>achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 to 10 years</td>
<td>&lt;30.27</td>
<td>69.03 to 30.27</td>
<td>107.79 to 69.04</td>
<td>≥ 107.79</td>
</tr>
<tr>
<td>11 to 12 years</td>
<td>&lt;45.68</td>
<td>86.27 to 45.68</td>
<td>126.84 to 86.28</td>
<td>≥ 126.84</td>
</tr>
</tbody>
</table>

Source: (CAPL, 2013)

Interpreting PACER Scores for Child (Laps Completed)

Males

<table>
<thead>
<tr>
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<th>Beginning</th>
<th>Progressing</th>
<th>achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;12</td>
<td>12 to 23</td>
<td>24 to 34</td>
<td>≥ 34</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;13</td>
<td>13 to 26</td>
<td>26 to 38</td>
<td>≥ 38</td>
</tr>
<tr>
<td>10 years</td>
<td>&lt;17</td>
<td>17 to 29</td>
<td>29 to 41</td>
<td>≥ 41</td>
</tr>
<tr>
<td>11 years</td>
<td>&lt;18</td>
<td>15 to 28</td>
<td>28 to 42</td>
<td>≥ 42</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;19</td>
<td>19 to 32</td>
<td>32 to 44</td>
<td>≥ 44</td>
</tr>
</tbody>
</table>
### Interpreting the Grip Strength for Children (Units in Kg)

#### Males

<table>
<thead>
<tr>
<th>Age</th>
<th>Beginning</th>
<th>Progressing</th>
<th>Achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;26.3</td>
<td>26.3 to 37.7</td>
<td>37.8 to 49.2</td>
<td>≥ 49.2</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;26.5</td>
<td>26.5 to 35.8</td>
<td>35.9 to 45.0</td>
<td>≥ 45.0</td>
</tr>
<tr>
<td>10 years</td>
<td>&lt;29.6</td>
<td>29.6 to 37.4</td>
<td>37.5 to 45.2</td>
<td>≥ 45.2</td>
</tr>
<tr>
<td>11 years</td>
<td>&lt;32.6</td>
<td>32.6 to 42.3</td>
<td>42.4 to 52.0</td>
<td>≥ 52.0</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;34.4</td>
<td>34.4 to 43</td>
<td>43.1 to 51.7</td>
<td>≥ 51.7</td>
</tr>
</tbody>
</table>

#### Females

<table>
<thead>
<tr>
<th>Age</th>
<th>Beginning</th>
<th>Progressing</th>
<th>Achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;24.1</td>
<td>24.1 to 31.3</td>
<td>31.4 to 38.4</td>
<td>≥ 38.4</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;25.7</td>
<td>25.7 to 34.3</td>
<td>34.4 to 42.8</td>
<td>≥ 42.8</td>
</tr>
<tr>
<td>10 years</td>
<td>&lt;27.7</td>
<td>27.7 to 35.3</td>
<td>35.4 to 43.0</td>
<td>≥ 43.0</td>
</tr>
<tr>
<td>11 years</td>
<td>&lt;30.2</td>
<td>30.2 to 38.4</td>
<td>38.5 to 46.6</td>
<td>≥ 46.6</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;31.5</td>
<td>31.5 to 45.3</td>
<td>45.4 to 59.2</td>
<td>≥ 59.2</td>
</tr>
</tbody>
</table>

Source: (CAPL, 2013)
Interpreting Flexibility Scores (Units in cm)

### Males

<table>
<thead>
<tr>
<th>Age</th>
<th>Beginning</th>
<th>Progressing</th>
<th>Achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;21.0</td>
<td>21.0 to 29.4</td>
<td>29.5 to 37.0</td>
<td>≥ 37.0</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;22.5</td>
<td>22.5 to 30.0</td>
<td>30.1 to 37.0</td>
<td>≥ 37.0</td>
</tr>
<tr>
<td>10 years</td>
<td>&lt;21.0</td>
<td>21.0 to 29.0</td>
<td>29.1 to 36.5</td>
<td>≥ 36.5</td>
</tr>
<tr>
<td>11 years</td>
<td>&lt;20.5</td>
<td>20.5 to 28.5</td>
<td>28.6 to 36.0</td>
<td>≥ 36.0</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;22.0</td>
<td>22.0 to 31.0</td>
<td>31.1 to 40.0</td>
<td>≥ 40.0</td>
</tr>
</tbody>
</table>

### Females

<table>
<thead>
<tr>
<th>Age</th>
<th>Beginning</th>
<th>Progressing</th>
<th>Achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;27.0</td>
<td>27.0 to 35.5</td>
<td>35.6 to 44.5</td>
<td>≥ 44.5</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;24.5</td>
<td>24.5 to 32.5</td>
<td>32.6 to 40.5</td>
<td>≥ 40.5</td>
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<tr>
<td>10 years</td>
<td>&lt;24.0</td>
<td>24.0 to 32.5</td>
<td>32.6 to 41.0</td>
<td>≥ 41.0</td>
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<tr>
<td>11 years</td>
<td>&lt;22.5</td>
<td>22.5 to 30.5</td>
<td>30.6 to 38.5</td>
<td>≥ 38.5</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;22.5</td>
<td>22.5 to 30.5</td>
<td>30.6 to 38.5</td>
<td>≥ 38.5</td>
</tr>
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</table>

Source: (CAPL, 2013)